SUNNY HILL
HEALTH CENTRE FOR CHILDREN
an agency of the Provincial Health Services Authority

Proudly Presents:

24th International Seating Symposium

Syllabus

March 6-8, 2008

Westin Bayshore Resort & Marina
1601 Bayshore Drive
Vancouver, BC Canada

UBC

Interprofessional Continuing Education
The University of British Columbia
A Team Approach to Learning

School of Health and Rehabilitation Sciences
The University of Pittsburgh

Program at a Glance

Thursday March 6, 2008

8:00	Registration, Breakfast & Exhibits Conference	Foyer and Exhibit Hall, Page 27
8:30	Opening Remarks	Stanley Park Ballroom, Page 27
8:40	Keynote Address	Stanley Park Ballroom, Page 27
9:25	Plenary Sessions (x3)	Stanley Park Ballroom, Page 27
10:40	Refreshment Break & Exhibits	Conference Foyer and Exhibit Hall, Page 27
11:30	Instructional Sessions - Group A	See Detailed Program, Page 27
12:30	Lunch & Exhibits	Conference Foyer and Exhibit Hall, Page 27
14:00	Simultaneous Paper Sessions 1	Salon 1, 2, 3, Page 28
15:15	Refreshment Break (held in the exhibit hall)	Exhibit Hall, Page 29
16:00	Instructional Sessions - Group B	See Detailed Program, Page 29
17:00	Reception & Exhibits	Exhibit Hall, Page 29

Friday March 7, 2008

8:00	Registration & Exhibits	Conference Foyer and Exhibit Hall, Page 29
8:30	Opening Remarks	Stanley Park Ballroom, Page 29
8:40	Plenary Sessions (x3)	Stanley Park Ballroom, Page 29
9:55	Refreshment Break & Exhibits	Conference Foyer and Exhibit Hall, Page 29
10:45	Simultaneous Paper Sessions 2	See Detailed Program, Page 30
12:00	Lunch (provided) Poster Session & Exhibits	Conference Foyer and Exhibit Hall
12:30	Poster Presentations	Conference Foyer, Page 31
13:30	Instructional Sessions - Group C	See Detailed Program, Page 31
14:40	Instructional Sessions - Group D	See Detailed Program, Page 31
15:40	Refreshment Break & Exhibits	Conference Foyer and Exhibit Hall, Page 31
16:30	Plenary Session	Stanley Park Ballroom, Page 31
17:30	Adjourn	

Friday March 8, 2008

8:30	Registration	Conference Foyer and Exhibit Hall, Page 32
9:00	1/2 hour Instructional Sessions - Group E	See Detailed Program, Page 32
9:35	1/2 hour Instructional Sessions - Group F	See Detailed Program, Page 32
10:10	1/2 hour Instructional Sessions - Group G	See Detailed Program, Page 32
11:10	Refreshment Break	Conference Foyer, Page 32
11:30	Plenary Sessions (x2)	Stanley Park Ballroom, Page 32
12:15	Closing Remarks & Evaluation	Stanley Park Ballroom, Page 32
12:20	Adjourn	

Table of Contents

Thursday March 6, 2008

Keynote Address / Plenary Sessions

Instructional Sessions - Group A

Simultaneous Paper Sessions: 1 - Room 1

Simultaneous Paper Sessions: 1 - Room 2

Simultaneous Paper Session: 1 - Room 3

Instructional Sessions - Group B

Friday March 7, 2008

Plenary Sessions

Simultaneous Paper Sessions: 2 - Room 1

Simultaneous Paper Sessions: 2 - Room 2

Simultaneous Paper Sessions: 2 - Room 3

Instructional Sessions - Group C

Instructional Sessions - Group D

Plenary Session

Saturday March 8, 2008

1/2 hr Instructional Sessions - Group E

1/2 hr Instructional Sessions - Group F

Instructional Sessions - Group G

Plenary Session

Poster Presentations

Poster Presenters are available for questions during the poster session on Friday at 12:00 - 13:30. Posters are available for viewing on all three days of the Symposium.

Planning Committee

Symposium Chairs

Maureen Story, **BSR (PT/OT)**
Symposium Co-Chair
Sunny Hill Health Centre for Children, Vancouver, BC

David Cooper, MSc. (Kinesiology)
Symposium Co-Chair
Rehabilitation Technologist
Sunny Hill Health Centre for Children, Vancouver, BC

Committee Members

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Occupational Therapist
Therapy Department
Sunny Hill Health Centre for Children, Vancouver, BC

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Therapy Department
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Associate Professor
Division of Developmental Pediatrics
Department of Pediatrics
University of British Columbia
and Senior Medical Director,
Sunny Hill Health Centre for Children, Vancouver, BC

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Conference Services Manager
Interprofessional Continuing Education
University of British Columbia, Vancouver, BC

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Department of Orthopaedics
BC Children's Hospital
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University of British Columbia, Vancouver, BC

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M. Dilabio	K. Marina	N. Wilkins
M. Eastman	B. McNair	
J. Evans	B. Ott	

Sponsorship

We would like to acknowledge and thank the following companies for the additional support:

A.R.T. Group - Symposium Bag

Body Point - Participants' Lanyards

AEL - in part sponsorship towards the Syllabus

Users First Alliance - in part sponsorship towards the Reception

Otto Bock - in part sponsorship towards the Friday Luncheon

Presenters Listing

Takanori Aikawa
Research Institute
National Rehabilitation Center for Persons with Disabilities
4-1 Namiki
Tokorozawa, Saitama. Japan 359-8555
aikawa@rehab.go.jp
"Measurement of the User's Load on the PSDs for a Long Period of Time"
Poster Presentation

Maria Amnell, OT
Educational Manager
Etac Sverige AB
Kista Science Tower
Kista, Sweden SE-164 51
Maria.amnell@etac.se
"The Propelling Technique's Impact on Positioning for Elderly Wheelchair Clients"
1/2 hr Instructional Session E4, March 8, 2008, 9:00-9:30

Marcy Antonio
Quantum Rehab Specialist
Western Canada with Pride Mobility Products
380 Vansickle Rd. Unit 350
St. Catherine's, ON L2R 6P7
marcy_antonio@shaw.ca
"Bridging the Gap: Powered Mobility Meets Electronic Aids to Daily Living"
Instructional Session A4, March 6, 2008, 11:30-12:30

Michael Banks, MA, CRTS
Director
Walla Walla Home Medical
329 S. 2nd
Walla Walla, WA 99362
mbanks@wallawallahomemedical.com
"Utilizing Smart Technology to Assist in the Monitoring of Air Floatation Cushions"
Paper Session 1 Room 1, March 6, 2008, 2:45-3:00

Theresa Berner, OTR/L, ATP
SCI Team Leader, Ohio State University,
Dodd Hall Rehabilitation,
5927 Stewart Hollow Dr.
Columbus, OH 43221
Theresa.Berner@osumc.edu
"Manual Wheelchair Configuration, Set-up and Performance Measurement"
PS5 Session, March 5, 2008, 1:30-4:30

Kendra L. Betz, MSPT, ATP
SCI Clinical Specialist; Chair, VA
Wheeled Mobility Integrated Product Team,
Veterans Health Administration
9277 Mountain Brush Trail
Littleton, CO 80130
kendra.betz@comcast.net
Assistive Technology Review Course"
PS3, March 5, 2008, 9:00-4:00
"Beyond the Owner's Manual: Essential Education & Training for Manual Wheelchair Users"
Instructional Session D4, March 7, 2008, 2:40-3:40
"To Push or Not to Push: An Interactive Discussion on Manual vs. Powered Mobility Choice"
Plenary Session, March 7, 2008, 4:30-5:00

Gordon Broughton
Seating Technologist
Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC V5M 3E8
"Fabrication of Seating Systems"
PS2 Session, March 5, 2008, 9:00-4:00

Sheila Buck, B.Sc.(OT), Reg. (Ont.), ATP
Occupational Therapist
Therapy NOW! Inc.
811 Graham Bell Crt.
Milton, ON L9T 3T1
therapynow@cogeco.ca
"Customizing Seating and Positioning for the Aging Population: Assisting in Restraint Reduction"
Instructional Session D1, Friday March 7, 2008, 2:40-3:40

Brenda Canning, OTR/L
Occupational Therapist
Wheelchair and Seating Centre
Rehabilitation Institute of Chicago
345 E. Superior Street
Chicago, IL 60611
bcanning@ric.org
"When to Take a Stand for Standing: Factors to Consider When Choosing Standing Wheelchair"
Instructional Session A5, Thursday March 6,2008, 11:30-12:30

Jo-Anne Chisholm, MSc.

Occupational Therapist
Access Community Therapists Ltd.
1534 Rand Avenue
Vancouver, BC V6P 3G2
joanne@accesstherapists.com

"Pressure Mapping of 64 Spinal Cord Injured Workers as Part of Wound Prevention Program: Analysis of Findings"
Paper Session 1 Room 3, Thursday March 6, 2008, 3:00-3:15

Victoria Claydon, PhD

Associate Member, ICORD, University of British Columbia
Associate Professor, School of Kinesiology
Simon Fraser University
8888 University Dr.
Burnaby, BC V5A 1S6
claydon@icord.org

"Unstable Blood Pressure Control During Sitting and Standing in Patients with Neurodegenerative Disorders"
Instructional Session A2, Thursday March 6, 2008, 11:30-12:30

Lori Cockerill, BSc(Psy), BSc(OT)

84-3711 Robson Court
Richmond, BC V7C 5T8
l.k.cockerill@gmail.com

"'Skin Care After a Spinal Cord Injury' The Use of a Multi-disciplinary Team Home Visit to Assess, Educate and Link Injured Workers with Community Resources"
Paper Session 1 Room 3, Thursday March 6, 2008, 2:45-3:00

Elizabeth Cole, MSPT

Senior Consultant
The Orion Group
1298 Red Mountain Drive
Longmont , CO 80501
elizabeth@orionreimbursement.net

"Linking Patient Coverage Criteria with Clinical Justifications for Seating, and Mobility Products"
Instructional Session G4, Saturday March 8, 2008, 10:10-11:10

Kevin Cook, B.Sc. (HK)

Senior Quantum Specialist
Eastern Canada with Pride Mobility Products
380 Vansickle Rd. Unit 350
St. Catherine's, ON L2R 6P7
kcook8@cogeco.ca

"Bridging the Gap: Powered Mobility Meets Electronic Aids to Daily Living"
Instructional Session A4, Thursday March 6,2008, 11:30-12:30

Dave Cooper, MSc. (Kinesiology)

Rehabilitation Technologist
Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC V5M 3E8
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"Crainopagus Conjoined Twins - The Journey"
Plenary Session, March 6, 2008, 10:15-10:40
"Fabrication of Seating Systems"
PS2 Session, March 5, 2008, 9:00-4:00

Barbara Crane, PhD, PT, ATP

Assistant Professor
Physical Therapy
University of Hartford
200 Bloomfield Avenue
West Hartford, CT 6117
bcrane@hartford.edu

"Development and Testing of an Innovative User Adjustable Support Surface for Wheelchair Seating Discomfort"
Paper Session 1 Room 1, Thursday March 6, 2008, 2:30-2:45

Kim Davis, MSPT

Clinical Research Scientist
Shepherd Center
Crawford Research Institute
2020 Peachtree Rd NW
Atlanta, GA 30309
kim_davis@shepherd.org

"The Science of Interface Pressure Mapping - Updates for Clinical Application"
Instructional Session C4, March 7, 2008, 1:30-2:30

Ian Denison
Equipment Specialist
GF Strong Rehabilitation Centre
4255 Laurel Street
Vancouver, BC V5Z2G9
ian.denison@vch.ca

"The Segway Personal Transporter for People with Disabilities. Phase II: Meeting Clients' Mobility Goals"
Paper Session 2 Room 1, March 7, 2008, 11:45-12:00

Brad E. Dicianno, MD
Assistant Professor
Dept of PM&R, UPMC
201 Kaufmann Bldg.
3471 Fifth Ave.
Pittsburgh, PA 15213
diciannob@herlpitt.org

"State of the Literature on Power Seating Functions: What is the Scientific Evidence?"
1/2 hr Instructional Session E2, March 8, 2008, 9:00-9:30

Carmen P. Digiovine, PhD, RT, ATP
President
6 Degrees of Freedom
20 Danada Square West, #255
Wheaton, IL 60187
carmen@6degreesoffreedom.com

"Manual Wheelchair Configuration, Set-up and Performance Measurement"
PS5 Session, March 5, 2008, 1:30-4:30

Mark Dilabio
Seating Technologist
Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC V5M 3E8
mdilabio@cw.bc.ca

"Fabrication of Seating Systems"
PS2 Session, March 5, 2008, 9:00-4:00

Brian J. Dudgeon, Ph.D.
Associate Professor
Department of Rehabilitation Medicine
University of Washington: Medical Centre
Seattle, WA 98195-6490
dudgeonb@u.washington.edu

"Leveraging the Internet to Provide Seating and Mobility Services in Developing Countries"
Paper Session 1 Room 3, March 6, 2008, 2:15-2:30

Rick Escobar, BS, ATP
Product Design
Fabrication and Mobility Consultative Services
7526 Dumas Drive
Cupertino, CA 95014
rjedesigns@hotmail.com

"Meaningful Modifications"
1/2 hr Instructional Session F5, March 8, 2008, 9:35-10:05

Ann Eubank, OTR, ATP
Clinical Services Manager
Permobil Inc.
6961 Eastgate Blvd.
Lebanon, TN 37090
ann.eubank@permobilus.com

"Evidence-Based Practice: Finding, Assessing and Using the Evidence"
PS4 Session, March 5, 2008, 9:00-12:00
"Cognitive, Visual and Perceptual Issues - Matching the Chair to the Client"
Instructional Session C2, March 7, 2008, 1:30-2:30

Geoff Fernie, PhD, PEng
Vice President, Research, Toronto Rehabilitation Institute
550 University Ave.
Toronto, ON M5G 2A2
fernie.geoff@torontorehab.on.ca

"New Technology for Age-old Needs"
Keynote Address, March 6, 2008, 8:40-9:25

Debbie Field, B.Sc.OT, MHSc.OT,
Occupational Therapist, Access Community Therapists Inc., Vancouver BC
Occupational Therapist, Sunny Hill Health Centre for Children
3644 Slocan Street
Vancouver , BC V5M 3E8
dfield@cw.bc.ca
"Toward Establishing the Responsiveness of the Seated Postural Control Measure (SPCM)"
Paper Session 2 Room 1, March 7, 2008, 11:15-11:30
"Reliability of the Wheelchair Outcome Measure in Adults with Developmental Disabilities"
Paper Session 2 Room 1, March 7, 2008, 11:30-11:45

Delia L. Freney-Bailey, O.T.R./L., A.T.S.
Pediatric Occupational Therapist, Pediatric Contracting Services, Richmond, CA, USA,
Senior Occupational Therapist
Kaiser Permanente
235 W. Macarthur Blvd.
Oakland, CA 94611
DDFreney@aol.com
"Seating and Safety: Transportation Issues"
Instructional Session A1, March 6, 2008, 11:30-12:30
"Seating and Mobility for Early Intervention"
Instructional Session D5, March 7, 2008, 2:40-3:40

Jan Furumasu, PT, ATP
Physical Therapist
Rancho Los Amigos National Rehabilitation Center
Los Amigos Research and Education Institute (Larei)
7601 East Imperial Highway
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jfurumasu@ladhs.org
"The Impact of Early Powered Mobility on Young Children's Play and Psychosocial Skills"
Paper Session 2 Room 2, March 7, 2008, 11:30-11:45

Doug Gayton, ATP
ATP Assistive Technology Practitioner, Assistive Technology Service, G. F. Strong Rehab Centre, Vancouver Coastal Health, Vancouver, BC
4255 Laurel Street
Vancouver, BC V5Z 2G9
doug.gayton@vch.ca
"Assistive Technology Review Course"
PS3 Session, March 5, 2008, 9:00-4:00

Jana Good, B.Sc. (Psych), M.OT
Occupational Therapist
Royal Alexandra Hospital
10240 Kingsway
Edmonton , AB T5H 3V9
sawulagood@hotmail.com
"Reliability of the Wheelchair Outcome Measure in Adults with Developmental Disabilities"
Paper Session 2 Room 1, March 7, 2008, 11:30-11:45

Michael Hahn, PhD
Assistant Professor of Biomechanics
Montana State University
119 Hosaeus Building
Bozeman, MT 59717-3360
mhahn@montana.edu
"Effects of Dynamic Wheelchair Seating in Children with Cerebral Palsy"
Paper Session 2 Room 2, March 7, 2008, 10:45-11:00

Courtney Hall
Occupational Therapist
Child Development Centre
#3-3800 72nd Street
Delta, BC V4K3N2
courtneyh@deltachilddevelopment.org
"Evaluating the Effectiveness of a Wheelchair Skills Training Program for Children"
Paper Session 2 Room 3, March 7, 2008, 10:45-11:00

Karen Hardwick, Ph.D., OTR, FAOTA
Coordinator of Habilitation Therapies
Texas Department of Aging and Disability
P.O. Box 1269
Austin, TX 78767-1269
karen.hardwick@dads.state.tx.us
"Wound Investigation Process"
Instructional Session B1, March 6, 2008, 4:00-5:00

Frances Harris
Research Scientist
Center for Assistive Technology & Environmental Access
490 Tenth St.NW
Atlanta, GA 30332

"Outcomes of an Expert vs Usual Care Intervention for Manual Wheelchairs"
Poster Presentation

Tatsuo Hatta, PHD
Occupational Therapist
Department of Health Sciences
Hokkaido University School of Medicine
Kita 12 zyou nishi 5 tyoume,
Sapporo, Hokkaido, JAPAN 060-0812

"Evaluating the Characteristics of a New Wheelchair's Adjustable Back Support"
Poster Presentation
"Characteristics of the Seating Buggy's Seating Surface Developed for Severely Disabled People"
Poster Presentation

Hideyuki Hirose, PT, Eng
Research Institute
National Rehabilitation Center for Persons with Disabilities
4-1 Namiki
Tokorozawa, Saitama, Japan 359-8555
hirose@rehab.go.jp

"Measurement of the User's Load on the PSDs for a Long Period of Time"
Poster Presentation

Douglas A. Hobson, Ph.D.
Emeritus Associate Professor, University of Pittsburgh
2310 Jane Street, Suite 1300
Pittsburgh, PA 15203
dhobson1@mac.com

"Development and Testing of an Innovative User Adjustable Support Surface for Wheelchair Seating Discomfort"
Paper Session 1 Room 1, March 6, 2008, 2:30-2:45
"Wheelchair Transportation Safety: Principles, Standards and Practice Risk Management"
Instructional Session D2, March 7, 2008, 2:40-3:40

Catherine S. Holloway
PhD Student
Civil Environmental & Geomatic Engineering
University College London
Accessibility Research Group
Gower Street
London, UK WC1E 6BT
ucescsh@ucl.ac.uk

"Carer Wheelchair Propulsion: Factors Affecting a Carer's Capacity"
Paper Session 2 Room 3, March 7, 2008, 11:45-12:00

Marju Huuhtanen, Pt
War Veterans Hospital, Kauniala Hospital
Kylpyläntie 19
Kauniainen, Finland 02700
marju.huuhtanen@kauniala.fi

"The Randomized Controlled Rocking Chair Trial"
Paper Session 1 Room 2, March 6, 2008, 2:15-2:30
"Rocking Chair Exercises as a Training Method for People with Physical Disabilities"
Poster Presentation

Linda Jablonski, BScPT
Physical Therapist
Equal Program
Dr. Vernon Fanning Carewest Long Term Care Centre
722 -16Ave NE
Calgary, AB T2E 6V7
linda.jablonski@calgaryhealthregion.ca

"The Use of Botulinum Toxin Type A (Botox®) to Facilitate Seating in Patients with Multiple Sclerosis"
Poster Presentation

Ainslie Jackel, BSc (Hons)
Research Assistant, Occupational Therapy Programme, Monash University, Melbourne, Australia,
PO Box 527
Frankston, Australia 3199
Ainslie.jackel@med.monash.edu.au

"The Use of Contoured vs Flat Cushions in Adaptive Seating for Children with Cerebral Palsy - Development of Measurement Systems and Results"
Paper Session 1 Room 1, March 6, 2008, 2:15-2:30

K. Paul Jensen, BSB ATS

Rehab Department Manager
Total Medical Solutions
4153 Flex Court
Sanford, FL 32771
kd7chr@gmail.com
"I Love My New Chair, But How Do I Get Inside My House?"
Poster Presentation

Bill Johnson

Prototypist Machinist
Bloorview Research Institute
Bloorview Kids Rehab
150 Kilgour RD
Toronto, ON M4G 1R8
bjohnson@bloorview.ca
"Mounting for Mobility"
Paper Session 1 Room 2, March 6, 2008, 2:30-2:45

Susan Johnson

Director of Education
Convaid, Inc.
2830 California Street
St.Torrance, CA 90503
suej@convaid.com
"Seating and Safety: Transportation Issues"
Instructional Session A1, March 6, 2008, 11:30-12:30
"Don't be a Crash Test Dummy!"
Instructional Session B3, March 6, 2008, 4:00-5:00

Susan Johnson Taylor, OTR/L

Clinician
Rehabilitation Institute of Chicago
Wheelchair and Seating Clinic
345 East Superior St. 15th Floor
Chicago, IL 60611
staylor@RIC.org
"Aging with a Disability: Update on Current Research and Clinical Practices"
Plenary Session, March 6, 2008, 9:50-10:15

Mary Beth Kinney, ATS, CRTS

Mobility Designs
3715 Northcrest Road #28
Atlanta, GA 30340
marybeth@mobilitydesigns.com
"A Case Study of Dakotah: Dramatic Difference Between Seating and Positioning in an Everyday Wheelchair vs. a Sports Wheelchair"
Instructional Session F2, March 8, 2008, 9:35-10:05

R. Lee Kirby, MD

Professor
Division of Physical Medicine and Rehabilitation
Dalhousie University, NS Rehab Centre
1341 Summer Street
Halifax , NS B3H 4K4
kirby@dal.ca
"Intrinsic Wheelchair-Skills Learning Induced by Testing: Case Report of a Person with Parkinsonism"
Paper Session 2 Room 1, March 7, 2008, 11:00-11:15

Kay Koch, OTR/L, ATP

Mobility Designs
3715 Northcrest Road #28
Atlanta, GA 30340
kay@mobilitydesigns.com
"A Case Study of Dakotah: Dramatic Difference Between Seating and Positioning in an Everyday Wheelchair vs. a Sports Wheelchair"
Instructional Session F2, March 8, 2008, 9:35-10:05
"Darius Goes West: Working as a Team to Provide a One of a Kind Wheelchair"
Plenary Session, March 8, 2008, 11:30-11:50

Andrei Krassioukov, MD, PhD, FRCPC

Associate Professor, Div Phys Med & Rehab, Department of Medicine; Scientist, ICORD, University of British Columbia, Vancouver, BC,
6270 University Blvd
Vancouver , BC V6T 1Z4
krassioukov@icord.org
"Automatic Dysfunction in Multiple Sclerosis Patients"
Instructional Session A2b, March 6, 2008, 11:30-12:30

Stefanie Laurence, B.Sc.OT, OT Reg.(Ont)

Education Manager
Motion Specialties – The Motion Group of VGM Canada
82 Carnforth Rd.
Toronto, ON M4A 2K7
slaurence@themotiongroup.com
"The Assessment is Done. Where Do I Go From Here?"
Instructional Session A3, March 6, 2008, 11:30-12:30

Todd Lefkowicz
Director
Mobility Builders
c/o Washington Technology Foundation
100 South King Street, Suite 280
Seattle, WA 98104
todd@mobilitybuilders.org
"Leveraging the Internet to Provide Seating and Mobility Services in Developing Countries"
Paper Session 1 Room 3, March 6, 2008, 2:15-2:30

Jenny Lieberman, MSOTR/L, ATP
Clinical Specialist
Department of Rehabilitation
Mount Sinai Hospital
diciannob@herlpitt.org
"State of the Literature on Power Seating Functions: What is the Scientific Evidence?"
1/2 hr Instructional Session E2, March 8, 2008, 9:00-9:30

Roslyn Livingstone, Dip OT
Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC V5M 3E8
rlivingstone@cw.bc.ca
"Power Mobility Assessment, Prescription and Training"
PS1 Session, March 5, 2008, 9:00-4:00

Eva Ma, OT, ATP
Occupational Therapist, Consultant, Private Practice, Walla Walla, WA, USA,
Occupational Therapist
1616 S.W. Harbor Way, Unit A 305
Portland, OR 97201
evama@netscape.com
"Utilizing Smart Technology to Assist in the Monitoring of Air Floatation Cushions"
Paper Session 1 Room 1, March 6, 2008, 2:45-3:00

Jacqueline Macauley, PT
Clinical Education Specialist
Sunrise Medical
5103 Fontaine Street # 118
San Diego, CA 92120
jacqueline.macauley@sunmed.com
"Power Wheelchair System Customization"
Instructional Session D3, March 7, 2008, 2:40-3:40

Kathie Marina, M.Ed, OT
Occupational Therapist, Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC V5M 3E8
kmarina@cw.bc.ca
"Power Mobility Assessment, Prescription and Training"
PS1 Session, March 5, 2008, 9:00-4:00

Sue McCabe, B.App Sc. (OT), M.Sc.
Senior Occupational Therapist, CPTech
The Centre for Cerebral Palsy (Western Australia)
Bradford St, Coolbinia
Perth, Australia 6016
sue.mccabe@tccp.com.au
"*The MAC and MiniMAC - Tools for Customised Seating Design and Production*"
Paper Session 1 Room 1, March 6, 2008, 3:00-3:15
"Sleep is Everybody's Business"
Plenary Session, March 7, 2008, 9:05-9:30
"What In the World Are We Doing About Sleep?"
Instructional Session C3, March 7, 2008, 1:30-2:30

Rachael McDonald, BAppSc(OT), PGDip (Biomechanics), PhD
Senior Lecturer, Occupational Therapy Programme, Monash University, Melbourne, Australia, and Honorary Lecturer, UCL Institute of Child Health, London UK, Occupational Therapy, Monash University Peninsula Campus
PO Box 527
Frankston, Australia 3199
rachael.mcdonald@med.monash.edu.au
"The Use of Contoured vs Flat Cushions in Adaptive Seating for Children with Cerebral Palsy - Development of Measurement Systems and Results"
Paper Session 1 Room 1, March 6, 2008, 2:15-2:30
"Adaptive Seating Interventions for Children and Young People with Severe and Complex Disabilities; Evidence, Research and Proposed Model for Future Research Practice"
Plenary Session, March 7, 2008, 9:30-9:55
"Developmental Level and Pre-requisite Skills Required for Successful Switching and Scanning to Effectively Access Assistive Technology"
Poster Presentation

William C. Miller
Associate Professor
Department of Occupational Sciences and Occupational Therapy
University of British Columbia
T-325 Wesbrook Mall
Vancouver, BC V6T 2B5
bcmiller@telus.net
"Mobility of Older Persons in Residential Care"
Plenary Session, March 6, 2008, 9:25-9:50

Jean L. Minkel, PT, ATP
Minkel Consulting
112 Chestnut Ave.
New Windsor, NY 12553
jminkel@aol.com
"Multiple Sclerosis - Understanding the Beast Within"
Plenary Session, March 7, 2008, 8:40-9:05
"Meeting the Challenge: Trying to Meet the Needs of Persons with MS"
Instructional Session C1, March 7, 2008, 1:30-2:30

Claire Morress, OTR/L, M.Ed, ATP
Faculty
Department of OT, Xavier University Cincinnati, OH; Assistive Technology Practitioner UCP Cincinnati, and PhD student, Nova Southeastern University, FL,
"Evidence-Based Practice: Finding, Assessing and Using the Evidence"
PS4 Session, March 5, 2008, 9:00-12:00

W. Ben Mortenson, BScOT, MSc, PhD Candidate
School of Rehabilitation Sciences, UBC
Practice Co-ordinator (OT)
Vancouver Coastal Health
4255 Laurel Street
Vancouver, BC V5Z 2G9
bmortens@interchange.ubc.ca
"Selecting Activity and Participation Outcome Measures for Wheelchair Users Based on the ICF"
Paper Session 2 Room 1, March 7, 2008, 10:45-11:00

Elaine Murray, Dip. COT
Service Manager
Eastern Region Postural Management Service
Enable Ireland
Sandymount Avenue
Dublin 4, Ireland
emurray@enableireland.ie
"Product Recall - Corrective Action Programme"
Poster Presentation

Kazuma Nakai, Eng
Research Institute
Railway Technical Research Institute
2-8-38, Hikarimati, kokubunnji, Tokyo, 185-8540
nakai@rtri.or.jp
"Measurement of the User's Load on the PSDs for a Long Period of Time"
Poster Presentation

Kristiina Niemelä, M.Sc., PT
Chief of Development, War Veterans Hospital
Kauniala Hospital
Kylpyläntie 19
Kauniainen, Finland 02700
kristiina.niemela@kauniala.fi
"The Randomized Controlled Rocking Chair Trial"
Paper Session, Room 2, March 6, 2008, 2:15-2:30
"Rocking Chair Exercises as a Training Method for People with Physical Disabilities"
Poster Presentation

Shigeo Nishimura, B.Eng
Rehabilitation Engineer
Division of Rehabilitation Engineering Counseling Office, Hokkaido Government
2-1-1 maruyama nishimati, chuo-ku
Sapporo, Hokkaido, JAPAN 064-0944
"Evaluating the Characteristics of a New Wheelchair's Adjustable Back Support"
Poster Presentation
"Characteristics of the Seating Buggy's Seating Surface Developed for Severely Disabled People"
Poster Presentation

Ginny S. Paleg, PT
Physical Therapist
Altimate Medical
Montgomery County Early Intervention
420 Hillmoor Dr
Silver Spring, MD 20901
ginny@paleg.com
"Don't be a Crash Test Dummy!"
Instructional Session B3, March 6, 2008, 4:00-5:00
"The Evidence Basis of Passive Standing Programs: Prelude to a RESNA Position Paper"
Instructional Session C5, March 7, 2008, 1:30-2:30
"Body Weight Support Gait Therapy and Functional Electrical Stimulation for a Toddler with T12 Spina Bifida"
Poster Presentation

Richard Pasillas
Seating Specialist
CUSHMAKER.com
14535 Valley View Avenue, Suite 'U'
Santa Fe Springs , CA 90670
cushmaker@cushmaker.com

"Custom Seating Fabrication Controls & Techniques - Assuring Successful Outcomes Before You Build"
Instructional Session G2, March 8, 2008, 10:10-11:10

Bradford Peterson
Vice President of Sales and Education
Motion Concepts
700 Ensminger Rd. Suite # 112
Tonawanda, NY 14150
bpeterson@motionconcepts.com

"When To Think About Lateral Tilt and Why"
Instructional Session B4, March 6, 2008, 4:00-5:00

Kevin Phillips, CRTS
Ability Center
San Diego, CA 92111

"Vision and Perception Related to Independent Mobility"
Instructional Session C2, March 7, 2008, 1:30-2:30

Scott Pickett, ATS
Clinical Education Specialist
Sunrise Medical/ The A.R.T. Group
965 Tern Rd.
Tallahassee, FL 32303
spickett@whitbio.com

"To Seat or Not to Seat? That is the Dilemma"
Instructional Session G1, March 8, 2008, 10:10-11:10

Teresa E. Plummer, MSOT, OTR, ATP
Faculty, Belmont University; Assistive Technology Practitioner, Vanderbilt, University; Phd Student, Nova Southeastern Univeristy, Nashville, TN,
Belmont University
1900 Belmont Blvd
Nashville, TN 37212
plummert@mail.belmont.edu

"Evidence-Based Practice: Finding, Assessing and Using the Evidence"
PS4 Session, March 5, 2008, 9:00-12:00
"Cognitive, Visual and Perceptual Issues - Matching the Chair to the Client"
Instructional Session C2, March 7, 2008, 1:30-2:30
"'Parents' Perception of Wheelchair Selection': A Qualitative Research Study"
Poster Presentation

David Porter, BSc, MSc, PhD
Elizabeth Casson Trust Reader in Occupational Therapy
School of Health & Social Care
Oxford Brookes University
Jack Straws Lane
Marston Campus
Oxford, UK OX3 0FL
dporter@brookes.ac.uk

"Does Postural Support Influence Ability to Perform Attention Tasks in Children with Cerebral Palsy?"
Paper Session 2 Room 2, March 7, 2008, 11:15-11:30

Mike Pramuka
Task Leader Rerc on Telerehabilitation
Department of Rehabilitation Science and Technology
University of Pittsburgh
5038 Forbes Tower
Pittsburgh, PA 15260
mpramuka@pitt.edu

"Telerehabilitation and Service Delivery: A Tool for Clinicians"
Poster Presentation

Sharon Pratt, PT
Physical Therapy, Director of Education
3555 Lakeshore Drive
Longmont , CO 80503
sharronpra@msn.com

"Preparing Letters of Medical Justification - Are we the Best we can be - Can we do Better ?"
1/2 hr Instructional Session E3, March 8, 2008, 9:00-9:30
"Selecting the Appropriate Seat Cushion - Is it Really that Much of a Challenge?"
1/2 hr Instructional Session F4, March 8, 2008, 9:35-10:05

Jessica Presperin Pedersen, MBA, OTR/L, ATP
Rehabilitation Institute of Chicago
345 E. Superior St. #1580
Chicago, IL 60131
jpedersen@ric.org

"Aging with a Developmental Disability"
Instructional Session B2, March 6, 2008, 4:00-5:00

Deborah L. Pucci, PT, MPT, ATP
Physical Therapist
Wheelchair and Seating Centre
Rehabilitation Institute of Chicago
345 E. Superior Street
Chicago, IL 60611
dpucci@ric.org
"When to Take a Stand for Standing: Factors to Consider When Choosing a Standing Wheelchair"
Instructional Session A5, March 6, 2008, 11:30-12:30

Anne Marie Renzoni, B.Sc., O.T., OT Reg. (Ont)
Occupational Therapist
Communication and Writing Aids
Bloorview Kids Rehab
150 Kilgour RD
Toronto, ON M4G 1R8
amrenzoni@bloorview.ca
"Mounting for Mobility"
Paper Session 1 Room 2, March 6, 2008, 2:30-2:45

Tina Roesler, PT, MS, ABDA
Director of Sales and Education, TiLite
1426 East Third Avenue
Kennewick, WA 99337
troesler@tilite.com
"Manual Wheelchair Configuration, Set-up and Performance Measurement"
PS5 Session, March 5, 2008, 1:30-4:30

Paula Rushton, MClSc(OT)
PhD student, Occupational Therapy
UBC - School of Rehabilitation Sciences
T325-2211 Wesbrook Mall
Vancouver, BC V6T 2B5
prushton@interchange.ubc.ca
"Wheelchair Participation in Individuals with Spinal Cord Injury"
Poster Presentation

Bonita Sawatzky, PhD
Associate Professor
Orthopaedics
University of British Columbia
4480 Oak Street
Vancouver, BC V6H 3V4
bsawatzky@cw.bc.ca
"The Segway Personal Transporter for People with Disabilities. Phase II: Meeting Clients' Mobility Goals"
Paper Session 2 Room 1, March 7, 2008, 11:45-12:00

Mark R. Schmeler, MS, OTR/L, ATP, PhD
Instructor, Department Of Rehabilitation Science And Technology, School Of Health And Rehabilitation Sciences, University Of Pittsburgh, Pittsburgh, PA, USA
Instructor, Department of Rehabilitation Science and Technology
School of Health and Rehabilitation Sciences, University of Pittsburgh
Forbes Tower, Suite 5044
Pittsburgh, PA 15260
schmeler@pitt.edu
"Assistive Technology Review Course"
PS3 Session, March 5, 2008, 9:00-4:00
"To Push or Not to Push: An Interactive Discussion on Manual vs. Powered Mobility"
Plenary Session, March 7, 2008, 4:30-5:00
"State of the Literature on Power Seating Functions: What is the Scientific Evidence?"
1/2 hr Instructional Session E2, March 8, 2008, 9:00-9:30

Allen R. Siekman, BSBA
President, Allen Siekman Consulting, Ben Lomond, CA, Adaptive Technology Specialist
Allen Siekman Consulting
290 Ridge Road
Ben Lomond, CA 95005
allen@ebold.com
"Testing the Heat and Water Vapor Transmission Characteristics of Wheelchair Cushions"
Paper Session 1 Room 1, March 6, 2008, 2:00-2:15
"Understanding Home Care and Therapeutic Mattresses (Support Surfaces)"
1/2 hr Instructional Session F3, March 8, 2008, 9:35-10:05
"The Development of International Standards and Testing Methodologies for Support Surfaces"
Instructional Session G3, March 8, 2008, 10:10-11:10

Cher Smith
"Intrinsic Wheelchair-Skills Learning Induced by Testing: Case Report of a Person with Parkinsonism"
Paper Session 2 Room 1, March 7, 2008, 11:00-11:15

Kelly Smith
Paralympic Athlete, Air Traffic Controller
19640 34A Ave.
Langley, BC V3A 7W6
kelly@wheel-power.com
"Attitude is Everything"
Plenary Session, March 8, 2008, 11:50-12:15

Les Smith, BSc (OT), MSc
Senior Occupational Therapist
Prince George & District Child Development Centre
1687 Strathcona Avenue
Prince George BC
less@cdcpg.org
"Use of a Family-Centred Satisfaction Survey to Guide Intervention for Children Accessing a Positioning and Mobility Clinic"
Paper Session 2 Room 3, March 7, 2008, 11:00-11:15
"Writing Effective Justification Letters – A Common Sense Approach"
1/2 hr Instructional Session F1, March 8, 2008, 9:35-10:05

Sharon E. Sonenblum, ScM
Bioengineering PhD Student
Center for Assistive Technology and Environmental Access
Georgia Institute of Technology
490 10th Street NW
Atlanta, GA 30318
sharon.sonenblum@coa.gatech.edu
"Understanding Wheelchair Use Patterns: Tilt-in-Space"
Paper Session 2 Room 3, March 7, 2008, 11:30-11:45

Jill Sparacio, OTR/L, ATP, ABDA
Sparacio Consulting Services
4600 Roslyn Rd
Downers Grove, IL 60515
OTSpar@aol.com
"Aging with a Developmental Disability"
Instructional Session B2, March 6, 2008, 4:00-5:00

Stephen Sprigle, PhD, PT
Director
Center for Assistive Technology and Environmental Access
Georgia Institute of Technology
490 10th Street NW
Atlanta, GA 30332-0156
Stephen.sprigle@coa.gatech.edu
"The Science of Interface Pressure Mapping - Updates for Clinical Application"
Instructional Session C4, March 7, 2008, 1:30-2:30

Robert Stickney
Seating Technologist
Sunny Hill Health Centre for Children
3644 Slocan St.
Vancouver, BC V5M 3E8
bstickney@cw.bc.ca
"Fabrication of Seating Systems"
PS2 Session, March 5, 2008, 9:00-4:00

Maureen Story, BSR (PT/OT)
Sunny Hill Health Centre for Children
3644 Slocan Street
Vancouver BC
V5M 3E8
mstory@cw.bc.ca
"Crainopagus Conjoined Twins - The Journey"
Plenary Session, March 6, 2008, 10:15-10:40

Stephanie Tanguay, OTR, ATP/S
Clinical Education Specialist
Motion Concepts
700 Ensminger Rd. Suite # 112
Tonawanda, NY 14150
stanguay@motionconcepts.com
"When To Think About Lateral Tilt and Why"
Instructional Session B4, March 6, 2008, 4:00-5:00

John Tiernan, BE, MEngSc, Ceng
Senior Clinical Engineer
Enable Ireland
Sandymount Avenue
Dublin 4, Ireland
jtiernan@enableireland.ie
"Product Recall - Positive Outcomes of a Corrective Action Programme"
Poster Presentation

Linda van Roosmalen, MS, Ph.D.

Task Leader Rerc on Telerehabilitation, Visiting Assistant Professor, Department of Rehabilitation Science and Technology,
University of Pittsburgh
2310 Jane Street Suite 1300
Pittsburgh, PA 15203
Lvanroos@pitt.edu
"Safety Issues of Wheelchair Seated Drivers in Private Vehicles"
Paper Session 1 Room 2, March 6, 2008, 2:45-3:00
"Wheelchair Transportation Safety: Principles, Standards and Practice Risk Management"
Instructional Session D2, March 7, 2008, 2:40-3:40
"Telerehabilitation and Service Delivery: A Tool for Clinicians"
Poster Presentation

Noorshina Virani, BSc PT, MD, FRCPC

Neuromusculoskeletal Consultant
Foothills Hospital
1403-29 Street
Calgary, AB T2N 2T9
noorshina.virani@calgaryhealthregion.ca
"The Use of Botulinum Toxin Type A (Botox®) to Facilitate Seating in Patients with Multiple Sclerosis"
Poster Presentation

Galina Vorobeychik, MD

Director, Fraser Health Multiple Sclerosis Clinic
Burnaby Hospital
3935 Kincaid Street
Burnaby BC
V5G 2X6
GVneuroMSClinic@shaw.ca
"Autonomic Dysfunction in Multiple Sclerosis Patients"
Instructional Session A2b, March 6, 2008, 11:30-12:30

Anna Vouladakis, B.Des

Seating Technologist
Sunny Hill Health Centre for Children
3644 Slocan St.
Vancouver, BC V5M 3E8
avouladakis@cw.bc.ca
"Fabrication of Seating Systems"
PS2 Session, March 5, 2008, 9:00-4:00

Joy Wee BSc, MD, FRCPC

Assistant professor
Department of Physical Medicine & Rehabilitation
Queen's University,
Providence Care, St. Mary's of the Lake Hospital, Postal Bag 3600
Kingston, ON K7L 5A2
weej@queensu.ca
"Low-cost, Appropriate Wheelchairs for Challenging Terrain in Developing Nations"
Paper Session 1 Room 3, March 6, 2008, 2:00-2:15
"Relative Contributions and Limitations of Wheelchairs in Supporting Activities and Participation of Persons with Disability"
Paper Session 2 Room 3, March 7, 2008, 11:15-11:30

Natasha White, B.Sc.(Kin) M.OT

Occupational Therapist
Royal Columbian Hospital
330 East Columbia Street
New Westminster, BC TV3L 3W7
ncwhite@telus.net
"Reliability of the Wheelchair Outcome Measure in Adults with Developmental Disabilities"
Paper Session 2 Room 1, March 7, 2008, 11:30-11:45

Marlene Wiens

Managing Director
Canadian Association for Participatory Development (CAPD)
44 Scanlon Place NW
Calgary, AB T3L 1V8
marlene.wiens@shaw.ca
"The Impact of Low-Cost Adaptive Technology in a Colombian Community"
Paper Session 1 Room 3, March 6, 2008, 2:30-2:45

Nicole Wilkins, BSc OT

Occupational Therapist, Sunny Hill Health Centre for Children
3644 Slocan St
Vancouver, BC V5M 3E8
nwilkins@cw.bc.ca
"Power Mobility Assessment, Prescription and Training"
PS1 Session, March 5, 2008, 9:00-4:00

Clare Wright, BSc (Hons), OT
Research Occupational Therapist
James Leckey Design Ltd
5E Weaver's Court
Linfield Industrial Estate
Belfast, UK BT12 5GH
clare@leckey.com
"How Effective is your Seating Prescription? Using Case Histories to Generate Evidence"
1/2 hr Instructional Session E1, March 8, 2008, 9:00-9:30

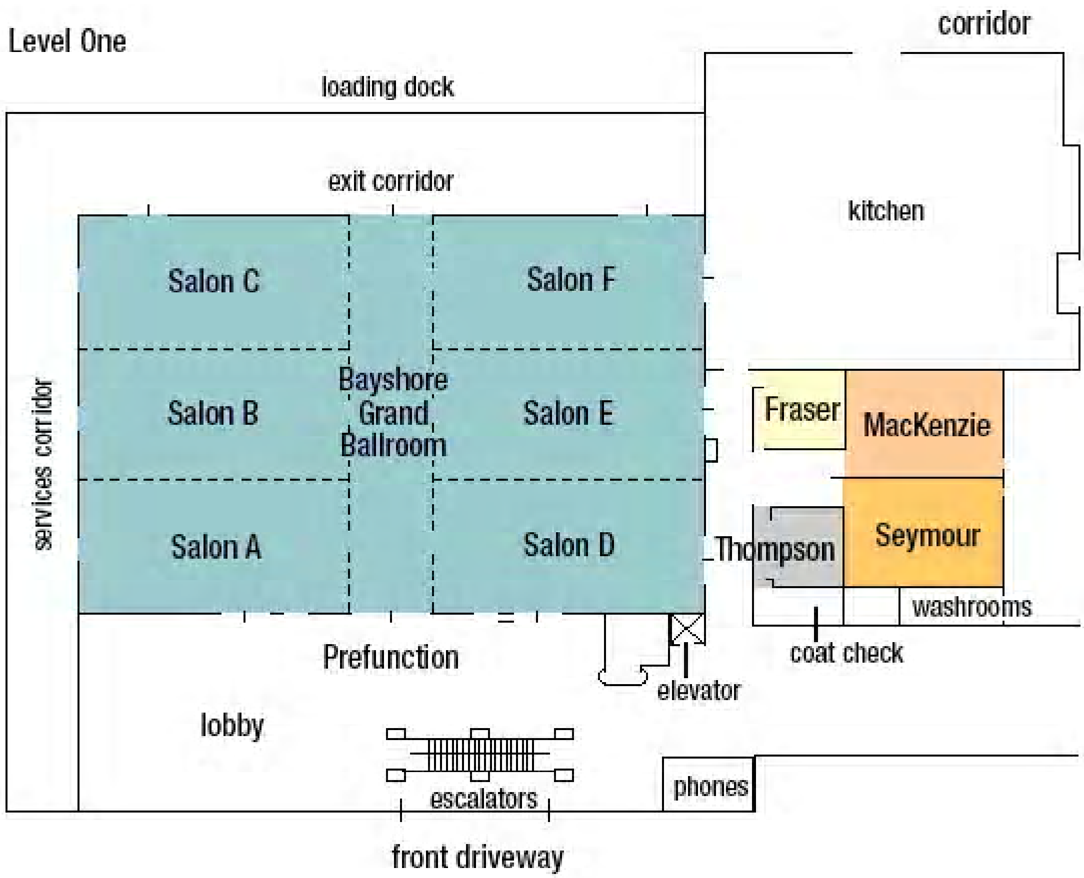
Christine Wright-Ott, MPA, OTR/L
Occupational Therapist, The Bridge School, Hillsborough, CA
Adaptive Technology Design
10690 Martinwood Way
Cupertino, CA 95014
chriswrightott@sbcglobal.net
"The TOTWalker Project: A Journey to the KidWalk"
Paper Session 1 Room 2, March 6, 2008, 3;00-3:15
"Mobility for Discovery"
Instructional Session B5, March 6, 2008, 4:00-5:00

Joanne Yip, BSR, OT
Access Community Therapists Ltd.
1534 Rand Avenue
Vancouver , BC V6P 3G2
ngyip@telus.net
"Pressure Mapping of 64 Spinal Cord Injured Workers as Part of Wound Prevention Program: Analysis of Findings"
Paper Session 1 Room 3, March 6, 2008, 3:00-3:15

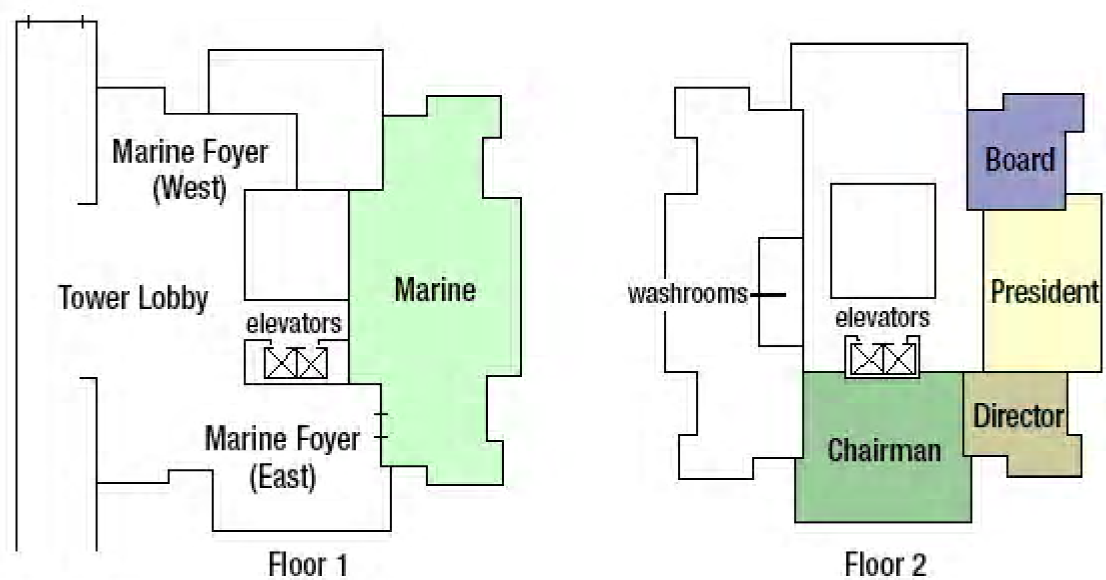
Karl F Zabjek
Scientist
Bloorview Research Institute
Bloorview Kids Rehab, 150 Kilgour Road
Toronto, ON M4G 1R8
kzabjek@bloorview.ca, k.zabjek@utoronto.ca
"Studying the Effect of Different School Chairs and Desks on the Seated Postures of Children with Cerebral Palsy"
Paper Session 2 Room 2, March 7, 2008, 11:45-12:00

Kamila Zloty, MOT
Occupational Therapist
OT Consulting/Treatment Inc.
749 E14th
Vancouver, BC V5T 2N3
kzloty@hotmail.com
"Evaluating the Effectiveness of a Wheelchair Skills Training Program for Children"
Paper Session 2 Room 3, March 7, 2008, 10:45-11:00

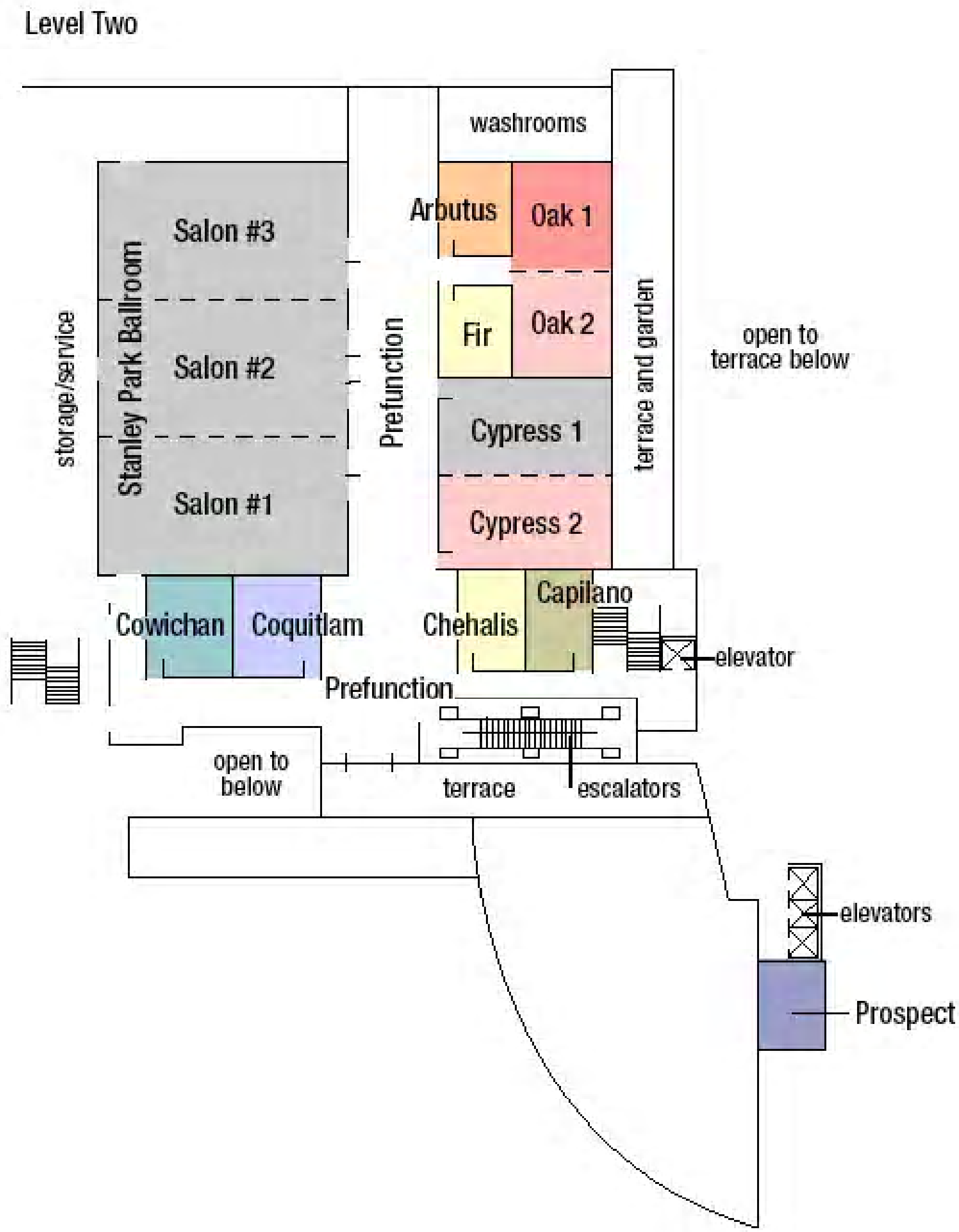
Meeting Room Layout



Tower Meeting Rooms



Meeting Room Layout

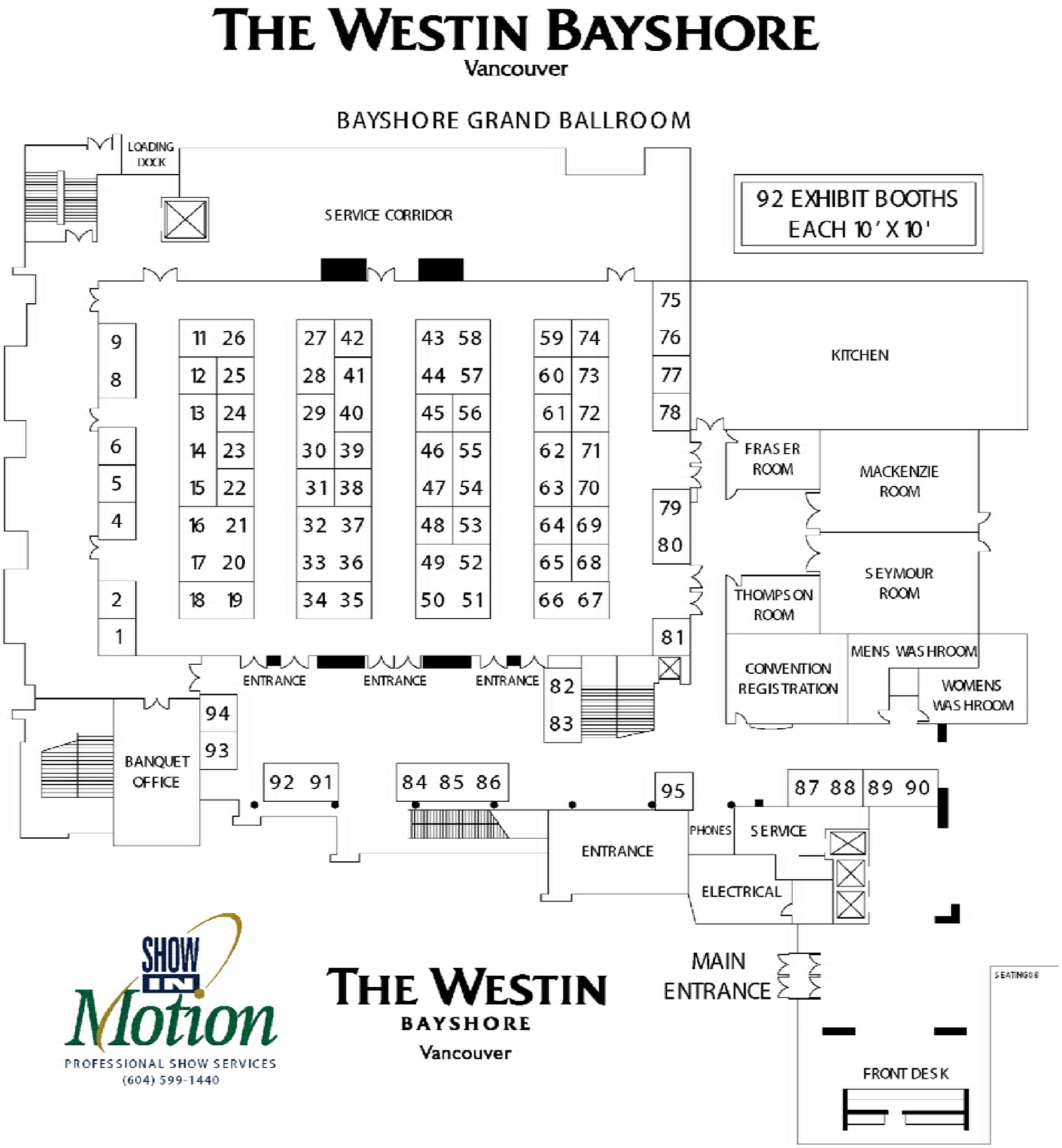


Exhibitors and Booth Assignments

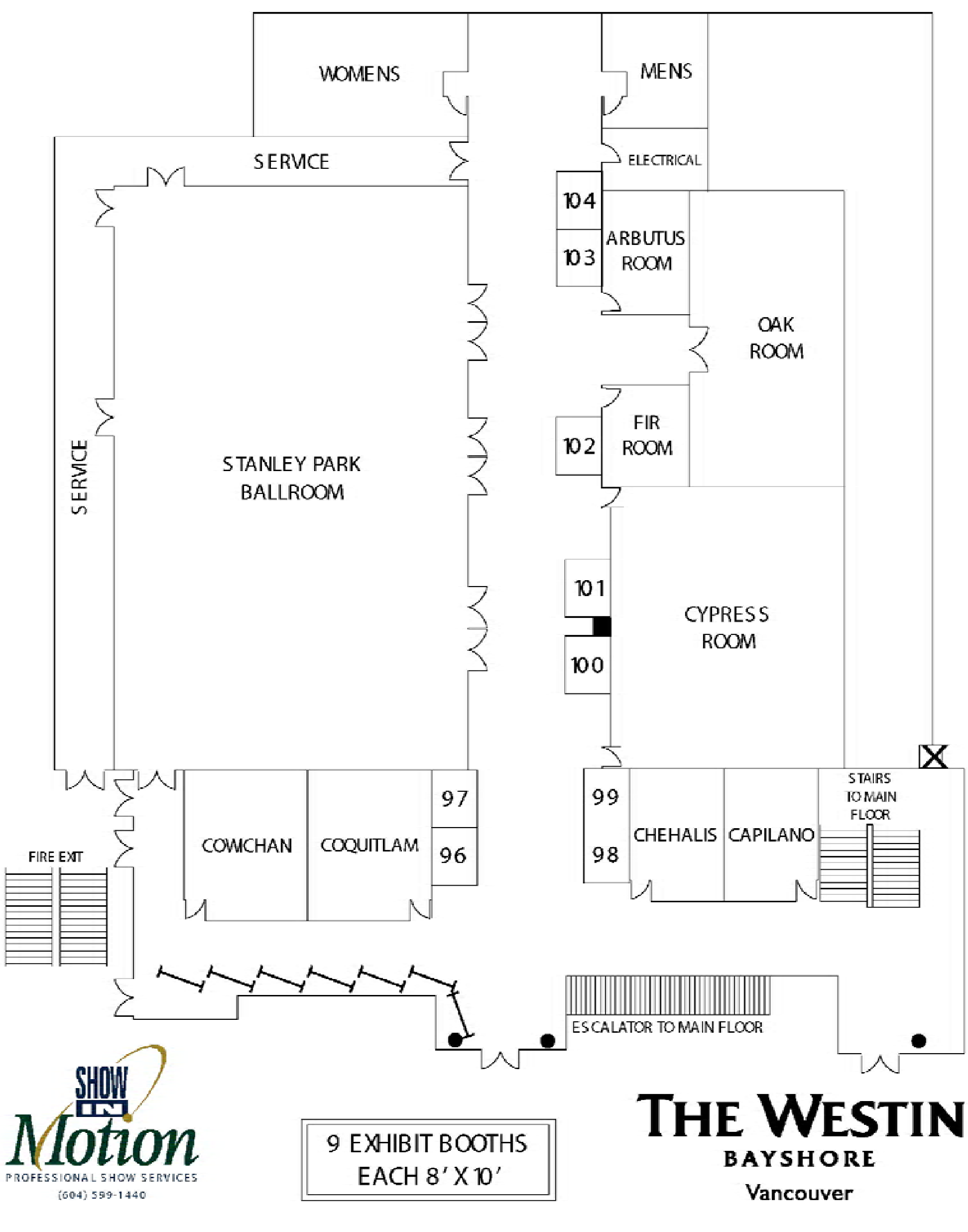
Company	Booth #
21st Century Scientific, Inc.	101
Activeaid Inc.	77
Advanced Health Care Products Inc.	24
Altimate Medical, Inc.	38
Amysystems	96
A.R.T. Group	49, 50, 51, 52
Bloorveiw Kids Rehab	69
Body Point	79, 80
Body Tech N.W. Inc.	6
Columbia Medical	4
Convaid Products	78
CS Mounting Systems	104
Daher Manufacturing	68
Dane Technologies / LEVO USA	91, 92
Dynamic Health Care Systems	93
Etac Sverige AB	13,14,15
Frank Mobility System	39
Freedom Concepts Inc.	1
Freedom Design	59
Frog Legs	95
Future Mobility Healthcare Inc.	84, 85, 86
Handicare	8, 9
Innovation in Motion	89, 90
Invacare	43,44,57,58
Ki Mobility	87, 88
LaBac / Falcon / Gel Ovations	22
Magic Wheels	34 , 35
Maple Leaf Wheelchair	40, 41
Monsam Enterprises Inc.	5
Motion Concepts	98, 99
New Mobility Magazine / Kids on Wheels	25
Next Mobility	31
Otto Bock	72, 73
Parsons ADL Inc.	2
PDG Product Design Group	66, 67
Permobil	27, 28
Physipro	70, 71
Pindot	60
Prime Engineering	23
Quantum Rehab, A Division of Pride Mobility	32, 33, 36, 37

Company	Booth #
Richardson Products Inc.	74
Ride Designs	94
Rifton Equipment	97
Sammons Preston	46, 47
Snug Seat	82, 83
SOS Rehab	18, 19
Specmat Technologies Inc.	64
Star Cushing Products	42
Stealth Products, Inc.	62, 63
Sunrise Medical	48
Supracor Inc.	54, 55
Symmetric Design	81
Tash International Inc.	56
The Comfort Company	75, 76
The "Elevation" Wheelchair by Instinct Mobility	102
The Roho Group	29, 30
Therafin Corporation	61
Three Rivers/Out-Front	45
TiLite	11, 26
Trulife	100
Varilite	16, 17, 20, 21
Visa Medical Ltd.	12
Vitacare Medical Products	65
Wenzelite Rehab Supplies div of Drive Medical	103
XSENSOR Technology Corp.	53

MAIN LEVEL


THE WESTIN BAYSHORE
Vancouver
BAYSHORE GRAND BALLROOM
LOADING DOCK
SERVICE CORRIDOR
92 EXHIBIT BOOTHS
EACH 10' X 10'
KITCHEN
FRASER ROOM
MACKENZIE ROOM
SEYMOUR ROOM
THOMPSON ROOM
CONVENTION REGISTRATION
MENS WASHROOM
WOMENS WASHROOM
ENTRANCE
ENTRANCE
ENTRANCE
BANQUET OFFICE
ENTRANCE
PHONES
SERVICE
ELECTRICAL
MAIN ENTRANCE
FRONT DESK
SHOW IN Motion
PROFESSIONAL SHOW SERVICES
(604) 599-1440
THE WESTIN
BAYSHORE
Vancouver

UPPER LEVEL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OAK ROOM
SERVICE
STANLEY PARK BALLROOM
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CYPRESS ROOM
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COWICHAN
COQUITLAM
CHEHALIS
CAPILANO
STAIRS TO MAIN FLOOR
FIRE EXIT
ESCALATOR TO MAIN FLOOR
SHOW IN Motion
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(604) 599-1440
9 EXHIBIT BOOTHS
EACH 8' X 10'
THE WESTIN
BAYSHORE
Vancouver

Restaurant Guide

Conference Venue

Westin Bayshore Resort & Marina
1601 Bayshore Dr.

Currents Restaurant & Bar
Breakfast

Seawall Bar & Bistro
Lunch and Dinner (full menu)

Stanley Perks
Coffee, soup, sandwiches, pastries to go

Within Walking Distance

White Spot Restaurant
1616 Cardero Street (At W. Georgia)
Burgers, Pasta, Salads, Dessert, licensed

Cardero's Restaurant & Marine Pub
1583 Coal Harbour Quay
604-669-7666
Seafood, Steak dining/Pub fare, licensed

La Gavroche
1616 Alberni Street (at Cardero)
604-685-3924
Fine French Cuisine

Café De Paris
751 Denman Street (at Alberni)
604-687-1418
Informal French dining

The Fish House
Stanley Park at English Bay
604-681-7275
Seafood dining in a park setting

The Tea House at Sequoia Grill
Stanley Park at Third Beach
604-669-3281
Light meals by the Seawall

Delilah's
1789 Comox Street
604-687-3424
Upscale modern restaurant, martini bar

Within Walking Distance (Continued)

Raincity Grill
1193 Denman Street (at Davie)
604-685-7337
BC Cuisine with views of English Bay

Liliget Feast House
1724 Davie (between Bidwell and Denman)
604-681-7044
BC Native Fine Cuisine

Krishna Vegetarian Curry Restaurant
1726 Davie (between Bidwell and Denman)
604-688-9400
Value! Indian Vegetarian Menu and Buffet

Olympia Pizza & Pasta Restaurant
998 Denman Street (at Nelson)
604-688-8333
Hearty Pizza, Pasta and Greek specialties

Further Afield - Recommended

Imperial Chinese Seafood
355 Burrard Street (at W. Pender)
604-691-2788
Fine Chinese dining

Diva At The Met
645 Howe Street (at W. Georgia)
604-602-7788
Award-Winning BC Cuisine

Kobe Steak House
1042 Alberni Street (at Burrard)
604-684-2451
Japanese steakhouse and sushi

Piccolo Mondo
850 Thurlow (at Nelson)
604-688-1633
Fine Italian cuisine, excellent wine cellar

Gigi's Pizza & Spaghetti
1047 Davie St.
Pizza, pasta and Greek food

Vij's
1480 West 11th Ave
604-736-6664
Best South Asian Fusion in North America
Early seating - 5:30 - no reservations

Full Day Sessions

PS1: Power Mobility Assessment, Prescription and Training
Roslyn Livingstone Nicole Wilkins Kathie Marina

PS2: Fabrication of Seating Systems (held at Sunny Hill Health Centre for Children)
Robert Stickney Gordon Broughton David Cooper Anna Vouladakis Mark Dilabio

PS3 Assistive Technology Review Course
Mark R. Schmeler Kendra L. Betz Doug Gayton

Morning Session

PS4: Evidence-Based Practice: Finding, Assessing and Using the Evidence
Teresa E. Plummer Ann Eubank Claire Morress

Afternoon Session

PS5: Manual Wheelchair Configuration, Set-up and Performance Measurement
Carmen P. Digiovine Theresa Berner Tina Roesler

Detailed Program

Thursday, March 6, 2008

Location	Time	Event
Confrerence Foyer and Exhibit Hall	*8:00*	*Registration, Breakfast & Exhibits*
Stanley Park Ball	8:30	Opening Remarks **Maureen O'Donnell**
Moderator: Maureen O'Donnell	8:40	Keynote Address: New Technology for Age-old Needs **Geoff Fernie**
Moderator: Maureen O'Donnell	9:25	Plenary Mobility of Older Persons in Residential Care **William C. Miller**
Moderator: Maureen O'Donnell	9:50	Plenary Aging with a Disability: Update on Current Research and Clinical Practices **Susan Johnson-Taylor**
Moderator: Maureen O'Donnell	10:15	Plenary Crainopagus Conjoined Twins - The Journey **Maureen Story, David Cooper**
Conference Foyer and Exhibit Hall	*10:40*	*Refreshment Break & Exhibits*
	11:30	**INSTRUCTIONAL SESSIONS - GROUP A (11:30 - 12:30)**
Salon 2 Moderator: Sonja Magnuson Assistant: Sandy Jagday	A1	Seating and Safety: Transportation Issues **Delia Freney-Bailey, Susan Johnson**
Seymour Moderator: Tanya St. John Assistant: Darcy Cooper	A2	Unstable Blood Pressure Control During Sitting and Standing in Patients with Neurodegenerative Disorders **Andrei Krassioukov, Victoria Claydon, Galina Vorobeychik**
Salon 1 Moderator: Karen Sauve Assistant: Stephanie Smith	A3	The Assessment is Done. Where Do I Go From Here? **Stefanie Laurence**
Salon 3 Moderator: Nicole Wilkins Assistant: Debbie Field	A4	Bridging the Gap: Powered Mobility Meets Electronic Aids to Daily Living **Kevin Cook, Marcy Antonio**
Cypress Moderator: Beth Ott Assistant: Janice Evans	A5	When to take a Stand for Standing: Factors to Consider When Choosing a Standing Wheelchair **Brenda Canning, Deborah L. Pucci**
Conference Foyer and Exhibit Hall	*12:30*	*Lunch (not provided, sandwich sales available) & Exhibits*

SIMULTANEOUS PAPER SESSIONS: 1

	Room 1 - Salon 1	Room 2 - Salon 2	Room 3 - Salon 3
14:00	Testing the Heat and Water Vapor Transmission Characteristics of Wheelchair Cushions **Allen Siekman**	The Randomized Controlled Rocking Chair Trail **Kristiina Niemalä, Marju Huuhteanen**	Low-cost, Appropriate Wheelchairs for Challenging Terrain in Developing Nations **Joy Wee**
14:15	The Use of Controured vs Flat Cushions in Adaptive Seating for Children with Cerebral Palsy - Development of Measurement Systems and Results **Rachel McDonald, Ainslie Jackel**	Mounting for Mobility **Bill Johnson, Anne Marie Renzoni**	Leveraging the Internet to Provide Seating and Mobility Services in Developing Countries **Todd Lefkowicz, Brian J. Dudgeon**
14:30	Development and Testing of an Innovative User Adjustable Support Surface for Wheelchair Seating Discomfort **Barbara Crane, Douglas Hobson**	Safety Issues of Wheelchair Seated Drivers in Private Vehicles **Linda van Roosmalen**	The Impact of Low-Cost Adaptive Technology in a Columbian Community **Marlene Wiens**
14:45	Utilizing Smart Technology to Assist in the Monitoring of Air Floatation Cushions **Michael Banks, Eva Ma**	The TOTWalker Project: A Journey to the KidWalk **Christine Wright-Ott**	"Skin Care After a Spinal Cord Injury" The Use of a Multi-disciplinary Team Home Visit to Assess, Educate and Link Injured Workers with Community Resources **Lori Cockerill, Bev Thompson**
15:00	The MAC and MiniMAC - Tools for Customised Seating Design and Production **Sue McCabe**		Pressure Mapping of 64 Spinal Cord Injured Workers as Part of Wound Prevention Program: Analysis of Findings **Jo-Anne Chisholm, Joanne Yip**

Location	Time	Event
Exhibit Hall	*15:15*	*Refreshment Break*
	16:00	**INSTRUCTIONAL SESSIONS - GROUP B (16:00 - 17:00)**
Salon 3	B1	Wound Investigation Process **Karen Hardwick**
Salon 2	B2	Aging with Developmental Disability **Jessica Presperin Pedersen, Jill Sparacio**
Seymour	B3	Don't be a Crash Test Dummy! **Ginny Paleg, Susan Johnson**
Salon 1	B4	When to Think About Lateral Tilt and Why **Stephanie Tanguay, Bradford Peterson**
Cypress	B5	Mobility for Discovery **Christine Wright-Ott**
Exhibit Hall	*17:00*	*Reception & Exhibits*

Friday, March 7, 2008

Location	Time	Event
Conference Foyer and Exhibit Hall	*8:00*	*Registration & Exhibits*
Stanley Park Ballroom	8:30	Opening Remarks **Maureen O'Donnell**
	8:40	Plenary Multiple Sclerosis - Understanding the Beast Within **Jean L. Minkel**
	9:05	Plenary Sleep is Everybody's Business **Sue McCabe**
	9:30	Plenary Adaptive Seating Interventions for Children and Young People with Severe and Complex Disabilities: Evidence, Research and Proposed Model for Future Research Practice **Rachael McDonald**
Conference Foyer and Exhibit Hall	*9:55*	*Refreshment Break & Exhibits*

SIMULTANEOUS PAPER SESSIONS: 2

	Room 1 - Salon 1	Room 2 - Salon 2	Room 3 - Salon 3
10:45	Selecting Activity and Participation Outcome Measures for Wheelchair Users Based on the ICF **W. Ben Mortenson**	Effects of Dynamic Wheelchair Seating in Children with Celebral Palsy **Michael Hahn**	Evaluating the Effectiveness of a Wheelchair Skills Training Program for Children **Courtney Hall, Kamila Zloty**
11:00	Intrinsic Wheelchair-Skills Learning Induced by Testing: Case Report of a Person with Parkinsonism **R. Lee Kirby, Cher Smith**	Does Postural Support Influence Ability to Perform Attention Tasks in Children with Cerebral Palsy? **David Porter**	Use of a Family-Centred Satisfaction Survey to Guide Intervention for Children Accessing a Positioning and Mobility Clinic **Les Smith**
11:15	Toward Establishing the Responsiveness of the Seated Postural Control Measure (SPCM) **Debbie Field**	The Impact of Early Powered Mobility on Young Children's Play and Psychosocial Skills **Jan Furumasu**	Relative Contributions and Limitations of Wheelchairs in Supporting Activities and Participation of Persons with Disability **Joy Wee**
11:30	Reliability of the Wheelchair Outcome Measure in Adults with Developmental Disabilities **Natasha White, Jana Good, Debbie Field**	Studying the Effect of Different School Chairs and Desks on the Seated Postures of Children with Cerebral Palsy **Karl F. Zabjek**	Understanding Wheelchair Use Patterns: Tilt-in-Space **Sharon E. Sonenblum**
11:45	The Segway Personal Transporter for People with Disabilities. Phase II: Meeting Clients' Mobility **Bonita Sawatsky, Ian Denison**		Carer Wheelchair Propulsion: Factors Affecting a Carer's Capacity **Catherine S. Holloway**

Location	Time		Event
Conference Foyer	*12:00*		*Lunch (provided) & Poster Session*
	13:30		**INSTRUCTIONAL SESSIONS - GROUP C (13:30 - 14:30)**
Salon 3		C1	Meeting the Challenge: Trying to Meet the Needs of Persons with MS **Jean L. Minkel**
Salon 2		C2	Vision and Perception Related to Independent Mobility **Teresa Plummer, Ann Eubank**
Cypress		C3	What in the World Are We Doing About Sleep? **Sue McCabe**
Salon 1		C4	The Science of Interface Pressure Mapping - Updates for Clinical Application **Kim Davis, Stephen Sprigle**
Seymour		C5	The Evidence Basis of Passive Standing Programs: Prelude to a RESNA Position Paper **Ginny S. Paleg**
	14:40		**INSTRUCTIONAL SESSIONS - GROUP D (14:40 - 15:40)**
Salon 3		D1	Customizing Seating and Positioning for the Aging Population: Assisting in Restraint Reduction **Sheila Buck**
Seymour		D2	Wheelchair Transportation Safety: Principles, Standards and Practice Risk Management **Douglas Hobson, Linda van Roosmalen**
Cypress		D3	Power Wheelchair System Customization **Jacqueline Macauley**
Salon 2		D4	Beyond the Owner's Manual: Essential Education & Training for Manual Wheelchair Users **Kendra L. Betz**
Salon 1		D5	Positioning Needs for Early Intervention **Delia Freney-Bailey**
Conference Foyer and Exhibit Hall	*15:40*		*Refreshment Break & Exhibits*
Stanley Park Ballroom	16:30		Plenary To Push or Not to Push: An Interactive Discussion on Manual vs. Powered Mobility Choice **Kendra Betz, Mark R. Schmeler** **Consumer Panel:** **Vivian Garcia, Brad Jacobsen, Bonita Sawatzky**
	17:20		*Adjourn*

Saturday March 8, 2008

Location	Time		Event
	9:00		**1/2 HOUR INSTRUCTIONAL SESSIONS - GROUP E (9:00 - 9:30)**
Salon 2		E1	How Effective is your Seating Prescription? Using Case Histories to Generate Evidence **Clare Wright**
Salon1		E2	State of the Literature on Power Seating Functions: What is the Scientific Evidence? **Brad E. Dicianno, Mark Schmeler, Jenny Lieberman**
Cypress		E3	Preparing Letters of Medical Justification - Are we the Best we can be? Can we do Better? **Sharon Pratt**
Salon3		E4	The Propelling Technique's Impact on Positioning for Elderly Wheelchair Clients **Maria Amnell**
	9:00		**1/2 HOUR INSTRUCTIONAL SESSIONS - GROUP F (9:35 - 10:05)**
Cypress		F1	Writing Effective Justification Letters - A Common Sense Approach **Les Smith**
Salon 1		F2	A Case Study of Dakotah: Dramatic Difference Between Seating and Positioning in an Everyday Wheelchair vs. a Sports Wheelchair **Mary Beth Kinney, Kay Koch**
Seymour		F3	Understanding Home Care and Therapeutic Mattresses (Support Surfaces) **Allen Siekman**
Salon 3		F4	Selecting the Appropriate Seat Cushion - Is it Really that Much of a Challenge? **Sharon Pratt**
Salon 2		F5	Meaningful Modifications **Rick Escobar**

Location	Time	Event
	10:10	**INSTRUCTIONAL SESSIONS - GROUP G (10:10 - 11:10)**
Salon 3	G1	To Seat or Not to Seat? That is the Dilemma **Scott Pickett**
Salon 2	G2	Custom Seating Fabrication Controls & Techniques - Assuring Successful Outcomes Before You Build **Richard Pasillas**
Cypress	G3	The Development of International Standards and Testing Methodologies for Support Surfaces **Allen Siekman**
Salon 1	G4	Linking Patient Coverage Criteria with Clinical Justifications for Seating and Mobility Products **Elizabeth Cole**
Conference Foyer	*11:10*	*Refreshment Break*
Stanley Park Ballroom	11:30	Plenary Darius Goes West: Working as a Team to Provide a One of a Kind Wheelchair **Kay Koch**
	11:50	Plenary Attitude is Everything **Kelly Smith**
	12:15	*Closing Remarks and Evaluation*

Plenary Session - Mobility of Older Persons in Residential Care

Miller WC
Occupational Science & Occupational Therapy, University of British Columbia
GF Strong Rehabilitation Lab, Vancouver Coastal Health Research Institute
International Collaboration on Repair Discoveries

Mobility impairments are common among older adults living in residential care facilities. In Canada an estimated 4.6 % of community dwelling respondents over the age of 64 use a wheelchair (Clarke & Colantonio, 2005) while 52 % of those living in residential care use a wheelchair as their primary means of mobility (Shields, 2004). As Canada's population ages, the number of people with mobility-related disabilities will increase and it seems likely that there will be more people living in some form of residential or assistive care institutions.

Mobility impairments can seriously limit the participation of older adults who live in care facilities (Bergen, Presperin, & Tallman, 1991). Addressing the mobility needs of these residents is a multi-faceted process, which involves cooperation between health care disciplines, collaboration with families and clients, careful allocation of staff and equipment resources, and procurement of appropriate mobility related equipment.

A properly prescribed and fitted manual or power wheelchair can facilitate mobility, which in turn can lead to both increased participation in valued activities, as well as a decreased dependency on others to access their environment (Buning, Angelo, & Schmeler, 2001; Mortenson et. al., 2005; Rader, Jones, & Miller, 2000). Moreover proper posture can improve respiratory function, which can increase speech volume and improve swallowing (Rader et al., 2000) as well as increase comfort (Pedersen, 2000) which can reduce the need for physical and chemical restraint use (Rader et al., 2000). On the other hand a poorly fitted wheelchair can produce negative sequelae such as pressure ulcers (Rappl et al, 2000), contracture formation and may limit independent mobility (Bergen, Presperin & Tallman, 1991; Pedersen, 2000; Rader et al., 2000). In their systematic review of the literature, Reid et al (2002) found that there is a lack of quality studies related to the impact of proper seating and wheelchair prescription and this is finding is especially evident for assistive living populations.

Prevalence of Wheelchair and Seating Needs in Assistive Living

Serious concerns have been raised about the quality of wheelchairs and wheelchair seating provided for institutionalized residents. Previously Redford (1993) reflected that many older adult residents spend their days sitting in inappropriately fitted wheelchairs. The magnitude of the problem of wheelchair seating needs of individuals living in residential care in the United States is serious with studies indicating that between 50-80% of residents experiencing some form of a problem with their seating system. Shaw and Taylor (1991) reported that 50% of the 153 respondents in their study indicated problems related to discomfort, hindered mobility, or poor posture. Krasilovsky (1993) indicated that 80% of the 67 nursing home residents sampled had some form of seating need that required attention. More recently Fuchs and Gromak (2003) reported that in their sample of 42 residents from Nebraska Medicaid based nursing homes, 50 % met all of the prescribing therapist's stated goals. These findings should be interpreted with caution as none of these studies used a standardized measure of wheelchair fit or need.

In contrast two Canadian studies used a standardized tool called the Seating Identification Tool or SIT (Miller et al, 2004) when assessing the need for seating intervention. In an unpublished study, using a sample of 169 older Canadians living in nine long term care facilities in Ontario, Miller et al. (2001) reported a 67% prevalence of need for seating. Specifically over 40% of the sample had a stage skin breakdown as evidenced by prolonged redness and 36% required frequent repositioning. More recently Bourbonniere and colleagues (2007) reported an average prevalence rate seating need of 22% in 2 long term care residences (32% in one and 12% in the other).

The discrepancy in findings between the Bourbonniere (2007) and the other studies cannot simply be related to the operationalization of need or the tool used to collect the data. One other reason for the variation in findings may be that the amount of resource available for seating (equipment and therapist time) forces a "one size fits all" approach to wheelchair seating in most facilities (Gavin-Dreschnack, 2005; Rader, Jones & Miller, 1999). As a result facilities may only provide their residents with sling back and sling seat wheelchairs or gerichairs which do not meet residents' individual wheelchair seating needs (Redford, 1993).

Indeed it is very plausible that the prevalence for need was lower in the Bourbonniere (2007) study because both facilities were resource rich. Both had a reasonable (yet still low) compliment of full time therapists who prescribed and modified wheelchair systems on an on going basis and both institutions had recently received considerable funding (3 million dollars over 5 years) to fund equipment purchases. Despite both facilities having premium levels of funding, the difference in need between the study facilities was statistically significant and it remained significant along with the number of co-morbidities in predicting the need for seating intervention in multiple regression analyses (Bourbonniere et al, 2007). This finding needs to be verified in other residential care settings.

Some additional support for the "one size fits all" hypothesis was provided by Trefler et al (2004) who investigated the effect of providing individually fitted versus generic wheelchairs using a semi-crossover design in a small sample of older adults living in an institution. They found a statistically significant improvement in straight ahead driving time and non significant trends toward improvements in forward reach, speed of independent mobility, and social interaction over baseline function. The latter findings are likely not statistically significant due to the limited study power.

Independent Mobility in Assistive Living

A dearth of literature exists regarding the prevalence of independent mobility among individuals living in residential care. Brechtelsbauer and Louie (1999) found that independent wheelchair mobility was minimal among the residents of the long-term care facility that they sampled. They concluded that the goal of independent mobility via a wheelchair was not realistic for the majority of their residents. The authors came to the conclusion that it was not cost effective for this population to receive individualized seating and suggested a 'one size fits all model' should be implemented. Moreover they recommended that therapists with experience in seating and wheelchair intervention would not be necessary under this model of care. This study, however, had several limitations including failure to use a standardized reliable and valid tool to determine resident mobility and they did not consider the link between specific wheelchair factors (e.g., goodness of fit) and mobility.

In direct response to the Brechtelsbauer and Louie (1999) study, Bourbonniere and colleagues (2007) addressed the identified limitations when looking at the mobility of the resident's in their sample. Mobility was measured using the Nursing Home Life Space Diameter (NHLSD) (Tinetti & Ginter,1990) reflecting the ability and frequency to independently move around his/her room, floor, facility, and outside the facility. Once again need for wheelchair and seating intervention was measured using the SIT. Overall, half of the residents were independently mobile in their

own rooms and on their units, but independence decreased when greater distances needed to be traveled. This result may be related to fatigue from self propelling and a lack of a reason or opportunity to move off the unit, two factors not considered in the study.
Perhaps of greater interest, in contrast to Brechtelsbauer and Louie (1999) multiple regression analyses revealed that the only significant predictor for participants' NHLSD scores were their overall SIT scores (Bourbonniere et al, 2007). Thus the fit of the wheelchair appears to be intimately linked to mobility. Because differences in samples may explain the variation in the results of these studies addition research in this area is encouraged.

Conclusion
While the benefits of adequate wheelchair equipment and wheelchair staffing resources for an individual living in residential care seems logical only recently have we had empirical evidence to support this long maintained clinical stance. Increased resource may not only improve the mobility, it may positively influence the socialization and participation opportunities for residents both within and outside their home. The hypothesis that adequate resources can lead to improved seating outcomes warrants further study using a controlled design. Larger studies will help determine resource allocation needs on a facility, health region, provincial, or national level and could identify specific institutional factors (such as therapy staff with seating experience, resource allocation, and or environmental accessibility) that contribute to proper seating for residents.
Mobility is a basic human necessity which can significantly affect social and economic independence along with physical and mental health. A proper fitting wheelchair has the potential to optimize the well-being of a large number of older individuals. Clinicians are encouraged to maintain an advocacy role providing evidence to residential care administrators and policy makers in an effort to enhance the living situation for their clients in residential care.

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Plenary Session - Aging with a Disability: Update on Current Research and Clinical Practices

Susan Johnson Taylor, OTR/L

Selected readings:

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Website:
www.agingwithdisability.org (Rancho Los Amigos) for a complete bibliography.

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Plenary Session - Craniopagus Conjoined Twins
The Journey

Maureen Story BSR(PT/OT)
David Cooper MSc(Kinesiology)

Conjoined twins are identical twins whose bodies are joined in utero. It is a rare phenomenon occurring in 1 in 200,000 live births.[1] Contradicting theories exist to explain the origins of conjoined twins. One theory is that of fission, in which the fertilized egg splits partially. The second theory is fusion, in which a fertilized egg completely separates, but stem cells find like-stem cells on the other twin and fuse the twins together. [2] Conjoined twins are more often female than male, at a ration of 3:1[3]

Conjoined twins are usually classified by the point at which they are joined, the Greek word pagos, meaning "that which is fixed". There are several different types of conjoined twins. The following are the basic classifications:

Thoracopagus	twins share part of the chest wall, possibly sharing the heart. The most common form of conjoined twins. (35-40%)
Omphalopagus	twins are joined from the waist to the lower breastbone (30%)
Pygopagus	twins are likely positioned back-to-back and have a posterior connection at the rump. (20%)
Ischiopagus	twins are joined at the coccyx and sacrum (6%)
Dicephalus	one body with two separate heads and necks (2%)
Craniopagus	twins joined at the cranium (2%)4

Craniopagus conjoined twins occur 1 out of 2.5 million live births.4 On October 25, 2006 craniopagus conjoined twins were born in Vancouver, B.C. The girls were born by caesarean section at 34 weeks gestation and their combined weight was 5.8 kilograms.(~13 lbs.) Their birth was uncomplicated and no resuscitation or interventions were necessary. The twins were alert, active and had spontaneous movement of all 4 limbs. The girls are conjoined at the level of the occipital, parietal and the temporal areas.They are classified as total craniopagus/angular.4 They are fused at about a 90º angle facing forward and slightly away from each other.

The initial post natal period was unremarkable. The girls were nasal gastric fed until mom could master feeding both babes. She attempted to breast feed but found this too cumbersome. The girls were bottle fed with no oral motor problems. Interestingly when central stimuli – oral, auditory or tactile, was applied to one twin, the other twin would promptly respond with an almost identical movement. If the twins were crying and a soother was put in one twin's mouth, both babies would stop crying. In response to peripheral stimuli, for example tickling, the twins responded independently.

Considering Separation:
The big question that was foremost in the family and professional's minds was could the twins be separated. It was difficult at birth to determine their exact intracranial anatomy. Further tests were put off until they were between 4 and 6 months old. Numerous tests were done including angiograms, CT scans, ultrasounds, MRI's and venography. The results of these tests showed that the girls shared some brain tissue, a major blood vessel and that one has more venous vasculature than the other. The results of all the tests were shared with a number of medical experts worldwide to help determine if separation was possible. The consensus was that separation would not be a good choice. If separation was attempted, and was successful, there would definitely be resulting neurological sequelae. The results of the tests and the views of the medical experts were discussed with the parents and they ultimately made the decision not to attempt surgery at this time.

Positioning:
Prior to the birth of the twins there was great concern regarding their positioning once they were born. How should they be positioned in bed? How could they be transported safely? What equipment would the parents need to care for them?

At Birth: the twins were placed on a wedge in their crib as a precaution to ensure a clear airway and avoid aspiration due to reflux. When they were positioned supine there was a gel pillow placed under their heads to avoid excess pressure and help reduce the chance of flattening of the skulls. Rolled up towels were placed along their sides and under their buttocks to cocoon them and prevent them from sliding down the wedge. The girls were positioned with their necks and spines as symmetrical as possible. When the girls were positioned in prone a small piece of viscoelastic foam was placed under their heads to ensure their faces were free of the surface as they could not turn their heads to clear their airways.

At One Week: The twins were healthy and although they would stay in hospital for further observations preparations were started to send them home. Like most newborns some equipment would be necessary. Number one priority was a carseat to safely transport them. They also needed a stroller, infant seat and something to bath them on. Due to the uniqueness of these twins, standard infant equipment would not work. Nothing could be purchased "off the shelf". All the equipment had to be custom fabricated.

The big debate – Do you position the twins for postural symmetry or for function. At one week of age it was obvious that the twins needed to be positioned to maintain a patent airway, especially in a carseat, as they had little head control.

The Carseat: After consultation with other centres, who had experience with conjoined twins, and a carseat manufacturer it was concluded that there was no commercial carseat that would fit the needs of the twins. All the commercial systems were too narrow and did not have the strapping that would accommodate them. It was decided to use the foam in box method of custom contouring to capture a mold of the twins. This mold would then be placed in an ABS plastic shell that could be tethered safely in the car. The 5-point shoulder/hip straps and the tether strap that were used were provided by the carseat industry. Every effort was made to simulate a standard carseat with respect to safety. The twins were positioned symmetrically with their necks and spines in alignment and their hips and knees bent to 90º to capture the mold. The angle of the base was about 5º and the girls were placed in the car rear-facing. To allow the carseat to grow with the girls layers of firm foam were placed under their buttocks that could be removed as they grew taller.

The Stroller: The girls needed a means of transport for the community. The usual commercial strollers were investigated and it was quickly determined that there was nothing available that would fit them. The easiest solution was to start with a folding stroller base, build a platform for it and create a locking mechanism to allow the carseat to be secured to it. This way the family could easily transfer the girls from car to stroller without taking them out of their carseat.

Bathing: The girls did not fit in a standard infant bathtub or a sink and none of the standard infant bath aids would support them. While in the hospital the girls were sponge bathed as they were hooked up to many monitors but once they were home the family wanted to bathe them in a tub. A bath support was custom fabricated to fit in a standard bathtub.

The girls were discharged from hospital at 1 month 20 days old.

At Five Months: The twins had grown and changed developmentally. They were lifting their heads in supine and prone, were grasping objects, bringing their feet to their mouths, were visually attentive, socially smiling, kicking their legs reciprocally and attempting to pull to sit. It was noted at this time that one of them was smaller than the other and that she also had higher blood pressure than her sister.

The girls at this time had outgrown their carseat. A second carseat was needed. They now had better head control, were trying to pull to sit, did not like being flat in their carseat, and the twin closest to the car door was hitting her feet on the door. The same process of custom contouring was used for the second carseat but this time symmetry had to be compromised to bring them into a more functional upright sitting position. The girls were brought closer together causing some lateral neck flexion but still maintaining a patent airway. With the girls improved head, neck and trunk control this position was considered safe.

Twins in second carseat.

Alternate Positioning: To encourage further motor development the twins needed to experience many different positions. The therapists providing treatment wanted them to be able to spend time in prone, sidelying and sitting.

Prone: A simple foam wedge was provided to be placed under the twins chests to encourage them to push up on forearms and possibly get up on their knees into 4-point kneel.

Sidelying: The girls were unable to attain sidelying on their own therefore a sidelyer was fabricated to allow them to experience this position.

Sitting: A foam seat was carved to allow the girls to be positioned in sitting to allow them to work on fine motor, visual, and social skills. As well as improve their postural stability.

At Fourteen months: The girls continue to grow and develop. There is a greater discrepancy in size between the girls. One twin is almost 1.5kgs(3lbs) larger than her sister. Further tests reveal that the smaller twin's heart is having to work harder than her sister's as she controls more of the blood circulation. The larger twin has developed more gross motor skills. She is able to roll from supine to prone if her mother gives her sister a helping hand to also roll. She will propel both herself and her sister across the floor by pushing with her heels. She is able to get up on all fours and rock. Both twins are beginning to talk and have about 8 words. And of course they have grown. Time for a third carseat, a new seating system, and parents would really like to see them on their feet… the journey continues.

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A1 - Seating and Safety: Transportation Issues

DELIA "DEE DEE" FRENEY, OTR/L, ATP, ATS; SUSAN JOHNSON, CONVAID INC.

Introduction:
This presentation will address safety issues in transporting children positioned in seating systems integrated with wheelchairs. This session is to increase awareness of your clients seating needs for the clinic, home, school and work environments as well as the safety and importance of transportation. The primary focus will be on the child, the seating and base all safely integrated into a transit safe system. Videos and case studies will be used to illustrate positioning as well as a hands-on opportunity to see crash tested approved dependent manual wheelchairs with supportive seating for simple to complex clients.

Safety Standards:
Why is wheelchair transportation safety important? It is important because almost all wheelchairs will at some point be used as a seat in a motor vehicle for transportation.

How can we help children and all end users ride more safely while seated in their wheelchair for travel in a van or bus?

What is the WC/19 Standard? What is the Canadian Standard (Z-604)?

W/C19 is a voluntary ANSI/RESNA standard developed by transportation safety and rehabilitation experts. The SOWHAT Committee's Goal is to provide a similar level of safety for a person riding in a motor vehicle in a wheelchair as that of a rider on the vehicle seat.

Many of the participants in the development of this standard were the same as those who have also been working simultaneously to develop harmonized transit wheelchair standards in ISO (7176/19) and Canada (CSA Z604).

What does WC/19 require?

- Adherence to design specifications
- Crash testing 30mph/20G forward facing
- Safety testing
- Four easily accessible securement points
- Wheelchair integrated lap belt connectors
- Labeling of chair and postural belts
- Presale/post sale disclosure of test results

Transportation Expert Recommendations:

1. When traveling in a motor vehicle, it is generally safest to transfer to a vehicle seat and use the seatbelts or a child safety seat that complies with federal safety standards. Your wheelchair should be stored and secured.
2. It is best if you have a wheelchair with the transit option that has been crash tested and complies with ANSI/RESNA WC/19.
3. A properly positioned headrest on the wheelchair will help protect the head and neck.
4. Occupants should be properly positioned in their wheelchairs for the ride. Some may need the assistance of anterior chest support, hip and/or trunk laterals, etc.
5. To provide effective restraint for the person in the wheelchair, a belt-type restraint must be used. A lap and shoulder belt helps prevent the wheelchair user from being thrown from the vehicle or from hitting the interior of the vehicle during a crash or emergency driving conditions.
6. Always position the person and the wheelchair facing forward in the vehicle.
7. It is best to ride with the wheelchair backrest reclined not more than 30 degrees. If more recline is needed, the shoulder-belt anchor point may need to be moved rearward along the vehicle side wall to maintain contact of the belt webbing with the rider's shoulder and chest.
8. If at all possible, remove and secure hard trays elsewhere in the vehicle to reduce the chance of rider injury from contact with the sharp edges of the tray. If it is not possible to remove the tray, place padding between the rider and the tray edge and make sure that the tray is securely attached so it will not break loose and cause injury to other occupants in a crash.
9. Secure medical or other equipment to prevent them from hitting people in a crash.

Seating for Safe Transit

Seating for function in the clinic, classroom, home and community settings may not be the same positions when being transported safely in a bus or van. Therapists working in these environments look for their children to be functional in their supported position.

Clinically, therapists use a variety of supports on their children to enable functional positions with regards to their orthopedic status and/or muscular tone. In treatment, therapists use their hands to dynamically support the child in various positions.

In wheelchair sitting, static positioners may be used to simulate the therapist's hands of support.

A seating system may have many positioning supports; primary and secondary. A primary positioning support may be an anti-thrust pressure management seat cushion or posture specific back. A secondary positioning support may be a lateral thoracic support or an anterior forearm support such as a tray.

The support system may include headrest systems to foot supports. Headrests and support collars may help or harm the client depending on how it is mounted. A soft cervical collar type neck support is safer for transportation than a back mounted fixed firm inverted U shape neck support.

In a transportation situation a supportive tray could act as a danger in the event of a crash. How can therapists choose between having no support or a potentially harmful support. What are the alternatives? How can a position in space chair be a benefit or potential harm in vehicle transportation? How do medically necessary accessory devices such as an O2 tank or a suction machine and its battery be safely secured?

Consideration for the child's safety throughout their entire day is paramount. As clinicians we must think about the child beyond leaving the doors out to their bus. Parents transporting their children in their seating systems and wheelchairs should be educated and aware of safe postioning for transit.

Conclusion:
What can you do to encourage safety in seating and transportation issues?
Group discussion

Questions and hands on equipment opportunity.

Website Reference: http://www.rercwts.pitt.edu/RERC_WTS_FAQ/RERC_WTS_FAQ.html

References:
Website:http://www.rercwts.pitt.edu/RERC_WTS_Res/RERC_WTS_Res_SP/RERC_WTS_res_sp6.html

Acknowledgements: We would like to thank Lori Brinkey and Miriam Manary for sharing their "Ride Safe" PowerPoint presentation expanding upon the information in the "Ride Safe" brochure. The "Ride Safe" brochure was developed by the staff at the University of Michigan Health System and the University of Michigan Transportation Research Institute with funds provided through a grant from the FRIENDS of the University of Michigan Hospitals. Additional support came from the RERC on Wheelchair Transportation Safety.

A2a - Unstable Blood Pressure Control During Sitting and Standing in Patients with Neurodegenerative Disorders. Clinical Evaluation of Orthostatic Hypotension in Individuals with SCI: The “Sit Up Test”

Victoria E Claydon

Background

Orthostatic hypotension (OH) refers to a reduction in blood pressure occurring with the assumption of an upright position (seated or standing) that is rapidly recovered following the resumption of a supine posture1. OH may be asymptomatic, but may also be associated with symptoms of dizziness, lightheadedness, nausea, impaired cognitive function, fatigue, and if severe, fainting. The causes of OH are multifactorial, but essentially it occurs due to the pooling of blood into regions of the body below heart level when upright, leading to a reduction in the volume of blood returning to the heart, and a consequent lowering of blood pressure1. This fall in blood pressure leads to a reduction in blood flow to the brain, and this is the ultimate cause of symptoms in patients with OH. OH is defined as a reduction in systolic blood pressure of >20mmHg, or in diastolic blood pressure of >10mmHg within 3 minutes of the assumption of an upright posture, whether or not symptoms occur2.

Individuals who have sustained a spinal cord injury (SCI) are particularly prone to OH3. This is because they have impaired reflex control of the circulation due to injury to descending sympathetic nervous pathways involved in the regulation of blood pressure and heart rate, coupled with paralysis of the skeletal muscles in the legs and abdomen that would normally contract during postural change and help to pump blood back to the heart and brain when upright. There are also abnormalities in salt and water regulation after SCI that tend to produce lower blood volumes, and further impair blood pressure regulation4.

OH after SCI impairs quality of life, can adversely affect an individuals’ ability to perform activities of daily living, and severely impedes rehabilitation[5]. OH should always be considered when mobilising individuals with SCI. Although it is generally individuals with high level severe SCI that are most prone to OH, it is not possible to predict on an individual basis whether a person with a SCI will be particularly prone to OH6. This is because their susceptibility largely depends upon the extent of injury to descending cardiovascular (sympathetic) pathways6, and this is not evaluated in the current clinical standard of assessment of SCI, the American Spinal Injury Association examination, which only evaluates motor and sensory pathways, and not pathways involved in cardiovascular control[7].

“Sit up test”

We have devised a simple bedside “sit up test” that can be utilised to determine the incidence and severity of OH in individuals with SCI[6].

Individuals are monitored continuously with a standard electrocardiogram (ECG) and a blood pressure monitoring device. In some cases, plasma catecholamine levels may be evaluated from a venous blood sample. A safety strap is attached to the subject’s waist to prevent them from slipping during the sit up procedure, and they then undergo a 15min period of supine rest for stabilisation. After 15 minutes of resting they are passively placed into an upright seated position by moving the head of the bed up by 90º and lowering the foot end of the bed by 90º. Cardiovascular recordings are continued for 15 minutes. If the subject experiences severe OH the test is terminated early and they are returned to the supine position. An example tracing of beat-to-beat blood pressure during the sit up test in a 33 year old female with severe SCI at the level of the 6th cervical vertebra can be seen below.

As is common in subjects with cervical SCI, there is resting supine systolic (SAP) and diastolic (DAP) hypotension. Upon the assumption of an upright posture ("sit up") her blood pressure rapidly and progressively declines until the point where she develops symptoms of impending loss of consciousness (presyncope) and the test is terminated. The subject is then returned to the supine position, whereupon her blood pressure rapidly returns to her normal levels.

The incidence and severity of OH is predicted by various cardiovascular reflex outcome measures8, including the catecholamine levels at rest, and the level and severity of injury to spinal cardiovascular pathways[6].

36

Using this assessment it is possible to evaluate the risk of an individual experiencing OH during activities of daily living, and rehabilitation. Where appropriate, treatment strategies (both pharmacological and lifestyle adjustments[3,9]) can be instigated to minimise the devastating effect of OH upon quality of life for individuals with SCI.

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A2b - Autonomic Dysfunction in Multiple Sclerosis Patients

G. Vorobeychik, A. Krassioukov

Multiple sclerosis (MS) is a chronic disease that presents with variety of visual, sensory and motor abnormalities. However, there is also clinical evidence of variety dysfunctions of autonomic nervous system in patients with MS. Until recently urinary tract infections due to bladder dysfunctions were leading cause of mortality in patients with MS and still have an important impact on the disability of the individual patient [1,2]. Other manifestations of autonomic dysfunction include abnormal sweating, gastrointestinal dysfunctions, and abnormal cardiovascular control [3-5]. Some investigators suggest that up to 50% of the patients with MS have symptoms related to autonomic dysfunction [4-6].

Significant number of patients with MS (70-90%) report symptoms of fatigue and associated lightheadedness, and nausea[7]. Often, these symptoms are present in the absence of any decrease in arterial pressure. However, the presence of orthostatic hypotension also could contribute to this clinical presentation[8].

It is well known that in patients with MS there is no consistency in how process affecting specific white matter tracts within the CNS. As a result, pathways critical for autonomic function in the spinal cord, brainstem, hypothalamus and the cerebral cortex may be involved in MS plaques. It has been suggested that plaques of demyelination may disrupt the central autonomic network in the insular, anterior cingulate and ventromedial prefrontal cortices, central nucleus of the amygdala, paraventricular hypothalamus and the medulla or interfere with the descending autonomic nervous system pathways during their course in the brainstem or spinal cord. However, some investigators reported that a significant association between autonomic dysfunctions was present with clinical and MRI evidence of brainstem lesions [9-13].

Summary

In our recent study10 patients with spinal cord involvement had higher rate of abnormalities on Holter monitoring than patient with only brain lesions, which points to necessity of early recognition and better understanding of abnormal autonomic control in MS patients with mild disability.

Unfortunately, autonomic dysfunctions with exception of bladder/bowel function in MS patients are underestimated and rarely assesses in clinical practice in spite of significant effect on patients quality of life and activities of daily living.

These findings could eventually enhance our ability to timely diagnose and manage autonomic dysfunction in patients with MS.

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A3 - The Assessment is Done. Where Do I Go From Here?

Stefanie Sukstorf Laurence
Motion Specialties – The Motion Group of VGM Canada

All good equipment prescriptions start with an assessment, whether it is a formal mat assessment by a therapist or a site visit by a sales consultant for accessibility equipment. The assessment is the process of gathering all relevant information to determine what the client actually needs and wants, resources available, as well as how, where and by whom the equipment will actually be used. But once that information is gathered, where do you go from there?

Client Assessment

A seating assessment, whether a formal mat assessment or an abbreviated version, is intended to determine what postures can be corrected, what postures or movements must be accommodated and what supports will invite further movements. A formal mat assessment is carried out in supine, but then moves to a seated posture where the alignment, ranges and restrictions determined in supine are translated to sitting and factor in the effect of gravity. Consideration is given to what supports are required to achieve what was attained in supine, and what impact these will have on function. A person's sitting abilities are graded as independent / hands free, propped / hands dependent or dependent. The goal of seating is to provide enough support to make someone a hands free sitter in order to maximize functional abilities.

The second goal of the assessment is to establish the postural requirements and seating parameters of the equipment; degree of contact of the contours to touch the person, whether for support or function, strength of the supports, properties of the seating mediums; foam, fluid or air, and their cover/surface qualities; airflow, incontinence, friction reductions and stretch. Seating parameters include changes in orientation-in-space; tilt and recline. Gravity can either be an assist or an enemy to postural alignment, depending on the individual and their functional abilities.

The third goal of the assessment is to get measurements of the person in their best supported posture. Regardless of what equipment the assessment is for, accurate anatomical measurements will help determine equipment parameters and set-up, and provide a baseline for comparison should issues arise when the equipment is dispensed.

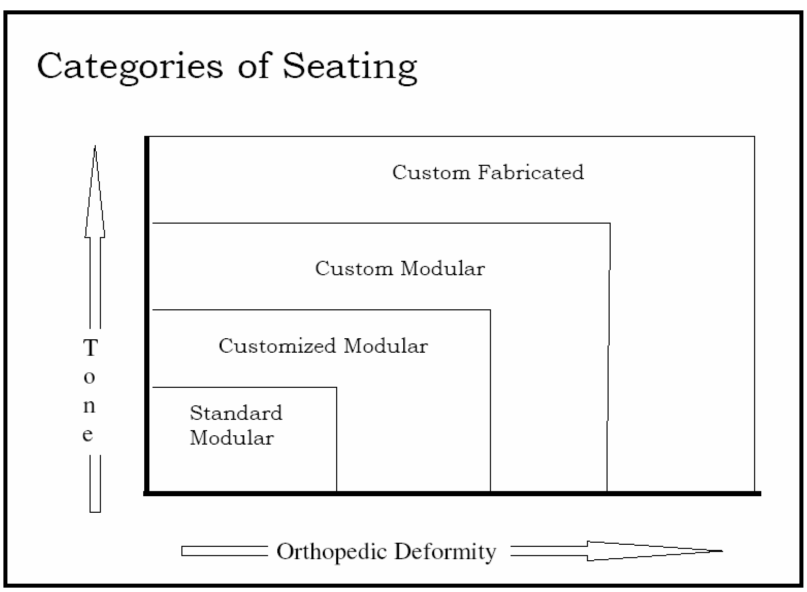
Based on the many elements of the assessment, goals are set for the equipment, e.g. a moderately contoured cushion with high pressure reduction under the ischia but will enable independent side transfers, 10" high back with low pelvic lateral stability, fabric covered, flat, gel arm pad style armrests that flip back but stay attached to the chair and foot rests that swing in for tight transfers. Setting the client goals for the system will then set the parameters that are needed when considering equipment options, and will allow matching of client needs with equipment available, or identify where and what compromises may need to be considered.

<u>Equipment Evaluation</u>
The second component of the prescription is the evaluation of equipment. There are a multitude of products on the market, with more introduced all the time. With so many options, how do you even narrow the choices?

It is a given that client factors will be taken into account of when considering equipment; physical shape/degree of deformity, muscle tone, size, skin health and functional abilities and the effect that the properties of the equipment will have on those factors – positive or negative. It is equally important to consider the environmental factors; where the equipment will be used, caregiver needs in handling the equipment and compatibility with other equipment components. Just as important is the technical skill and resources of the company selling, setting up and supporting the equipment. A piece of equipment may work perfectly, but if it cannot be maintained or repaired in a timely manner, it will not be meeting any of its intended goals.

Seating products lend themselves easily for categorization (Figure1). Using tone and orthopedic deformity as most critical client factors in determining posture, seating can be classified as standard modular, customized modular (a standard modular cushion that is modified by the vendor or end user, e.g. minor leg length discrepancy), custom modular (standard modular product that is created by the manufacturer in a custom configuration, e.g. a 14x24" cushion), or custom (one-of-a-kind seating specifically shaped for that particular individual).

Figure 1



Every seating product on the market can be slotted into one of these categories. Whether a cushion can be customized or built in a custom configuration is dependent on the manufacturing process, properties of the materials involved and the technical skill and resources of the vendor or manufacturer.

While seat cushions are the easiest example of this categorization, the same principle can be applied to backs, head rests, commodes, mattresses, slings, wheelchair frames or any piece of durable medical equipment.

Ultimately the product needs to match the client's requirements. Whether or not a product is adequate in its standard configuration or can be customized to fit will determine whether it is on the list of options for that client.

Anatomy of a Product

Every product can be evaluated on the surface contour that contacts the client, the materials that create and support that shape and in the case of custom seating, the process that creates the shape.

Using seating again as an example, a cushion can be broken down into two components: structure or support (influence on skeletal structure), and comfort or microsupport (influence on the tissue). In order to achieve pressure redistribution and postural support, most products work on the principle of maximizing client contact either by gross area or in precise placement of support. Using gross area, the product either works by increasing the ability to immerse into the seating medium (comfort layer), or having structure built up around the body structures (structural layer). Each method has its pros and cons. The more you have to immerse into a product, the more 'fluid' and hence unstable the medium has to be. Conversely, the more malleable the medium, the more able it is to accommodate changes in posture or shape. Having structures built up around the person will be more rigid hence more stable. The tradeoff is that it may interfere with function, e.g. transfers, or changes in shape e.g. due to weight less.

Using precise placement requires the ability to have an appropriate size and shaped contour, and support structure that lends itself to personalized set-up, e.g. adjustable laterals.

Other factors that need to be taken into consideration when evaluating a product include the effect the seating medium will have on the individual's tone, manage heat and moisture, how easily can it be cleaned, address allergy restrictions (e.g. latex), cost, portability, ability to change over time due to changes in size or functional abilities, and ease of use by the user, caregiver and technical staff. A cushion that is initially set up incorrectly, placed backwards in the chair following cover laundering, or falls apart when the cover is removed will certainly not be effective in the long term.

Seating does not take place in isolation. The person's posture effects the equipment that is required, but at the same time how the equipment is set up will determine the person's posture. Foot rest height, hanger angle, armrest height and wheel placement can all have a major impact on how people position themselves in their seating. Utilizing the adjustability of a wheeled base, whether a rehab shower commode or wheelchair may actually be able to decrease the complexity of the seating required.

Prescription

Having determined the client physical and functional requirements, set goals for the equipment and then match them with products that meet those needs, the next step is ensuring that the correct equipment is ordered in the right size with the appropriate hardware and set up to meet the goals. The best analogy is that the prescription is best viewed as a blueprint for the equipment; how will the various components be combined to create the finished system. It is not unusual to have products from 6-8 different companies in a single prescription of a manual wheelchair with seating. This requires effective communication between the client and therapist, the therapist and the sales consultant, the client and the sales consultant, the sales consultant and the technical staff, and the technical staff and the client. Equipment prescription can be a very creative process. How the various components, both modular and custom can be combined to create a functional system is limited only by the skill and imagination of the people involved.

Related to this issue is training in the proper use of the equipment. A cushion may have been properly measured, prescribed and set up, but if the user and/or caregivers have not been guided in effective positioning, they will not get the full benefit of the product.

After the prescription is complete and the equipment delivered, the last step is to provide follow-through or follow-up. The two terms imply very different tasks. Follow-through is following the client through the fittings and dispensing whether through physically being present at each appointment or communicating with the client or staff involved. Follow-up on the other hand is checking out the efficacy of the equipment once the equipment has been dispensed. The 'no news is good news' approach may be a strategy for managing overwhelming caseloads, but is not necessarily the best approach to ensure that the issues that originally started the prescription process in the first place were addressed.

The assessment may be done, but instead of being an end point, rather should be seen as a road map to guide what equipment will be appropriate, how it needs to be set up to be for the user and provide a reference point to judge the effectiveness of the prescription.

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A4 - Bridging the Gap: Powered Mobility Meets Electronic Aids to Daily Living

KEVIN COOK and MARCY ANTONIO

Quantum Rehab

Living with a severe disability can be devastating. The loss of mobility, independence and control of one's environment can lead to low self-esteem and depression. The use of EADL (Electronic aids to daily living) to increase independence and access to one's environment, can improve a person's self esteem by allowing them to participate in every day living, school, work, and leisure activities.

EADL Basics: What is an EADL and how does it work?

Also known as ECU (Environmental Control Unit), EADLs provide a means to interact and manipulate one or more electronic appliance such as: a television, radio, CD player, lights, and fan etc. This is accomplished using voice activation, switch access, a computer interface, and adaptations such as X-10 units. All EADLs transmit signals to the devices that will be controlled and many factors must be considered when choosing the transmission method. AC wiring throughout the house, ultrasound, infrared (IR), or radio frequency (RF) signals can all be used to transmit these signals.

Access: How does one control/activate the EADL device?

EADL have historically been divided into two basic types: computer based, and stand-alone or direct access systems. However, recent developments in powered mobility have made it simple and cost effective to integrate EADL functions with one's power wheelchair drive controls, eliminating the need for additional switch access.

Integrating EADL with Powered Mobility: Equipment options

ECU Module: Allows direct interfacing of after market devices. Provides user access through power wheelchair drive controls using relay switches through ECU channels.

- Door openers
- Specialized telephones

Specialty Devices: Plug and play devices designed to interface directly with specific power wheelchair controls.

- Switch-it mouse driver.

All-in-one displays: Specialty control devices equipped with infrared and blue tooth transmitters. Programmable for various alternative drive controls as well as numerous EADL applications.

- Integrated, wireless mouse emulation.
- Easy to train, intuitive IR programming.

A5 - When to Take a Stand for Standing: Factors to Consider When Choosing a Standing Wheelchair

Brenda Canning, OTR/L
Deborah L. Pucci, PT, ATP

Consumers of wheeled mobility now have greater access to information on the products available to them and more people are expressing an interest in standing wheelchairs. Making a good choice on an expensive piece of equipment involves understanding potential benefits, limitations, and drawbacks of the equipment. This presentation will focus on the information needed to complete an assessment that considers a standing wheelchair as a mobility option.

It is the role of the therapist who specializes in wheeled mobility and seating to be able to guide the consumer through the decision making process by determining the realistic benefits and drawbacks for that individual. The potential physiologic benefits of standing may be a reason why some clients would like to be able to stand from their wheelchair. Clients have sometimes been told about the benefits from wheelchair manufacturers, other consumers, or health care professionals. Reported potential benefits are:

- Reduced rate of demineralization and decreased osteoporosis
- Maintenance or improvement of joint range of motion
- Decrease in spasticity
- Assistance with maintaining skin integrity
- Improved Bowel and bladder function

If these benefits are the main reason the client is electing to pursue a standing wheelchair, he or she should be educated about the evidence available. It is also up to health care professionals to be aware of the research to date on this topic to ensure that they are not providing misleading information to the client or in a letter of medical necessity. In addition to the perceived physiologic benefits of standing, individuals often express the desire to stand for functional and psychological reasons. Functional benefits of using a wheelchair for standing are: the potential for increased standing time/consistency, no additional transfer is required to stand, and the potential to complete functional tasks from standing.

There have been few studies that look at standing programs, thus conclusive evidence of the effects of passive standing has not been documented.[1] One study looked at the effects of standing on spasticity, contracture, and osteoporosis in 6 males who were long time wheelchair users. Two had multiple sclerosis and 4 had spinal cord injury. There were no positive improvements noted in spasticity, contraction or osteoporosis; however use of the standing frame did have a positive psychological benefit.[2] Another study from 1981, however, revealed that individuals with SCI who underwent a single session on a tilt table at a near vertical position experienced reduced resistance to passive ankle joint movement.[3] A single subject study on an individual with SCI by Bohannan, indicated that improvements in spasticity following tilt table standing do not result in carry over to the next day.[4] Standing has been indicated to improve bowel function by reducing constipation in a case study. [5] Despite the indication that standing helps to improve bladder function by reducing hypercalciuria, there is little evidence to support the prevention of osteoporosis or improvement in bone density with passive standing.[6,7] Goemaere et al, found the bone mineral density in the lumbar spine and femoral shaft to be greater in patients with SCI who were at least one year post injury and participated in a program of passive standing when compared with individuals who did not, however, Frey-Rindova et al found that there was no difference in bone density measures between individuals who underweight regular weight-bearing activity in a rehabilitation setting and individuals who did not at one year post SCI.[8,9]

The Clinical Evaluation

A referral from the client's physician stating the client is able to stand for the evaluation protects the safety of the client. One of the first areas addressed during the evaluation is a review of the medical history. Certain conditions are considered contraindications for standing such as severe osteoporosis and unresolved orthostatic hypotension. Other contra-indications such as severe spasticity, significant postural asymmetries or range of motion limitations are revealed during the seating evaluation. The client who seems to be a good candidate for standing but has not stood for a significant period of time, may need to be referred to physical therapy to work on gradually being able to achieve an upright position using a tilt table or stander. He or she may then decide to return to try a standing wheelchair.

The clinical evaluation begins the same way as any seating evaluation. The client's goals and expectations are determined. Information about the client's home situation, support systems, transportation, and activities of daily living is gathered. A physical evaluation of seated posture, the need for postural supports in sitting, range of motion, muscle strength, sensation, skin integrity, and spasticity is a starting point. The following must be looked at closely to determine if a standing wheelchair would be appropriate or determine the best method of transitioning to a standing position:

- The effect of spasticity on posture: The effect of moving from hip and knee flexion to extension on lower extremity alignment, trunk and upper body position.
- Range of motion at the hip, knee, ankle and foot
- Leg length discrepancy in sitting and supine
- Postural deformity and head position

Individuals need to demonstrate adequate range of motion to achieve stance in the mobility device without the production of abnormal stress on joints or soft tissue that could result in injury such as fracture, dislocation, or impaired skin integrity. Postural asymmetries or fixed deformities must be able to be adequately accommodated and/or supported to ensure safety. Spasticity must be controlled so that limb movement does not cause injury due to forceful movement within the supports of the mobility device.

Trial of a standing wheelchair is the next step in the process and has its own set of challenges. Obtaining and adjusting the wheelchair(s) to fit the client is essential to determine if the chair will allow the client to stand completely, if the chair can provide the support needed to allow the desired function from a standing position, and if the necessary postural supports can be provided for both sitting and standing (considering the dynamic nature of the seating). More than one chair may need to be tried in order to find one that works well for the client.

Options to Consider

There are drawbacks and benefits to each piece of equipment and the client needs to gain an understanding of these when comparing the options/and configurations of a particular standing wheelchair. Factors such as weight, portability, seat to floor height options, footplate options need to be considered. Many wheelchair users who have a standing wheelchair will often use it as a second wheelchair for a particular activity or vocation.[10]

Another option for standing is the use of a separate standing frame. Although they cannot increase independence in ADL, standing frames should be considered when discussing a standing wheelchair because they are engineered specifically to provide support in the standing position and may provide better standing alignment than a standing wheelchair, whose supports need to function in multiple positions. Standing frames are also often covered by insurance. The biggest drawbacks of standing frames are the need to transfer, storage space requirements, and lack of mobility in standing for the user. Power wheelchairs with seat elevators should also be considered for clients because they can assist in achieving some of the same goals as standing wheelchairs, such as reaching objects in overhead cabinets or interacting at eye level with standing individuals.

There are a number of options for standing wheelchairs, with most manufactures residing outside the United States. Since funding is one of the driving forces for manufacturers, this is not a surprise. Standing wheelchairs are more expensive than most other wheelchairs. The following is a list, in alphabetical order, of some of the larger manufactures of standing wheelchairs. There are also companies who make after market power standing options for power wheelchairs. Many other smaller companies also specialize in standing wheelchairs. An important consideration when choosing a standing wheelchair is the local service available for repairs and modifications.

- Balder
- Levo
- Permobil
- Redman
- Lifestand

In Conclusion

The presentation will assist individuals involved with wheelchair prescription to understand the evaluation process, as well as the benefits and drawbacks of standing wheelchairs in particular situations. The information is limited to Adult wheelchair users.

The presentation will conclude with case studies to illustrate the real life application of standing wheelchairs.

Integrating EADL with Powered Mobility: Important variables to consider.

Power wheelchair electronics: Does the client have an expandable system as a foundation? Are the appropriate switch interfaces present? Can you change drive control, as client needs progress without effecting EADL function? Can you retrofit EADLs at a later date and at what cost?

Programmability: Is standby select available? Is programming Global or profile specific? Can menu be tailored to individual client? Can the client manipulate/re-train the system over time?

Menu navigation: Is a quick access list available? Is there an integrated scanner present? Can the navigation method be changed over time, as one's needs change?
Modularity: Can the system start with a single function and expand into a full system at a later time? Can the user exclude functions that he/she does not need?
Multiple control base sites: Can the system be operated from a wheelchair as well as from bed and from different rooms?
Direct Connection: Does the ECU provide for the operation of electrical devices by direct connection or is there a need for an X-10 transmitter?
Accessory Accommodation: Will the system accommodate the addition of accessories to control additional functions?

The EADL Evaluation: Important variables to consider.

Access: Can the user effectively operate the available access method? Is the access method reliable and repeatable? Can the access method be modified to accommodate changes in the user's condition?
Ease of Learning: Can the user handle the memory and sequencing requirements? Is the method of operation intuitive, logical and easy to learn?
Menu: Are choices presented in an understandable way? Is the entire menu visible at all times so the user can see all options? Can the menu be customized to include icons? Are there different font sizes and types.
Feedback: Can the user adjust the EADL feedback to accommodate specific needs (e.g. vision or hearing problems). Is the feedback reliable and recognizable?
Funding and Cost: Consider which system gives you the most function for the dollar? Which is the best VALUE? Can mobility funding apply to EADL equipment?

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Paper Session 1 Room 1 - Testing the Heat and Water Vapor Transmission Characteristics of Wheelchair Cushions

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Introduction

The temperature and humidity of the microclimate just above the cushion are thought to have a direct effect on skin integrity for the sitter. This microclimate can be dramatically different depending on the temperature and moisture dissipating properties of the cushion. The international group charged with developing standards for wheelchair seating has spent considerable time and energy on the development of a standardized test fixture and protocol for characterizing cushion response to this microclimate.

One proposed test to measure this cushion/user microclimate uses a surrogate buttocks and thigh indenter to provide, measure and control the cushion interface microclimate. While the use of this laboratory-based system is showing much promise, there is currently no test fixture designed to allow the researcher or clinician to measure the heat and moisture present in a clinical setting.

This pilot study was conducted to determine the feasibility of using a portable heat and humidity test instrument for measuring the cushion/user microclimate in a clinical setting. This was accomplished by using the laboratory-based test fixture to provide a controlled microclimate environment. Three sets of sensors, the on-board sensors on the test fixture and two prototype portable field-use sensor systems measured heat and humidity.

Background

When a person sits on seat cushion there is a build-up of heat and humidity at the cushion/user interface1. Ambient temperature and humidity, physical characteristics of the cushion and the level of physical activity can affect this microclimate. Research has shown that increasing heat and humidity causes an increase in skin temperature with a corresponding increase in skin ulcer risk2. It is well known that heat plays an important role in the development of skin ulcers. While this is certainly the case, it is perhaps better to consider the cause of increased risk as the increase in metabolic demand rather than the simple rise in temperature.

Almost all skin ulcers can be traced to a lack of sufficient nutrient and oxygen flow to the affected tissue. This imbalance in nutrients is commonly caused by occlusion of blood flow but can also be present when the blood flow is unchanged but cellular metabolic demand is increased. In a clinical setting, skin ulcers are caused by the combination of pressure, shear and temperature but in most clinical evaluations the microclimate at the seat/cushion interface is neither considered nor examined.

There is a 10% increase in cellular metabolism for every 1° C increase in skin temperature. Kokate demonstrated that there is a significant increase in skin ulcer risk with elevation of skin temperature even if the pressure pattern is unchanged.

The international group charged with developing standards for wheelchair seating has spent considerable time and energy on the development of a standardized test fixture and protocol for characterizing cushion response to the user/cushion microclimate. This work is ongoing and is not yet complete but noteworthy and significant progress has been made. First generation test fixtures are in multiple research facilities around the world. The temperature and humidity characteristics of the cushion are measured with sensors in 5 locations corresponding to the right and left ischial tuberosities, the right and left posterior thigh and the perineum.

Methods

In this pilot study, the prototype test fixture with on-board temperature and humidity sensors was used to evaluate the temperature and humidity characteristics of a series of wheelchair cushions. Two prototype portable sensor systems were also used to gather data using the same heat and moisture source.

Three measurement systems were used. The first system is the on-board sensor array that is part of the heat and water vapor test fixture. It uses thermocouples for heat measurement and Honeywell humidity sensors to gather the humidity data. This is a laboratory-based system that is attached to a heated water supply and is hard wired to a computer and data logger. While very functional, it is certainly not portable.

Two portable temperature and humidity sensors systems were used in this study. The first system was fabricated by EC Services in Bountiful, Utah, USA. The second portable system was provided by the manufactures of the FSA pressure mapping system; Vista Medical Ltd, ?Winnipeg, Manitoba, Canada.

Prior to testing he humidity sensors were placed in two different controlled humidity environments, at 32.8% and 75.3% relative humidity (RH). The controlled environments were obtained using a humidity sensor calibration kit manufactured by Nielsen-Kellerman Inc, Boothwyn, PA for their Kestrel humidity testing equipment. By placing all of the humidity sensors into known environments, it is possible to determine the base-line difference in reading between the systems and individual sensors.

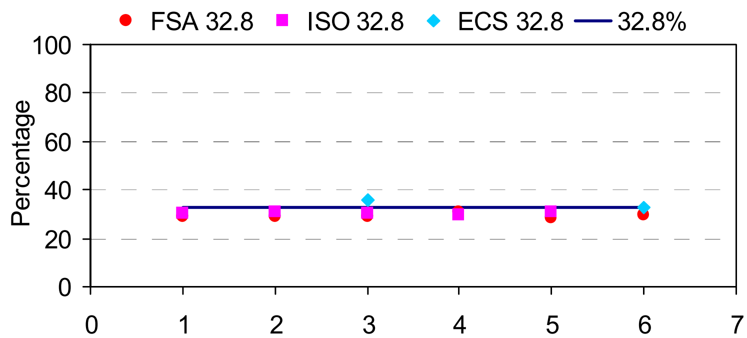
Testing

Tests were conducted using the same protocol. Sensors were attached to the bottom of test fixture at the five locations mentioned earlier. The test fixture was allowed to reach a steady state by running for one hour prior to cushion testing. The fixture was then positioned on the cushion for a period of 3 hours at a load of 500 Newtons. Temperature and humidity readings were sampled at a minimum of once per minute on all measurement systems.

At the end of the 3-hour test, the fixture was raised off of the cushion for a minimum of 45 seconds to simulate a pressure relief. After the lift, the fixture was repositioned on the cushion for 15 additional minutes. Data comparison was completed using readings captured at 30 minutes, one hour, two hours 3 hours, 3 hours and 45 seconds and finally at 3 hours and 15 minutes.

Results

Results from the test indicate that all 3 systems were able to measure temperature and humidity in similar values at the same sites. In the initial calibration recorded temperature values on all three systems were within less than 1° C (figure 1).



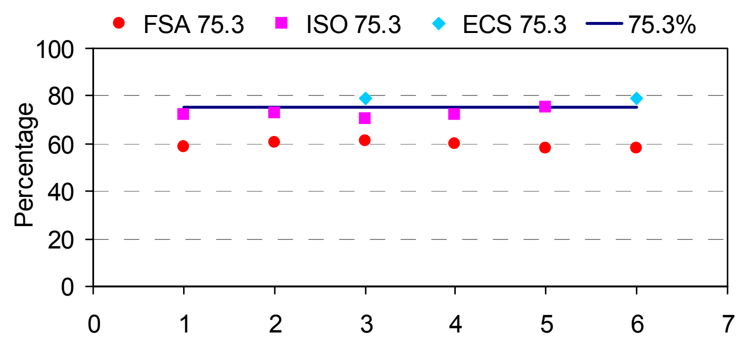


Figure 1 systems in controlled 32.8% and 75.8% environments at 3 hrs

In calibration, the humidity sensors had a larger variation. There were also differences between the systems in reported humidity levels during testing but all systems did follow the same proportional changes in humidity levels during the 3-hour test. In this test, the absolute humidity values may have differed slightly, but the three sensor systems did show the same type of humidity patterns on each cushion test (figure 2). All of the sensors indicated levels of humidity that would allow differentiation between the cushion types.

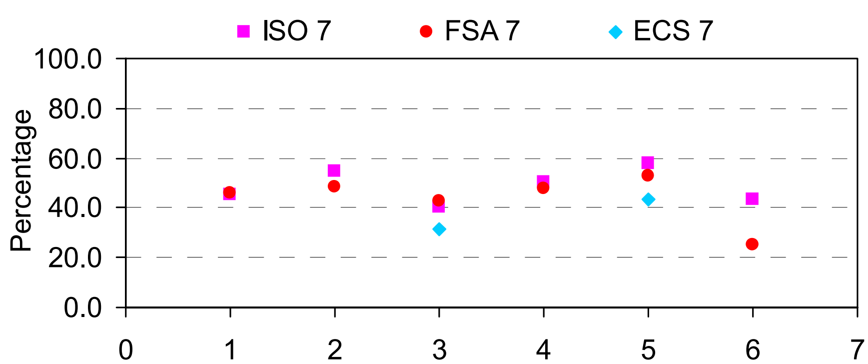


Figure 2 – Readings on cushion 7 at 3 hrs

Discussion

The two prototype devices used in this test provided temperature and humidity measurements that paralleled the readings from the laboratory-based system. The absolute values for the temperature sensors were quite accurate. The recorded values for humidity did vary from system to system but the patterns of humidity increase or decrease during cushion testing were similar on all systems.

Further work will need to be completed on the prototype systems to determine if the problem with humidity readings is in the sensors or in the calibration of the sensors to known humidity levels. Calibration of the humidity sensors used in all three systems is possible. It is believed that the development of a calibration protocol is a necessary component of any system that is designed for field use. This study was primarily concerned with the feasibility of using a portable heat and humidity test system in the clinical setting.

Summary

The creation of a standardized test fixture for determining the performance characteristics of cushions is an essential part of the development of comprehensive wheelchair seating standards. If the information that is gained from this test is to be useful in the clinical setting a method of testing the microclimate at the cushion interface in the clinical setting is also needed.

This study indicates that the development and use of a clinical tool for measuring cushion microclimate is indeed possible. Further research is needed to determine calibration and testing protocols. Further hardware development is needed to produce accurate, robust and simple measurement tools for clinical use.

Acknowledgements

Partial funding for this work was provided by AireRx Healthcare, Nashville, Tennessee USA.

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Paper Session 1 Room 1 - The Use of Contoured vs. Flat Cushions in Adaptive Seating for Children with Cerebral Palsy – Development of Measurement Systems and Results

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Introduction:

This research project involved the development of assessment tools to measure the seating posture and seated function of children with neurological conditions necessitating the use of adaptive seating within a wheelchair. The methods were developed and piloted on 6 children, followed by a randomised crossover research project to compare two seated cushion bases – one flat seat and a ramped contoured seating insert. Literature supports that adaptive seating for children with complex difficulties helps with the development of motor skills, functional and adaptive skills and to help prevent fixed deformity [1, 2]). However, rigorous research into the effectiveness of adaptive seating systems or their components remains elusive.

Adaptive seating systems tend to be large pieces of equipment, in which children sit for prolonged periods of time (up to 10 or more hours in some instances [3]. They can be difficult for families to use [4, 5], and may not be improving posture [6] or indeed comfortable for the child [7]. If the wheelchair is to be used, and as a consequence the access to participation in the community and environment of the child with complex needs and their families is compromised, then as clinicians we need to be confident that we are acting in the best interests of the child.

In a previous project we showed that a commonly used type of adaptive seating system was helpful in addressing some of the postural issues for children who had cerebral palsy and complex seating needs, but not improving other aspects of the children's posture [6, 8] in the way that it had claimed. Furthermore, it was found that the parents of the children found the seating systems difficult to use, but persisted in making the children sit in the seating system as they believed it was improving the children's posture [4].

We felt one of the major difficulties with research into adaptive seating interventions was the lack of reliable objective measurement. In short, adaptive seating systems are used to correct posture, reduce barriers to life, improve functioning etc, but there is little clinical or research proof that they are successful in achieving any of these functions. There are a number of challenges in researching the area of adaptive seating for children; the dual nature of the devices as a medical device and a functional one [9], difficulties with appropriate research methodologies and lack of heterogeneous participants [10].

Taking these considerations into account, we designed a research project to attempt to measure the differences in amount of movement, function and postural alignment of children with complex seating needs and neurological conditions.

Research Objectives:

1. The development of objective measurements to enable researchers and clinicians to make objective and reliable judgement regarding effectiveness of seating systems
2. To develop and measure seated functional activities, using activities that are repeatable and relevant specifically to children with complex disabilities.
3. To use pressure-mapping technology to measure distribution of seated pressure through the children's whole bodies and measure change following seating intervention

4. To use the above measures to perform a project using a randomised crossover design address the effectiveness of a contoured ramped cushion vs flat cushion for school aged children with complex disabilities.

Participants:

Thirty five children of primary school age (4-11) participated in the trial. All children had a neurological diagnosis, and had no functional independent ambulation. There were 18 boys and 17 girls.

Methods

Accelerometry: We attached an MTx minature intertial measurement sensor [11] to the sternum of the children. We hypothesised that there would be a difference between the two seat surfaces in terms of the amount of upper body mobility.

Actigraphy: The MicroMini Motionlegger Actigraph [12] is generally used in sleep studies and has recently been shown to be a valid and reliable method of measuring low levels of physical activity amongst people with spinal cord injury and use wheelchairs [13]. This is a means of measuring and judging different levels of activity intensity and frequency. We placed one of these on the right ankle and one on the right risk of each of the participants.

Pressure Mapping: We used the Xsensor pressure mapping system. We cleaned the data for artefacts, and then took peak pressure, average pressure and cell contact area for both the back and the seat cushion.

Seated Functional Activities: We used the first five of the ordinal scaled activities from the Seated Postural Control Measure [14], as we have found previously for this group of children the others are often beyond their capacity. We supplemented this with four further activities, involving activating a switch with either hand, or side of the head.

Manual Goniometry: Manual goniometry was the primary data collection tool for postural alignment, but has limitations with reliability [15]. We attempted to use electrogoniometry as an objective way of validating and reliability testing the manual goniometry, but as the 13 body segments we measured were static, this was not possible

Non-Communicating Child's Pain Checklist – Revised (NCCPC-R): Although most children are not in frank pain during their waking hours, we felt it important to measure whether there was a difference between the seated positions. We used the NCCPC-R to detect a change between seated surfaces, and examine whether certain categories may indicate discomfort in children who are unable to verbally communicate by proxy parental reporting.

Procedure

Each child was seen at home, in school or in a clinical setting depending on preference. The child was measured for the seating system attached to the clinic, and this was then set up for their individual measurements. We used a bespoke adaptive seating system, with two seating cushions, a bifurcate lap belt, hip guides, lateral pads and headrest. Upper body harness was used if the child required it. The child was randomised as to which seat they used in the first instance – either flat or ramped contoured. A full set of measurements was then taken, which involved taking goniometric measurements, then giving the child seated functional activities and reaching tasks whilst sat in the chair. The child was taken out of the chair, the seat cushions swapped over, then the measurements were repeated on the alternative cushion. Two risk factors for the reliability of the data were fatigue and learning, however, the randomisation of order minimises this.

Results

Accelerometry Data: We were successful in gaining measurements for all 35 participants. Using t-tests, the data initially appeared significant, however on closer inspection, the data did

did not take a normal distribution, despite logging. Using a Mann-Whitney U test, there was a difference between the two seat types, although only approaching statistical significance. When outliers are accounted for, there is a statistically significant difference in mean average backwards and forwards movement (1.7 degrees/second in ramped contoured seat and 1.4 degrees/second on a flat seat).

Actigraphy: The actigraphy data was inconclusive. This was exacerbated by the difficulties with using the actigraphy – faulty equipment, some children refusing to wear the wristwatch etc. Additionally, we used a zero crossing mode to determine frequency. When examining the data, there appears to be some trend towards increased

Pressure Mapping: We were successful in gaining all 35 participants, and the data was normally distributed. There were no statistically significant results on either t-testing or Mann-Whitney U tests for average and peak pressure. There were statistically significant results ($P<0.05$) for average contact pressure for both the seat cushion and the seat back.

Seated Functional Activities: No statistically significant differences were found for the comparative activities. However, there were mean differences, particularly in the activities which used activating a toy via a switch, with more success in the ramped contoured seat than the flat one.

Manual Goniometry: The participant number varies for each of the 13. Two categories (right hip rotation and left hip flexion and extension) were normally distributed and showed statistically significant decreased angular deviation from neutral on t-testing. All 11 other joint angles showed statistically significant results for the angular deviation from neutral using Mann Whitney U tests, with the angular deviations higher on the flat seated cushion.

NCCPC-R: There were no statistically significant differences between the two seat cushions, but using descriptive statistics, there were more frequently items that scored higher (ie less comfortable) on the flat cushion than the ramped contoured cushion.

Conclusion, Discussion and Future Work: The purpose of the project was to discover robust measurements that can be used to measure components of seating, and then to test the theory. On balance, it appears that using objective measures, that ramped contoured seating is beneficial for children with complex seating needs, rather than an alternative flat seat. Of greater import is the ability to collect data in an objective way. Our plan is to repeat and develop batteries of measurement that are reliable. Furthermore, we plan to perform multiple regression statistics on the different aspects and contexts so that we can minimise the number of measures necessary, and perhaps substitute others. The measures of function and comfort are still in the early stage of development, but initial results show a positive indication that with further improvement they will be useful additions to the picture of effectiveness for measuring effectiveness of seating interventions for children with complex motor and cognitive difficulties.

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Paper Session 1 Room 1 - Development and Testing of an Innovative User Adjustable Support Surface for Wheelchair Seating Discomfort

Douglas Hobson, PhD1, Barbara Crane, PhD, PT2, Stephen Stadelmeier, M Sc3

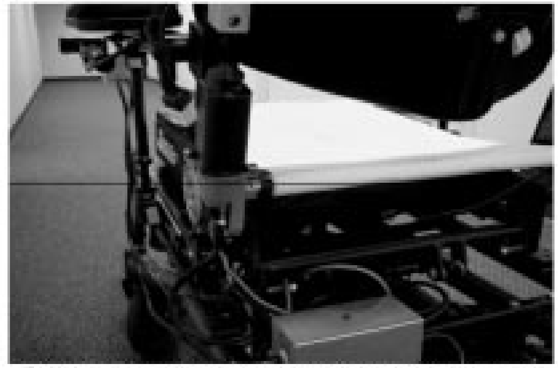
Introduction

Discomfort is an important problem for many wheelchair users who have limited mobility and an intact sensory system[1]. Discomfort frequently limits wheelchair use and ultimately participation in functional activities[2]. In spite of this, there has been little product development in this area due to the perception that "comfort" is not a medical need and is therefore not reimbursable in a third party payment, durable medical equipment market. This need is especially urgent for wheelchair-seated persons with intact sensation but lack the ability to independently relieve buttock and related discomfort. This group of wheelchair users was identified as the primary target market for a development project. National Institutes of Health-STTR, Phase I, project funding was obtained for the purpose of developing and testing a product designed to address the discomfort needs of the target market. The investigators wished to answer a basic question: Is it possible to improve user comfort, autonomy and wheelchair usefulness through the implementation of a seating device that allow real time user control over geometry and surface configurations that effect sitting discomfort?

After investigating a number of design options, the project resulted in the development of the "butt scooter," a seat device designed to allow a wheelchair user to reposition him or herself in the wheelchair, therefore changing the relationship of his or her pelvis to the seat and back surfaces. Two prototypes were developed and tested by wheelchair users in the target market. Three subjects tested the device for a minimum of 2 weeks each in a single subject, multiple withdrawal (ABABA) design. Additionally, the prototypes were used to conduct a focus group with expert seating and mobility clinicians to further investigate efficacy of the prototype designs. Four prototypes of the Butt Scooter were built: first and second proof of concept devices, and third and fourth, the final two prototypes that were subjected to extensive in-community user testing and focus group evaluation.

The two test wheelchairs with installed "Butt Scooters" were assembled and the V-Trac back support systems were configured to allow subject testing. Three subjects who met all inclusion criteria and who were able to utilize the test wheelchair in their home environments were ultimately recruited and participated in the single subject design testing of the Butt Scooter. Subject 1 was a woman in her 50's with a diagnosis of Multiple Sclerosis. Subject 2 was a man in his 40's with a diagnosis of Multiple Sclerosis. Subject 3 was a man in his early 20's with Muscular Dystrophy.

Butt Scooter mounted on powered wheelchair. Conveyor fabric on cushion



Close up showing single motor roller drive mechanism

Butt Scooter mounted on powered wheelchair. Conveyor fabric on cushion Close up showing single motor roller drive mechanism

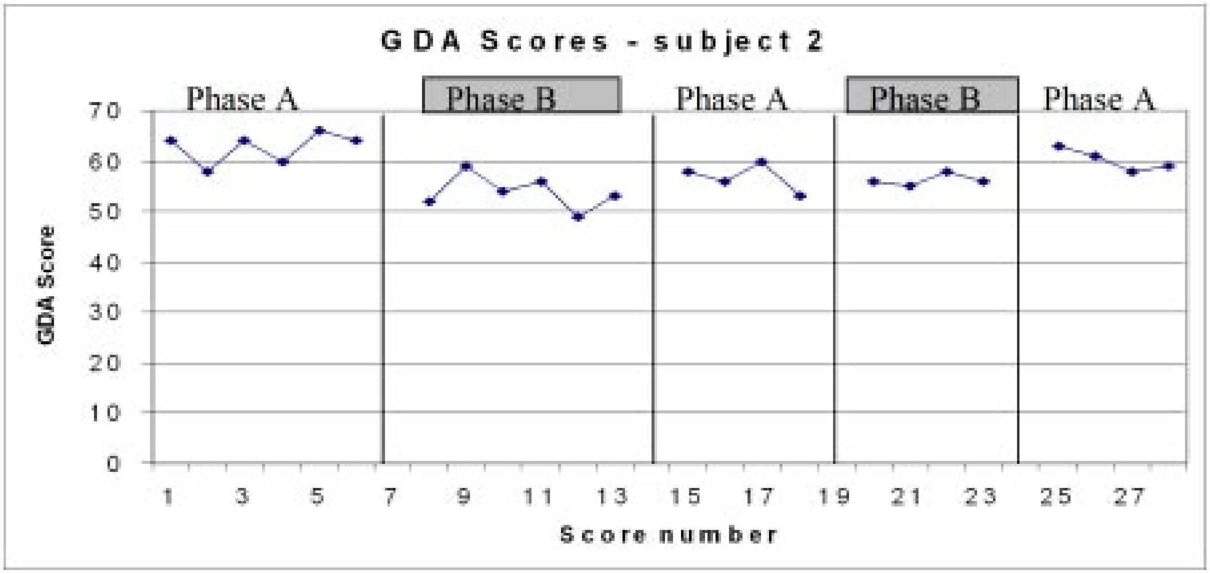
Results

All subjects completed the Tool for Assessing Wheelchair Comfort on a daily basis to allow researchers to track their seating discomfort levels.[3]

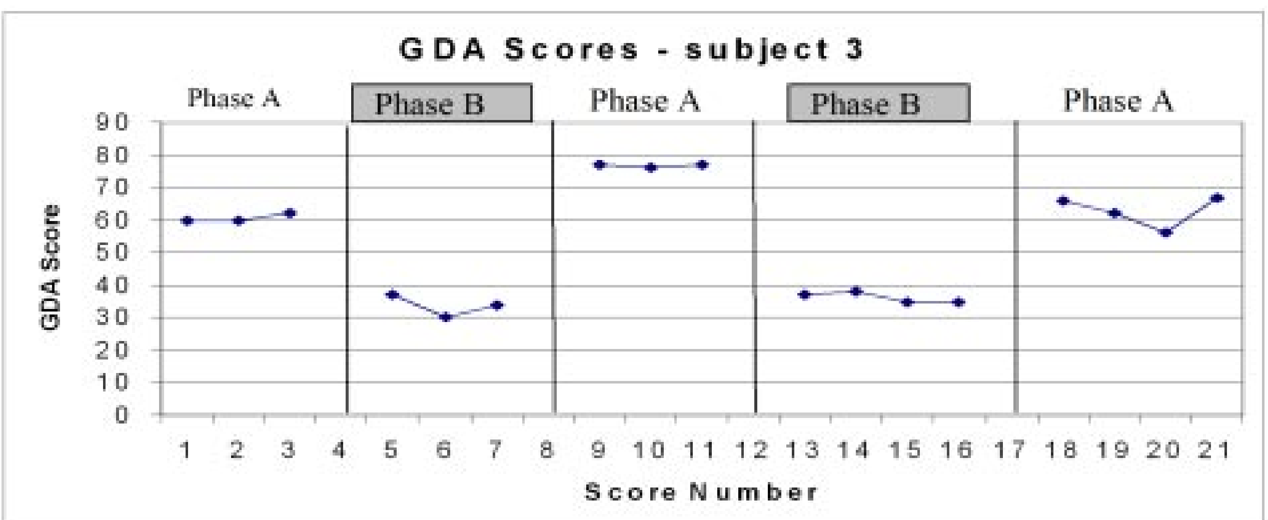
Subject 1: The first subject began testing on October 23, 2006 and completed testing on November 10, 2006. She experienced several delays in testing due to a significant illness in her family and difficulties she was having with her van which captured the majority of her attention. In spite of several contacts with the researcher, via both email and telephone, this subject completed TAWC measure incorrectly. She scored her discomfort each day when she transferred into the test wheelchair rather than after 4 – 6 hours sitting in the wheelchair. Because of this, her discomfort scores were invalid. She did provide positive verbal feedback and enjoyed testing the butt scooter. She found the system particularly helpful in assisting her with sliding forward on her seat in preparation for performing her stand pivot transfers.

Subject 2: The second subject began testing on November 14, 2006 and completed testing on December 27, 2006. His testing schedule was interrupted once by a failure of the wheelchair electronics, which necessitated replacing the test wheelchair, and then by the holiday season, which he described as a very busy season for him. He completed the TAWC assessment appropriately following at least 4 hours of sitting, however his discomfort scores were not remarkably different with the test wheelchair. His comments indicated strong positive feelings about using the sliding mechanism for positioning in the wheelchair and for preparation for transfers. Subject 2 also commented that he believed strongly that his discomfort is due to his medical condition (Multiple Sclerosis) and he although he felt the butt scooter helped him, the discomfort scores were not substantially lower.

The GDA scores from Subject 2 test results are presented following this text. The test schedule includes three “A” phases during which he used his own wheelchair and two “B” phases during which he used the test wheelchair. The schedule of testing was ABABA with multiple withdrawal phases. The TAWC GDA discomfort scores range from a possible low score of 13 and a possible high score of 91. His own low score was 49 and his high score was 64. There was no evidence of either a ceiling or floor effect from his testing. Although his discomfort scores declined slightly during the first introduction of the test wheelchair (initial phase B), this effect was not repeated during subsequent phases. His testing indicated no significant differences in discomfort level using this measure when he was testing the butt scooter system.



Subject 3 – The third subject began testing on 1/22/07 and completed testing 2/5/07. He had reported significant discomfort in both his back and his buttocks when sitting in his own wheelchair, in spite of having access to a power tilt system. He was only able to complete 1 discomfort assessment score on most days, however both his GDA and DIS scores were remarkably stable from day to day. Although there were too few data points to analyze these data using the celeration line, two standard deviation band, or C-Statistic the visual analysis of these data are quite convincing.



The previous graph of the GDA discomfort scores indicates a range of scores for this subject between 30 and 77. His Phase B scores were all between 30 and 40 and his Phase A scores were all above 50, with most above 60. There was a remarkable drop in discomfort during both "B" phases – during which he was using the test wheelchair. Additionally, the withdrawal phases, during which he returned to using his own wheelchair, showed a return to his previous levels of discomfort following each withdrawal of the test wheelchair. This pattern of results provides convincing evidence that this subject experienced significant declines in discomfort associated with use of the test wheelchair. The pattern exhibited with the GDA discomfort scores was repeated in the DIS scores. His Phase B DIS scores were all below 25 and his Phase A scores were all above 35. As with the GDA scores, his within phase scores were very stable overall. The alternating pattern in discomfort for these scores helps to reinforce the findings of the GDA scores.

In spite of these limited subject-testing results, the "butt scooter" system showed great promise. The third of the three subjects to complete the full protocol met all inclusion criteria, as did the others, however this subject truly experienced seating related discomfort and was literally unable to re-position himself at all when in his wheelchair. This subject demonstrated all characteristics of a patient for whom this system was designed. His dramatic improvements in comfort when using the butt scooter demonstrated the potential for this system. Although the first and second subjects met the inclusion criteria for the study, neither of them was completely unable to reposition themselves when sitting. Even lacking the precise patient profile, these two subjects benefited from the improved ease of wheelchair transfer. In general, results from the limited subject testing were very positive, indicating substantial changes in comfort and unexpected changes in ease of transfers for the subjects involved.

Three expert seating clinicians were invited to try the latest Butt Scooter prototype and then respond to prepared questions, as well as provide informal input and recommendations. In general, their collective responses were positive. However, all three experts felt the Butt Scooter had as much or more value as a front transfer aid, as it did to allow the users to reposition themselves and thereby relieve sitting discomfort. Several suggestions were made that perhaps two products should be pursued rather then combining both functions into a single device.

Discussion

The NIH-STTR Phase I funding was awarded to Falcon Rehabilitation Inc., with the University of Pittsburgh, RST as their research partner. Unfortunately, this project was brought to a close at the end of Phase I, as Falcon did not have the capability to take the prototype through the product development and production engineering phases necessary for market release. However, the University of Pittsburgh stands ready to work with any manufacturer wanting to pursue this innovative development.

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Paper Session 1, Room 1 - Utilizing Smart Technology To Assist In The Monitoring Of Air Floatation Cushions

Michael Banks and Eva Ma

Introduction

Air flotation cushions have been a steadfast solution of seat cushions in the high risk and chronic skin issue population for many years. The broad acceptance of air flotation cushions, such as the ROHO, is based on their effectiveness in the moderate to high risk population in the management of tissue interface pressure. Because most air flotation products are adjustable by the amount of air contained within the volume of the cushion, they have always been subject to user practices. A *Smart Monitoring* tool is now available to assist users to monitor cushion inflation. Monitoring air pressure alone is not a reliable predictor of cushion performance because it does not account for user mass, density, and total contact area. Monitoring interface pressures with transducers at the tissue interface is appropriate for the clinical setting (Palmier, 1980), but has limitations for everyday users. It is well documented that effectiveness of this type of support surface depends on immersion into the interface. The greater the immersion, the greater the surface area to support the mass of the client, thereby lowering interface pressure. The MERLIN™ Proximity Sensor (ROHO Inc.) is a product that monitors the *change in distance* between the lowest point of the body and the solid surface under the cushion. It is a sensing pad that indicates to the user when distances increase (over-inflation, indicated by a yellow LED), or decrease (under-inflation, indicated by a red LED) from a pre-established point (indicated by a green LED) set by the user according to cushion manufacturer inflation instructions. Users and caregivers may rely on a routine of inflation practices that may not be optimal for cushion performance. We investigate regular users of high profile ROHO cushions to evaluate consistency, of both inflation and performance, based on pressure mapping technology (Xsensor Technology). We endeavor to quantify average pressure and contact area relative to the three modes (yellow, green, and red LEDs) indicated by the MERLIN. We examine vertical distance (immersion distance) relative to the indicator modes of the MERLIN as well. We also surveyed the regular caregivers of our three subjects to get their impressions of using the MERLIN, and inquired about their inflation monitoring method prior to using the MERLIN.

Methods

Three subjects who are daily users of high profile ROHO wheelchair cushions were selected. All three subjects have spinal cord injuries resulting in tetraplegia. **Subject 1**- 59 years-old with an injury at C3-4 level, post 6 years, partial sensation, history of skin breakdown on his left ischial tuberosity, ventilator dependent, drives wheelchair using a chin control. **Subject 2**- 47 year-old, 25 years post spinal cord injury at C4-5 level, history of skin breakdown and myocutaneous skin flap surgery. He drives using a *joystick* control. **Subject 3**- 48 year-old, three years post spinal cord injury at C-4 level, and drives using a *sip and puff* control.

Subjects were each designated a MERLIN unit for the measurement trials. Contact area, average pressure, and degree of immersion were measured relative to the standard procedure for the inflation of a ROHO cushion (http://www.therohogroup.com/medical/downloads.jsp, ROHOINSTRUCTION.PDF). Based on this procedure, the MERLIN was set at its baseline from which the inflation was monitored. After setting the baseline reference point for the MERLIN, a green LED illuminates. The cushion was gradually inflated to activate the yellow LED alerting the user that they have increased the vertical distance between their lowest bony prominence and the sensor pad. Measurements were taken while the MERLIN stayed on the yellow LED. The cushion was then gradually deflated so that the MERLIN *just* went into the red LED indicating that the user's lowest bony prominence had become closer to the sensor pad from the baseline point. Care was taken to inflate and deflate the cushion so that the MERLIN *just* went to the yellow or red indicator. One goal was to determine how much vertical distance, and therefore immersion, changed, i.e. the range of distance between activation of the yellow and red LEDs. Interface pressure mapping (Xsensor Technology) was employed to ascertain average interface pressure, and contact area changes relative to the three MERLIN modes. An anatomical caliper was utilized to measure distance between the seat pan of the wheelchair and the iliac crest. Palpation of bony landmarks was problematic with the clients in sitting position in light of the amount of soft tissue each possessed, and the mechanical interference of the armrests and sideguards, the removal of which would have affected pelvic positioning. Three able-bodied clients (subjects 4, 5, and 6) were used to measure immersion distance between the yellow and red LEDs. A more precise method was employed, utilizing a laser level placed across the front of the pelvis on the individual's lap. A vertical meter stick was affixed just to the left of the client. Change in vertical distance, and therefore immersion, was read directly off the meter rule where the laser contacted it.

Each subject has a regular caregiver present at least eight hours per day. Each caregiver has been working with the client for at least 18 months. These individuals were responsible for monitoring cushion inflation. They were asked to answer some questions relative to their routine methods of inflation, and experience with the ROHO cushion.

Results

Following the standard inflation procedure as outlined in the ROHO instruction booklet, we then measured interface pressure and contact area in an overinflated

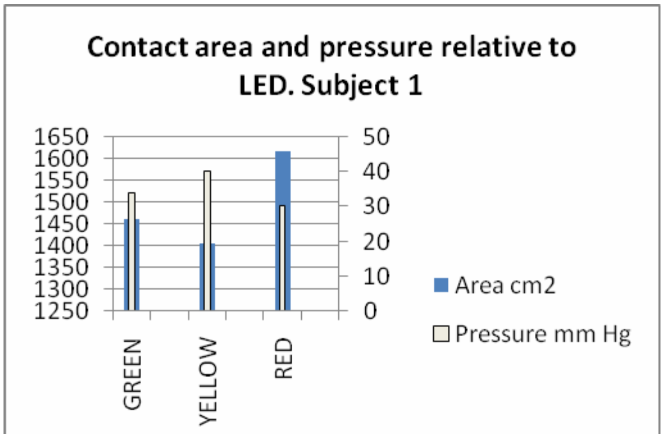


Fig. 1

(yellow LED), properly inflated (green LED) and underinflated (red LED) cushion. Figures 1-3 indicate the expected relationship between contact area and pressure. We observed the lowest interface pressures with the red LED illuminated in all of the trial measurements (10 total). The highest interface pressure related inversely to the lowest contact area. These values were intermediate when the green LED illuminated.

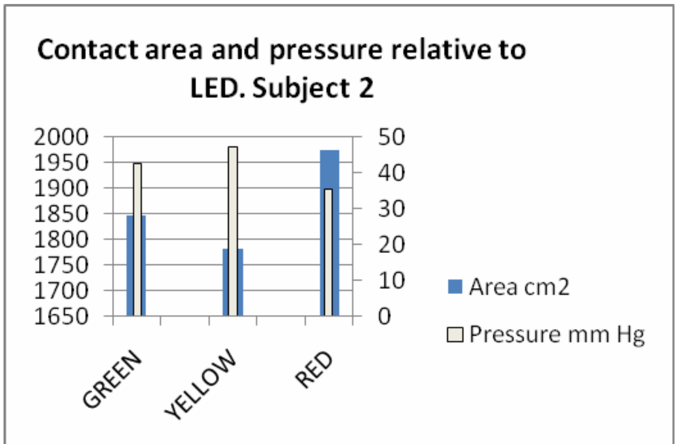


Fig. 2

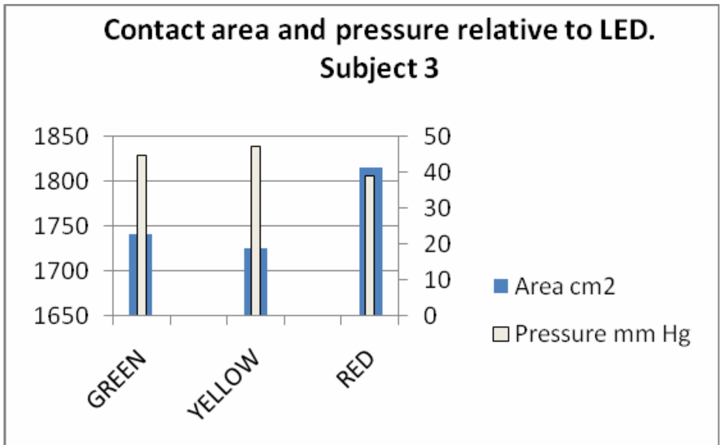
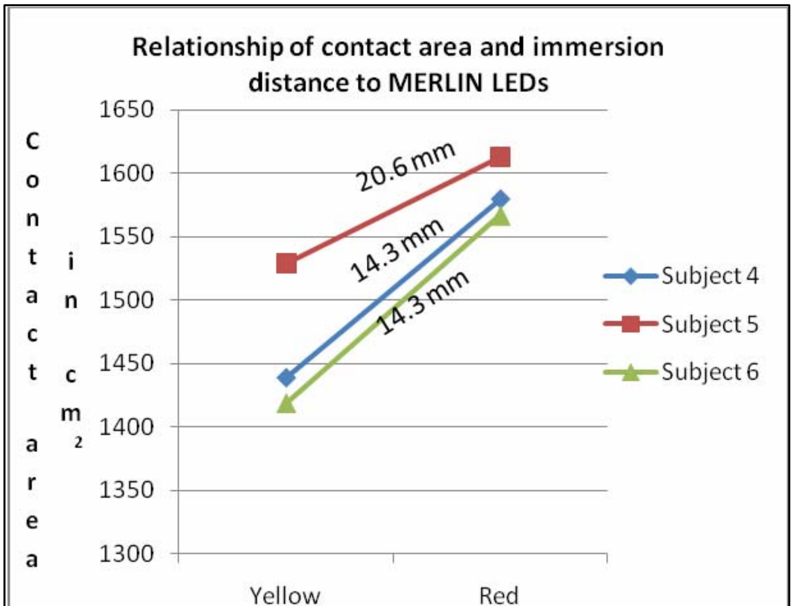


Fig. 3

Immersion measurements help to put in perspective the pressure and contact area measurements relative to the LEDs. Each of the subjects shown in Fig. 4 had an average reduction of 4 mm Hg in interface pressure with an increase of between 14.3 and 20.6 mm of immersion.



LED Indication on MERLIN. Fig. 4

Based on the questionnaire, the three principal caregivers reported they all used the "hand check" method similar to the standard procedure. They regularly use the "two handed push" technique as well. All three responded that they typically leave greater than ½ inch space between the ischial tuberosity and the seat pan. They also all reported that the device provides more "peace of mind" when inflating the cushion according to manufacturer's instructions.

Discussion

Subjects were each designated a MERLIN unit for the measurement trials. Contact area, average pressure, and degree of immersion were measured relative to the standard procedure for the inflation of a ROHO cushion (http://www.therohogroup.com/medical/downloads.jsp, ROHOINSTRUCTION.PDF). Based on this procedure, the MERLIN was set at its baseline from which the inflation was monitored. After setting the baseline reference point for the MERLIN, a green LED illuminates. The cushion was gradually inflated to activate the yellow LED alerting the user that they have increased the vertical distance between their lowest bony prominence and the sensor pad.

Measurements were taken while the MERLIN stayed on the yellow LED. The cushion was then gradually deflated so that the MERLIN just went into the red LED indicating that the user's lowest bony prominence had become closer to the sensor pad from the baseline point. Care was taken to inflate and deflate the cushion so that the MERLIN just went to the yellow or red indicator. One goal was to determine how much vertical distance, and therefore immersion, changed, i.e. the range of distance between activation of the yellow and red LEDs. Interface pressure mapping (Xsensor Technology) was employed to ascertain average interface pressure, and contact area changes relative to the three MERLIN modes. An anatomical caliper was utilized to measure distance between the seat pan of the wheelchair and the iliac crest. Palpation of bony landmarks was problematic with the clients in sitting position in light of the amount of soft tissue each possessed, and the mechanical interference of the armrests and sideguards, the removal of which would have affected pelvic positioning. Three able-bodied clients (subjects 4, 5, and 6) were used to measure immersion distance between the yellow and red LEDs. A more precise method was employed, utilizing a laser level placed across the front of the pelvis on the individual's lap. A vertical meter stick was affixed just to the left of the client. Change in vertical distance, and therefore immersion, was read directly off the meter rule where the laser contacted it.

Each subject has a regular caregiver present at least eight hours per day. Each caregiver has been working with the client for at least 18 months. These individuals were responsible for monitoring cushion inflation. They were asked to answer some questions relative to their routine methods of inflation, and experience with the ROHO cushion.

Results

Following the standard inflation procedure as outlined in the ROHO instruction booklet, we then measured interface pressure and contact area in an overinflated (yellow LED), properly inflated (green LED) and underinflated (red LED) cushion. Figures 1-3 indicate the expected relationship between contact area and pressure. We observed the lowest interface pressures with the red LED illuminated in all of the trial measurements (10 total). The highest interface pressure related inversely to the lowest contact area. These values were intermediate when the green LED illuminated.

Paper Session 1 Room 1 - The MAC and MiniMAC - Tools for Customised Seating Design and Production

Sue McCabe

Introduction

The MAC (Multi-adjustable Assessment Chair) and the MiniMAC (a small version of the MAC, to suit infants and young children) were designed and developed by clinical and technical staff of CPTech, at The Centre for Cerebral Palsy in Perth, Western Australia.

Clinicians and technicians involved in the challenge of providing appropriate seating for people with complex needs are aware of the importance of getting all parameters of the seating system 'just right'. This can be a difficult and time-consuming process, particularly when creating a custom-designed seating system. Often, it is not until the system is almost completed and the client is well supported that the team can make the most informed decisions about factors such as the best base-to-back angle, best line of pull for the pelvic strap, or the exact position required for the headrest. The process can be a long, costly and frustrating one of make – assess – re-make – reassess – until the seating system is just right.

The MAC and Mini MAC provide a seating assessment system that can be easily adjusted across necessary parameters for optimal postural support. This paper will include an overview of the features of the MAC and the MiniMAC, with discussion of their clinical application for the process of seating assessment, prescription and production.

Background

The MAC and MiniMAC were designed and developed in 2004 by the 'McTeam' – Sue McCabe, Senior Occupational Therapist, and Bob McAuliffe, Technician.

The idea for the development of the MAC originated from:

- clinical need, for an improved seating assessment and specification process;
- an interest in, and investigation into, the use of perforated metal as an alternative material for postural seating inserts; and
- development of an idea for completion of a design unit, as part of Master of Clinical Science studies at the Curtin University of Western Australia.

The prototypes of the MAC and MiniMAC have been used at CPTech since that time, with Julie Bolton, Senior Physiotherapist, and other clinicians and technicians providing additional development ideas for the use of the systems, for clients of all ages.

Provision of postural support systems for seating

The Centre for Cerebral Palsy in Western Australia provides seating and postural support systems through CPTech, a dedicated equipment and assistive technology service. Seating and postural needs are identified by a team of clinicians (occupational therapists, physiotherapists, speech pathologists, engineer), with each client's system designed in consultation with the technicians who fabricate the systems.

Clinicians may recommend the use of a commercially available system or components, if this best suits the needs of the client. Frequently, however, custom designs are recommended, with systems fabricated to suit each client. This approach reflects that recommended by Healey, Ramsey and Sexsmith (1997, p.709), who describe individuals with complex needs as being “better served through the in-house fabrication of custom seating components”.

The seating assessment, prescription and fabrication process

Clinicians and technicians working in the field of seating provision will be well aware of the challenges involved in the provision of suitable seating support for clients with complex needs. The assessment and prescription process is a complex one. It must account for:

- the abilities and needs of each client;
- the user’s environment;
- the needs of carers; and
- transport, funding, maintenance and replacement issues.

The use of the MAC or MiniMAC facilitates this assessment and prescription process by allowing varied and individualised set up of seating positions and components, the effects of which can be observed and measured over a period of time. Clinicians are able to set the system up, and make changes to get all aspects ‘just right’, and then keep this set up to provide the technicians with the specifications required for fabrication of the client’s seating support system.

The process works best with the technicians involved in the assessment and decision making process, as well as the fabrication. However, clinicians are able to take the MAC or MiniMAC off-site, for use in various locations, and develop the ‘set up’ to bring back to the technicians to replicate if required.

The design features of the MAC and MiniMAC

The MAC and MiniMAC have been designed to incorporate essential elements of design that allow for:

- accuracy of size, angles and positioning of components of the seating system;
- secure attachment of all components of the seating system; and
- easy adjustment of all components of the system.

Use of perforated metal as the key material for the system allows the adjustability that is required, with accurate and secure positioning of components such as headrests, brackets and straps, belts or harnesses.

Design details of the MAC and MiniMAC

The MAC and MiniMAC are made of 4mm thick marine grade aluminium, with 7mm diameter perforations on the diagonal, 20mm centre to centre. The size and spacing of the perforations have been selected to provide optimum adjustment range, and to fit with the sizes of the attachment brackets that are used in the CPTech workshop. Rubber-edged pinchweld provides covering to edges.

The MAC is mounted onto a wheeled base, and allows quick and easy adjustment of: seat depth (including accommodation of leg length discrepancy); back height; base-to-back angle (recline); tilt in space (forwards and backwards); angles within the backrest (split back angles); legrest length and angle; and footplate angle.

It allows secure attachment and easy adjustment of headrests, supporting brackets and straps and harnesses.

The MiniMAC allows similar adjustment, with some variations: the base-to-back angle is not adjustable (an angle of 95° has been found to be suitable for most young children, with exceptions being some children with specialised feeding and digestion needs); and the system is not mounted on a wheeled base (it is light and portable, and so can be used on a plinth or in the child's stroller or wheelchair for the assessment and prescription process).

Both systems are made without adjustment of seat and back width. For the purposes of assessment and specification, adjustment of width is not required: measurements can be taken when the client is seated on the MAC or MiniMAC to determine the width required for each client's own system.

Additional technical ideas

Over the three years that the MAC and MiniMAC have been in use, clinicians and technicians have identified additional features for future designs. These include:

- interchangeable back canes, so that the MAC and MiniMAC can be set up to take cane-mounted back systems such as V-Trac, Jay, Matrix V and Dualflex;
- provision of a mobile base and tilt in space adjustment for the MiniMAC; and
- provision of a slotted back system, to create gaps which will allow clinicians and technicians to access the back of the seat when making custom-moulded back cushions.

Clinical application

The MAC and Mini MAC have been:

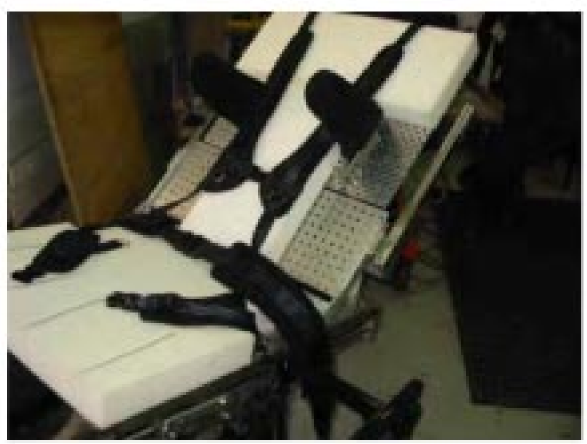
- used to provide support and best positioning when developing custom-moulded or foam in place systems for contoured seating support;
- used to set up and observe the effectiveness of various base cushions, headrest systems, bracketry and supports, and straps and harness systems;
- used in a number of environments: seating clinic, home, school or other settings to best suit the client and family; and
- made available for use by other organisations in Western Australia (for clients with conditions other than cerebral palsy, including acquired brain injury, multiple systems atrophy, Parkinsons disease, muscular dystrophy and multiple sclerosis).

There have been a number of noted benefits of using the MAC and MiniMAC:

- They allow set up, support and observation of client in a new, corrected or adjusted seating position.
- They have reduced the need for re-working of seating inserts as they are being made, with considerable savings in time and resources.
- They have reduced the number of clinic sessions required for completion of the seating insert, with savings in time and cost as above.
- They can be set up to provide the required support while trialing new or different base cushions, allowing pressure mapping as part of the assessment process.
- They can be set up to provide the required support for the trial of varied tilt in space positions, with the use of pulse oximetry and clinical observations to determine the effects of the changes. This has been particularly useful in the area of mealtime management, to help to determine the optimal angle of tilt for safe oral intake.
- They can be used in any location, reducing the need for clients and their families or carers to travel to The Centre.

Further application of the perforated metal adjustable system

The design and materials that are used for the MAC and MiniMAC have been applied towards the development of a custom 'growth systems' for individual clients: seating systems that are made of perforated metal and allow for easy modification and adjustment as clients grow or change. This has proved particularly useful for younger clients, who grow rapidly and so need frequent adjustments to their seating systems, and who are not yet being transported in their wheelchair and seating systems (the perforated metal has not been crash tested).



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Paper Session 1 Room 2 - Six-Week Rocking Chair Intervention - A Randomized Controlled Trial

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Background

Significant challenges for the rehabilitation of ageing population include falls and weakness of motor capacity. Several areas of functional capacity deteriorate with increasing age, and the point when functional deficiencies begin, their progress rate and their effect on the individual's everyday coping vary with the individual. Physical activity is an important factor in maintaining the functional capacity of an ageing person. Physical exercise interventions for the ageing have been effective [1, 2], and active training has been shown to improve the daily activity of elderly people with weak functional capacity [3,4,5]. Weakened muscular power has been shown to be linked with increased risk of falls and difficulties in independent coping [6, 7]. Despite effective training at a rehabilitation institute, it has been shown that the physical performance of the elderly does not improve permanently unless they continue with the training between rehabilitation periods and after institutional rehabilitation. The prerequisite for physical training is that its intensity, duration and number of repetitions are sufficient [8]. The most essential aspect of independent and home rehabilitation is to find evidence-based means to maintain and improve the functional capacity of the ageing population.

The study aims at developing a practical model and a utility value in supporting the coping at home of elderly persons. In Finland, the rocking chair is a common item of furniture, especially in the houses of elderly people [9]. It is also commonly found in the maternity wards in hospitals, and an ordinary rocking chair has been adapted for use in rehabilitation [10], but nevertheless knowledge of its physiological impact on elderly people with physical disabilities is minimal.

However, certain studies report that rocking in a rocking chair has a positive impact on elderly people. The EMG activity during rocking was found to be 5% of the maximum. After a six-week intervention, repetitions in the sit-up test had increased by 44% [11, 12]. These studies have shown that rocking in a rocking chair activates m. rectus abdominis, and therefore it could be used as a training method for neuro-muscular activation in the rehabilitation of elderly men. The attainment of a significant training effect on the abdominal muscles remained open because of the preliminary character (small number of subjects) of the study. To the best of our knowledge, there exists only one randomized controlled trial study using a rocking chair [13].

The purpose of this study was to investigate the rocking chair training protocol (Keinutuolijumppa®) as a training method to increase the functional capacity of elderly women. This paper presents the study design and the preliminary results of the study.

Methods

The study was carried out in the Kauniala Hospital for Disabled War Veterans. The study was approved by the ethics committee of the University Hospital of Kuopio, Finland. The study group consisted of 51 community-dwelling women aged 75 and older, who participated in a 2-week rehabilitation period. Participation in the study was voluntary. In the beginning of the rehabilitation period half of the subjects (n=26) were randomly assigned to the rocking chair group (RCG) and the rest to the control group (CG). Both groups were measured at the end of the rehabilitation period, which was the base line, and after six weeks. The RCG carried out a six-week training programme at home. The training followed the rocking chair training protocol, which included five rocking chair sessions per week, 30 minutes per day, consisting of ten different movements per session focusing on the lower extremities.

Measurements

A structured interview on health status, diseases, symptoms, use of medication, activities of daily living (ADL), physical activity, number of falls and hobbies was administered to the subjects. Functional capacity was studied by hand grip, maximal isometric knee extension strength, maximal walking speed over 10 meters [14, 15], chair rising five times, standing balance on one leg [16, 17].

The difference in the means differences in RCG and CG were tested with a T test with independent samples. The difference between the groups was analyzed by using repeated measures of ANOVA.

Results

The preliminary results of this study showed a statistically significant improvement between the groups in maximal knee extension strength ($p<0.02$) and in maximal walking speed ($p<0.03$).

Discussion

It seems that active rocking chair training with these ten exercises can improve the muscle strength and walking speed. This helps to maintain the physical function in the daily coping of elderly people.

The rocking chair training protocol (Keinutuolijumppa®) was implemented without expensive equipment or the presence of staff at home. The protocol could be implemented alone or in a group. The rocking chair exercises and training were enjoyable, simple, safe, comprehensive and suitable for everyone regardless of skill or fitness. There were many variable elements in the training programme. It included movements for different muscle groups and purposes (relaxation, exercising, stretching). The intensity and duration were adjustable.

Developing forms of physical activity which the elderly can use at home poses several challenges. The movements and the equipment needed must be safe and also motivate the person. In this study, rocking chair exercises were developed for home-dwelling elderly persons, to activate their daily living. Rocking is combined with exercise, which is assumed to have an impact on the maintenance and even improvement of the physical functional capacity of the elderly.

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Paper Session 1 Room 2 - Mounting for Mobility

Bill Johnson, Anne Marie Renzoni

Introduction

Persons with complex physical needs, including those with cerebral palsy, muscular dystrophy and spinal cord injuries may require simultaneous access to a variety of assistive technology to support their daily activities. For example, an individual using a power wheelchair may also use a speech-generating device for communication, or a lap top computer on a tray with specialized access through an integrated joystick control. The result of multiple systems may be a cluttered and incoherent system, which can be cumbersome both for the user and caregivers. The mounting system is a critical component that integrates the different assistive technology components and enables them to function as a whole system (Hitchcock, 2003, Lange & Racicot, 1999).

Case studies will be presented to highlight the team process and design considerations for developing customized mounting systems.

Process

For clients with complex needs, customization of mounting systems may be required, ranging from adapting commercially available systems to fully customized solutions requiring design and fabrication. With increasing diversity of wheelchair options and designs, access options and complexity of communication devices, a comprehensive approach is required to determine the optimal solution.

The assessment process will be described using the SETT framework (Student, Environment, Tasks, Tools) (Zabala, 2002), which was developed to guide assistive technology service delivery in the school system. The SETT framework provides a process of collaboration with the team to gather information on the student, the environments in which the student participates and the tasks that he/she needs to do to participate in the environment. The "tools" are selected to help the student achieve specific tasks in their daily lives. The mounting system is often a key "tool" to integrate communication technology with the mobility system. To determine the optimal mounting solution, the process involves a team approach with the inclusion of a team member with mechanical design skills (Johnson & Renzoni, 2004). The initial assessment phase requires consultation from all team members (client, family, caregivers, seating/mobility, communication team) and can be a lengthy process. The additional time taken during the assessment phase, utilizing input from all team members provides essential information to the design and fabrication of a functional mounting solution.

The integration of assistive technology systems requires knowledge of wheelchair systems, access peripherals and communication systems. Considerations for wheelchairs to be discussed include:

- frame design and chair mechanics
- seating systems (laterals, pommels, head supports)
- options of tilt and recline
- space available for adding peripherals
- weight and stability

- matching aesthetics and
- integrated tray systems.

Considerations for the communication system include:
- integration of both low tech and high tech systems
- access methods and peripherals
- positioning of the device for access and vision and,
- specific environments in which the device is used (e.g., indoor, outdoor, home, community).

The mounting system design is determined through the assessment process with the client and team, and consideration of the assistive technology components. The case studies will highlight customized mounting solutions that:
- address safety for the device and for the client
- provide a consistent set-up (small changes can make it frustrating and impossible to access the device)
- be user friendly (if cumbersome then the device may not get used) and,
- have a streamline design.

Summary

Individuals with complex physical needs may require the use of multiple technologies to support their activities in everyday life. The mounting system plays that vital role of linking the subsystems to the wheelchair and helps to facilitate the effective use of the entire system.

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Paper Session 1 Room 2 - Safety Issues of Wheelchair Seated Drivers in Private Vehicles: Positioning of Driver Controls and Seatbelts Relative to Injury Risk for Wheelchair-Seated Drivers During Frontal Crashes

Linda van Roosmalen PhD, Nichole Ritchie MS and Lawrence W. Schneider, PhD

ABSTRACT

Fifteen wheelchair-seated drivers were observed while preparing to travel in their private vehicles. The distances between the drivers and the vehicle (steering) controls or grip assistive devices were measured. Test results show that many controls and assistive devices are in close proximity to the wheelchair-seated driver, thereby increasing the likelihood of injurious contact in a frontal collision. In addition, the position of steering controls is in front of drivers' chests and components of these controls are often protruding out towards the driver, creating a possible safety hazard during a frontal impact. The injury hazard presented by these controls is compounded by the lack of properly positioned belt restraints observed on most wheelchair-seated drivers. Results of this study can be used to improve the safety of vehicle controls used by wheelchair-seated drivers of private vehicles. Additional research is needed to further evaluate the specific effects of vehicle control design and positioning on risk of injury to wheelchair-seated drivers in frontal crashes.

BACKGROUND

In the United States, nearly 1.7 million people use wheelchairs for daily mobility needs [1]. For 80% of wheelchair users, public transportation is not a feasible means of transportation [1]. According to the Bureau of Transportation Statistics' Omnibus Survey, 83% of adults with disabilities ride or drive in a private vehicle [2]. The majority of private vehicles modified for accessibility are full-sized vans and mini-vans and accessibility modifications are made more frequently for drivers than for passengers [3]. Thus, wheelchair users who are not able to transfer from their wheelchair to a vehicle seat are increasingly traveling as wheelchair-seated drivers in privately owned vans and minivans [3].

A wide variety of adaptive driving controls and grip enhancing devices are available for wheelchair-seated individuals who cannot use the OEM steering devices and gas and brake pedals. Specially designed hand controls, reduced-effort steering, electronic gas and brake controls and touch pads to activate secondary controls such as power windows and climate controls are available for wheelchair-seated drivers with limited upper-extremity function. In some cases, it is necessary to alter or remove federally-required safety equipment to enable individuals seated in wheelchairs to drive [4]. When adapting vehicles for wheelchair-seated drivers, OEM safety belts are often altered or replaced by alternative seat belt systems [5]. No information is available in the literature on how these systems protect wheelchair seated drivers. Additionally, it is unclear how the design and installation of vehicle control systems and removing or disconnecting airbags can affect wheelchair occupant injury risk in motor vehicles.

STUDY OBJECTIVE

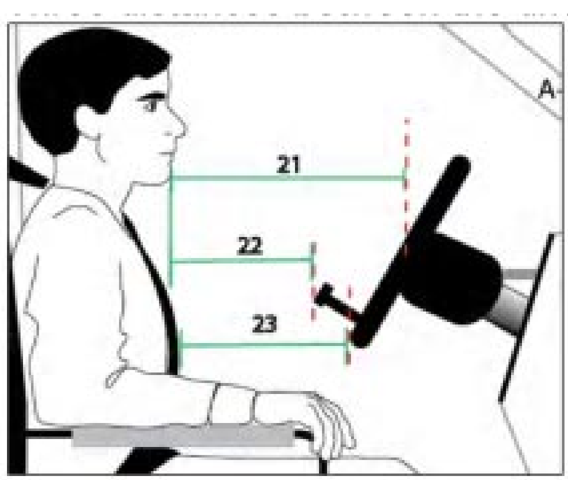
The study objective was to quantify distances between vehicle controls and assistive grip devices and wheelchair-seated drivers in private vehicles. Additional objectives were to document the different types of driving controls and assistive devices that are commonly installed in modified vehicles, driver airbag status (not altered, disconnected, or removed) and to qualitatively evaluate the use and positioning of lap and shoulder belts by wheelchair-seated drivers.

METHOD

Data were collected for 15 individuals who drive private vehicles while seated in their wheelchairs. Participants were recruited from the western Pennsylvania and southeastern Michigan areas. Subjects were observed while getting ready for travel. Once in position and ready for travel, a survey related to vehicle use and safety was conducted and photographs were taken of the seat belt configuration, the steering controls, and the position of wheelchair-seated drivers relative to the steering controls. Three distances between the driver and the steering controls and steering assistive device were also measured as shown in Figure 1. These include:

a. Measurement #21: Horizontal distance from center of steering wheel to subject's chin
b. Measurement #22: Horizontal distance from other steering control device to subject's chin
c. Measurement #23: Horizontal distance from lower steering-wheel rim to subject's abdomen.

Figure 1: Example showing the measured distances of the steering controls relative to the wheelchair-seated driver.



RESULTS

To date, 15 wheelchair-seated drivers have been recruited and tested. Two of these subjects used manual wheelchairs with power assist features, and the remaining 13 subjects were using powered wheelchairs. The average age of the subjects was 47.4 years. On average, subjects had driven private vehicles while seated in their wheelchairs for 15.8 years. Drivers indicated that they used their vehicles about 5.4 days per week and about 1.3 hours per day.

All but one subject used automated docking-type securement systems (EZ-lock or Q'Straint Dock 'N Lock). One subject was awaiting delivery of a securement system and had been driving with an unsecured wheelchair. Most subjects indicated that they felt safe to very safe when driving their vehicles and when entering and exiting their vehicle.

When getting positioned in the vehicle, most wheelchair users with powered seating systems would adjust their seating systems or leg rests to prevent their legs and feet from contacting the instrumentation panel and to achieve a suitable posture and position for travel. Two subjects had non-modified original equipment manufacturer (OEM) vehicle restraints installed in their vehicle, whereas 13 vehicles were equipped with after market seat belt systems or modified OEM seatbelts. Investigators observed poor seatbelt fit in many cases; pelvic restraints were routed over the armrests, high over the abdomen or not used at all. Shoulder belts, when used, were often routed off the shoulder, or used without a pelvic belt restraint. Two subjects hooked their seatbelt around the wheelchair armrest structure or around the push handles of the wheelchair instead of buckling their seatbelt latch plate into the receiver. Three subjects indicated that positioning their occupant restraint interfered with their vehicle controls. This interference was mostly due to the close approximation of the armrest and wheelchair mounted joystick and the driving controls. Of the 15 vehicles, one vehicle had the steering-wheel airbag removed and two had the driver airbag disconnected. One subject was unsure if the airbag had been modified or removed from his vehicle.

The subjects used various types of steering-grip enhancers including triple-pins (tri-pin) and spinner knobs. Other steering systems that were used included a reduced-diameter wheel or joystick, instead of the OEM steering wheel (Figure 2). These latter two devices could be adjusted to the left, to the right, or in front of the driver, depending on the drivers' preference and functional reach.

Tri-pin positioning. Reduced diameter-wheel positioning.

Figure 2: Examples of steering controls and grip enhancer positioning.

Measurement results on the distances from steering device to the driver's chin and abdomen are summarized in Table 1 and a comparison of measures is depicted in Figure 3. While the distances between the drivers' chins and the center of the standard steering wheel are reasonable and similar to those for ambulatory drivers seated in OEM vehicle seats (6), the distances to other types of steering controls and grip-enhancers, and the distances between the drivers' abdomens and the lower rim of the steering wheel are considerably smaller and may therefore expose wheelchair-seated drivers to a higher risk during frontal vehicle crashes.

DISCUSSION AND CONCLUSIONS

Steering control configuration and positioning relative to wheelchair-seated drivers were measured in 15 modified vehicles. The results from this study provide researchers with the geometric information of steering-control positioning with respect to wheelchair-seated drivers. The results also show that proper seatbelt positioning and use is often compromised for wheelchair-seated drivers due to interference from wheelchair armrests or other wheelchair components. Common types of steering configurations used by wheelchair-seated drivers are tri-pins, spinner knobs, reduced-diameter wheels and joysticks. Close proximity of drivers to steering controls in combination with a lack of proper seatbelt use and/or fit can be expected to adversely affect wheelchair occupant injury risk during frontal vehicle crashes.

Study limitations include the relatively small number of subjects tested to date and the fact that most of the special equipment required by the wheelchair drivers was installed by a few van modifiers in the Pittsburgh and Michigan areas. Study results will be used to guide the design of improved driver controls and seatbelt systems for wheelchair-seated drivers. Results will also be used to further investigate the effects of control positioning and control design on wheelchair driver injury risk in frontal collisions.

Table 1: Distances from steering device to the driver's chin and abdomen.

N=15	Min. (mm)	Avg. (mm)	St.Dev (mm)	Max. (mm)
21. Distance from chin to center of steering wheel	120	329	96	508
22. Distance from chin to other steering control or grip enhancer on steering wheel	38	214	115	356
23. Distance from abdomen to lower steering wheel rim	3	159	81	305

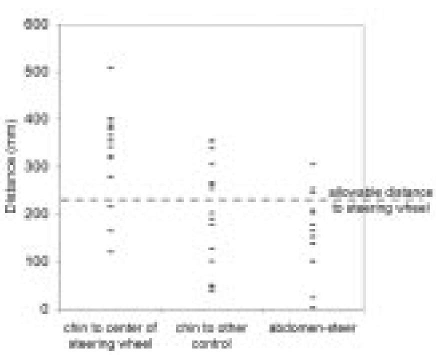


Figure 3: Distances measured between driver and control device for 15 subjects.

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ACKNOWLEDGEMENTS

The RERC on Wheelchair Transportation Safety is funded by the National Institute on Disability and Rehabilitation Research (NIDRR), Department of Education, Washington, D.C., Grant # H133E060064. The opinions expressed herein are those of the authors and are not necessarily reflective of NIDRR opinions.

Paper Session 1 Room 2 - The TOTWalker Project: A Journey to the KidWalk

Christine Wright-Ott, OTR/L, MPA , Richard Escobar, BS, ATP

BACKGROUND The early years of a child's development depends on the ability to interact with and explore the environment, particularly indoors where the majority of the day is spent. Children have a strong desire to explore, which in turn provides a tremendous amount of sensory-motor experiences like reaching, getting close to objects and people, interacting with peers, carrying objects, touching and feeling, pushing and pulling toys, opening and closing drawers, running, bumping into objects and learning to move in, around and through space (1,2). Children with disabilities who are mobility impaired may spend more time in positioning equipment or lying on the floor than exploring their surroundings in an upright position using self-initiated mobility. The TOTWalker (Transitional Ortho-Therapeutic Walker) Project was written by an occupational therapist with the goal of designing a new type of mobility system for preschool children with disabilities that could be maneuvered more efficiently in small indoor spaces and over carpeted surfaces than other support walkers. A more efficient mobility system would increase opportunities to explore and use the upper extremities. The project team included Christine Wright-Ott, occupational therapist, grant author and principle investigator; Richard Escobar, assistive technology practitioner; Sharon Leslie, physical therapist, consultant engineers and machinists. Other contributors to the project included an Advisory Board of consumers, care providers, "expert clinicians," engineers, physicians and a government funding agency representative. Funding for the TOTWalker Project was provided by the U.S. Department of Education, NIDRR, OSERS, PR/Award H133G990103.

DATA COLLECTION The first phase of the design process (pre prototype) was to evaluate the fit, function and maneuverability of 10 commercially available support walkers designed with a seat, hip, trunk and a head support. During this phase both disabled and non disabled peers were observed maneuvering the support walkers. It is interesting to note that several of the support walkers could not be "steered" in a desired direction by able bodied users. Maneuverability was tested by measuring resistance to pulling each walker, weighted with 20 lbs on a child mannequin the size of a 2 year old and unweighted, over various surfaces using a digital scale measured in ounces and pounds. (7) Body measurements were recorded for all subjects in order to determine the range of adjustability needed for the TOTWalker. The greatest limitation to indoor maneuverability of existing support walkers appeared to be the size of the wheels (the smaller the wheel the more resistance to moving over carpet and thresholds), the number of wheels (3 rows of 3" casters had the poorest performance), the turning radius and difficulty directing the walker due to swiveling of front casters during ambulation, which tended to steer the walker left or right during weight shift movements. Two focus groups of physical and occupational therapists were conducted to gain information on attitudes towards the importance of early mobility, perceived obstacles to attaining mobility and recommendations for features of a mobility system. The data obtained from the focus groups, testing the support walkers and observations of fit and function assisted in determining the design goals of the TOTWalker:

DESIGN GOALS The TOTWalker mobility system would have to be designed to meet the needs of children, primarily with cerebral palsy, from the most complex clients with quadriplegia to those with the ability to use a hand held walker. The project goals were to develop a mobility system that would enable a child to explore the indoor environment by making the system highly maneuverable over carpets, thresholds and in small spaces and allow the child to get within arms reach of objects and people in the environment. It would provide hands free support so the upper body could be used for exploration to augment sensory motor, social and cognitive development based on previous research in brain development and self-produced locomotion (3,4,5,6). The TOTWalker would also complement therapeutic goals by providing a means for weight shift, encouraging rotation of the upper body over the pelvis when turning and the ability to reduce or remove supports around the trunk to encourage core strength and balance. The design goals included:

- Hands free support of the child with minimal hardware in front of the child.
- Ability to turn around in a 38" hallway.
- Least resistance moving over carpet and thresholds than any other walker tested.
- One adult can place child in or out of it and adjust it within 10 seconds.
- Infinite height adjustability with child in it
- Upper trunk supports can be removed for child who only needs pelvic support
- No tools required for adjustments.
- Can be transported in a trunk of a car.
- A more able user could get into and out of the TOTWalker without assistance.

TOTWALKER FEATURES Ideas for the TOTWalker design were gathered from engineers who knew of the design goals but had no knowledge of the abilities of the target population or other devices so as not to impart one way of thinking based on previous experiences. Ideas from the engineering team, the Advisory board, therapists and consumers as well as the project team's experience with previous support walkers and the target population were gathered and the features of the TOTWalker were proposed. The first prototype of the TOTWalker was fabricated in 2001. The features of the TOTWalker included (Note: * features are patented):

- *Large wheels placed in a mid-wheel position on the frame with front anti-tips.
- *Lateral weight shifting mechanism to encourage more natural movement.
- *Self centering hip guide adjustment to assure symmetrical pelvic placement
- *Swivel, self centering seat to accommodate leg movements.
- *Footplate option for accessing various table heights.
- Spring board support to allow for vertical movement during ambulation
- Removable upper body support to accommodate users needing just pelvic support and to encourage balance activities during therapy sessions.
- Hands free and body steerable.
- No hardware in front of the child which limits a 10" arm reach.
- No tools required for adjustments and transportable in a trunk of a car.
- Height adjustable by one person with weight of child.

TOTWALKER TESTING The prototype phase required an efficient means for evaluating the fit and function of the TOTWalker while being able to make immediate changes to the hardware for retrial with the same subject. A mobility camp model was established to accomplish this task. With this method 10 children could use the prototype each day followed by changes to the hardware in preparation for retesting the following day. Three “camper subjects” would attend mobility camp for 1 ½ hours, daily, for two weeks. During the camp each subject was observed using both a commercially available support walker and the TOTWalker to test fit and function while exploring, reaching into drawers and cabinets, walking over various surfaces, playing and interacting with siblings. Comments from care providers at camp included excitement over the first time their child walked up to them for a hug, children taking longer naps and sleeping through the night, a happier disposition, and an increase in vocalizations.

Trials of the TOTWalker prototype were conducted at local therapy units through California Children’s Services, in physical therapy private practices and in subject’s home environments. Approximately 150 children were evaluated in the TOTWalker over a 6 year period. Maneuverability tests indicated the resistance of the TOTWalker moving over carpet and thresholds was less than ten other support walkers previously tested. (7)

Unexpected reactions of children using the TOTWalker in the home environment included one subject with spastic quadriplegia who used a quick protective reaction response of his arms, which was previously never observed, to prevent bumping into a table. Peer interactions changed such that one subject’s sibling couldn’t stop staring at his brother and touching him when he was in the TOTWalker, confused to see him stand and walk. The TOTWalker provided a new level of independence for most children, particularly for one child who was able to open the refrigerator to get his yogurt and carry it to the table, saying “Thank you” to his Mother, not realizing he was responsible for getting his snack rather then his Mother, who routinely brought it to him.

DESIGN CHALLENGES The greatest challenge to designing the TOTWalker was determining the style, function, shape, and placement of positioning components to accommodate a variety of physical abilities and postures, as well as designing components that would adjust to fit children ages 1-6 years with the same unit. The seat size, shape and density were great challenges considering most children used it as a weight bearing surface during rest periods. A dynamic, well padded swivel seat, that could be removed, was selected over a sling seat to provide the user with more control of the pelvis during ambulation and for steering the unit by rotating the trunk over the pelvis. Alignment of the legs for some users was a challenge, but was accomplished using several strategies: seats of various lengths provided alignment for children who adducted their legs during ambulation; leg wraps made of a dynamic material placed around each leg to the back upright posts of the TOTWalker assisted in reducing hip flexion and maintaining alignment while providing feedback for position in space of the legs; and the pelvic pads could be placed slightly lower onto the hips to guide the legs.

PERFORMANCE OF TOTWALKER USERS Subjects were typically able to move the TOTWalker in a forward direction quite easily following slight adjustments to the angle of tilt and seat height. The most optimal position of the pelvis was in neutral under the trunk or slightly anteriorly tilted behind the trunk, making the anterior pelvic pad placement a key factor in performance. If the anterior pelvic pads were too loose, the pelvis might tilt posteriorly and the child would only move backwards. Some children required "motoring" to learn how to initiate turns by having the adult repeatedly turn the unit towards the weighted leg demonstrating rotation of the trunk over the pelvis. Five children with spastic quadriplegia were unable to move their legs reciprocally until their foot orthoses were removed. About 5% of the children had an unidentified leg length discrepancy which affected maneuverability. This discrepancy can be observed when one leg externally rotates, a sign of a low seat height, while the other leg faces forward. Once a lift was placed under the shorter leg, maneuverability improved. Several children, who were using a hand held walker with difficulty maneuvering it at home, were able to use the TOTWalker with pelvic support only and preferred the hands free feature of the TOTWalker and the ability to reach to the floor.

TECHNOLOGY TRANSFER & KIDWALK MANEUVERABILITY TESTS Several companies were interested in manufacturing the TOTWalker. Prime Engineering of Fresno, California was selected as the manufacturer and distributor of the TOTWalker and re-engineered the TOTWalker for production, renaming it the KidWalk. Testing results over carpet, pulling straight, with a 20 lb weighted mannequin, indicate the KidWalk requires 4 lbs of pull compared to a range of 4.6lbs-7.3 lbs of pull for the other commercially available support walkers tested. Pulling resistance of the KidWalk over a ¼" threshold on linoleum is 6.8 lbs of pull which is a total score for front and rear wheels versus a range from 11.lbs-17.3lbs of pull for other walkers.

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Paper Session 1, Room 3 - Low-cost, Appropriate Wheelchairs for Challenging Terrain in Developing Nations

Joy Wee, MD,FRCPC, Carol Scovil, PhD

Introduction

The objective of this paper is to review the existing literature regarding wheelchairs available for challenging terrain in low income settings, and to discuss componentry in relation to advantage conferred, including renewable energy options.

Cultural relevance is important in wheelchair design. In India, a ground level mobility device has been designed for women living in rural areas, to allow them to maintain usual customs, which often involve sitting on the ground, when performing their usual roles [1] and details can be obtained through Vikram Panchal (nid@adinet.ernet.in).

Another consideration is the level of wheelchair skills training each user has received. For example, given appropriate training, it is possible to maneuvre curbs and steps with manual wheelchairs. Further details may be obtained through the Dalhousie University website www.wheelchairskillsprogram.ca. Where possible, such skills should be optimized in wheelchair users.

Main Points

Two literature searches conducted by each author separately on the topic of low cost wheelchairs appropriate for rough terrain in low income settings were conducted. Very few publications on low cost wheelchairs for low income settings were located, numbering less than a dozen articles and one thesis. We review the existing literature regarding low cost wheelchairs and componentry available for challenging terrains. Suggestions regarding componentry to consider in wheelchair design are made. Cost and material considerations in various settings should be considered.

In some settings, terrain is so rough as to require assisted mobility. Some transporters, such as The Bush Wheelchair [2] have been developed. Studies have shown that velocity is lower with higher levels of Spinal Cord Injury (SCI), and lower for grades of 4% or 8% [3]. Participants with C-6 tetraplegia need to work near maximal capacity for basic community function using a manual wheelchair. Therefore, power mobility would be a logical alternative, if available. There exists a hybrid hub-motor-assisted, hand-rim wheelchair that allows 60% less exercise intensity [4]. Unfortunately, unless motors use readily available fuel sources available in developing countries, power mobility options remain limited. One possible technology is pedal powered stored energy, in conjunction with a battery [5], that could perhaps be powered by able-bodied family members.

Currently, 90% of wheelchairs are hand-rim propelled, which can lead to repetitive strain on upper extremities. Lever and crank-propelled wheelchairs are more efficient [6], and are preferred in developing countries, particularly in the form of tricycles [7]. They allow one-arm use and alternating use of arms, and are superior on rough terrain and steep slopes through the use of gear systems. Lengths of levers can be adjusted. However, maneuverability and steering in small spaces are a challenge. Effects of gears have also been studied, with higher efficiencies shown with heavier gear settings, particularly with synchronous propulsion [8], using the backrest to generate reaction forces. There is a proprietary spiral direct drive propulsion system chair being developed, but such chairs will be commercialized, and not likely readily available in developing countries [9].

As wheelchair users age, they also develop anatomical changes, such as muscle atrophy, and thoracic kyphoses. Back and seat cushions are important elements to consider. For outdoor use, mobility base has to be durable, and seating system must support a stable posture [10]. In developing countries, 80% of persons with spinal cord injuries die of pressure ulcers [11]. Low cost cushions such as the Tuball cushion have been developed, and perform similarly to more expensive ROHO cushions [12].

One key message for wheelchair developers is that the focus needs to be on the wheelchair user, and not the wheelchair [13]. Historical market forces have not encouraged such important collaborative research, but it remains important to keep the end user in mind, for the purposes of wheelchair utility, acceptability, maintenance and repair with parts and services that are available and affordable. Some organizations, such as Whirlwind Wheelchair International focuses on such development processes [14].

Conclusion – Further research into low cost wheelchair design is required, given the current paucity of theory-based research, particularly from a biomechanical (mechanical load) and ergonomic efficiency standpoint, using crank or lever-based wheelchairs. Such research needs to occur in developing countries themselves, with end-users playing a key role in their development.

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Paper Session 1 Room 3 - Leveraging the Internet to Provide Seating and Mobility Services in Developing Countries

Todd Lefkowicz, Brian J. Dudgeon

Introduction. There is a large unmet need for wheelchairs in developing countries. Mett (2000) finds that the percentage of people with disabilities who live in low and middle income countries may range from a low estimate of 47 percent to a high estimate of 77 percent. Estimates of the number of people who need wheelchairs but don't have access to them range from 20 million to 120 million (Hotchkiss & Knezevich, 1990; WHO, 2007; Pearlman, et al., 2006). In fact, Pearlman et al (2006) estimates that only 1% of the need for a wheelchair is being filled.

There are several models of wheelchair provision to the developing world. The greatest number of wheelchairs is depot or molded plastic wheelchairs that are donated to developing countries. For instance, to date more than 35,200 wheelchairs from the Free Wheelchair Mission (2008) and more than 51,700 wheelchairs from the Wheelchair Foundation (2008) have been delivered to Peru. Another model for wheelchair provision is to reclaim used wheelchairs from developed countries and deliver them to developing countries. Still other organizations provide configurable wheelchairs or wheelchair kits to seating and mobility services in developing countries. Finally, there are numerous small to large wheelchair factories within developing countries that build wheelchairs locally for local or regional use.

Small and Medium Enterprises (SME's), producing locally consumed goods form the economic foundation of many developing countries. The Standard Rules on the Equalization of Opportunities for Persons with Disabilities (UN, 1993) states that it is important for assistive technologies to be produced locally using locally available material when possible. Yet local provision of wheelchair services has failed to meet the needs. Pearlman et. al. (2006) argue that workshops that produce wheelchairs to meet patient-specific needs are not capable of large production. They also find that the investment of time, financial resources, risk of business failure, and quality issues are too great to make this a viable model for meeting the seating and mobility needs in such countries.

Mobility Builders, a newly-formed nonprofit organization, leverages information and communication technologies (ICT) to make the provision of clinically appropriate, locally-built wheelchairs through local seating and mobility services cost-effective, scalable, and sustainable. The model, though incomplete, builds upon ongoing work providing computer and internet-based supports for The Wheelchair Project, a small seating and mobility service in Lima, Peru.

Discussion. Several computer technologies have been developed to address specific challenges encountered by The Wheelchair Project. The project's first wheelchair, built in 1997, used adjustable mounting hardware to fit locally-built seating components to a locally-built Whirlwind wheelchair. Unfortunately, the use of the adjustable mounting hardware added complexity, weight, and cost to the wheelchair. It also prevented the wheelchair from being easily folded for transport on a bus or in a trunk of a car. As wheelchairs in Peru were frequently built one-by-one, the team decided to develop a seating simulator to help find the optimal seating configuration for each user, then custom design each wheelchair frame and seating system to match the specific needs of each user. The wheelchairs could be built in less time, but the local team had difficulty designing custom equipment. To simplify the process, software was written that customizes the design of a wheelchair frame based on the Whirlwind Africa using about 20 parameters entered by the user (Lefkowicz & Olivera, 2000; Krizack, 2000). The software creates a dimensioned drawing set for each customized wheelchair frame that can then be built in about ten hours using all locally available materials. A wood and foam seat and backrest can be mounted flat against the tubes of the frame so as to accommodate about five inches of growth over time of use.

The introduction of software to custom design each wheelchair frame allowed the local clinicians access to affordable wheelchairs designed to meet specifications, but it didn't ensure that the wheelchairs would be clinically appropriate for each user. An Internet-based database was developed to help the team of Peruvian therapists address frequent issues around clinical appropriateness, choices to be made, and managing information. Local clinicians could then upload information and photos to the database to facilitate communication among Peruvian and US team members. The database contains contact information and communication records for each client and tracks progress on each wheelchair. It also allows the data and photos of local seating evaluations to be uploaded to an online form, where they are reviewed by volunteer therapists with more experience and training in special seating. The database allows the more experienced seating clinicians to mentor in-country therapists and helps promote clinical appropriateness and equipment quality. Since the implementation of the database, clinical appropriateness, organization, and follow-up services have significantly improved.

The online technologies are being further developed to address other concerns currently faced by the people served by local seating and mobility services. Many families have been unhappy with the amount of time lapsed between the seating evaluations and provision of equipment. The database is being modified so that the local therapists must forecast and enter target completion dates in order to save information. The database program then track the status of the wheelchair service for each case and makes it clear to the therapists if they are behind schedule. Online training packages are also being developed to address the quality of information entered into the system. If the standards of quality become lax, the user will be required to complete online retraining packages prior to having access to the database. Quality and timeliness standards will need to be met in order for the system users to log into the database and access the software to design the wheelchairs.

Plans for future development include creating online training curriculums complete with online testing for clinical seating and mobility services as well as wheelchair fabrication. The online curriculums promote project scalability by reducing costs associated with program replication. That is, clinicians and equipment fabricators would develop a foundational knowledge prior to any hands-on training, thus reducing overall training costs. The online training could also perform a screening function, ensuring that limited resources are reserved for the most promising candidates.

Future plans also include developing a system to improve equipment fabrication efficiencies, reducing the service and equipment costs (currently $200 in Peru), and improving product features, such as adding a tilt-in-space feature.

Conclusion. Mobility Builders feels that ICT holds significant potential for improving the local provision of seating and mobility services in countries with limited resources. An integrated system could not only help a greater number of services to provide clinically appropriate and affordable wheelchairs, but could require that developing country partners maintain clinical, technical, and cost standards in order to have continued access to the system. Once a local team develops expertise in seating, they could themselves use the database system to replicate, mentor, or incubate other "franchises". The database enables separation of clinical services and equipment fabrication. Small remote seating and mobility services could become viable without providing services to large numbers of people, as the equipment could be built in a central hub and shipped to smaller services.

Mobility Builders is interested in developing new partnerships with organizations providing or interested in providing seating and mobility services in countries with limited resources.

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Paper Session 1 Room 3 - The Impact of Low-Cost Adaptive Technology in a Colombian Community

Marlene Wiens BPT, BSc, MSc

Introduction

This presentation provides a picture-based story of the effect of appropriate technology coupled with a home program, on the life of a girl with hydrocephalus living in a low-income community in Colombia. The objective of the presentation is to demonstrate the effectiveness of providing this intervention on the physical, social and intellectual development of this girl, whom we shall call Julia. In addition, the presentation will include the effect of this intervention upon Julia's family and upon the disability organization to which Julia belongs.

Brief History

Julia was born in December 1996 with hydrocephalus that was not treated until she was one year old. By that time her head had enlarged significantly and the muscles of her neck, trunk, arms and legs had been severely weakened. When I first met Julia in about 2000, she was not able to sit in a chair or lift her head to a fully upright position. This meant she had to lie on a mat or in her bed day and night. Julia came to the attention of a small disability organization called FANDIC (Friends of Disabled Children for their Integration into the Community) and it was through this organization that I continued to follow her progress.

In 2002 Julia began to use a small chair in the home, but as it was very uncomfortable she could only tolerate 30 minutes of sitting at a time. In 2003 we held an appropriate technology workshop to construct a custom chair for her. The workshop brought together Julia's mother, Colombian volunteers, representatives from FANDIC and me, a representative from CAPD (Canadian Association for Participatory Development). Together we learned the principles of seating, and designed and constructed an insert that could be placed in the chair that she was given in 2002. It had a reclining back and provided supports for her head, trunk and legs. The insert served two purposes in that it could also be placed into a loaned wheelchair for mobility outside the house. We also constructed a small table for indoor use so Julia could have a surface for playing, drawing and eating.

The adaptation was an immediate success with Julia. It was amazing to see how she changed from sullenly refusing to face the camera, to someone who smiled for the camera, laughed and chattered happily. The chair apparently improved her self esteem; suddenly she was proud to be the person she was.

In 2004 FANDIC instituted a Home Exercise Program and Julia's family selected her sister to be her activity leader. From that point onwards we began to see amazing progress in Julia's physical condition. She went from not being able to lift her head to a fully upright position to maintaining her head position for two hours while participating in activities.

Julia has made impressive physical gains and is now working on her schooling. Whereas she was dependent in all activities before the chair was built, she is now independent or semi-independent in many activities of daily living, is able to sit in an ordinary chair for extended periods and to keep her balance while sitting on the floor. Some of her gains are due to increasing age, but it is very unlikely that she would have attained these skills without the interventions.

In 2007 Julia received an adult wheelchair from the government and the family chose to use this chair for her outdoor mobility needs. From a good seating perspective this chair was not very satisfactory because of its width and the hammock back and seat, so it was modified in FANDIC to provide Julia with a firm back and seat. Otherwise, no other adaptations to the seating system were needed.

Community Involvement

The interventions of adaptive technology and home program are components of Community Based Rehabilitation (CBR), a program that has been promoted by the World Health Organization (WHO) since the 1980s. As an organization that practices CBR, FANDIC sought to include various people in the appropriate technology workshop in order to enrich the experience for the child and family, and to draw awareness about disability issues and solutions in the larger community. Julia's mother attended the workshop out of interest but also to understand the principles so that she could adapt the insert as Julia grew. She was an important member of the team and the one who determined the type of adaptation the team would construct. She had input into all stages – the design, the construction and the finishing touches. The other group members varied in their abilities and professions, and this led to a good team process and interesting solutions.

Also consistent with CBR, the insert was constructed with locally purchased, low-cost materials such as plywood, foam of various qualities, glue, webbing and upholstery fabric. The participants found it interesting, if not incredible, that such a good solution could be achieved with easily available materials. It seemed contrary to a common assumption held by some medical professionals in low-income countries, that sophisticated, high cost solutions are required to achieve a good result.

CBR encourages the community to become involved in promoting opportunities for people with disabilities1. In Julia's case, the primary level of community is her family. Because the construction of the insert took place in Julia's house, the family became at least an observer if not an active participant in the activity. Being part of the process prepared them to use the insert frequently and effectively. It also prepared them to take a more active role later, in Julia's Home Program.

Combined Interventions

The Home Program was designed by combining the expertise of the family and that of professionals in FANDIC. The family appointed an activity leader who made up Julia's activity booklet with a student physiotherapist, implemented it in the home, and attended FANDIC twice weekly for short talks on disability issues and group therapy practice. Julia's family was very committed to the home program and carried it out faithfully. The benefit of their commitment could be noted in Julia's steady progress. It was nothing less than amazing.

One could question whether Julia would have improved so dramatically if only one of the interventions was applied. It appears that the combination of the two interventions was important. Seeing Julia sitting so well stimulated the family o view her as a person with potential. They were encouraged to see such a large change as the result of one simple intervention. From that day, her mother began to formulate goals for Julia – things that she wanted her to achieve.

The Home Program built on that motivation by providing ongoing training and information for the family. Weekly activities in FANDIC stimulated them to continue with Julia's home activities and to seek ways to include her in activities in the home. The regular contact served as a means of encouragement and follow-up, important for families with limited resources.

Concluding Remarks

The appropriate technology workshop in 2003 was beneficial from various perspectives. It provided an initial stimulus to Julia to develop functionally, socially and intellectually. It served as a motivator for the family to become involved in her development. It also had a broader effect in that it became the first of a series of workshops held by FANDIC. Over the last several years other children have benefited and now have a piece of equipment that will assist them in reaching their developmental goals.

The home program helped to capitalize on the hope generated within the family by the appropriate technology workshop. They wanted to keep working and became dedicated to Julia's development. The regular educational opportunities offered by FANDIC helped the family to understand the disability of their child, which in turn helped to reduce their sense of powerlessness. The regular practice with other children with disabilities and their activity leaders led to improved skill level, greater socialization and increased commitment to continue working with the child in the home.

The appropriate technology workshop resulted in a paradigm shift for families with disabilities, health professionals and FANDIC. The families learned that the child could improve and was not condemned to a life of passive compromise. Health professionals learned that they could promote a child's development with creative, well designed, low cost interventions. FANDIC took hold of a simple technology to improve the lives of disabled children. They built on that technology by adding the home program, which in turn developed ability, commitment and ownership.

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Paper Session 1 Room 3 - "Skin Care After Spinal Cord Injury" The Use of a Multi-Disciplinary Team Home Visit to Assess, Educate and Link Injured Workers With Community Resources

Lori Cockerill BSc(Psy); BSc(OT) & Beverley Thompson RN

In 2003 a survey was conducted with workers who have spinal cord injuries. It supported the premise that the prevalence and cumulative incidence of serious wound care issues in this population were worse than in other populations.

In May 2007, a pilot was implemented with 65 spinal-cord injured workers and finished in November 2007. The project objective was to provide a multidisciplinary visit to workers in their own homes to offer; information, education and to determine if this would ultimately prevent pressure ulcers in this compromised population. A pre-test questionnaire was administered and a post-test questionnaire is conducted three months after the home visit.

The population selected was 22% of the total number of injured workers with spinal cord injuries in British Columbia. They were selected in three areas of the province where wound care resources were limited.

During the visit, information using standardized and non-standardized assessment tools was gathered. An education presentation was provided and each worker received an education book and a long handled mirror to use for skin checks.

The pilot has had positive feedback from all stakeholder groups. Additional qualitative and quantitative results will be extracted from the pilot data once it concludes.

Paper Session 1 Room 3 - Pressure Mapping of 64 Spinal Cord Injured Workers as Part of Wound Prevention Program: Analysis of Findings

Authors: Jo-Anne Chisholm and Joanne Yip

Workers with spinal cord injury in British Columbia have been identified as a group that is more likely to develop pressure ulcers than other person with spinal cord injury1. A pilot project was funded by WorkSafe BC for a health care team from Access Community Therapists to visit 64 workers with spinal cord injury in 3 regions of the province with the aim of reducing the incidence of pressure ulcers. The project was conducted from May to October 2007.

Of the identified 64 workers, 49 workers (77%) were visited by the team and 44 workers had their primary seating surface pressure-mapped. Of the 49 workers seen, the 5 workers who were not pressure mapped were ambulatory so did not use a wheelchair for primary mobility while all others used wheelchairs for primary mobility.

The team consisted of a nurse wound clinician IIWCC (international wound care course) and an occupational therapist with specialization in seating, spinal cord injury, and pressure-mapping. Workers and their doctors were sent a letter introducing the project and the workers were contacted by phone to schedule an appointment and complete a phone interview pretest. The pretest was intended to capture the workers current knowledge and behaviours related to pressure ulcer prevention and management.

All visits were in the worker's home and family members, doctors and caregivers were invited to attend. The visit consisted of an in-depth medical interview, physical/functional seating assessment, observation of skin and assessment of any ulcers (including photographs, PUSH, PSST), blood pressure, circulatory assessment (pulses, edema, lower limb circulation), pressure mapping of wheelchair sitting surfaces2, and at the discretion of assessing OT of other weight bearing surfaces (couches, commodes, motorcycles, van seats, mattresses, ATV) and equipment evaluation. As part of the assessment, the Braden Scale for Assessing Pressure Sore Risk3 and the Pressure Ulcer Risk Assessment Scale for Persons with Paralysis4, as well as a nutrition screen (Mini Nutritional Assessment5) were administered. The visits concluded with a PowerPoint education session tailored to the worker's situation. The workers received a skin check mirror and educational booklet which was referred to in the presentation and were provided with relevant local and provincial resource information.

Each visit generated a comprehensive combined Nursing/OT report of the assessment findings. The report included the pretest, client data, community supports, health information, nutrition status, skin and wound health findings (with pictures), functional findings, description of equipment and environment, physical assessment findings, pressure mapping, summary of issues and corresponding recommendations presented in table form. The report ended with a worker statement of what they would change as a result of the visit. The reports were submitted to WorkSafe BC and were followed up individually by case managers. A post-test was done within 3 months of the visit.

How the Pressure Map was used

Assessment

All workers using wheelchairs had their primary sitting surface pressure mapped with the FSA system for baseline documentation. A pressure mapping protocol was followed including:

- o Bagging the mat to prevent cross infection
- o Pre-testing mat function each time
- o Display set to 200 mm Hg
- o Landmarking bony prominences and noting coordinates
- o Minimum of 10 minutes sitting on primary surface before recording

Depending on therapist discretion, other surfaces were pressure mapped. For example one worker had his motorcycle, van seat, commode and mattress mapped in an attempt to understand the source of his pressure ulcer which did not appear to be caused by his primary sitting surface.

Simulated wheeling, weight shifting, tilt and recline (when available) were also pressure mapped as indicated.

Education of the worker:

The pressure map was introduced after the physical assessment. The worker was interviewed and observed in their wheelchair, and then they transferred into bed for the physical assessment and observation of skin. The pressure mapping was done when workers transferred back to their typical wheelchair and seating configuration and were shown how their pressure was distributed. It was at this point of the visit that the concept of pressure, posture, positioning and weight distribution became personal for the workers. This phenomenon, the teachable moment6, was noted by all team members. The abstract notion of pressure ulcer risk became a real possibility because of the real-time visual display of their own sitting posture, sitting surface and the effects of weight shift.

The teachable moment was capitalized on for each worker:

- o Small interventions were made such as correctly orienting a cushion, adjusting inflation, adjusting wheelchair components (backrest angle, footrest position, armrest height, etc.), replacing one cushion with another (often workers had more than one cushion).
- o Mapping of the effects of postural adjustments helped the worker understand the impact of posture on pressure distribution. For example, how reducing lateral trunk lean, tightening back upholstery, changing seat angle, increased femoral weight-bearing could improve overall pressure distribution.
- o The worker was pressure mapped doing a typical weight shift. This was compared to alternate weight shift techniques and the most effective method noted. Sometimes this resulted in the worker finding a better way to do their weight shift. The benefit of more frequent and sustained weight shifts was also introduced in this context.
- o The location of pressure ulcers or redness found during the skin assessment was identified on the worker's pressure map. Pointing out the relationship between high pressure on the mat and their own skin breakdown helped the worker better understand the importance of their sitting surface.

Justification of recommendations

Relevant pressure maps were inserted into reports and referred to in the identified issues and recommendations section. Inserted pressure maps demonstrated the need for equipment modification or replacement, the need for further assessment, and for additional care-giving or other resources.

Analysis of findings

The intention of the authors is to review the pressure maps of the 44 workers and compare the following results:

- o Age
- o Level of spinal cord injury
- o Years injured
- o Braden Scale for Assessing Pressure Sore Risk
- o Pressure Ulcer Risk Assessment Scale for Persons with Paralysis
- o Nutrition risk
- o Postural asymmetry
- o Surface mapped (cushion)
- o Maximum pressure and location
- o Coefficient of Variance
- o Clinical interpretation of pressure map
- o Current pressure ulcer(s)
- o History of pressure ulcers
- o Overall clinical estimation of risk

Preliminary Impressions

1. The pressure map process had very strong educational value in this project.
2. Existing pressure ulcer risk scales do not accurately reflect the risk of this population (spinal cord injured workers living in community) as compared to clinical estimation of overall risk.
3. Use of pressure mapping in assessment in community is an effective adjunct in determining risk

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B1 - Wound Investigation Process
“It’s NOT Always the Chair”

Karen Hardwick, Ph.D., OTR, FAOTA, Mace Welch, PT

Wounds and other skin integrity issues are not always caused by pressure. Decubitus ulcers are but one cause of wounds that occur on weight bearing and other skin surface areas that may be associated with individuals who have seating, positioning, and mobility issues. In other words, it’s not always the wheelchair.

This presentation will define and show examples of skin integrity problems related to pressure wounds (Pershall, 2008), shear, skin approximation, skin tears, maceration from persistent wetness, fungal infection, impaired circulation, and other sources. There will be a discussion of the problem solving process and solutions to treat and prevent further problems.

When pressure is suspected one should look at the location of the wound, determine what is touching the skin, and perform pressure mapping (XSensor, 2008) to identify areas of concern or risk. Wounds on the trochanters, sacrum, heels or elbows could indicate the bed as a source. Wounds at the ischial tuberosities, sacrum, trochanters, spinous or other bony prominences could indicate the seating or alternate positioning device. If splints or other orthotic devices were used, points of contact on the limbs or joints could result in wounds. Possible solutions might include changes in cushions, mattresses or other pressure relieving devices; customization of seating and positioning systems; development of Physical Nutritional Management programs; and alterations of other equipment/devices as needed (Hardwick, 2002).

When moisture is suspected one should look for excoriation and or signs of fungal infection. The investigation should explore recent changes in continence or factors that could cause diarrhea. G-tube sites and other stomas should also be checked as potential sources of moisture that could result in skin problems. Possible solutions for wounds caused by moisture include changes in personal schedules or PNMPs, use of moisture barriers or antifungal preparations, and specialized cushions or mattresses to facilitate air circulation and reduce sweating.

Circulation should be considered as a source of poor skin integrity in addition to pressure and moisture. Venous and arterial insufficiency and complications of diabetes are potential precursors to wounds (Wikipedia, 2007). Possible solutions include decisions about elevation of extremities, use of multiple positions in space, programmed positioning, compressive hosiery, skin checks, hygiene routines, and avoidance of static positions.

If pressure, circulation, or moisture are not factors, look for other causes. These may include infection, self injurious behavior, insect bites, and others. Possible solutions include medical treatment; psychological programming, medications, and therapeutic surfaces, ex. a pressure

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B2 - Aging with a Developmental Disability

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In 1900, the life expectancy in the general population in the United States was 47 years. By 2000 it had reached 77 years. People with disabilities had significantly less life expectancies up to the twentieth century with an example being that of a person with Downs Syndrome a having a life expectancy of 16 years in 1945. With advances in medicine and technology, life expectancy increased. Kemp states that individuals with severe impairments are beginning to have a life expectancy close to 80-90% of normal.(1,2)By 2030, the number of individuals over the age of 60 having lifelong developmental delays is predicted to double. (3)

Aging from conception to death is assumed to follow the same sequence in all people. Overeynder et al, describe aging without disease or trauma as "a series of developmental changes that ultimately lesson a person's ability to cope successfully with the demands of the environment." Life begins with growth, development and skill acquisition during infancy, childhood and adolescence. Organs systems usually mature around the age of 20 developing a reserve capacity beyond what is needed for basic survival. (1,4) During adulthood, the focus is on maintenance of function, and finally in later stages of life, function begins to decrease. As individuals get older, the response to stressors in the environment is not as effective as when they were younger. If the body is unable to respond to physiological stressors, the result is decreased function. (1,4)Aging changes are noted in "sub cellular, cellular, organ systems, performance, psychological and social levels" (1) "When there is no reserve capacity remaining, the organism crosses a threshold into a state of disease." (4)

When aging is superimposed on a person with a disability or impairment, the maximum capacity may be less due to the characteristics of the impairment. Kemp notes that the increased life expectancy noted in people with disabilities has resulted in an increase in premature aging at a relatively young age. The Average person begins functions at about 40% peak capacity at about 75 years of age. The rate of decline from age 20 is about 1% a year. In comparison, a person with a disability may demonstrate organ capacity declines at 1.5-5% a year reaching 40% peak capacity at age 55-60. (1). Kemp notes that individuals with disability will demonstrate varying levels of decline depending on their disability, onset, and resulting impairments. (1,2, 4) It is not surprising that a person who used a wheelchair from the time of childhood would have less bone density than a person the same age without a disability. (4,1)

Cerebral Palsy

Cerebral palsy is defined as a non-progressive disorder of movement and posture that is attributable to a one time injury to the immature brain of a fetus or infant. (7). It has been noted by Klingbeil et al that the emergence of secondary conditions appears to be the consequence of life long abnormal movements, altered postures, immobility, chronic medication consumption and poor nutrition. Concurrent conditions that impact an individual's ability to function also play a large role in the aging process. These can include seizure disorders, mental retardation, visual and auditory impairments, learning disabilities and communication disorders. (7,8,9,10)

The medical needs are often observed to change in individuals with cerebral palsy. As the aging process progresses, changes can be noted in respiratory capabilities/effort, bowel and bladder function, bone density and the report of arthritis/pain. 84% of women in a survey conducted by Turk reported pain which is almost 60% greater than the general population. Individuals with spastic type CP reported a greater number of pain sites than those with other types of CP and over 40% of adults with CP reported hip pain. (11) These issues are also usually a result of a lifetime of muscle imbalance, skeletal and postural asymmetries and overuse issues. (7,8,9,10,11,12) Fractures are five times more common in persons aging with cerebral palsy(8) Osteopenia is found to be present in a high number of individuals with cerebral palsy (13, 11) Wallingford, a person with CP who developed a website on aging with CP, states that stenosis and spondylosis begin to manifest itself in individuals with CP around the ages of 45-50. (14,15,16) Symptoms are often so familiar with cerebral palsy that they go undiagnosed for years. (14) Strauss et al indicated findings in over 900 subjects with cerebral palsy over 60 years old demonstrating marked decline in ambulation. (16) Cardiovascular, pulmonary, and gastrointestinal issues are also reported to increase as adults with CP age. Increased mortality from ischemic heart disease or aspiration have been reported. (17,18,19,20)

Spina Bifida

Spina bifida is a group of developmental defects occurring during the formation of the neural tube.(7) Resulting disabilities can vary in range of presentation from mild to severe, usually resulting in sensory and motor loss to areas of the body below the lesion. Commonly seen characteristics include spinal deformities, pelvic obliquities, skin issues due to lack of sensation, and overuse injuries due to compensatory and overuse effort. Many of the complaints of early aging cited by individuals with SCI are reiterated by those with span bifida. Additional findings differing from those with SCI are problems with shunts. (7) Klingbeil et al reported that 90% of adults with spina bifida coming to a clinic have ventricular-peritoneal shunts in place. Shunt malfunctions can produce chronic headaches, vomiting, and neurological problems. Tethored cord syndrome is also reported. Charcot joints may be caused by chronic lack of sensation or muscle imbalance. Pain is frequently reported and osteoporsis from lack of bone stimulation due to non-ambulation often begins in childhood with exacerbation in adulthood. (21) Decreased skin tone and changes in fat and muscle tissue distribution occur with aging, making some more prone to new skin issues. (21, 7) In addition, issues with incontinence/ bowel and bladder function tend to be more prevalent with the aging individual with spina bifida. Obesity is often noted possibly due to decreased mobility (21) Adults with spina bifida may have more severe reactions to latex as reserve capacity decreases. (7)

Down Syndrome

Down Syndrome is the most common chromosomal cause of developmental disabilities, occurring in 1 out of every 700 to 1,000 live births. (Barnhart, Connelly) Over the past 60 years, the life expectancy for individuals with Down Syndrome has drastically increased. In 1949, it was 12 years. Currently, the life expectancy is over 55 years. (3) With this increased life expectancy, concurrent aging issues have emerged.

There are some unique physical conditions that appear to influence the aging process with individuals with Down Syndrome. 40% of all people with DS will develop hypothyroidism. Thyroid dysfunction can be the precursor to other aging conditions. Untreated hypothyroidism can present with decreased cognitive ability, lethargy, weight gain, constipation and bradycardia. Often times when left undiagnosed, these symptoms can be interpreted as dementia, depression and obesity, all other characteristics of the aging process. (3) Cardiovascular disorders are common in children and young adults however the prevalence of additional heart problems increases with adulthood. Mitral valve prolapse is reported in up to 57% of adults with DS (22) The early signs of cardiovascular disease can also be confused with dementia, depression and obesity and need to be specifically ruled out. (3)

Adults with DS report mid-cervical arthritis at a higher rate than the general population (3) Hip displagia, hip instability, and foot pronation are also noted in maturing individuals with DS. Barnhardt also cited one study of individuals with DS living in the community found a high proportion of osteoporosis in young adults with a mean age of 35. (3)

In addition to the physical process changes noted above, there is a very strong correlation between Down Syndrome and Alzheimer disease. (23,24,25) Barnhart and Connelly cite that almost all adults over 40 years of age display neuropathology consistent with Alzheimer disease. (3) The onset occurs at a relatively young age with the progression rapid. Clinically, individuals with this combination can lose their ability to function independently in a short time, moving from an ambulatory status to dependent in a few months.

Implications of Aging with Seating and Wheeled Mobility

Murphey et al reported major concerns regarding equipment for adults with cerebral palsy. Many individuals has poor fitting or broken equipment. Only 3 of 67 individuals had adaptive postural supports in the wheelchairs with the rest having sling seats. Pain was a major issue with these individuals until proper adaptations to their seating systems was made. (19)

When providing services relating to seating and wheeled mobility for aging individuals with developmentally disabled adults, care needs to be taken to provide equipment that can change as their needs change. In today’s environment where funding appears to dictate equipment choices, consideration of the individual’s current status as well as their prognosis must occur.

During the evaluation process, a thorough evaluation is needed to address all areas of need, including a physical evaluation, a thorough medical history and questioning of medical personnel to identify possible prognosis. Weight issues and trends also need to be addressed to insure that any loss or gain trends are identified and planned for. The need for additional seating components has to be evaluated for the provision of external support to help maintain postural alignment. The use of base modifications, tilt in space and recline, needs to be discussed for future use. A common trend with all aging processes includes increased lethargy and a loss of energy. The use of a tilt in space option may provide beneficial postural support at some point. Power wheelchairs to increase functional skills and conserve energy might be an option.

In summary, the impact of aging for individuals with developmental disabilities can be quick and debilitating. The aging process tends to be pathological in nature, resulting in greater dependence and a loss of ability to function. In additional to functional loss, pathologies develop within other systems that facilitate the effects of aging. The seating therapists can be a conduit to facilitation of preserved function by recommending the optimal fit for seating and a wheelchair base.

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B3 - Don’t Be a Crash Test Dummy!

Authors and Presenters: Ginny Paleg and Susan Johnson

INTRODUCTION:

Motor vehicle transportation is an important requirement for community living in our society. Persons with disabilities must travel in motor vehicles to medical appointments, religious services, work, school, voting polls, shopping, and other necessary community activities as well as to travel to areas outside of their community. Because persons using wheelchairs may be unable to safely transfer to a vehicle seat or may need the supportive seating of their wheelchair, they may use their wheelchairs as seats to travel in motor vehicles. In the selection and recommendation of wheelchairs and wheelchair seating and postural supports, transportation should be seen as a foreseeable use for a wheelchair and therefore an important safety consideration.

RESEARCH AND RECOMMENDATIONS OF THE EXPERTS ON TRANSPORTATION SAFETY:

Studies performed and referenced by the RERC on Wheelchair Transportation Safety(2) have shown that persons riding in motor vehicles seated in wheelchairs are more likely to sustain injuries than those seated in the vehicle seat. Most wheelchairs are not designed for or recommended for use as a seat in a motor vehicle. The concern is that the rider seated in a wheelchair may become injured in the event of a collision or sudden driving maneuver such as turning or braking.

The ANSI/RESNA standard, WC19 (3), provides design and testing criteria for wheelchairs to be used as seats in motor vehicles, referred to as “transit” wheelchairs. WC19 compliant wheelchairs have successfully “passed” a prescribed crash test. Therefore they have known crashworthiness in a forward facing 30 MPH/ 20 G frontal impact. (The 30 MPH is not the driving speed of the vehicle, but rather the “delta V”, or rather the change in velocity at the moment of impact.)

Manufacturers of WC19 compliant wheelchair products must provide instructions for wheelchair securement and occupant restraint for their “transit” wheelchairs. They are also required to comply with labeling requirements for the chair and postural belts on the chair. They are required to disclose information about crash test results, vehicle belt accommodation, and other criteria; giving prescribers and consumers information to make informed comparisons of products.

CLINICIANS AND SUPPLIERS CAN IMPROVE WHEELCHAIR TRANSPORTATION SAFETY BY CONSIDERING AND EDUCATING ABOUT THE RECOMMENDATIONS OF THE TRANSPORTATION EXPERTS:

Positioning for transportation has different goals and characteristics than positioning for function. It is important for clinicians and suppliers to consider both when selecting and recommending mobility equipment for clients. Education of clients regarding safe use of the wheelchair for transportation can be provided by the clinician and equipment supplier.

Transportation experts recommend that, in general, the vehicle seat is the safest place to sit during transportation. Clinicians and suppliers can contribute to wheelchair transportation safety by assisting in assessment of whether the client can independently transfer and sit safely on a vehicle seat for transportation. In addition, the wheelchair should be evaluated in terms of its appropriateness in terms of safe seating during transportation.

When it is determined that a client will use his wheelchair as a seat during transportation, clinicians and suppliers can contribute to wheelchair transportation safety by recommending crashworthy wheelchair bases whenever appropriate and feasible. A list of wheelchairs that have been crash-tested and information about their compliance with WC19 is available at www.rercwts.org.

In addition, the crashworthiness of the seating system, including its attachment hardware, is important to consider when selecting equipment. When ordering seating from a manufacturer other than the wheelchair base manufacturer, it is important that the seating company be aware that it will be used in a "transit" base to ensure that it is mounted with crashworthy hardware. A new ANSI/RESNA standard, WC20, is in the proposed stages. It will provide design and testing criteria for transportation safety of wheelchair seating systems.

Guidelines for the use of secondary postural supports during travel have been published in a consumer article by the RERC on Wheelchair Transportation Safety(3).
Recommendations are discussed in the session.

Secondary postural supports provide pre-positioning for the client which may improve occupant restraint performance, but they present additional concerns during transportation. Postural support belts on the wheelchair should not be considered to take the place of the occupant restraint system, the wheelchair tiedown and occupant restraint system (WTORS). They are not strong enough and may not be positioned properly to provide protection against crash forces and emergency driving maneuvers.

It is important that the postural supports, such as hip guides, armrests, trunk supports, do not interfere with the placement of the occupant restraints, ie. lap/shoulder belt, of the WTORS.

Fit of the crash tested lap belt, part of the WTORS, is critical to safety. It should be placed low on the bony pelvic structure and secured tightly. The crash tested shoulder belt portion of the WTORS should cross the center of the chest and attach to the lap belt at the hip. Care should be taken that the WTORS do not interfere with medical equipment such as a tracheotomy, feeding tube, ventilator tubing, or shunt.

A properly positioned, firmly attached headrest may help protect the head and neck from injury during transportation. Headrests should be placed as close to the back of the head as possible and no more than 2 in. (50 mm) from the rear of the head, and at a height such that the middle of the headrest aligns with the top of the ears. It is important that the rider's head be positioned and supported to prevent the head from going under or around the headrest pad while the vehicle is in motion. Avoid using any head support that attaches the head to the back of the seat.

The maximum recommended tilt angle for transportation is 30 degrees or less. The concern is to maintain good contact with the shoulder belt of the WTORS. If a client must be tilted more than 30 degrees for postural support reasons, consider additional postural supports for use during the ride. If the client must remain tilted more than 30 degrees for other medical reasons, the shoulder belt attachment to the vehicle should be moved rearward and the strap adjusted vertically to achieve the best possible contact.

Trays should be removed during transportation. If the tray is used for postural support, additional postural support or use of a foam tray should be considered for the ride. At the least, if the hard tray stays on, it should be securely fasted to the chair and padded near the area that might be contacted by the client.

Medical or other equipment should be secured for transportation to prevent them from hitting people in a crash and causing injury. Loose or modestly secured equipment, can break loose or become inoperable.

When the wheelchair and/or the client are heavy (in excess of 250 lbs.), the risk for injury to the person seated in the wheelchair may be higher in higher severity crashes when traveling in vans and minivans. Use of additional tiedown straps in the rear may reduce the risk to the user.

CONCLUSION:

- Consideration for the clients' safety throughout their entire day is paramount in the selection and recommendation of seating and mobility equipment
- When adding secondary postural supports to a system, consider possible interference with the positioning of occupant restraints
- We need to work as a team with transportation providers for the client's benefit
- Educate clients and caregivers about safe transportation in motor vehicles for persons riding seated in wheelchairs

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CRASH TESTS SHOWN IN SESSION MAY BE VIEWED AT:
www.rercwts.org/RERC_WTS2_KT/RERC_WTS2_KT_Edu/RERC_WTS2_crashtest.html

B4 - When to Think About Lateral Tilt and Why

Stephanie Tanguay OTR, ATP/S
Clinical Education Specialist ~ Motion Concepts
Bradford Peterson

Lateral Tilt positioning systems are certainly not a new concept in mobility base seating. Many of the first lateral tilts were custom constructed for individual consumers by Rehabilitation Technology Suppliers (RTSs) and Engineers (1, 2, 3). Commercially manufactured systems with lateral tilt are available in manual and power options. While limited representing a fraction of all repositioning systems utilized, requests for this type of device appear to be increasing each year. When are lateral tilt devices being utilized and why? Are there specific diagnosis or conditions for which alternative positioning in the frontal plane should be considered?

Consideration must be given to the specific primary diagnosis and secondary conditions for which lateral tilt has been successfully utilized. Many of the consumers have intact sensation with neuron-muscular involvement which limits active movement. Frequently, significant pelvic obliquity, severe scoliosis or roto-scoliosis and possible lordosis are present. Incidence of skin breakdown in areas trapped between two overlapping boney structures do occur. Spinal scoliosis alters head alignment and impacts visual orientation, functional positioning and alignment of oral and internal structures. While these orthopedic conditions present pressure and positioning issues, they can perpetuate physiological complications with respiration (5), swallowing (2, 6) and circulation. Dysphagia is the term used to describe the disruption of oral intake of nutrition. Karen Hardwick has written and spoken of the benefits of positioning and positioning seating systems to enhance the oral motility of food and fluids and to improve the peristalsis of swallowed material (6). She described the success of lateral (frontal plane) tilt with two case studies in 1992 (2).

Orthopedic changes can have serious effects on the skeletal structures and, subsequently, the internal organs. Lateral tilt systems have been utilized to counter-act scoliotic postures and collapse by redirecting the effects of gravity on the spine. In the RESNA proceedings of 1989, Jody Whitmyer (1) described a custom seating system which moved on two axis; specifically to position a consumer with a severe right lateral scoliosis against gravity (tilted 35* to the left). In 2004, Kevin Clements et al (3) presented two case studies of consumers with 90* C-curve scoliosis who received custom systems which tilted 40*-45* laterally. While most commercially available lateral tilt systems allow movement throughout the frontal plane (to the consumers' right and left), the range of movement is limited to 15* in each direction.

Prior to 2004, there are only a handful of case studies or presentations describing the use of lateral tilt positioning. All of these were custom built systems. The diagnosis and imperative needs of the consumers who received those systems had some similarities. Hardwick's 1992 case studies (2) both presented with spastic quadriplegia. Whitmyer's 1989 case study (1) presented a man with muscular dystrophy. The two consumers in the Clement, et al (3) case presentation both had Cerebral Palsy, 90* scoliosis and Dysphagia.

Included in the ISS proceedings of 2004 was a presentation by Dave Cooper (4) detailing the provision of 17 lateral tilt systems over a three year period. While many of these examples were custom modified; 10 were manual and 7 were power systems. Most intriguing were the diagnosis and secondary complications for which lateral tilt was prescribed. After adding the diagnostic facts of the five previously published case studies, some trends remained consistent.Having access to data for power lateral tilt systems ordered from Motion Concepts, it was determined that at least 21 lateral tilts were built between 2005 and 2007. The companies who ordered these systems were contact by the clinical education specialist from Motion Concepts and attempts were made to speak with the providing RTS in each case. In each instance, the providers were asked about the consumers' primary diagnosis, secondary conditions and/or reasons that lateral tilt was prescribed and if the equipment had been successful – that is, did the lateral tilt positioning system achieve the goals for which it was prescribed?

While many of the primary diagnosis were consistent with those reported by Cooper (4), some additional diagnosis for which lateral tilt was prescribed included Multiple Sclerosis and Spina Bifida. Secondary conditions were consistent with those described by Cooper (4); the most common being severe scoliosis and subsequent need to improve head positioning and counter the spinal collapse. Additional applications for lateral tilted position included improved comfort and skin integrity with lateral weight shifting; a concept which was found to be effective by Ma and Banks (7) and was also mentioned by Sparacio and Roesler (8).

Although the number of lateral tilting mobility bases is relatively small by comparison to the well established and widely utilized posterior or sagital plane tilt system; it appears that lateral tilt is an effective positioning component for consumers with diagnosis of spastic quadriplegia (most commonly resulting from Cerebral Palsy), some types of Muscular Dystrophy including Duchenne, Spinal Muscular Atrophy (type 2). Lateral tilt has also been used successfully with some consumers with Multiple Sclerosis and Spina Bifida. Equally important are the secondary diagnosis for which lateral positioning has proven to be a valuable tool in addressing spinal collapse and head positioning issues. It is equally encouraging that many of the power systems ordered from Motion Concepts in the last three years were funded by a variety of payers; from Medicaid to Medicare & Medicaid, State Rehabilitation Services and Private Insurances.

It is anticipated that the request for lateral tilt positioning systems will continue to increase as documented applications and successful outcomes continue to be reported. Alternative movement in the frontal plane is certainly not appropriate for all diagnosis. Ideally, evaluation with a lateral tilt system will assure successful applications. Simulation of lateral positioning can be a first step in determining possible benefits of lateral tilt.

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The author would like to thank the individual consumers who graciously allow their stories and pictures to be shared so that we might all generate new ideas, learn new approaches and be better able to help meet the needs of other consumers.

Additional thanks to the RTSs and clinicians who provided invaluable time information. Special thanks to Faith Saftler Savage for her wonderful case study.
Thank you to Katie McSween and Kim Davis, the best R.W.s anyone could have.

B5 - Mobility for Discovery

Christine Wright-Ott, OTR/L, MPA

Introduction

Mobility for Discovery is a multi-sensory approach that encourages children with physical disabilities to experience self-initiated mobility and sensory motor activities which incorporate vestibular, proprioceptive and tactile input to augment development. Children who have a means for self-initiated mobility decide where, when, and how to move to explore their surroundings. Those who cannot use self-initiated mobility to move across a room to reach out and explore an object or place are at a great disadvantage. (1,2,3,4) These children typically have limited sensory motor experiences through the day such as pushing or pulling toys, accessing recess activities at school, reaching and touching objects and peers, moving quickly for vestibular input (provided by activities like running or jumping) or learning spatial relations by moving around or under objects. Restricted experiences and mobility during early childhood has a diffuse and lasting impact on development. If a child's mobility continues to be one of a passive nature, never active or self-initiated early in life, the child is further disadvantaged in his development.(1,2,3,4) The significance of experiencing mobility in early childhood has been demonstrated.(5,6,7) The challenge then is to determine how children with physical disabilities can experience upright, self-initiated mobility to explore their environment and participate in developmentally appropriate sensory motor activities, particularly at an early age. Programs which encourage self-initiated mobility, physical exercise, access to recess activities and sensory motor experiences should be encouraged.

The Bridge School's Mobility Program

The Bridge School is an educational program dedicated to ensuring that children with severe speech and physical impairments achieve full participation in their communities through the use of augmentative & alternative means of communication (AAC) and assistive technology (AT) applications. The Bridge School has included Mobility for Discovery in their curriculum by assuring that each student has a standing mobility device such as a support walker which provides opportunities for self-imitated mobility, physical activity and access to recess. Each student participates in 2 one hour weekly mobility/recreation sessions, directed by paraprofessionals and an occupational therapist. Increased motor activity has been shown to lead to better physical and mental health and to augment other aspects of functioning such as cognitive performance, and more recently has been shown to promote neural and functional recovery in people with damaged nervous systems (8).

Mobility Equipment

Students typically come to the Bridge School in either a manual or a power wheelchair. However most students do not have a standing mobility device upon entering the program, such as a support walker, which provides access to recess activities and physical exercise on the playground. Each student is therefore evaluated for a hands free support walker and IEP goals are established to access recess activities using the recommended support walker. The walker must be hands free to participate in the mobility program. Students who use hand held walkers are loaned a support walker to provide hands free mobility during the mobility recreation group. Support walkers most frequently used by students in the Mobility for

I would be interested in meeting with you regarding web design work at NS8, however, I have a pressing deadline for my current client this coming week. Could we schedule a time for the following week after the dust settles on my end?

Mobility Activities
Activities using a hands free support walker have included hide and seek, softball, playground activities like running and chasing peers, an ice skating fieldtrip, tap dancing, soccer, pushing down towers of boxes, moving under tunnels, tag, driving a boat and car placed over the walker for creative play, a treasure hunt, painting with feet on a floor canvas, Valentines delivery, racing down a sloped sidewalk, washing cars, and a scavenger hunt. Each activity has a component that ties into the classroom theme for that week such as transportation, community helpers, size of objects and the body.

The Sensory Processing System and Activities
The sensory processing system regulates the vestibular (movement) tactile (touch) and proprioceptive (knowing where ones limbs are in space) messages to the brain. The vestibular system is quite powerful. It helps us sense movement, orients us in space and helps us maintain balance. Children who sit in equipment all day do not get to experience vestibular input like children experience when they are able to jump, run, fall, and hang upside down on the playground bars. This system directly connects to the digestive system as we are aware of when movement causes gastrointestinal upsets such as motion sickness. 90% of the cells in the visual cortex in the brain respond to vestibular stimulation. Both the auditory system and the vestibular system interconnect. It is also responsible for coordinating movements of the eyes, head and body. Disorganized processing of the vestibular system can contribute to hypotonia, fear of movement or craving movement, repetitive or disorganized movement, and attention and listening difficulties. It is a powerful system and activities in the mobility and movement group include a vestibular component such as spinning, swinging, moving down a ramp, and jumping.

The proprioceptive system helps us know where our body is and how it is moving. Information is sent to the brain from the muscles and tendons stretching and from compression of our joints. Proprioceptive dysfunction can contribute to difficulty with motor planning, motor control (not knowing how to move your body), grading of movements, and postural stability (holding and maintaining postural muscles to feel safe and secure when moving). Activities such as jumping in a support walker like the WalkAbout and KidWalk, which provide vertical movement, is one way to provide proprioceptive input, especially during recess activities.

The tactile system is the largest sensory system in the body. Preterm babies in the neonatal unit given tactile and kinesthetic stimulation gain more weight, spend more time awake and active and show more mature motor development (9). The tactile system may be disorganized in children with physical disabilities as reflected in defensive responses to tactile input. However, many children with disabilities never have the opportunity to touch objects or others or even their own body to help regulate their sensory system. Sensory motor activities should include a tactile component such as touching one's body, holding hands with peers, and exploring various objects and textures with feet and hands.

Sensory motor activities are included in the weekly mobility group through activities that incorporate vestibular, proprioceptive, tactile and spatial relations experiences. Favorite student activities that include sensory motor experiences include “running” in the support walker down a ramp, dancing in a walker, spinning in the IKEA egg chair, moving in swings or hammocks in sitting, supine and standing positions, moving from sit to stand in a walker or standing power chair, sitting and bouncing on the IKEA bungee chair, and rocking in a video game chair.

Summary

Several researchers have studied the impact of early exploration on a child's development. One study demonstrated that children who seek stimulation in their environment at a young age demonstrate increased cognitive, scholastic, and neuropsychological test performance at 11 years.8 The study determined that "Young children who can physically explore their environment, engage socially with other children, and verbally interact with adults, create for themselves an enriched, stimulating, varied, and challenging environment."(8) The Mobility for Discovery program attempts to provide children who would not have a means to explore and experience physically challenging environments a means to do so through sensory motor and self-initiated mobility activities.

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Plenary - Multiple Sclerosis - MS
Understanding the Beast Within

Jean Minkel, PT, ATP

Pathophysiology of MS

Multiple Sclerosis (MS) is thought to be an auto immune disease, meaning, for reasons that are not well understood, the body reacts to it's own tissue,as if, that tissue is foreign matter. In the case of MS the attacks occur on the Central Nervous System including, the brain, spinal cord and the optic nerve.

In an intact neurological system, myelin surrounds the axon which carries the signal either from a sensory organ to the brain or from the brain to the muscles. It is unclear what triggers an attack in MS, but during an attack, the body misidentifies the myelin as a foreign substance and releases the myelin antigen to "disease fighting" – T-cells. T-cells are white blood cells which are capable of crossing the blood brain barrier and attack myelin both in the brain and along peripheral nerves. The result of this attack can be both "demyelination ", as well as, damage to axon itself.

The result of the demyelization is an interruption of the smooth transmission of the signal along the nerve. Following an acute attack, which is also referred to as an exacerbation or relapse, remyelination is possible which can lead to full or partial recovery of function. However, if the damage is axonal, there can be a permanent loss of function.

Triggers for an Attack

Just as the pathophysiology is not well understood, either is the question, "what triggers the body to attack it's own myelin?" Several factors are thought to be at play, and many experts feel the trigger may in fact be "multi-factorial". There are several key factors cited in the literature:

- Genetic link - MS prevalence rates are quite variable between different ethnic and racial groups, being highest in northern European Caucasians, and lowest in Asians. While no causative gene has been identified, the risk for MS is 10 to 50 times higher for persons with an affected relative than for persons with no family history; the risk, however, remains low.
- Virus - Peripheral blood antibody titers to many viruses are elevated in people with MS. (Olek, 2005)
- Environmental Factors – MS is more frequent at greater distances from the equator. This applies to regions within a country itself—in the U.S., the incidence of MS is greatest in the northern states (Halper & Holland, 2002).

  It is likely that multiple genes are involved, and an interaction with an external trigger, such as a virus or environmental factor, may be necessary to initiate disease (Miller, Lublin & Coyle, 2003).

Clinical Symptoms

The clinical symptoms and deficits are quite varied among persons with MS, and they typically change (and worsen) as the disease evolves. The most frequent include (Van den Noort & Holland, 1999): Fatigue, Motor involvement, Visual involvement, Sensory symptoms, Spasms, Genitourinary symptoms, Cognitive deficits, and Depression.

CLINICAL PATTERNS

MS is essentially divided into four main courses (Lublin & Reingold, 1996):

- Relapsing-remitting—Episodes of acute worsening of neurologic function, with some amount of recovery (the most common form) and no progression of symptons in between attacks.
- Primary-progressive—Continuing worsening of disease without distinct relapses.
- Secondary-progressive—Relapsing-remitting disease initially, eventually converting to a progressive form with a gradual loss of function.
- Progressive-relapsing—Progressive disease from onset, with acute relapses and continuing disease progression.

Treatment Options

Relatively new medications have assisted people in the management of MS. These drugs include Copaxin ® (glatiramer acetate) and interferon beta 1a and 1b, along with other more complex medications. Positive outcomes have been recorded with these medications including reduced severity of attack, or exacerbation, reduction in frequency of attacks and reduced involvement of brain tissue. It is the recommendation of the US National MS Society to initiate, as soon as possible, following the confirmation of the diagnosis of MS for person with active replacing disease. Use of these disease modifying agents should be continuous, once initiated, and stopped only when there is a clear lack of benefit or if the side effects are too difficult for the person. Other medication options are available and should be considered for persons with worsening conditions.

Living with the Beast Within

In 2004, a very dear friend to the Wheelchair Industry, Dave Williams wrote a book entitled, “Battling the Beast Within: Success in Living with Adversity”. This book is a MUST read for any health care provider working with people with MS. In the book Dave provides a very personal insight to what it is like to live life following a diagnosis of MS.

“The fact that MS itself is not known to cause premature death is both a blessing and a curse.” The cure, “without a moment’s notice the disease can rear its ugly head and impose new and dramatic changes in his or her life and the lives of family and loved ones.”

The outline of the curse provides us with insight on many key issues: living with a constant sense of uncertainty and the impact of the disease not only on the person with the diagnosis, but also the family and friends.

Dave describes three phases of the disease he has experienced:

- What is It?
- You Can't Do That !
- Let's Try this

As healthcare providers it is essential to understand where your client may be in their own understanding and coping with the disease. Are you a provider who keeps telling people what they "can't do"? A common concern among mobility specialists is "should I provide a scooter to a person with MS? "Not being" a wheelchair may be a really important consideration for the person who is just admitting to the need of wheeled mobility assistance. If the rate of change has been slow they maybe able to get many years of use from the scooter, before needing a more "complicated" device like a power chair.

Most importantly, try and embrace the mindset of "Let's Try This". This mind set requires a willingness to participate in a partnership with the client and his/ her family. Be prepared to listen, (really listen) and look for opportunity to provide options and choice from which the client can make a decision. Keep you door and ears open to respond to the person's experiences and changes.

Like many persons who are originally diagnosised with relapsing-remitting MS, Dave progressed to the secondary progressive clinical pattern. He notes a significant change in both the rate and severity of the change of function with the secondary progressive pattern. The result has been a daily balancing act to control desired activity level, chronic fatigue and the "most challenging adversary", the pain that is made worse with fatigue. Careful planning is needed to prevent the vicious cycle of ACTIVITY leads to FATIGUE, which increases PAIN making it very difficult to sleep to get the REST needed to remain ACTIVE.

With a holistic approach, we as healthcare providers can be a resource to help our clients with MS to explore their own "Functional Activity Triangle" (Enders and Leech, 1996) – the combined use Strategies, Tools and Personal Assistance to complete a functional activity in a manner that is satisfying to the person. Provide the person the opportunity to "try this"!

"Battling the Beast Within" has a sub title – "Success in Living with Adversity". We all live with some adversity, be it self-perceived or perceived by others. Dave's "lessons learned" from his own adversity are readily available for each of us to apply in both our professional and person lives. Thanks Dave for all your wisdom.

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Plenary - Sleep Is Everybody's Business

Sue McCabe

Introduction

Sleep is everybody's business. More specifically, our clients' sleep is our business.

Our work in the area of assistive technology is affected by the way our clients are sleeping. And, we can contribute a great deal towards the management of our clients' sleep.

Sleep matters

Good sleep is essential for development, health, wellbeing and daily performance of all children and adults (1,2). Reduced, disturbed, or poor quality sleep has been associated with many health issues including management of obesity, heart disease and diabetes (3), epilepsy (4), depression and anxiety (4,5). Mood, behaviour, attention, and memory are affected by sleep (5) as are reasoning abilities, learning and task performance (5,6), with impact on family and social relationships, and on performance and safety at school, work and in everyday tasks.

Sleep for people with disabilities

People with disabilities have been identified as having greater incidence of sleep difficulties than the general population (1,5,7). Children and adults with conditions such as cerebral palsy, acquired brain injury, epilepsy, autism, vision impairment and intellectual disability have significant sleep disturbance, with prevalence reported to be as high as 83% for some groups (1,5,8,9).

Wright et al (10) identified and described the diverse issues affecting sleep of people with disabilities and their families in their questionnaire study of sleep issues in children with physical disabilities. Reflecting this, similar issues are identified for the children and adults with cerebral palsy who are seen at the Sleep Solutions service, at The Centre for Cerebral Palsy, in Western Australia.

We find that the factors that affect sleep for people with disabilities are diverse, and often complex. These include issues around pain and discomfort, pressure/skin integrity, muscle spasm and uncontrolled movements, management of deformity and other orthopaedic conditions, compromised breathing and swallowing, reflux and vomiting, and regulation of body temperature. Additional issues may concern constipation and/or incontinence, hunger or thirst, management of feeding regimes, or the need for assistance to manage the sleep environment. Bed safety risks can be a particular concern. Behavioural issues may also influence our clients' sleep – with people with intellectual disability , autistic spectrum disorder and ADHD particularly vulnerable. Sleep timing problems may also be an issue, as people with neurological impairment are likely to be affected by chronic circadian rhythm sleep disorders (11), and the effects of seizures and associated medications. Daytime activity and evening/settling routines may be poorly established, with communication difficulties, frequent hospitalisations, and concern for their child's safety or comfort causing families to have difficulty in establishing and maintaining consistent settling and sleeping routines.

Added to this, people with disabilities and their families are as vulnerable as anyone else, often more so, to the many other issues that may affect their ability to sleep well. These include health conditions such as tonsillitis, asthma, eczema, allergies, ear infections, chest infections or colds and flu. Daily habits and routines - including diet, exercise, use of technology (television, computer, mobile phones), regular exposure to morning sunlight, and management of daily stresses – also affect sleep.

The impact of sleep disturbance on people with disabilities

The physical, psychological and socio-emotional effects of poor sleep are significant for all people, of all ages. For people with disabilities, and their families, these effects are amplified by the many challenges of everyday life. It is reported that people with disabilities are less inclined than the general population to report or seek help for sleep problems (9, 11), either not perceiving sleep as a problem, or believing that this is part of living with a disability. Furthermore, health professionals often miss their clients' sleep problems (9).

Our early experience when setting up the Sleep Solutions service (before promoting awareness of sleep issues) was that clinicians did not routinely ask about their clients' sleep, nor did clients and families report sleep problems. We find that it is only when we ask, and probe for specifics about what is happening with sleep, that the extent and nature of difficulties become apparent.

The impact of our clients' sleep difficulties on our intervention

It is evident that clients who are chronically tired are less able to participate in therapy programs – they have reduced stamina, attention, frustration tolerance and learning ability. The physical effects of poor sleep can be significant - clinicians working in seating and mobility will be aware of how varied clients' postural control and tone can be when tired or fatigued. We are also familiar with the families who regularly miss appointments, turn up late, forget to bring the vital piece of equipment, or neglect to carry out the recommended home programs. Clients and carers may be inattentive or short tempered during clinic sessions.

This all makes sense when we learn that the whole family has been getting by on just a few hours of sleep each night, or that a parent spends each night sitting by his son's bed so that he can provide essential re-positioning or suctioning throughout the night. Our team have met many families who have had little sleep for many years – one parent, a widow in her 70s, reported that she had been getting up to her son about 5 times each night for all of his 54 years. It never occurred to her that help might be available. It was never offered, and she never asked.

What do we have to offer?

In the four years that we have been developing our Sleep Solutions service we have discovered that, as clinicians who work as part of a multi-disciplinary, specialised equipment team, we are very well placed to bring valuable information and resources to the challenge of resolving sleep issues for clients of all ages.

Much of the knowledge and clinical skills that we have brought to the Sleep Solutions service comes from our experience in the provision of specialist support for seating, mobility, communication or management of the environment.
Our knowledge about the importance of 24 hour postural care plays a big part in our approach to sleep management. We apply our skills for postural assessment and for consideration of the many other factors (behavioural, sensory, cognitive, social, financial, environmental) that influence equipment prescription.

We apply the same multi-disciplinary assessment process and tools, for sleep assessment, as we use when considering meal-time management or positioning for function. We use assessment tools such as pressure mapping, temperature and moisture measures, pulse oximetry and clinical observations. We use the same clinical reasoning skills when we evaluate and select products to provide postural support, comfort, or pressure care that is needed for sleep. We trial the use of materials such as Supracor or Evolite. We consult with technicians towards developing custom products such as cushions, wedges or custom-contoured body supports. We use our professional links with other key clinicians - such as team physiotherapists, speech therapists, occupational therapists, dieticians, nurses, and psychologists - to coordinate a holistic, multi-disciplinary approach. We use our clinical knowledge about sensory processing, behaviour, cognition, learning and family centred practice to guide our intervention and recommendations.

What more do we need to know?
We have found that we have a lot to learn - about normal sleep, and sleep disorders. We need to discern when our clients' issues are related to their disability, when they are related to other health, social or environmental issues, and when they involve other sleep disorders.

It is important that we know about normal sleep – the stages of sleep, and the amount of sleep that is considered suitable at different ages. We need to know what helps people to sleep, and what can interfere with this. It has been enlightening to learn about the effects of activity, diet, exercise, sunlight, stress, routines, noise, light and temperature. We need to know about the effects of medical conditions, and of medications.

We have found it useful to learn more about the role of other clinicians who are involved with our clients, and to establish links so that intervention and advice can be well coordinated - many of our clients are seen by orthopaedic surgeons, gastro-enterologists, pediatricians, endocrinologists, respiratory physicians, and neurologists. We need to liaise with others - community nurses, clinical psychologists, social workers, teachers, GPs, or employers – towards a holistic and integrated approach to our clients' days and nights.

We have found it important to promote awareness of the importance of sleep amongst our colleagues and clients. We believe that those who work in the area of disability must learn about sleep: how sleep works, what can go wrong with sleep, and the interventions that may be effective in resolving sleep difficulties. Similarly, it is important that those who work in the area of sleep medicine are aware of the unique and complex needs of people with disabilities. This is everybody's business.

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Plenary - Adaptive Seating Interventions for Children and Young People with Severe and Complex Disabilities; Evidence, Research and Proposed Model for Future Research Practice

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Introduction

Children with complex seating needs present challenges for families, clinicians and researchers. There is always compromise between the needs of the child and the family, often budget constraints and the lack of robust evidence on which to base clinical decisions. High quality research in the field of managing childhood disability is limited, although gradually improving [1]. However, this does not necessarily apply to theory, research and evidence on which clinical decisions are made in the area of postural management for children [2]. There are numerous reasons for this. From a research design, the lack of homogenous groups is a challenge. Even when children are identified as having the same health condition, the clinical manifestations of the health condition is not the same for individuals, nor is the same individual consistent from day to day in their body functions and structure or performance of activities. Further challenges arise in study design; robust study designs which will give meaningful clinical information. Randomised controlled trials for some seating interventions are often inappropriate due to heterogeneity of groups of children, ethical issues, and lack of clinical applicability and generalisation of results. Children with complex needs are by definition a vulnerable population – caused by both their age and their underlying health condition [3], and therefore it is essential that the benefits of research outweigh the risk and discomfort to the child and their family. Furthermore, we currently lack knowledge and understanding of the impairments and outcomes of children with different conditions. Medical treatment and social change has enabled different outcomes to many health conditions, so interpreting results are a challenge.

Investigation into evidence for practice is further hampered by the continued lack of suitable tools available for objective and repeatable assessments. Children with complex disabilities are often unable to undertake traditional standardised assessments, which use activities that are not accessible to children with physical and cognitive limitations. In addition, the results of such assessments may be meaningless. The absence of rigorous, robust and relevant assessment tools and continuing lack of evidence in this area imply that applying evidence based practice remains a challenge for the researcher and clinician.

Although measuring the effectiveness of wheelchairs and adaptive seating with users is a methodological challenge for all users [4], it is a particular challenge for children. Firstly, the children are always part of a family unit, whether traditional or non-traditional in its makeup. This means that effectiveness may differ as to whether the recipient is the child or their family. As with any wheelchair or seating system, the wheelchair has the dual purpose as a medicinal device or a functional one [5]. But here again are two competing needs – a device to meet the health needs of the user of helping to prevent deformity and secondary health issues of the child with complex needs, or helping to maintain, or even damage the health of their carer. Our research has focussed on trying to address the impact of the adaptive seating system on the body functions and structure, activity, participation and personal factors of the child and their family.

Although it has been proposed that activity and participation have been proposed to be the most important constructs impacting on wheeled mobility and seating [5], children who use wheelchairs are given devices within their wheelchairs to improve their posture and reduce the development of fixed deformity and improve functional skills [2, 6-9]. The impact of secondary deformities developing in the bodies of young children makes managing posture a necessary priority. However, the impact of the seat on the development of these postural problems is still very difficult to measure. Whether or not the child uses a device is down to the child themselves as well as their familiy and parents. We have shown in previous work that these devices are difficult for families to use, but that parents and families will undergo enormous practical and environmental difficulties as they believe that the adaptive seating system is helping their child [10, 11]. Little scientific evidence exists on the efficacy of these devices in relation to postural management and control, seated stability or enhancement of function, and given the implications of using the wheeled mobility on the lives of the children and their families, we have a responsibility to thoroughly investigate the evidence on which we base our clinical decisions.

Theoretical Model: We have chosen to use the International Classification of Functioning, Disability and Health (ICF) [12] as a model for our clinical research[13]. The ICF seeks to bring together the social and medical models of health care, and this is particularly relevant for reviewing children with complex seating needs. Due to the complexity of the child and their situation, clinicians are often able to deal with one aspect at a time – dealing with the issues of body function and structure, without considering the child's need for activity, or the families need for community participation for example. We feel that the ICF model is an ideal theoretical basis for adaptive seating system assessment and provision, given that these systems often conflict between the medical model of reducing or delaying impairment of body functions and structures and the social model of children and families accessing and participating in life and environmental situations through mobility and seating equipment [13]. We purport that all the domains of the ICF need to be measured and developed objectively assessed within the context of providing adaptive seating and wheeled mobility for the child and their family.

For each of the ICF domains we have identified potential outcome measurement tools. We have piloted these tools in a randomised crossover research design to compare a ramped contoured seat cushion with a flat seat cushion to explore the differences in seated behaviour in the areas of seated stability, comfort in a seated position, seated function and postural alignment. We have matched these to the ICF domains of body functions and structure, activity, participation, and personal factors. Theoretically, in a ramped, contoured seat cushion, we would expect an improvement in stability, functional movement, postural alignment and comfort than a standard flat seat cushion.

Outcome Measurement Tools: In a study of 30 participants, all of whom had complex disability, we used a number of novel measurements in a randomised crossover study design comparing seat cushions which were flat with those that were ramped and contoured. Detailed results are reported elsewhere. However, the objective measures used include the MTx minature intertial measurement (Accelerometer)[14] is an accurate way of collecting body orientation, kinematic & acceleration data. We are attached a sensor to the sternum of the children, and found a difference in one plane of movement. The MicroMini Motionlegger Actigraph[15] is generally used in sleep studies, but has recently been shown to be a valid and reliable method of measuring low levels of physical activity amongst wheelchair users [16], as a means of measuring and judging different levels of activity intensity and frequency. We used the Xsensor pressure mapping system [17] was used to show difference in average and peak pressure and contact area. Manual goniometry was the primary data collection tool for postural alignment. In several projects, we have experimented with electrogoniometry, but found this to be insensitive in the areas we wanted. In all of the above, we were able to elicit statistically significant results, in favour of the contoured seat. Our next step is to perform multiple regression statistics to examine relationships between the variables.

We used the Non-communicating Children's Pain Checklist – Revised (NCCPC-R) [18] and the Paediatric Pain Profile [19] to identify discomfort rather than frank pain in children who are unable to verbally communicate, and Seated Functional Activities (SFA's) which are low level switch activated toy activities used in a standard way to attempt to address function. At present, these have shown differences between the two seats, but not to a statistically significant level, and further projects are underway to increase the sensitivity of these measures.
The final tool was a survey, developed to measure the user's perception of the usability, postural management, appearance and function of the adaptive seating system and wheelchair [11]. The survey was a representation of the thoughts of the child's own seating system, regardless of type. Similar results to previous studies were found; confirming the hypothesis that parents and families use seating systems given to them by clinicians as they believe they are helping their child, however, they are very difficult for families to use, and have a secondary impact on the health and participation of the child and their main caregiver. Themes arising from the open ended questions relate to the heaviness and lack of manoeuvrability of the chairs, combined with transport access and environmental difficulties that impact on the ability of the family to participate in activities.

Discussion and Future Directions

Our project showed some positive statistically significant results, using some robust, and some less robust measurements. In this study we changed one aspect of the seating system only (the seat cushion), and randomised the order of presentation to minimise bias and fatigue of the children. Changing only one element, gives some confidence in the meaning of the results. Multiple measures can be criticised, and we have found that some of the methods are more sensitive than others. The most statistically significant results were in manual goniometery, which is inherently unreliable. However, by pairing that with the more robust technical aspects, we can begin to have some confidence in the evidence. We are still missing vital information about the long term effects of the seat on the child and their family, as well as robust measures of activity and participation. We need to understand the effect of wheelchairs and special seating systems on both the user and their carer, to maximise health, enable activity and promote participation of children and their families.

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Paper Session 2 Room 1 - Selecting Activity and Participation Outcome Measures for Wheelchair Users Based on the ICF

W.B. Mortenson, W.C. Miller, C. Auger

When attempting to decide upon an appropriate outcome measure for wheelchair system intervention, researchers and clinicians must choose from an increasing array of potential instruments. The World Health Organization's International Classification of Functioning, Disability and Health (ICF) offers the ability to compare these measures at a conceptual level using a common language. Its explicit inclusion of assistive technology as a feature of the environment makes it particularly attractive for this purpose.

Objective

Given that no studies have critically evaluated wheelchair user specific activity and participation outcome measures, a systematic review was undertaken using the ICF as a framework.

Method

CINHAL, PsycINFO, Google Scholar, EMbase and Medline were searched using a variety of search terms. Reference lists from relevant articles and conference proceedings were searched manually, and a content expert in the area was consulted. Titles of articles were screened and, if deemed appropriate, an abstract was retrieved. If the abstract was relevant, the article was obtained for consideration. If a measure was selected for inclusion in the study, relevant grey literature, including doctoral theses and conference proceedings and manuals, was obtained when available. Measures were evaluated in terms of their conceptual foundations by mapping items from all the measures to the ICF using the procedure outlined by Cieza et al. (1). As well, information was collected about their psychometric properties (2,3) and practical applicability (4).

Results

A number of conceptual, psychometric and applicability issues were identified with the 11 wheelchair specific measures included in the review, which included the 1. Functional Evaluation in a Wheelchair Questionnaire (5), 2. Mobility assessment for wheelchair-dependent paraplegics (6), 3. Obstacle Course Assessment of Wheelchair User Performance(7,8), 4. Power-mobility Community Driving Assessment (9), 5. Power-mobility Indoor Driving Assessment (10), 6. Reliability of four functional tasks (11), 7. Wheelchair Circuit (12), 8. Wheelchair Outcome Measure (13), 9. Wheelchair Skills Test (1.0)(14), 10. Wheelchair Skills Test (2.4) (15) and 11. Wheelchair Users Functional Assessment(16). Some of the most serious issues included lack of assistive technology sensitivity, limited psychometric testing (5, 9-11, 16) and high administrative and respondent burden (7-9, 12, 14-15). Eight tools measured mobility exclusively (6-12, 14-15) and most items focused on the ICF code of d465, moving around using equipment.

Discussion

By reviewing the measures based on the ICF, a number of issues become apparent. Most scales measure capacity to perform mobility in a standardized environment (6-8, 11-12, 14-16), a few measure capacity in a patient's natural environment (5, 9,10), and only one client-specific assessment has the potential to measure activity and participation performance (what an individual does in his or her natural environment) across all ICF domains (13). Although most of the measures acknowledge the use of assistive technology, very few 1) indicate whether it is necessary to document the type of wheelchair system used by the individual or 2) provide guidelines about the subject's use of assistive technology during testing. These limitations are a serious concern when attempting to determine the impact of wheelchair system interventions with clients (17).

Recommendations

Many current measures would benefit from additional instructions that indicate the need to record the specific assistive technology used and describe how to deal with assistive technology use during testing (i.e. can multiple chairs be used to complete different tasks? etc.)(18). Future instruments could be developed that explicitly consider the use of wheelchair systems and measure both performance and capacity (19).

Conclusion

A variety of issues were identified with wheelchair-specific activity and participation outcome measures included in this review. These issues need to be considered when selecting clinical or research outcome measures for individuals who use wheelchairs and suggest future directions for the modification of existing tools or development of new instruments in this area.

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Acknowledgements

Ben Mortenson's work was supported by a Quality of Life Strategic Training Fellowship in Rehabilitation Research from the Canadian Institute of Health Research Musculoskeletal and Arthritis Institute, the Canadian Occupational Therapy Foundation and a graduate fellowship from the Canadian Institute of Health Research. Salary support for Dr Miller was provided by the Canadian Institutes of Health Institute of Aging. Claudine Auger was supported by a Canadian Institute of Health Research Institute of Aging Fellowship and by a doctoral grant from l'Ordre des Ergothérapeutes du Québec.

Paper Session 2 Room 1 - Intrinsic Wheelchair-Skills Learning Induced by Testing: Case Report of a Person with Parkinsonism

R Lee Kirby, Cher Smith, Laura Smith, Don MacLeod, Peter Aikman

Background

It has become increasingly recognized that a more formal approach to wheelchair-skills assessment and training is warranted (1-5). However, there remains much to learn about how people learn motor skills, particularly when they have neurological impairments. The objective of this case report is to describe a person with parkinsonism whose experience illustrates an apparent intrinsic-learning effect on wheelchair-skills performance due to wheelchair-skills testing.

Methods

In an attempt to document the extent of "on-off" differences (related to the timing of medications) in his wheelchair performance abilities, we administered two Wheelchair Skills Tests (WSTs, Version 4.1)(5,6) to a 61-year-old man with Parkinson's Disease. The tests were 3 days apart (over a weekend with no intervening therapy). For WST#1, he was in the "on" condition and for WST#2 in the "off" condition.

Results

The total performance scores were 53% and 63% for WST#1 and WST#2. The total safety scores were 95% and 100%. As expected, on the second day, he exhibited some signs of the lowered medication effect, in particular, an episode of "freezing" and slowness (WST#1 took 35 minutes and WST#2 took 47 minutes). He failed one skill (turning 180° in place) on WST#2, having passed it on WST#1, due to straying slightly outside the 1.5m-square turning box. However, on four of the moderately difficult skills – getting through a door, ascending a 5° incline, getting across a 15cm pothole and ascending a 5cm level change – he failed on WST#1 and passed on WST#2.

Discussion

Although there have been a number of reports of successful rehabilitation interventions for people with parkinsonism (e.g. 7,8), only two case reports have described wheelchair propulsion (9,10). Neither case related to motor-skills learning. This case suggests that some intrinsic learning had occurred between the two WSTs, in spite of a lowered effective dose of medication during WST#2. This intrinsic-learning effect is encouraging from the perspective of wheelchair skills training. However, to avoid a systemic error due to test-retest irreliability in future training studies, investigators should consider either avoiding a baseline WST altogether or using the questionnaire version of the WST (the WST-Q) for the baseline comparison between groups.

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Paper Session 2 Room 1 - Towards Establishing the Responsiveness of the Seated Postural Control Measure (SPCM)

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Purpose

The purpose of this presentation is to assess the responsiveness of the Seated Postural Control Measure (SPCM) by examining the relationship between changes on the SPCM and changes on the Level of Sitting Scale (LSS).

Background

Adaptive seating systems are widely prescribed by therapists to enhance the postural control of children with neuromotor disabilities who are unable to sit independently1,2,3. Within contemporary motor control theory, the function of postural control is viewed as the integration of movements into coordinated action sequences to achieve a task goal. Adaptive seating is thought to influence postural control by affecting the starting conditions for movement and by controlling the degrees of freedom of movement and limits of movement to those which are controllable by the individual. Although enhanced postural control is a frequently specified goal, there few measures available to evaluate postural control changes resulting from adaptive seating interventions in children with neuromotor disabilities. None of the existing measures has yet been fully validated for children across ages and severity.

The SPCM is a 34 item criterion-referenced evaluative measure4. This measure is comprised of two scales – the Function Scale and the Alignment Scale. Viewed within the World Health Organization's International Classification of Function, Disability and Health5 (ICF), the SPCM focuses on measuring postural control outcomes for the Body Function component (Alignment scale) and the Activity component (Function scale). Acceptable reliability, content validity and face validity of the SPCM measure were reported in previous studies6,7,8,. In addition, the capacity of each item to measure change was demonstrated through item analysis9.

To complete the validation of this measure, a large repeated measures study was designed to further assess the responsiveness of the overall SPCM scales. This presentation reports on a component of the larger study – the relationship between SPCM change scores and Level of Sitting Scale change scores.

Study Participants

One hundred and twenty four children with neuromotor disabilities were recruited to the study from treatment centres in British Columbia. Sample size was calculated using the SPCM test-retest reliability of 0.87 and Cohen's sample size tables to detect a correlation coefficient of 0.40 at alpha 0.05 and power of 0.90. A range of children who were expected to change (n=60) and those who were expected to remain stable (n=64) over the six month course of the study were recruited. Children in the expected change group were young children with neuromotor disabilities, children with deteriorating conditions and children recovering from acquired injuries or surgeries. Participants in the stable group were children over five years of age with cerebral palsy or other stable neuromotor conditions.

Participant Characteristics

Age		Seating System	
0-3 years	n=14	No System	n=11
4-6 years	n=12	Planar	n=82
7-9 years	n=20	Custom Contoured	n=31
10-12 years	n=28		
13-15 years	n=28	Male	n=70
16-19 years	n=22	Female	n=54

LSS score	
Level 1	n=1
Level 2	n=19
Level 3	n=31
Level 4	n=9
Level 5	n=22
Level 6	n=11
Level 7	n=12
Level 8	n=12

Methods

Children participating in the larger responsiveness study were assessed on two occasions - at enrollment (Time 1) and six months later (Time 2) , an interval over which change in postural control (resulting from development, disease progression or spontaneous recovery) is likely to occur. The Seated Postural Control Measure, Level of Sitting Scale, video recording and Global Change Scales were completed at Time 1 and Time 2.

Therapist assessors were trained in the use of the measures and reached criterion level of agreement with an 'expert' rater before commencing data collection. Reliability monitoring during the study consisted of concurrent scoring of five assessments (randomly selected) by a second rater at Time 1 and Time 2. The SPCM was administered to each child on both occasions by the same rater to achieve the highest reliability. The Level of Sitting Scale[4] is an 8 category criterion reference scale with category scores assigned for the ability to maintain and move within the sitting position. The LSS was adapted from the Chailey Level of Sitting Ability Scale[10] to increase scale reliability. An additional measure, The Global Change Scale[11] was also used in the larger study with questions tailored for postural control outcomes. This scale was rated by parents and masked therapists (using video recordings) but is not being reported as part of this presentation.

Analysis

Calculation of change scores for the LSS and the SPCM subscales were conducted by subtracting Time 1 from Time 2 scores for each instrument.. Pearson correlation coefficients were calculated to examine the relationship between LSS change score and SPCM Scale change scores. A 2-tailed test of significance of the correlation coefficients was performed. The Statistical Package for the Social Sciences (SPSS) was used for all analyses.

Findings

The distribution of change scores for each measure approximated the normal distribution and met the assumptions for use of the correlation coefficient. The correlation of LSS change scores with the SPCM Function Scale change scores was .324 (p<.01). The correlation of LSS change scores with the SPCM Alignment change scores was .029 (p>.05)

Discussion

This study begins to provide evidence for the responsiveness of the SPCM Function Scale and for the Level of Sitting Scale by demonstrating a correlation between the change score on both these instruments which purport to measure changes in dynamic postural control. It is not surprising that a linear relationship is not evident between LSS change scores and SPCM Alignment Scale scores because the LSS does not contain items focused on static postural alignment. This finding endorses the conclusions of another study3 and evidence reviews2,12 which cast doubt on the presence of a linear relationship between the ICF components of Body Function and Activity when considering seated postural control. Because improved alignment is still one of the frequently cited clinical goals of adaptive seating, it will be important to design future studies to evaluate the responsiveness of the SPCM Alignment Scale. The emerging International Standards for Postural Measures13 may facilitate this endeavor.

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Paper Session 2 Room 1 - Reliability of the Wheelchair Outcome Measure in Adults with Developmental Disabilities

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Introduction

Assistive technology has a large impact on the choice, control, and quality of life of adults with developmental disabilities.1 Since mobility impairments are associated with many conditions that fall within the spectrum of developmental disabilities, wheelchairs are a common assistive technology device used by this population. However, despite this prevalence, there is a paucity of wheelchair-related research evidence specific to the population of people with developmental disabilities. Additionally, Dychawy-Rosner and Eklund state that there is a lack of research about the occupational performance issues of adults within this population in general, adding that clinical assessments are performed in an unsystematic manner due to the lack of appropriate standardized assessment tools available. 2

International Classification of Functioning, Disability and Health (ICF)

The revised International Classification of Functioning, Disability and Health (ICF) provides a useful theoretical framework for the examination of seating system outcomes within the population of adults with developmental disabilities.3 There is a small, but growing body of evidence that applies the framework of the ICF to the examination of seating and mobility systems.5,6 However, despite the growing emphasis on participation – viewed as the optimal goal of rehabilitation - a literature review conducted in August 2007 revealed a lack of wheelchair-related outcome measures that evaluate this construct. The majority of existing outcome measures focus on the 'body function and structure' level of the ICF, which includes items such as posture control and pressure relief, or the 'activity' level, which considers items such as bathing and transferring.

The Wheelchair Outcome Measure (WhOM)

Developed to address the lack of existing tools to measure the outcome of wheelchair prescription, the WhOM is a semi-structured, client-centered outcome measure that uses the conceptual framework of the ICF. 7 The WhOM evaluates wheelchair-related participation goals in individuals with a wide range of disorders and physical impairments. This semi-structured interview identifies and quantifies wheelchair users' satisfaction with their current ability to perform participation-oriented goals both inside and outside of the home. The changes in goal satisfaction that are quantified using the WhOM before and after a seating system intervention can be used to evaluate the effectiveness of the intervention.8 To date, the WhOM's measurement properties have only been evaluated within the population of people with spinal cord injuries.9 The purpose of this study was to investigate the inter-rater reliability of the WhOM in community dwelling adults with developmental disabilities.

Data Collection

Participants for the study were recruited from two British Columbian health authorities based on referral to a private community–based occupational therapy company for specialized seating and mobility intervention. Consenting participants were eligible to participate if they: 1) were >19 years of age with a diagnosis of a developmental disability; 2) lived in a supported living environment in the community and 3) used a wheelchair as primary method of mobility. Participants were interviewed at their place of residence (either a group or foster home setting). Prior to administering the WhOM during the first visit (Time One), consent and/or assent was obtained and a demographic questionnaire was administered. The communication strategy used by the participant was classified according to the Social Networks Inventory.10 In cases where participants were unable to provide verbal self report a proxy respondent was used to administer the WhOM. The second administration of the WhOM (Time Two) occurred no more than three weeks after Time One. At this time, the WhOM was administered by a seating specialist from the private occupational therapy company. A health status questionnaire was also administered during Time Two to capture any changes in the participant's health status and function.

Data Analysis

Data were analyzed using SPSS Statistics version 15.0. Descriptive statistics were calculated to describe the sample. The Intraclass Correlation Coefficient was derived using the one-way analysis of variance random effect model (ICC, 1,k) accompanied with the 95% confidence interval (CI). Although there is a lack of agreement on the interpretation of ICC scores, as a general guideline it has been suggested that coefficients between 0.50 – 0.75 indicate moderate reliability and values >0.75 represent good reliability.11

Results

The WhOM provides reliable information about inside satisfaction scores (ICC = 0.90), but is less reliable with outside satisfaction scores (ICC = 0.77). The combined inside and outside score inter-rater reliability was ICC = 0.83. Despite the lower reliability on outside scores, all values indicate a 'good' level of reliability between raters according to the general guidelines provided by Portney and Watkins. 11 Inter-rater reliability was also calculated by excluding all self-report data to explore the potential influence of proxy-derived scores (n = 6). For inside and outside scores the inter-rater reliability was ICC = 0.91 and 0.63 respectively. For combined inside and outside scores the inter-rater reliability for proxy only data was ICC = 0.84. With the exception of the coefficient obtained for the outside scores, the proxy-derived scores also suggest a good level of inter-rater reliability and did not show evidence of a systematic bias.

Discussion

The overall inter-rater reliability value obtained in this study (ICC = 0.83), though not as high as values obtained when the WhOM was examined within the spinal cord population (ICC = > 0.89), still shows good reliability within the population of adults with developmental disabilities.9 This adds to the growing body of evidence regarding the WhOM's psychometric properties, supporting its use as a reliable client-centered measure of satisfaction with wheelchair use. However, the magnitudes of reliability coefficients for the outside goals are less than the reliability values for inside goals. This difference increases when we examine the subgroup of proxy-only respondents, suggesting a possible influence of proxies on reliability. A review of related literature in August 2007 suggests that response agreement between participants and proxy respondents has been found to be most closely related to the amount of contact and familiarity the proxy has with the participant.12,13 Although the proxy respondent was the same at WhOM Time One and Time Two, all respondents were caregivers within the predominantly group home settings where the participants lived. Therefore, they may have had varying levels of familiarity with the client's outside goals which may have influenced the stability of their satisfaction ratings between Time One and Time Two. Nonetheless, despite the flaws that may exist, the use of proxies in research can provide several benefits including an increased sample size, a decrease in sample bias, and improved generalizability of results.14 As stated by Sneeuw, Sprangers and Aaronson, the possible bias due to imperfections in proxy ratings needs to be balanced against the bias introduced by exclusion of certain populations in research.15

Limitations:

There are three main limitations to this study. Firstly, generalization of the results is limited due to the small sample size that results in a lack of statistical power, and increases the possibility of a type II error. Secondly, the extent or length of the participant-proxy relationship was not collected. This could have impacted the reliability values obtained. Lastly, due to the test-retest design the client or proxy may have reflected on their goals during the time between the first and second interview and changed their perception, thus potentially altering their satisfaction scores. Similar changes in perception of prioritized activities have been found within research examining the Canadian Occupational Performance Measure.16,17

Future Research

A further study with an increased sample size is required within this population to increase the generalizability of the results. Additionally, an evaluation of the WhOM's responsiveness and clinical utility are important areas for future exploration.18 There is a growing body of literature examining the leisure interests of individuals with developmental disabilities using observational methods. 19,20 Future studies using the WhOM within this population will add to this research by providing a client-centered, quantitative measure of participation, rather than relying merely on observations of this client group. Moreover, the role that this data may play in the evaluation of community-based supported living environments is an exciting opportunity that warrants further exploration.

Summary

Obtaining the perspective of clients with developmental disabilities is essential in guiding the clinical reasoning of therapists during the seating and wheelchair intervention process. The WhOM shows promise as a reliable method of identifying and quantifying this population's goals related to seating and wheelchair use. At an individual level, it may reduce the physical risks and functional limitations associated with the provision of inappropriate seating and mobility systems, thereby allowing these clients to engage in occupations that are most meaningful to them. Additionally, the WhOM may well play a vital role in the evidence-based evaluation of health care service delivery to this population as a whole.

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Paper Session 2 Room 1 - The Segway Personal Transporter for People with Disabilities. Phase II: Meeting Clients' Mobility Goals

Bonita Sawatzky, PhD; Ian Denison, PT; Amira Tawashy, BSc

Introduction

There are many different types of mobility aid devices with different advantages and limitations making them suitable for various circumstances. The Segway Personal Transporter® is an alternative to the traditional wheelchairs and other assistive devices. The rider stands on a small platform 20 cm off the ground by two parallel wheels, and holds onto handlebars; mounted on the left handlebar is a twist grip used to steer this powered device. The Segway balances itself using solid-state gyroscopes and sensors.[1] The Segway has not been widely marketed to those with mobility impairments. In addition, there is a paucity of peer-reviewed literature concerning the use of the Segway for people with mobility impairments. As a result, the goal was to determine how the Segway compares to clients' current methods for mobility at meeting specific mobility goals.

Methods

Participants

Ten participants were randomly selected from a previous study population of 24 participants with a variety of disabilities.[2] The inclusion criteria were adults aged 19 – 65 years who were able to follow verbal English instructions; were able to walk 6 meters with or without assistive devices; and had a functional impairment requiring them to consider using an assistive device for mobility. The project was approved by the local university and hospital clinical research ethics boards.

Primary Outcome Measures

1) Wheelchair outcome measure (WhOM)[3]

The WhOM is a 20 - 30 minute, semi-structured interview that assesses the wheelchair users' participation in activities both inside and outside their home, ranking their importance.3 Though primarily designed for assessing wheelchairs, the authors considered the WhOM to be the best measure available.

2) Time to complete indoor obstacle course

To compare the mobility methods, we chose an agility course designed to represent common obstacles encountered by manual wheelchair users. Participants familiarized themselves with the course using both mobility devices. While being timed, the subjects were asked to negotiate the course safely and at a comfortable pace, first using their current mobility device then using the Segway.

Secondary Outcome Measures

1) Assistive Technology Device Predisposition Assessment C (ATDPA-C).[4]

One complicating facet of this study was whether those subjects more accepting of new technical devices were more inclined to accept the Segway. The ATDPA-C was chosen to assess this factor because it examines an individual's satisfaction with their current level of function as well as their view of assistive devices.

Analysis
Paired t-tests were computed for both primary outcome measures. Results from both the indoor obstacle course task and the WhOM assessment for the participants' current method of mobility and the Segway were compared. Pearson correlation coefficients were used to describe the relationship between clients' perceptions/attitudes of assistive technology (ATDPA-C) and the difference in the WhOM score for the Segway versus the current mobility device.

Results
Average WhOM scores obtained with the Segway were significantly higher than those obtained with the individual's current mobility method (80.0 vs. 40.3; $p < 0.0001$). Though the average increase in speed on the obstacle courses was not significant (8.30+ 23.45 seconds), three participants were more than 35 seconds faster on the Segway than using their current mobility aid. There was no significant relationship between ATDPA-C total scores with respect to change in WhOM scores; however, when analyzing the four sub-scores there was a significant yet modest relationship between subject's perceived "level of disability" and change in WhOM scores between mobility methods ($r=-0.36$). The more disabled an individual, the more likely the Segway was perceived to be beneficial for that person.

Discussion
Individuals with disabilities often have a single mobility aid for all aspects of daily life. This can be limiting, as a single mobility device may not meet all mobility needs. The results of this study provide evidence for the Segway's role in the growing arsenal of mobility options because it is offers power mobility in a standing position. It does not require significant energy expenditure or upper extremity strength.

From an efficiency standpoint, participants negotiated the short indoor obstacle course with the Segway in comparable time to their current mobility aid, or in three cases much faster. For the subjects who were slower with the Segway it may be due to inexperience or unfamiliarity. Consequently, one can imagine that, with some practice, participants' handling ability of the Segway potentially could improve further, perhaps to the point of significance in time difference.

Results from the WhOM indicated that the Segway could significantly increase participants' satisfaction in their ability to meet daily goals. Furthermore, three participants noted that they would consider using the Segway for therapeutic purposes such as standing, improving balance, and reducing spasticity. In addition to the obvious mobility benefits it had to offer, the participants also gained clear psychosocial benefits, commenting that they felt less disabled when riding the Segway.

Limitations
Although the WhOM and the ATDPA-C have been shown to be both reliable and valid, their validity and reliability have not been tested for the diverse population encompassed in this study. Participants' scores on the WhOM and indoor obstacle course may not have reflected the potential magnitude of change given a more extended period of time with the Segway.

Another limitation in this study is the fact that there may be a sampling bias as participants originally self-selected themselves for Phase I and II of this. Furthermore, the favourable results from the Segway may be due in part to the novelty of power mobility in general, rather than the specific aspects of the Segway. Finally, the sample size used in this study was too small to be able to generalize the results to a larger population.

Conclusion

The Segway has a set of characteristics unique from other assistive devices for mobility that could match a clients needs better than existing alternatives. Although the Segway is not a replacement for the cane, wheelchair or any other mobility device, this study suggests that there is a need for another device in the spectrum of current mobility aids.

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Paper Session 2 Room 2 - Effects of Dynamic Wheelchair Seating in Children with Cerebral Palsy

Michael E. Hahn, Sheri L. Simkins

Introduction

Patients with cerebral palsy (CP) can present exceptionally high muscle tone. If their is no therapeutic intervention they can suffer chronic shortening of the musculotendinous system to the point of contracture. Increases in muscle spasticity may result in reduced range of motion (ROM) and a concomitant decline in gross motor function. Functional independence is restricted by these conditions, commonly resulting in confinement to wheelchairs for support and ease of transportation. However, confinement to traditional seating systems may complicate maintenance of motor function due to the inherent restriction of mobility. Patients with hypertonic expressions of CP often present high force, high frequency extensor thrust patterns. A complication for these children is soft-tissue injury due to a variety of sources; including repetitive impacts with a wheelchair's rigid constraints, and shear stress. The repetitive, high impact extensor thrusting can critically damage wheelchair seating systems, including failure of the back canes and frame, footrest hangers, and headrest mounts [1].

Recent efforts have explored dynamic seating components to reduce wear on chair components and soft-tissue of the patient. The ideal of dynamic seating may be defined as allowing controlled, balanced, and supported movement while providing mechanical stability [2]. Another design ideal is that wheelchair components should be designed to move freely in response to the high force movements of the patient [3]. Common goals for dynamic seating components include reduction of painful muscle spasms, and reduced agitation from restricted posture [4-9]. Meeting the ideals of dynamic seating should increase comfort and sitting tolerance, improving quality of life.

The purpose of this study was to determine the effect of using a dynamic seating system as a therapeutic intervention on clinical outcomes in a sample of children with CP. With the use of a dynamic seating system, it was hypothesized that range of motion would increase and muscle spasticity would decrease. Further, we hypothesized that gross motor, social and cognitive function would increase as a result of this intervention.

Methods

Study Design

A two factor, repeated measures design was used in this study. The experimental group received a custom-fit dynamic component wheelchair. The control group received a chair similar to the experimental group, except with locked components. The study consisted of three visits to the therapy center, with three months separating each visit. The first visit consisted of initial measurements and functional assessments followed by a fitting session. Follow up visits involved the same assessments. No changes were made to the patients' therapy regimen due to study involvement.

Intervention Device

The Kids Up Rock Active™ chair has a dynamic function created by pivot points in the seating which allows the occupant to extend at the hips and knees. The pivot points are based around the anatomy of the human body, thereby minimizing the shear forces on the occupant. In addition, the pivot points allow for proper pelvic positioning and alignment throughout the range of hip extension. Various amounts of tension can be applied to the active components to accommodate each occupant. The seating system can also be locked out to prevent the dynamic motion if required. When the seat back pivots posteriorly the seat bottom rises simultaneously with extension of the trunk. When the occupant relaxes, the chair returns to original position. The lower extremities also have the ability to extend through a limited range and return to a neutral position when relaxed. All settings are initiated by the caregiver, minimizing risk of injury.

Participants

Sixteen children were recruited and randomly assigned to either a static or dynamic wheelchair seating system. Nine children were entered into the experimental group, with seven in the control group. Of the 16 children entered, four were removed from the study due to complicating circumstances (1 experimental, 3 control); including illness, non-compliance with the study's chair use paradigm, or loss of contact with researchers for the follow up sessions. Thus, the sample sizes were reduced to eight children in dynamic seating systems (3 female; mean age = 6.6 ± 3.0 years), and four in static seating systems (3 female; mean age = 4.8 ± 1.5 years).

Measurements

Active and passive ranges of motion (ROM) were measured with a hand-held goniometer. Muscle tone was evaluated with the Modified Ashworth Scale (MAS) in the upper and lower extremities [10]. The Gross Motor Function Measure (GMFM) was used to assess each patient's capacity to perform tasks within five major categories [11]. The Pediatric Evaluation of Disability Inventory (PEDI) was used to assess the patient's ability to perform tasks of daily living within three major categories [12].

Results

At study initiation, MAS scores ranged from 0 to 4, and Gross Motor Function Classification Scale (GMFCS) values ranged from 3 to 5. The initial GMFM scores were similar between groups. Category analysis revealed specific deficits of both study groups; namely poor crawling, standing, and walking. Additionally, the initial PEDI scores showed similar deficits between the groups; namely self-care and mobility. Over the study's 6 month span, the experimental group regressed to the mid-range of MAS scores over the 6 month period, while the control group showed no distinct trend. Joint ROM increased in both groups, however, children in the experimental group exhibited greater increases in ROM for hip flexion and knee extension.

GMFM -66

Modest increases (3-4%) were seen in GMFM-66 total score percentages for both groups, with no distinct difference between the two groups. There were a variety of responses to the seating type within the separate categories of the GMFM measure. The experimental group increased 7.3% for the Lying/Rolling category in the first 3 months then lost 1.4% by the 6-month visit, whereas the control group increased 6.9% by the 3-month visit, and then gained another 1.4% by month six. The control group increased more than the experimental group in the Sitting category; increasing 12.9% in six months, compared to a 3-month increase of 3.3% and subsequent 1.6% decrease in the experimental group at the 6-month visit. The control group showed an increase in the Crawl/Kneel category of 12.5% in three months, but lost 8.9% of that by month six. The experimental group showed total gains of 1.7% at the 6-month visit. The experimental group increased more than the control group in the Standing category; increasing 6.2% by the third month, and losing only 0.3% of that by the 6-month visit. In contrast, the control group lost 1.3% in the first three months, and returned to initial values by the sixth month. Both groups increase moderately in the Walk/Run/Jog category, with the experimental group showing slightly greater improvements; increasing 2.8% by the 6-month visit, compared to a 2.1% increase in the control group.

PEDI

More tangible gains were observed in the PEDI scores. Generally, each group improved, with the experimental group improving slightly more. The experimental group improved by 5 points in the Self-Care category by the third month then gained another 4 points by the 6-month visit. The control group increased by 3 points at the 3-month visit then gained another 2 points by the sixth month. The Mobility category showed less group specific effects, with the experimental group improving 7 points at the 6-month visit, and a 6 point increase in the control group. The experimental group improved in the Social Function category by 4 points in three months, followed by another gain of 2 points by month six. In comparison, the control group decreased 2 points by the third month then rebounded to a total increase of 3 points by the 6-month visit.

Discussion

The experimental group increased twice as much in hip and knee ROM. Muscle tonicity tended to regress toward the middle range of the scale when a dynamic seating system was used. This indicates that children who are low-tone would benefit from dynamic seating by encountering small levels of resistance producing a training effect. Further, our results indicate that children with high-tone would benefit from a dynamic seating system, reducing overall expression of tone.

GMFM-66

While both groups showed improvement across all scoring categories, the control group outperformed the experimental group in the categories of Lying/Rolling, Sitting, and Crawl/Kneel. However, the experimental group did show greater improvements in the categories of Standing, and Walk/Run/Jog. These mixed results may indicate a ‘targeting’ phenomenon resulting from increased motion and slight resistance training in children with poor lower extremity motor performance. If the lower extremity systems are strengthened and allowed to increase in ROM, it follows that the resulting expansion of functionality would be better suited to standing (multi-joint stability) and locomotion (coordination of multi-joint mobility and stability). Conversely, if a child is placed in a well-constructed, customized static seating system it is not surprising that trunk stability would improve to a allow functionality in the tasks of rolling, sitting, and kneeling.

PEDI

The PEDI measurements revealed more consistent improvement in the children who were in the experimental group, who exhibited greater improvements in the categories of Self-Care and Social Function. These improvements may be an indirect result of energy released during exercise within the chair, and enhanced self-confidence that comes with being able to reposition their bodies. Many caregivers for the children in the experimental group mentioned that their child began interacting more with siblings, peers, and adults once they adapted to the new dynamic system.

Conclusion

The dynamic seating showed no negative effects, but rather improvements in each measure. Generally the data suggests that use of the dynamic seating system will benefit children with a GMFCS of 3-5. Further analysis of individual outcomes may yield more clinically significant findings.

Acknowledgements

This study was supported by a grant from the Thrasher Research Fund (#02822-7).

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Paper Session 2 Room 2 - Does Postural Support Influence Ability to Perform Attention Tasks in Children with Cerebral Palsy?

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Background

Having a stable sitting posture is thought to be important when carrying out tasks requiring concentration particularly in children with cerebral palsy. It is assumed that postural instability can be distracting although little evidence exists to support this assumption.

Most researchers who have looked at posture and balance have concentrated on standing. However, several authors have looked at postural sway in sitting and have considered its influence on the development of postural control1 and endurance2. Other researchers have tried to investigate the effect of changing seating variables on functional ability3, 4 and IQ5.

In a wide ranging study, Green6 investigated cognitive function in children with severe motor and cognitive impairment and observed that some cognitive tasks were improved with upright positioning and postural support. These particular findings were based on analysis of results from seven children and therefore further research work is required to address this issue.

Objective

To establish whether support to provide postural stability has an effect on performance of attention tasks in children with bilateral cerebral palsy.

Design / Methodology

A randomised cross-over study was carried out involving three different levels of postural support. The primary outcome was the alertness subtest from the test of attentional performance (TAP) validated battery of tests7. Speed and accuracy when playing a computerised game of snap was also measured.

Participants

Participants were 6-15 years; at level 4-5 on the gross motor function classification system for cerebral palsy7; had a Chailey level of sitting ability8 of 2–5; and could respond to reaction tasks. The target sample size was 30.

Main findings/ results

To date 25 participants have been seen. Preliminary findings suggest that when using the test of attentional performance there was a significant reduction in both response time ($p=0.014$) and in the number of lapses of attention ($p=0.01$) with increased postural support. When playing the snap game there was an increase in the score achieved and a decrease in lapses in attention with increased postural support (both $p<0.01$). The majority of participants (15/25) reported to prefer the third level of support (i.e. with both pelvis and trunk stabilised) when carrying out the tests.

Conclusion

If confirmed at the end of the study, the findings may offer evidence to support the use of posturally supportive seating in school and other settings.

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Paper Session 2 Room 2 - The Impact of Early Powered Mobility on Young Children's Play and Psychosocial Skills

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ABSTRACT

Objective evidence of the benefits of powered mobility for young children may aid clinicians in justifying a powered wheelchair recommendation to families, physicians, and insurance companies. The current study collected outcome measures assessing language, play and psychosocial skills on 23 young children at four assistive technology centers across the country. Measures were collected two times before receiving a powered wheelchair (at the time of recommendation and at the time of receipt of the wheelchair), and again several months after receiving a powered wheelchair. Significant improvements were found in several social components (e.g., expressive behavior, cooperation, remaining engaged in a task, interacting with family), in quantity of motor activities, and in quality of interactive and symbolic play. No differences were found in language skills. This research provides additional evidence of the psychosocial and play benefits of independent powered mobility.

KEYWORDS: Pediatric powered mobility, outcomes, psychosocial development, disability

BACKGROUND

For children with severe physical disabilities, the lack of self-initiated mobility increases the risk for developmental, cognitive and psychosocial delays. Early provision of powered mobility is believed to facilitate and enhance learning, socialization and self-esteem by enabling independent movement and interactive play. There is increasing evidence to support the benefits of early powered mobility. Benefits that have been documented include improvements in psychosocial and cognitive developmental skills, as well as increases in interaction levels with objects and people [(1), (2)]. Many researchers have used single subject designs or case studies to explore the effects of powered mobility on children. For example, Deitz and colleagues [(3)] and Nilsson & Nyberg [(4)] studied children with profound developmental delays and found some positive effects of powered mobility. These effects included an increase in self-initiated contacts, qualitative play, wakefulness and alertness, and limited intentional upper extremity use. Bottos and colleagues [(5)] examined seven outcome measures in 29 children with cerebral palsy before and after receiving a powered wheelchair. They found no change in receptive vocabulary, quality of life or gross motor function, but found a significant improvement in indoor/outdoor transfers, achievement of driving competency, and parental perceptions of the wheelchair and in the child's behavior and disposition. Often families may be reluctant to place young children in a powered wheelchair [(6)]. Greater evidence of the benefits of powered mobility for the child may help parents in the acceptance of a powered wheelchair. In addition, Sneed and colleagues [(7)] found that physicians often rely on other therapists to assist in the evaluation and recommendation process. More objective evidence of the benefits of powered mobility for young children may aid clinicians in justifying a powered wheelchair recommendation to families and physicians, as

METHODS

Assessment Instruments

Assessment instruments were used to evaluate changes in children's cognitive, language and psychosocial skills, and various family-related factors such as parental stress, family support and satisfaction with devices and services. The Adaptive Social Behavior Inventory (ASBI) [(8)] is an assessment battery that evaluates social behavioral competence in children ages 24 to 40 months. It encompasses two 'prosocial' behavior scales (Express, Comply) and one negative social scale (Disrupt). A second assessment, the Preschool and Kindergarten Behavior Scales (PKBS) [(9)] was used to evaluate social skills and problem behaviors in slightly older participants (36 to 72 months). Language skills were assessed using the Peabody Picture Vocabulary Tests (PPVT-IIIA) [(10)] and the Preschool Language Scale-3 (PLS-3) [(11)]. The PPVT is used to assess receptive vocabulary and verbal ability in pre-school children, while the PLS-3 is used to assess receptive and expressive language in young children. An observational data form was also developed for this project to assess social, play and verbal interactions. A rater observed the child in an informal play setting and tallied the number of interactions with toys/objects and the number of motor activities that the child participated in. The rater also provided a rating for the developmental quality of the child's play and verbal interactions every three minutes over a period of 12 minutes. These ratings were determined by a clearly specified, pre-determined scale. The Symbolic Play assessment [(12)] was used to evaluate qualitative developmental changes in level of play skills. The Survey of Technology Use [(13)] used parents' reports to assess the child's typical activities and behavior/personality, as well as parents' overall attitude toward technology. Additional family-centered data assessing the degree of impact of the wheelchair on parental stress and satisfaction was also gathered but will be presented elsewhere.

Participants

Children with orthopedic disabilities (non-cerebral palsy) between the ages of 18 and 42 months and children with cerebral palsy (CP) between the ages of 18 and 72 months were eligible to participate in the study. Children with profound cognitive delays and children who were functional ambulators were not eligible. The four recruitment centers were Connecticut Children's Medical Center, Hartford, CT; Cincinnati Children's Hospital Medical Center, Cincinnati, OH; Rancho Los Amigos National Rehabilitation Center, Downey, CA; and Cook Children's Medical Center, Denton, TX.

Procedure

A total of 54 children who were evaluated for powered mobility were invited to participate in an earlier phase of this study (evaluation of a new model of powered mobility assessment and recommendation). Of these, all children who were recommended and received a powered wheelchair were invited to participate in the current phase – an assessment of various outcomes potentially associated with use of a powered wheelchair. A first battery of pretest data was collected at the time the wheelchair was recommended. If the wheelchair was received during the next four to six months, the second set of pretest data was collected, immediately prior to wheelchair delivery. In 3 cases, the wheelchair was not received during this timespan and an additional set of pretest data was collected in order to control for developmental maturation and other changes that may occur over time. Approximately 4 months after the child had received and began using the wheelchair, a final posttest set of data was collected.

At each data collection session, language scales were administered to the child, and the child participated in a structured play session with the clinician. This symbolic play session was videotaped and later scored by another researcher. Observations of the child's self-initiated contacts people and objects, movement in environment, and quality of play and verbal interactions were collected in a familiar play setting for the child (either at home or at school). At each data collection session, the parents were also asked to complete several batteries that evaluated their child's current social/behavioral skills and typical activities. Pre/post data sets were collected for 23 children (an additional 12 children began the pre/post-testing phase but dropped out before complete data sets could be collected).

Data Analysis
Since this was a repeated measures design, data for each assessment were analyzed using the General Lineal Model (GLM) procedure in a statistical package called MiniTab15. This GLM is a type of analysis of variance that allows specification of the within subjects factor, with 'phase' (pretest1, pretest2, posttest) and subject specified as factors in the model, and 'subjects' specified as a random factor. A confidence level of 0.05 was specified for each analysis.

RESULTS

Several scales showed improvements in social skills. Analysis of the ASBI data showed a significant difference between pre- and post-tests for the 'prosocial' component ($F=5.30$, $p<.05$). The prosocial component, which contains items such as 'Understands others' feelings, like when they are happy, sad or mad,' 'Is helpful to other children,' 'Cooperates with requests,' and 'Plays games and talks with other children,' increased significantly during the post-test phase. No differences were found in the 'disrupt' component, which was fairly low throughout. For the PKBS, there was a significant difference in all positive social skills (cooperation, interaction and independence). However, this difference was found during the first and second pretests; no additional gain was found during the post-test phase. There were no significant differences in negative behaviors on the PKBS (which encompassed things like self-centered/explosive behaviors, attention problems, and antisocial/aggressive behaviors). Finally, the Survey of Technology Use found that there was a significant difference between pre- and post-testing in the child's ability to remain engaged ($F=3.60$, $p<.05$). Interestingly, the trend showed needing more support or prompting to remain engaged in a task after using the wheelchair. There was a significant difference in 'interactions with family' ($F=3.2$, $p<.05$), with frequency of family interactions increasing during the post-test. Three other factors (self-esteem, self-confidence, and composure) showed significant increases from pre-test1 to pre-test2.

No significant differences were found in language development on either the PPVT or the PLS-3.

Findings related to the child's level of play were also significant. The observational data scale showed a significant difference in motor activities from the pre- to the post-tests during indoor play ($F=4.53$, $p<.05$); however, there was no difference in interaction with toys or objects. During outdoor play, there was a significant difference the quality of interactive play from pre- to post-test ($F=4.24$, $p<.05$). The level of play increased from playing alone and/or watching another with no interaction or sharing, to playing alongside another and playing briefly with another with limited sharing, turn-taking and interacting. In the Symbolic Play assessment, children's developmental level of symbolic play remained the same during the two pre-testing phases but increased significantly from pre- to post-testing phase (F=4.9, p<.05).

DISCUSSION

The findings support the positive impact of the wheelchair on young children's psychosocial skills. The ASBI, which was administered to the parents of younger children (30 months at the time of the 1st pre-test), showed significant improvements in parents' perceptions of their child's 'prosocial' skills following the provision of a powered wheelchair. Parents reported that their children were more confident, cooperative, and interactive. The Survey of Technology Use also supported increased interactions with family after the child had used the wheelchair for several months. Interestingly, the PKBS also showed improvements in the social skills of the older children in the study (these children averaged 51 months of age at the time of 1st pre-test). However, these changes occurred between pre-test 1 and pre-test 2, rather after receiving the wheelchair. These older children were typically more severely physically involved, and tended to have more practice in the wheelchair before the wheelchair was ordered (average of 5.3 evaluation sessions versus 3.4 for the younger children). It is possible that parents, after observing their children during these evaluation sessions, had begun to see positive benefits in social skills from the self-initiated movement. These skills did remain at these higher levels during the post-testing phase, supporting the impact of the powered wheelchair. Similar results were found with several social factors reported on the Survey of Technology Use. Significant improvements were reported by parents in the child's self esteem, self-confidence and composure f rom pre-test1 to pre-test2. These levels also remained high during the post-testing phase. No significant differences were found in receptive comprehension and expressive language skills, a finding that was similar to the findings of Bottos [(5)]. Finally, a significant impact was noted in play skills after provision of the wheelchair. This was found in both the observational assessment, during which children were involved in spontaneous free play outside with peers or siblings, as well as on the Symbolic Play assessment during which the child was involved in structured free play with the test administrator. In both cases, the quality of children's play increased in complexity and level of interaction, perhaps suggesting that the introduction of the wheelchair afforded them greater opportunity to interact and develop. In summary, this pre/post study of 23 young children who used powered wheelchairs found numerous positive effects of the wheelchair on young children's developmental and psychosocial skills. It provides further evidence of the importance of early, independent, self-initiated mobility and may be of use to clinicians in supporting a recommendation of powered mobility to families and in justifying such a recommendation to physicians as well as to insurance companies.

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ACKNOWLEDGEMENTS

Funding for this research was provided by the National Institute on Disability and Rehabilitation Research (NIDRR), US Department of Education, grant #H133E003001. Opinions expressed in this article are those of the authors and should not be construed to represent opinions or policies of NIDRR.

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Paper Session 2 Room 2 - Studying the Effect of Different School Chairs and Desks on the Seated Postures of Children with Cerebral Palsy

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It is important to measure the functional performance of children with cerebral palsy (CP) as they participate in social and educational activities in order to understand the effectiveness of clinical interventions. Within this context, we know that children with CP exhibit decreased postural stability when sitting and standing [1,2,3], which consequently affects their ability to perform concurrent movements and tasks using their upper extremities [4]. To enhance stability and positioning, previous work has focused on optimizing seating design. However, evaluative studies have presented contradictory evidence with regards to the effectiveness of these interventions in enhancing function and stability [5,6].

Detailed assessments of postural positioning and stability are essential to understanding how seating interventions optimize functional performance. Empirical approaches used to understand aspects related to postural positioning and control have employed motion capture systems that estimate the average position and orientation of individual body segments and their variability over time [7,8]. The overall scope of the present pilot project is to advance these techniques to assess the seated posture of children with CP as they perform manual tasks.

OBJECTIVE

The present study is part of a larger pilot project that explores the influence of school furniture design on the printing performance of young children with Gross Motor Function Classification System (GMFCS) Level 1 and 2 CP. In this paper, we propose a new methodology to discriminate the dynamic seated postural alignment and control of children who use different seating interventions.

METHODS

Participants: The participants of this study were recruited from an initial cohort of 30 young children in Grades 1 and 2 who participated in another related, study also conducted at Bloorview Kids Rehab in Toronto, Ontario, Canada. From the 30 participants, the first 10 participants who agreed were asked to participate in this protocol.

Protocol: All children underwent a postural assessment in the Human Movement Laboratory at Bloorview Kids Rehab. We digitally recorded the reference standing posture and then recorded the seated posture of each child using two different seating systems. The two seated configurations included a) an oversized standard school chair and desk, and b) and an ergonomic school chair and desk adjusted to the manufacturer’s specifications (Figs 1a and b). The order of testing was randomized between seating configurations and a 5-minute adjustment period was provided prior to testing to allow each child to become accustomed to each chair and desk. Each participant was provided verbal instructions for a standardized handwriting test and shown a picture of another child sitting in the ‘ideal’ position at each desk. A standardized handwriting test was administered. The actual duration of the handwriting test for each seated configuration ranged from 2 to 5 minutes.

Instrumentation: The posture of each participant was captured over time using a 7-camera Vicon motion capture system. This system constructed the 3-dimensional position of individual reflective spheres placed on pre-defined anatomical landmarks of the child. These landmarks were located on the head, shoulders, pelvis, thigh, shank and feet (Fig 1c).

Figure 1: a) Child seated at the standard school chair and adjustable height desk; b) Child seated at the ergonomic table and chair adjusted to the manufacturers specifications; c) Reflective spheres positioned on anatomical landmarks located on the head, shoulders, pelvis, legs and feet.

Outcome Measures: The positions of the reflective spheres were used to quantify both linear and angular postural parameters (Reid, 1996; Zabjek 2005). The data were collected continuously over the test period, graphically presented, and visually interpreted. Preliminary statistics included the reference average position of the child's standing posture, and a moving root mean square (RMS) window. In this present paper, we consider only the positional data for one child from C7 in relation to the first sacral prominence (spinal extension), and orientation of the pelvis in relation to the frontal (ML-obliquity), sagittal (AP-tilt) and transverse (rotation) planes.

RESULTS

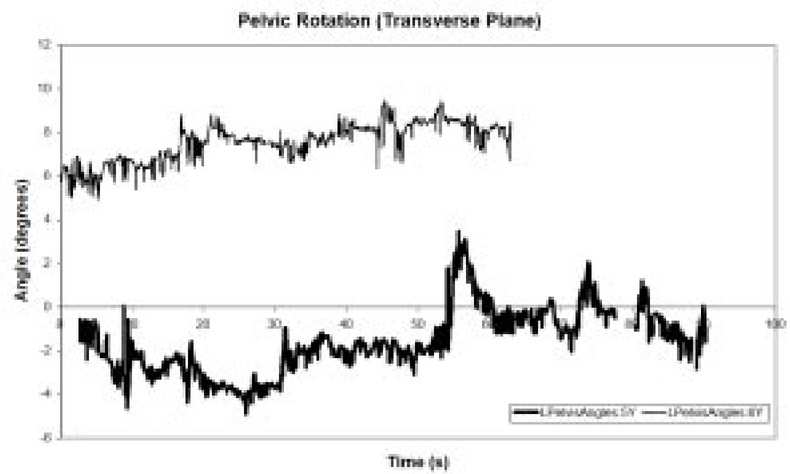
The reference standing postural alignment parameters of one participant (Diagnosis: GMFCS Level 1 CP) is presented in Table 1. From these data, it is evident that the primary postural deviations were present in the pelvis, with a significant lateral tilt, anterior-tilt and rotation in the transverse planes.

Table 1: Standing postural alignment characteristics of 1 representative participant.

	Spinal Extension - ant/post (mm)	Spinal Extension - med/lat (mm)	Spinal Extension - vertical (mm)	Avg Pelvic Orientation - ant/post	Avg Pelvic Orientation - transverse	Avg Pelvic Orientation - sagittal
Standing Reference	115.2	6.1	293.2	-7.7	-9.3	17.0

Figure 2 provides real time and mean deviation in pelvic rotation and spinal extension from the reference standing position during the two different seating conditions. The data terminates when the standardized printing test is completed for each condition. Visual inspection of the data reveals unique pelvic positioning for each condition. Figure 2a displays the rotation of the pelvis in the transverse plane, showing evidence of an abrupt shift (at t=55s) and gradual drift for the standard school chair and desk condition. Although the deviation from the reference standing position is greater for the ergonomic condition, we observed lesser drift in pelvic rotation for this participant. Similarily, spinal extension data displays periods of gradual drift, shifting, and larger amplitude, higher frequency oscillation for the standard condition (Fig 2b).

a



b

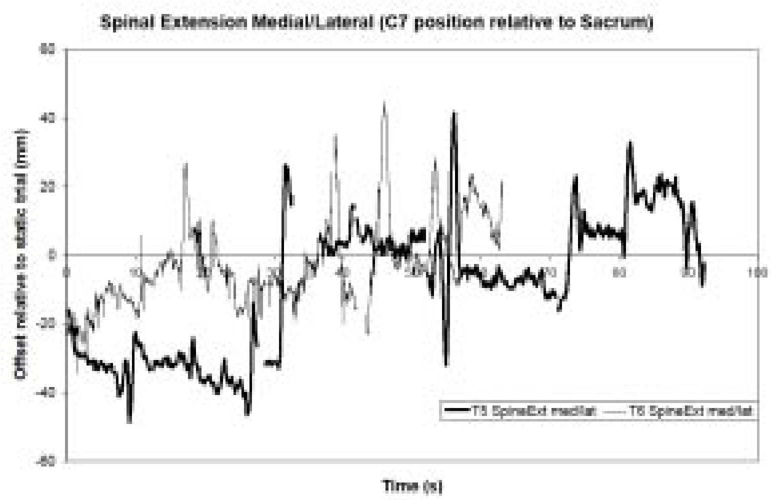


Figure 2: a) Rotation of the pelvis in the transverse plane for two seated configurations. b) Anterior-posterior position of C7 in relation to S1 (Spinal Extension). The thin lines represent the ergonomic configuration, and the thick line represents the standard configuration.

DISCUSSION and CONCLUSION

Our preliminary analysis reveals that under both furniture configurations the participant's posture changed transiently as reflected by an abrupt sustained and/or unsustained shift, and gradual changes reflected by a low frequency drift during the printing test. The posture adopted by the participant may be related to an underlying neuromuscular condition such as spasticity. The changes in position observed over time may be related to the participant's ability to control his seated posture, the type of furniture used, his attention, and/or ability to perform the task.

The proposed methodology appears to provide the fundamental data needed to study associations between transient seated postures, handwriting performance, and potentially other important clinical outcomes. Due to the complexity of the transient postural changes observed through the duration of the handwriting task, our present analysis explored the utility of standard summary statistics to describe these postural changes. We plan to use this approach to sort and summarize the seated postural data from 10 children who participated in the study.

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Paper Session 2 Room 3 - Evaluating the Effectiveness of a Wheelchair Skills Training Program for Children

Hall, C, Zloty, K, Denison, I, Valentine, N, Sawatzky, B

Children will not learn the necessary skills for independent wheelchair mobility if they are not provided with the opportunity to learn these skills. They need a chance to learn how to problem solve, handle accessibility, and maneuver curbs or uneven terrain. Not being provided with these opportunities results in children that are dependent, not because they are not able to do anything but because nobody lets them do anything[1]. A variety of skills are necessary in order for manual wheelchairs users to function independently, particularly in environments that are not wheelchair accessible[2]. These skills can make the difference between dependence and independence in everyday life. If manual wheelchair users do not know how to overcome obstacles safely, such as rough ground and curbs, they may avoid them all together, resulting in limited participation[3].

Recently, wheelchair skill training has received an increase in attention as an important factor in addressing mobility and participation barriers. MacPhee et al.[4] argue that there are relatively few studies that focus on the training of independent manual wheelchair skills despite suggestions that such training could improve independence, freedom of movement, and quality of life. Of the studies that do exist, wheelchair training has been shown to help decrease the stress that is placed on the upper extremity resulting in fewer injuries[5]. Various wheelchair skills training programs have been applied to adult populations[4,6] and have been found to be an effective addition to conventional training during the initial rehabilitation of wheelchair users[7]. However, no such wheelchair training programs have been used with a paediatric population.

The purpose of this pilot study was to evaluate the effectiveness of a two-day wheelchair skills program for children in assessing wheelchair skill acquisition and its application to children's daily functional activities. The study will demonstrate whether such programs can be used as an effective method for teaching and retaining wheelchair skills in a paediatric population. It is hypothesized that participation in a wheelchair skills training program will improve children's wheelchair skills as well as increase their functional independence at home and in the community.

Methods: Paediatric therapists at British Columbia Children's Hospital made recommendations for potential participants. Letters were sent out describing the upcoming camp and purpose for the study. Potential participants were followed up with phone calls further explaining the study.

To be included in this study, participants had to be between the ages of 6-19 years, part time or full time wheelchair users with any condition necessitating manual wheelchair use, in stable physical health, present at both sessions of the camp, which spanned two weekends, cognitively able to follow two-step instructions and be able to process and retain new skills.

The risk of participation was judged to be minimal. Ethics was obtained from the Research Ethics Board of the University of British Columbia.

The Wheelchair Skills Camp took place on two consecutive Saturdays. Participants were mailed the Activity Scale for Kids[8] questionnaire two weeks prior to the camp, and completed this prior to participating in the camp. Participants also completed a short initial questionnaire to provide demographic information.

Participants current level of skills was assessed using an obstacle course based on Lee Kirby's Wheelchair Skills Test (WST)[3, 9-11]. The obstacle course was divided into 7 stations, with one marker per station. Skills were assessed as complete, almost complete and did not complete, with a section for comments.

The wheelchair skills were taught verbally and by demonstration. Safety was emphasized at all times. The participants' skill levels were re-assessed at the end of the second day, using the same obstacle course as the first day of the camp. At the end of the camp, the participants were encouraged to continue practising the wheelchair skills they had been taught.

Outcome Measures: The ASK is a self-report measure for children 5 to 15 years of age12. It is a 30-item questionnaire that has been shown to be valid, reliable and able to discriminate between level of disabilities[8, 13] and has been used in a variety of studies to measure activities and level of participation of children with disabilities[14,15].

The WST, developed by Kirby, is an objective test of wheelchair skills and the measurement properties have been reported in detail[7]. Previous studies9-11 have shown the WST to be a reliable and valid measure. The goal of the WST is to document initial status and subsequent improvements for individual wheelchair users[16]. The WST evaluates, in a safe and controlled environment, the wheelchair user's ability to perform a range of skills required in everyday life[4]. It has been used as an outcome measure in a variety of similar studies [3, 4 ,6 ,7 ,9,] however it has never been used with a paediatric population.

Results: The final number of participants was six. Two were males and four were females, between the ages of 7 and 19. Three participants were full-time manual wheelchair users and three were part-time users. All had spinal cord injuries, with five being congenital and one having an acquired condition.

The results from the WST revealed that participants improved an average of 9% on their wheelchair skills. There was a significant difference between the pre-test scores and the post-test scores (p=0.030). ASK data revealed that two participants demonstrated no change in their mobility participation scores and four participants demonstrated a decrease in their scores. Analysis of the data from the Final Questionnaire revealed themes of development of independence through newly acquired skills, decrease in shoulder pain and fatigue, improvement in wheelchair skills, importance of family participation in training and the importance of integrating school and other caregivers into training process.
Discussion: The WST results demonstrate that participants were able to perform more skills successfully and were further able to improve upon already existing skills following the camp.

The skills that demonstrated the highest level of skill improvement were the 13cm obstacle, the wheelie no hands rest against the wall, the 10cm level change decent, and the right and left quick turns. It is interesting to note that the skills in which the greatest improvement was shown are all skills that have specific techniques to them, and that once taught are much easier to accomplish.

Some modifications were made when using the WST version 3.2 due to the fact that it was being applied to a paediatric population and some of the skills were thought to be too difficult and not functional for children in this age group. Due to the fact that modifications were made to the WST 3.2, reliability and validity of the data may be questionable. Recently, a newer version of the WST (version 4.1)[17] was developed, and some of the changes made were to skills that were found to be difficult for this specific population.

The ASK results indicate that improvement in wheelchair skills may not result in an increase in a child's ability to perform their daily functional activities. This may be due to the fact that although children struggle with certain activities, they continue to participate even if they find it difficult. Therefore, improvement of wheelchair skills might facilitate participation in such activities, but would not necessarily result in an increase in overall participation.

The ASK is unique as it reflects the child's perspectives of their disability, however children may at times have unrealistic insight into their capabilities, and this resulted in skewed data. Due to the fact that the data were collected longitudinally, some of the tasks may not have been performed during both data collection phases. As a result, we do not believe that the ASK was the best measure to used in this study and for this reason, a final questionnaire was used to determine the functional implications of the study.

The results from the final questionnaire demonstrated an improvement in a number of areas. Interestingly, although the ASK data did not reveal an increase in independence after participation in the camp, the primary theme revealed was that of an increase in independence due to newly acquired wheelchair skills. This is an important finding because the acquisition of new skills is only helpful to clients if it facilitates something that they already do in their daily lives or allows them to do things that they were previously unable to do. Another important theme that was revealed was that of decreased shoulder pain and discomfort. This realization is of importance because prevention of upper extremity strains from overuse is essential for maintaining strength and ability. Future research should look at including therapists in such camps and simultaneously teaching wheelchair skills to children and their therapists. In the present study one participant had both a parent and a therapist attend the camp. The therapist was later able to reinforce the skills taught with his care aid. Therapists that participate in such camps would learn essential wheelchair skills and how to teach them to their own clients, such education of therapists is the key to sustainable wheelchair skills training.

Conclusion: A wheelchair skills camp for children is an effective way to teach necessary skills to a population that otherwise would not receive such training. Results were statistically significant and qualitative data demonstrates that participation in such a camp is beneficial and does in fact have a positive impact on the lives of the participants. Further research is required to evaluate how these skills can best be taught in order for skill transfer to the community to occur.

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Paper Session 2 Room 3 - Use of a Family-Centred Satisfaction Survey to Guide Intervention for Children Accessing a Positioning and Mobility Clinic

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A family-centred satisfaction survey was designed and used to inform and guide intervention for children accessing the positioning and mobility clinic at the Prince George and District Child Development Centre. This paper will outline what information was gathered and how that information helped to determine how the clinic was restructured to reflect family-centred service delivery.

Paper Session 2 Room 3 - Relative Contributions and Limitations of Wheelchairs in Supporting Activities and Participation of Persons with Disability

Joy Wee, MD,FRCPC

Purpose – This paper reviews types of wheelchairs available, and describes general relationships between impairments and wheelchair type required. It describes the impact of manual wheelchairs and power mobility on activities and participation of persons with disability. It also discusses wheelchair limitations and provide recommendations for further development.

Methods –Wheelchair users were purposefully sampled from the catchment area of a tertiary rehabilitation centre to include a broad representation of impairments and circumstances. In-depth semi-structured interviews guided by categories of two outcome measures were conducted. The Barthel Index measuring activities of daily living, and the Participation Scale measuring participation were used. Mixed methods were used, employing qualitative and quantitative analysis of data. Audiorecordings of interviews were transcribed verbatim, and data were entered into NVIVO 7,TM codified, and analyzed according to themes. Self-reported ratings of factors identified as affecting each outcome measure category were analyzed quantitatively.

Results – 20 wheelchair users were included, including 6 obligatory manual chair users, 7 obligatory users of power mobility, and 7 non-obligatory users of manual wheelchairs and power mobility. The manual wheelchair users preferred this mode of mobility for its ease of transportation when compared with other types of wheelchairs. They also found them more convenient to access places with stairs, as compared with power mobility devices. Most indicated that without the wheelchairs, they would be confined to within the home.

Table 1. Obligatory manual wheelchair users

Gender	Age	Barthel Index Score (no devices)	Participation Scale Score
M	58	75 (55)	7
F	90	95 (80)	9
F	40	80 (55)	4
F	56	90 (60)	22
M	77	100 (65)	8
M	60	80 (65)	12

Table 2. Obligatory power wheelchair users

Gender	Age	Barthel Index Score (no devices)	Participation Scale Score
F	56	75 (65)	12
M	27	25 (5)	4
M	77	65 (20)	15
M	30	30 (5)	29
M	89	40 (10)	3
F	65	45 (25)	18
F	20	30 (20)	7

Table 3.. Non-obligatory wheelchair users

Gender	Age	Type	Barthel Index Score (no devices)	Participation Scale Score
F	54	M	95 (85)	9
F	55	P	95 (75)	9
F	93	P	80 (55)	23
M	69	P	100 (70)	5
F	65	P	85 (75)	33
F	58	M	95 (80)	4
M	50	M	90 (70)	11

Quantitative comparison of wheelchair contribution relative to other factors identified by participants shows the largest contributory factors are: impairment (0.9), income (0.9), transportation (0.8), wheelchairs (1), accessibility (1.6), and personality (1.6). Scores in brackets show relative contributions in relation to wheelchairs.

Qualitative analysis recorded participants' experiences. For obligatory users, wheelchairs meant independence in activities and participation. Some users clearly described embracement of the wheelchair, incorporating it into their identities. For non-obligatory users, they permitted more participation. Some obligatory users of power wheelchairs found that having manual wheelchairs allowed them to overcome some accessibility barriers at the expense of independence. Many reported negative attitudes, but generally did not let such attitudes affect their participation. Limitations included development of complications particularly from long-term use of manual wheelchairs, and mobility difficulties of both manual and power wheelchairs in winter or wet weather. These findings concur with those of a review on impact of wheelchairs, that calls for more research in this area [1]. They also found more need for implementation of barrier-free access, consideration of personal roles of users, and reduction of discriminatory attitudes towards wheelchair users.

Conclusions – Wheelchairs are sometimes necessary for conducting many activities, and are one of the most important factors in the lives of some persons with disabilities. Non-obligatory users of wheelchairs generally used them to extend their participation. Some persons requiring power mobility also found it useful to have manual wheelchairs to negotiate accessibility barriers. Despite their utility, there remain limitations that need to be explored and overcome.

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Small and Medium Enterprises (SME's), producing locally consumed goods form the economic foundation of many developing countries. The Standard Rules on the Equalization of Opportunities for Persons with Disabilities (UN, 1993) states that it is important for assistive technologies to be produced locally using locally available material when possible. Yet local provision of wheelchair services has failed to meet the needs. Pearlman et. al. (2006) argue that workshops that produce wheelchairs to meet patient-specific needs are not capable of large production. They also find that the investment of time, financial resources, risk of business failure, and quality issues are too great to make this a viable model for meeting the seating and mobility needs in such countries.

Mobility Builders, a newly-formed nonprofit organization, leverages information and communication technologies (ICT) to make the provision of clinically appropriate, locally-built wheelchairs through local seating and mobility services cost-effective, scalable, and sustainable. The model, though incomplete, builds upon ongoing work providing computer and internet-based supports for The Wheelchair Project, a small seating and mobility service in Lima, Peru.

Discussion. Several computer technologies have been developed to address specific challenges encountered by The Wheelchair Project. The project's first wheelchair, built in 1997, used adjustable mounting hardware to fit locally-built seating components to a locally-built Whirlwind wheelchair. Unfortunately, the use of the adjustable mounting hardware added complexity, weight, and cost to the wheelchair. It also prevented the wheelchair from being easily folded for transport on a bus or in a trunk of a car. As wheelchairs in Peru were frequently built one-by-one, the team decided to develop a seating simulator to help find the optimal seating configuration for each user, then custom design each wheelchair frame and seating system to match the specific needs of each user. The wheelchairs could be built in less time, but the local team had difficulty designing custom equipment. To simplify the process, software was written that customizes the design of a wheelchair frame based on the Whirlwind Africa using about 20 parameters entered by the user (Lefkowicz & Olivera, 2000; Krizack, 2000). The software creates a dimensioned drawing set for each customized wheelchair frame that can then be built in about ten hours using all locally available materials. A wood and foam seat and backrest can be mounted flat against the tubes of the frame so as to accommodate about five inches of growth over time of use.

The introduction of software to custom design each wheelchair frame allowed the local clinicians access to affordable wheelchairs designed to meet specifications, but it didn't ensure that the wheelchairs would be clinically appropriate for each user. An Internet-based database was developed to help the team of Peruvian therapists address frequent issues around clinical appropriateness, choices to be made, and managing information. Local clinicians could then upload information and photos to the database to facilitate communication among Peruvian and US team members. The database contains contact information and communication records for each client and tracks progress on each wheelchair. It also allows the data and photos of local seating evaluations to be uploaded to an online form, where they are reviewed by volunteer therapists with more experience and training in special seating. The database allows the more experienced seating clinicians to mentor in-country therapists and helps promote clinical appropriateness and equipment quality. Since the implementation of the database, clinical appropriateness, organization, and follow-up services have significantly improved.

The online technologies are being further developed to address other concerns currently faced by the people served by local seating and mobility services. Many families have been unhappy with the amount of time lapsed between the seating evaluations and provision of equipment. The database is being modified so that the local therapists must forecast and enter target completion dates in order to save information. The database program then track the status of the wheelchair service for each case and makes it clear to the therapists if they are behind schedule. Online training packages are also being developed to address the quality of information entered into the system. If the standards of quality become lax, the user will be required to complete online retraining packages prior to having access to the database. Quality and timeliness standards will need to be met in order for the system users to log into the database and access the software to design the wheelchairs.
Plans for future development include creating online training curriculums complete with online testing for clinical seating and mobility services as well as wheelchair fabrication. The online curriculums promote project scalability by reducing costs associated with program replication. That is, clinicians and equipment fabricators would develop a foundational knowledge prior to any hands-on training, thus reducing overall training costs. The online training could also perform a screening function, ensuring that limited resources are reserved for the most promising candidates.

Future plans also include developing a system to improve equipment fabrication efficiencies, reducing the service and equipment costs (currently $200 in Peru), and improving product features, such as adding a tilt-in-space feature.

Conclusion. Mobility Builders feels that ICT holds significant potential for improving the local provision of seating and mobility services in countries with limited resources. An integrated system could not only help a greater number of services to provide clinically appropriate and affordable wheelchairs, but could require that developing country partners maintain clinical, technical, and cost standards in order to have continued access to the system. Once a local team develops expertise in seating, they could themselves use the database system to replicate, mentor, or incubate other "franchises". The database enables separation of clinical services and equipment fabrication. Small remote seating and mobility services could become viable without providing services to large numbers of people, as the equipment could be built in a central hub and shipped to smaller services.

Mobility Builders is interested in developing new partnerships with organizations providing or interested in providing seating and mobility services in countries with limited resources.

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Paper Session 2 Room 3 - Understanding Wheelchair Use Patterns: Tilt-in-Space

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Introduction

In this study, we explored how fulltime power wheelchair users utilized their tilt systems. This study focused exclusively on power tilt systems because they are frequently prescribed in the local seating clinic for pressure relief and are believed to have many additional benefits.

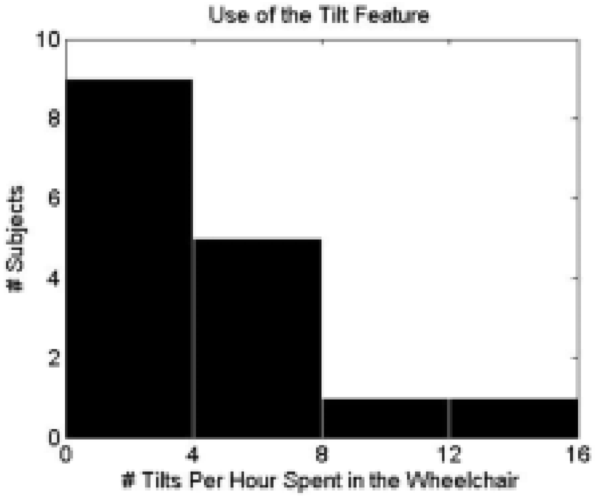
Methods

A convenience sample of 16 adults (11 men, 5 women) who used power tilt-in-space wheelchairs as their primary mobility device were recruited with IRB approval. Subject's tilt use was monitored for one to two weeks using the WhAMI (Wheelchair Activity Monitoring Instrument). Position was measured every two seconds with a uni-axial accelerometer fixed to the seat pan. Wheelchair occupancy was monitored every two seconds using Ribbon Switches placed beneath the cushion.

In this study, we looked at the amount of time spent at different positions (Table 1) and the tilt frequency, or the frequency with which subjects changed their position (Figure 1). A tilt was defined as a position change of 5° in either direction (i.e., more tilted or towards upright) lasting 20 seconds or more. A specific type of tilt, called a pressure relieving tilt, was defined as a backwards tilt to a position > 30°. The tilt frequency was calculated by dividing the total number of tilts per day by the number of hours spent in the wheelchair on that day.

Results

Subject	% of Time in Wheelchair			
	< 15°	15°-29°	30°-44°	= 45°
1	91%	5%	2%	2%
2	93%	6%	0%	0%
3	98%	1%	1%	0%
4	98%	2%	0%	0%
5	100%	0%	0%	0%
6	25%	67%	8%	0%
7	36%	63%	0%	0%
8	37%	61%	3%	0%
9	39%	58%	2%	1%
10	19%	52%	29%	0%
11	28%	42%	30%	1%
12	54%	26%	6%	14%
13	70%	9%	21%	0%
14	80%	6%	13%	1%
15	84%	5%	9%	3%
16	84%	16%	0%	0%



Discussion Points

- Subjects use their tilt system in many different ways, including:
  - o sitting predominantly upright and rarely tilting
  - o sitting predominantly at a slightly tilted position (i.e., at positions = 15°)
  - o sitting at many different positions throughout the day
- Despite that all chairs studied had the ability to tilt beyond 44°, very few subjects ever tilted to 45°. Only one subject spent a significant amount of time tilted = 45°.
- 5 subjects never tilted to 30°.
- Nearly half of the subjects use their tilt system frequently (> once per fifteen minutes)
- If pressure relief recommendations include performing one pressure relieving tilt (i.e. > 30°) every 15-30 minutes for at least one minute, that is equivalent to approximately 3-6% of time spent tilted.
  - o 10 of 16 subjects met this requirement of pressure relief performance.
  - o Only 1 subject did pressure reliefs with the suggested frequency.

Questions Raised

- Who utilizes their tilt feature and who benefits from tilt features?
- Why do many people not tilt at as frequently as prescribed for pressure reliefs?
- Do people need to tilt beyond 45°? If so, how can we get people to tilt more?
- Are there additional benefit to non-pressure relieving tilts (>5° but <30°) (e.g. functional or postural).

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Paper Session 2 Room 3 - Carer Wheelchair Propulsion: Factors Affecting a Carer's Capacity

C. Holloway , M. Ferguson-Pell, N. Tyler, J. Tully

There are approximately 1.2 million wheelchair users in England (1), a third of whom use carer-propelled wheelchairs as their primary method of mobility (2). The provision of carer-propelled wheelchairs has a substantial impact on the quality of life of both the carer and the occupant of the wheelchair, “where provision may mean the difference in being able to cope or not” (3). However, there has been little research carried out to investigate how much strength is required for a carer to push a wheelchair when carrying out everyday tasks. It is felt that this information could be extremely valuable to wheelchair services when prescribing a wheelchair to a user who will be primarily pushed by a carer and could help to prevent injuries to carers be they family, friends or healthcare workers.

Background

The World Health Organisation (WHO) recently proposed a hybrid biopsychosocial (ICF) model to replace traditional medical and social models of disability (4). The ICF model focuses on the removal of barriers which impede a person’s functional ability to achieve the things they wish to do. When the model is applied to carer wheelchair propulsion it is clear that the barriers exist due to a combination of factors. These factors can roughly be divided into the type and set-up of wheelchair prescribed, the environment the occupant of the wheelchair wishes to traverse, the capacity of the carer and the combined weight of the occupant and wheelchair. In order for the barriers to be removed it is essential to know what capacity a carer has to propel a wheelchair and what this capacity means to their ability to accomplish everyday tasks. It should be emphasised that if a carer is unable to propel the wheelchair around the built environment there is a risk of social exclusion for the wheelchair occupant and in some instances the carer also. In a recent survey of North West England into the social implications to the increased use of wheelchairs in society it was found that 39% of all wheelchair users found the roads where they lived were too steep for them to get out of their houses in their wheelchair with help (2).

Figure 1:"Joined Up Thinking".
Taken from the Care Services Improvement Partnership's report "Out and About"

The ideas of measuring capacity and of matching the wheelchair to a users activities was discussed in “Biomechanics of wheelchair propulsion”, where the authors stated prescription was not only about choosing a wheelchair but also getting the right components e.g. backrests, armrests to better aid propulsion efficiency (5). At the centre of the above process is the user. The idea of having the user at the centre of the service provision is something the Care Services Improvement Partnership also recommends, see figure 1 (3). In this illustration carer’s needs are seen as an essential component to a person’s ability to lead a fulfilled life.

There are increasing numbers of wheelchair users who are solely pushed by an attendant due to an increasing aging population. The number of people over 85 years old grew by 64,000 in 2005 a reported 6% increase (6). There have been no studies the authors could find documenting cases of injury to carer as a result of pushing a wheelchair. However, carrying and pushing have been found to be activities significantly associated with back pain for nurses (7, 8). It is reasonable to assume carers are at risk of injury when pushing a wheelchair and that as the number of elderly carers increases this number will also increase.

Objective

The objective of the current study was to see what affect changing occupant weight and floor surface had on the kinetics and kinematics of pushing a standard wheelchair (see figure 2) necessary to push a wheelchair. The wheelchair used was adapted so that horizontal and vertical handle forces could be recorded unilaterally (from the left handle). The vertical forces were measured using a pair of uni-axial strain gauges (Vishay Micro-Measurements; part number EA-06-125 BT-120) positioned on the curve of the left handle. A force transducer (Interface Inc, model LW2050-250 capacity 20Ibf) was fitted in line of the push handle to measure the horizontal force.

Figure 2: Anthropometric dummy in a Standard “9L” wheelchair on artificial grass

Methodology

The experiments took place at the Motion Analysis Laboratory at the Royal National Orthopaedic Hospital, Stanmore, UK. Kinematic data was recorded using a CODA motion analysis system, which is capable of detecting and recording the location of co-ordinate positions of active markers attached to the participants body. The ground reaction forces as recorded by force plates (Bertec Corporation 6-component force transducers type 4060-10) set into the floor of the walkway at the Motion Analysis Laboratory were also recorded by the CODA system. Markers were placed on major anatomical landmarks to define rigid body segments.

Four participants (2 male and 2 female) were asked to push the wheelchair over 2 distinct surfaces (smooth linoleum, which is typical of the surface found in hospitals) and artificial grass, which was representative of a high-pile carpet; and up a 110mm (4.33 inches) step. All 3 conditions were done with 2 occupant weights; 75Kg and 100Kg. The study was carried out in 2 dimensions (horizontal and vertical) and was done unilaterally (left hand side only).

Subjects were asked to walk up the 5m walkway until a minimum of 2 clean ground reaction forces were recorded. The condition was then changed and the participant was asked to again walk up the walkway. The trial conditions were randomised before the start of the experiments. Due to the distance between the wheelchair's back wheel and the leading leg of the participant, it was very difficult to get a clean heal-strike as the wheel did not have sufficient distance to leave the force plate before the heal-strike. Thus, all values of ground reaction force detailed in the results below refer to maximum toe-off forces.
A 2-way between-groups analysis of variance was conducted to explore the impact of surface (artificial grass and linoleum) and occupant weight (0Kg i.e. free-walking, 75Kg and 100Kg) on the magnitude of the magnitude of the resultant force, and also on the time taken to take one stride. All ground reaction forces were normalised for body weight before being statistically analysed. Each of the output measures will be discussed separately below. The mean and standard deviation (SD) values for both output measures are shown in table 1.

Results

Stride time had a statistically significant main effect for surface [$F(1,42) = 0.392$, $p = .005$] and weight [$F(2,42) = 0.167$, $p = .032$]; the effect size was large in both cases. Post-hoc comparisons using the Tukey HSD test for weight found free-walking was significantly different from the 100kg group ($p = .025$). The 75kg group did not differ significantly from the other 2 groups. The interaction effect [$F(2,42) = 1.746$, $p = .187$] did not reach statistical significance.

	Artificial grass		Linoleum	
Output measure	Mean	SD	Mean	SD
Stride time	1.26 s	0.19 s	1.08 s	0.05 s
Resultant force	9.66 N/kg	0.10 N/kg	10.26 N/kg	0.13 N/kg

Table 1: Mean and standard deviation (SD) values for the significant output measures

Resultant force had a statistically significant main effect for surface [$F(1,42) = 17.918$, $p = .000$] and weight [$F(2,42) = 9.825$, $p = .000$]; the effect size was large in both cases. Post-hoc comparisons using the Tukey HSD test for weight found free-walking was significantly different from the 75kg ($p = .004$) and 100kg ($p = .000$) groups. The 75kg and 100kg group did not differ significantly from each other ($p = .783$). The interaction effect [$F(2,42) = 0.522$, $p = .597$] did not reach statistical significance.
The trunk angle relative to the z-axis was calculated using the coda motion system; the mean trunk angles for the four subjects for each test condition are shown in Figure 3. When pushing the chair the trunk is angled forward consistently and this significantly increases with both

weight and surface for all conditions. When walking without the wheelchair, the mean trunk angle is slightly negative, for both the linoleum and the artificial grass. It has been shown that when the trunk inclination increases the compression at L4/L5 also increases for the pushing and pulling of 2 wheeled containers (9). A linked segment model analysis of the data may show this to be the case for carer wheelchair propulsion.

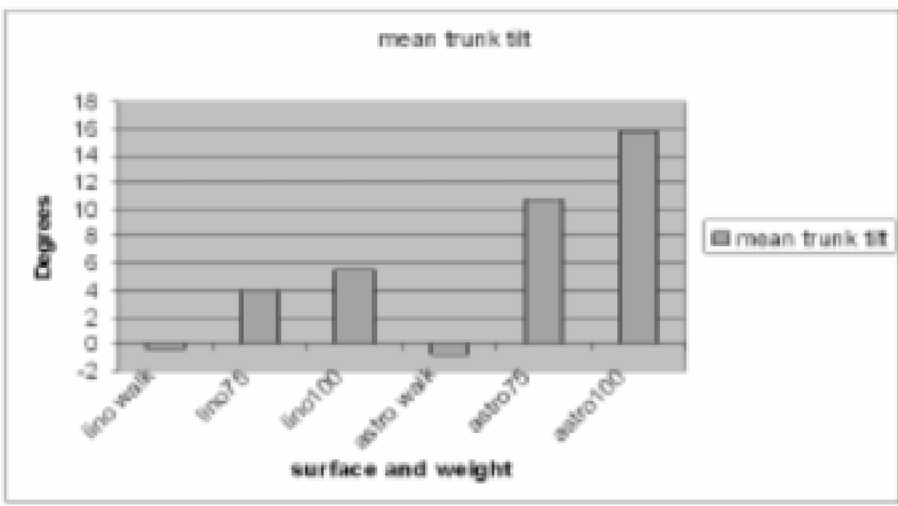

Figure 3: Mean trunk tilt

Further Work

The results shown above are only part of the analysis, the external handle data will be analysed and a validation attempt of a 2 dimensional linked segment model (10) will also be attempted. It is hoped that the results of the full analysis will help healthcare professionals when prescribing carer propelled wheelchairs.

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C1 - Meeting the Challenge: Trying to Meet the Needs of Persons with MS

Jean L Minkel, PT, ATP

In 1996, JAMA, Journal of the American Medical association, published an article by the title, "When Walking Fails". The author is Lisa Iezonni, MD, MPH, a physician, and a woman with M.S. The article opens with Lisa's reflection on importance our society place on "ambulation", "walking", "getting around, without help". The circumstance for Lisa's reflection was the overwhelming negative reaction she received upon driving her new scooter into her work place – a Boston teaching hospital. She was so surprised, because, just as she was driving into work, she had a new sense of freedom, it was not HARD to get to work – I have energy, I feel like a butterfly! Her medical colleagues questioned her, "What's wrong?, Why did you give up?, Why did you let the disease take over?"

Persons with a diagnosis of MS, have either lost the ability to walk or are in fear of a future that "that day will come". Seeing the societal value of walking, through the eyes of a person with MS, should give us some insight on the critical need to OPEN, listen and look for "mutually agreed upon solutions".

Key Factors to consider

Due to the unpredictable nature of this progressive disability, it is essential to work with a team of people who are familiar with this client. The team may not be in the same room at the same time, but we all need to be on the same page. It is essential to SHARE information with the client and family and have a complete understanding of the medical management, from an MD, clinic professionals or other health care professionals providing services to the person.

1. What clinical pattern of MS is being presented?

- Relapsing – Remitting – the most common pattern seen at initial diagnosis. Clearly defined "attacks" with either full recovery or a residual loss – no progression of symptoms between attacks.
- Primary Progressive – persistent loss of function, with little of no clear "remission" – only about 10% of people present with this pattern.
- Secondary Progressive – Begins as Relapsing-Remitting, for frequent attacks result in greater loss of function – a progressive disability.
    - Seen in 50% of clients 10 years after diagnosis.
    - Seen in 90% of clients 25 years after diagnosis.
- Progressive- Relapsing – least common form of the disease. Progressive loss of function with clearly defines periods of of acute relapses.

Understanding the implication of the clinical pattern being presented, will assist in "figuring out" how much flexibility needs to be built in to address future needs. In the most common pattern, Relapsing –Remitting, the device may wear out, before the person needs major modifications for safe and effective use.

2. Why is the person seeking assistance, NOW?

The "seating and mobility solutions" for persons with MS cover the spectrum of products available to any person with a mobility impairment. The biggest difference with persons with MS, as compared to other persons, is the progressive nature of the disease – a progressive nature which is unpredictable both in timing and severity.

Common "Milestones"

A. **Initial Diagnosis** – It is important to inquire why the person sought medical attention that lead to the diagnosis of MS. Were the primary "concerns" – sensory (tingling, numbness), visual or motor – inexplicable falls. If falls were the primary concern, would an ambulation aide – walker or cane, provide the needed added support.

B. **Shortly after an "attack"** - The functional need for a new seating or mobility system may present itself either during or shortly following an exacerbation. In the most typical clinical pattern, there is often at least some restoration of function. If possible, during the exacerbation, it is wise to either modify existing equipment or explore the option of rental or loaner equipment until the "actual" functional level can be determined following "recovery" during remission.

C. **"Just need a replacement"** – the person's equipment may have worn out before they had a change in function. This is becoming more common with the use of medications which affect both the frequency and severity of exacerbations. Change can be difficult. Even if the same products are available there will be a difference – "broken sneakers" verse new stiff shoes. Be patient and ask the person to use the equipment for some period of time before making lots of changes.

3. Anticipating and planning for change

While the natural history of the disease is predicted to result in a loss of function, it is very unclear when that change will take place, which body systems will be involved and to what degree will there be a permenent change in function. As seating and mobility providers, we like to plan ahead, build in flexibility for the future. This desire to "build in for the future" may be overwhelming to the client and introduce costs into the system for features which may never be used. One method to try and find a balance between meeting current needs and planning for the future is to be very aware to the person's recent history (1-2 years) regarding changes in function. A great question to ask, especially if family members are also present, "tell me how you were getting around last year around the holidays – New Years Eve for example; and the year before that?" The answers may give you some insight to the rate and severity of change. Of particular caution is working with a person who may be 10-15 years post diagnosis – who have been historically displaying the Relapsing –Remitting clinical pattern; but now – due to the continued progressive nature of change, maybe demonstrating the Secondary Progressive clinical pattern. It is much more likely, that more flexibility and modifications will be needed in a shorter period time, now, in the secondary progressive phase, than may have been needed in the past when the remissions were longer and the was a re-gaining of function between attacks.

Mobility Options

Depending on where a person is the spectrum of functional ability a whole variety of devices may be appropriate. Remember the prime secondary complaint of persons with MS is fatigue, especially in warmer weather. Any type of mobility should be energy efficient, not painful and as spontaneous as possible. Working with people with MS over a long period of time you learn the "genius of AND and the tyranny of OR". Many people have access to, and functionally use of, a variety of devices depending on the environment of use and the distance needed to travel – a walker in the home, a power chair for the neighborhood and a manual chair to fold in the car to be pushed into an inaccessible (though delicious) restaurant. Mobility demands are very environmentally dependent. Knowledge of the environment of use (beyond the flat halls of a hospital or clinic) is a critical piece to understand the type of device which will meet an individual's need.

When considering power mobility with a person with MS – whether a scooter or a power chair, safety is key. Safety to BOTH, the person and others in his or her environment needs to be safeguarded. MS may effects the sensory system, cognitive abilities as well as motor abilities. Safe use of power mobility requires visual processing and cognitive judgment. A "test drive" can be a great screen. If the person's performance raises safety concerns, a referral should be made for either visual processing and/or cognitive testing.

Postural Support Needs

Many persons with either Secondary or Primary Progressive forms of MS will have significant changes in muscle tone. Spasms and resulting contractures are common in those persons with more advanced involvement due to persistent disability. The contractures of both the hamstrings and adductor muscles can make wheelchair positioning every challenging. Often adaptive footplates will be needed to accommodate a lack of knee range of motion. Many of the new power chairs with center mount footrests provide a good solution. Very tight Adductors not only make positioning difficult but also interfere with perineal care.

Several pharmological options are available which can assist in long term positioning – including use of an indwelling Baclofin® pump and use of Botox® on selected muscles. Both drugs can effect the tightness of the muscles; Baclofin® with a more generalized, full body response and Botox® providing very selective, short term 2-6 month effect.

Low trunk tone and increased fatigue can affect trunk support and respiration. A corset can be an effective, circumferential support for the back, abdomen and even the diaphragm.

Skin Integrity

Persons with MS may present with moderate to high risk for skin breakdown, especially as the disease progresses. Risk factors are diverse – moisture due to incontinence, limited ability to re-position, even if the sensory processes are still in tact, and of course, a reduction in sensation.

For power chair users, power seating is essential for postural support, maintaining skin integrity and to change position depending on fatigue level. For persons unable to self-propel or operate a power chair, safely, a manual tilt chair can provide a change in position to facilitate functions including eating, without significant caregiver burden to transfer to change positioning a static standard chair.

Remember – "Let's Try This"

Every person presents a new opportunity. Our experience may allow us to present options, that easily solve a person's problems. Other times, especially with persons with MS, tried and true just don't work. Be prepared to listen, participate in a partnership and offer, "Let's try this" – welcoming a chance to learn for those to who we provide service.

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C2 - Cognitive, Visual and Perceptual Issues - Matching the Chair to the Client

Teresa Plummer, MS, OT, ATP Ann Eubank, OTR/L, ATP

Understanding and articulating clients' skills and abilities, prior to prescribing a power wheelchair, can improve the likelihood of appropriate funding. It is important, when justifying a power wheelchair, to use developmental and neurological evidence–based information along with orthopedic justification. As the clinician becomes more aware of the visual, cognitive and perceptual issues related to driving powered mobility, along with the developmental training steps, power mobility may be an option for more consumers.

For many children the lack of independent mobility has been the limiting factor to self-directed activities. Research indicates that self-produced mobility has an important impact on a child's psychosocial and cognitive development (Tefft, Guerette, & Furumasu, 1999). As children develop their visual system and the inherent structures that support the visual system, they also develop their ability to move in space. Nawrot (2003) finds that motion and depth are invariably linked and relate to the neural processing of functional mobility. For children who do not exhibit independent mobility their visual development and subsequent perceptual and cognitive development may be hindered. This may preclude a child from developing the necessary skills to move about their environment with adapted devices such as wheelchairs. If independent mobility requires a specific set of visual skills it behooves an assistive technology practitioner to understand the link between mobility and vision. Understanding the inter-relatedness of vision and mobility is helpful information in the process and selection of appropriate mobility devices.

Research indicates that self-produced mobility has an important impact on a child's psychosocial and cognitive development. (Dietz, Swinth & White, 2002; Nilsson & Nyberg, 1999; Tefft, Guerette, & Furumasu, 1999) Without mobility, children may exhibit depressed motivation, apathy and a lack of initiation. (Beckwith as cited in Staincliffe, 2003) Restricting mobility may affect the child's interest and ability to communicate, participate in social and leisure activities, and create diminished self-efficacy. If vision and independent mobility are extrinsically linked it requires that we understand the specific visual skills that may be requisite to independent augmented mobility.

Kaldy & Kovacs (2003) found that development of the primary visual cortex occurs over the course of many years in children and is not an adult-like state until 14 years of age. The primary visual cortex integrates visual stimuli via the dorsal pathway and is responsible for context integration and size constancy. Information about distance is related to perceived size constancy Information about distance is related to perceived size constancy.

Neonates and infants gain much information about objects by orally interacting with these objects. At 2 and 3 months of age spontaneous interaction with a new object begins with oral contact (Henderson & Pehoski, 2006). As the infant develops, the hands become the primary source of perceptual learning. During the first year of life and its concomitant opportunities to explore objects, children learn to interact with their bodies, the environment and how their actions affect changes. Through haptic perception, an infant learns to recognize common objects, gain information of texture, weight and spatial orientation. Individuals with impaired mobility may have limited experience manipulating objects in their hands that may impair haptic perceptual development.

Perceptual awareness and spatial localization through the use of vision and haptic exploration develops at an early age. In a study by Landau in 1991 (as cited in Henderson & Pehoski, 2006) children who were blind were able to identify common objects after 180 degrees of rotation. The first goal directed reaching movement occurs during the time of successful grasp, approximately at 3- 6 months of age. Reaching activities are accompanied by the first direction-specific postural movement. This has significant impact on the relationship between vision, hand function and postural control. This period of transition, 6 months, is marked by an infant's ability to sit independently, visually track objects and manipulate objects using haptic perception (Henderson & Pehoski, 2006). The dynamic synthesis of information allows the infant to perceive an internal picture of their orientation in space. This internal picture is also thought to contribute to a child's body scheme, and is used as a template for perceiving spatial properties of objects (Henderson & Pehoski, 2006).

Pretchl, et al., (2001) in their studies of the role of vision and movement with children with blindness found significant motor delays. While infants with blindness exhibited relatively normal motor development during the first 3 months delays became evident after that time period. The first sign of developmental delay was in relation to head control. Infants who were blind exhibited an abnormal head lag, which continued for another 3 months. A normally developing infant will keep its head in a horizontal plane when lifted or moved into another plane. For infants with blindness this response was absent until the end of the first year. "This insensitivity suggests a delay in vestibular function due to the lack of visual calibration of the labyrinthine functions" (Pretchl, 2001, p. 199). All infants in this study showed a delay in gaining postural control of their trunk and midline head position. "Due to visual projection to the cerebellar vermis and cortex it could be assumed that a lack of input leads to a delay in cerebellar control of balance in the sitting position and hence leads to a very prolonged period of instability, expressed as ataxia" (Pretchl, et al., 2001, p. 200).

In conclusion, research strongly suggests that independent mobility is linked to visual, perceptual and cognitive abilities. A limitation in mobility may create a developmental delay. Therefore, early independent mobility for neurologically involved individuals will facilitate visual, perceptual and cognitive skills.

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C3 - What In The World Are We Doing About Sleep?

Sue McCabe

Background

People with disabilities have a high incidence of sleep problems - with serious impact on their health, wellbeing, and daily function, and that of their families and carers. Weeks, months, even years of disrupted sleep take a toll – affecting health, well being, relationships, and performance at work and at school. Sleep difficulties may be missed by clinicians, and may not be reported by clients or families as being a priority for intervention. The difficulties can be complex and severe - at times life threatening - with no single solution which will work for everyone.

Many factors affect the sleep of people with disabilities, including: postural deformity; pain/discomfort; uncontrolled movements; muscle spasms; decreased ability to move or change position in bed; pressure/skin care issues; temperature regulation difficulties; breathing difficulties; reflux; swallowing and digestive difficulties; incontinence; circadian rhythm abnormalities; effects of seizures; effects of medications; effects of co-existing conditions such as ADHD, autistic spectrum disorder, sensory impairment, intellectual disability; disrupted routines due to hospitalisation, pain, or illness; and difficulties managing the environment.

People with disabilities may also experience sleep difficulties for the same reasons as the general population: sleep disorders such as insomnia and parasomnias; effects of anxiety, stress or depression; effects of conditions such as asthma, hay fever, eczema or back pain; a disruptive sleep environment; and daily and evening routines and habits that are not conducive to sleep - such as poor diet, high caffeine or alcohol intake, irregular sleep times.

Clinicians and researchers around the world are recognising the importance of sleep, and there is a growing body of knowledge in this area. It is important that this knowledge is shared and integrated in a holistic way, so that people with complex conditions can receive effective services and solutions. Those working in the area of disability must learn about sleep: how sleep works, what can go wrong, and interventions that may be effective. Equally, it is important that those who work in the area of sleep medicine recognise the unique and complex needs of people with disabilities.

What are we doing at the ‘Sleep Solutions’ service

The Sleep Solutions service at The Centre for Cerebral Palsy (TCCP) in Western Australia has developed over the past four years, evolving from an equipment provision program for postural support in bed, as part of 24 hour postural care.

We (physiotherapist and occupational therapist) see clients of all ages, most with a diagnosis of cerebral palsy. We work with the clients’ primary therapy teams (occupational therapist, physiotherapist and speech therapist). We also see people referred from other agencies, with conditions including autistic spectrum disorder, intellectual disability, motor neuron disease, multiple sclerosis, multiple systems atrophy, and acquired brain injury.

Service delivery
We provide a service to clients throughout Western Australia. This is usually as home based assessment and intervention, for clients who live in the metropolitan area of Perth. We also hold clinics at TCCP, for metropolitan and rural clients who visit the centre for therapy or equipment clinics. We provide an equipment trial service, provision of written information, and a consulting service to therapy teams. A telephone service and videoconferencing facilities are available, as an option for advisory input for clients in rural and remote settings.

The Sleep Solutions service addresses clients' needs at a number of levels:

i) trial and prescription of specialised or customised equipment for sleep (postural support equipment, mattresses, specialised beds and bed accessories);
ii) provision of individualised sleep management programs for clients and their families; and
iii) case management, to coordinate clients' access to other specialist services in relation to the complex factors that may be affecting sleep (eg neurologist, meal-time management team, dietician, respiratory physician, GP).

Assessment
At TCCP, clients are seen by both of the clinicians from the Sleep Service team wherever possible, along with clinicians from the referring therapy team. We are guided by the referring therapists in terms of preferred numbers of clinicians to be involved, preferred time and location, and issues to be focussed on or avoided.

Initial assessment involves semi-structured interview using the TCCP Sleep Profile, with an overview of the all the factors that might be affecting sleep. We complete a Safety Checklist (to identify priorities around pressure, pain, breathing, pain, temperature, entrapment, carer needs, and postural management). Assessment also involves postural review, photographs of usual sleep position, and (if indicated) use of pulse oximetry, pressure mapping, overnight video recording, and temperature and moisture measures. We use sleep diaries, have developed a Day-Night Activity Log to record effects of daytime activity on sleep, and may also ask the primary therapist to complete the Sensory Profile.

Intervention
Intervention includes provision of information and recommendations for management of sleep difficulties. We provide equipment for trial - for comfort, safety and postural support. Within guidelines, we apply for funding for provision of the equipment. Intervention may include referral to other specialists (eg paediatrician, neurologist, physician, GP, mealtime management team, clinical psychologist, social worker, community nurse). The intervention process may involve a series of trial, review, re-trial of equipment and sleep strategies. Involvement of the Sleep Solutions team may be as brief as one assessment/advisory session, or may involve many sessions over many months.

Equipment Used

The Sleep Solutions team has a comprehensive repertoire of trial equipment for postural support, comfort, independence and safety during sleep. We also obtain additional equipment for trial through local suppliers.

The ‘sleep systems’ that we most commonly use are: ‘Symmetrisleep’ overlays, sheets, brackets and cushions; ‘Leckey Sleepform’ moulding bags and overlays; and ‘Pelican’ (a local manufacturer) wedges and cushions. Also available for trial are the ‘Dreama’ positioning support system, and the ‘Moonlight’ system. We are also aware of the benefits of the ‘Chailey Lying Support’, but to date are unable to get these in Western Australia.

A simple positioning item is the ‘Happy Strap’. We have also learned, from clinicians in Canada and the UK, of the use of ‘Theratogs’ and ‘Contour V’ lycra shorts to provide positioning support during sleep.

Because the Sleep Solutions team operates within CPTech, a customised equipment service, we have been able to develop our own positioning equipment pieces. These include triangle brackets, the ‘Three Lobe’ roll cushion, the ‘W’ cushion and the ‘Knee Sleeper’. With help from the engineer and technical teams at CPTech, we also provide custom contoured foam lying supports if required.

Safety in bed

There is a need to ensure that our clients are safe when in their beds. This can be a high risk environment.

There is a risk of ‘entrapment’ within bed rails, between rails and mattress, or between mattresses and walls or head boards. Clients with strong, uncontrolled movements risk injury when hitting limbs against walls or side rails. They may need specialised beds, with side rails and side rail protectors. Clients with intellectual disability or sensory impairment may also be at risk - they may be very active, and climb and topple from their beds. Although a low bed may be most suitable here, we often find that the bed needs to be quickly and easily raised to a suitable height for parents or carers to attend to health and safety needs. Special beds are needed.

Pressure management is of course a big issue during sleep. A range of specialised mattresses and overlays is available through local suppliers.

Breathing during sleep is important, with risk due to reflux, vomiting, apnea, and poor management of saliva. The supine position may be recommended for best postural management and body symmetry, or for management of pain – but the supine position may the least preferred for breathing. We need to be able to identify the safest position. Parent and carer reports, overnight video and pulse oximetry are useful tools. We use expertise from the mealtime management team. On occasions we request an overnight sleep study, as we are not able to measure the risk.

Temperature regulation is also important, especially for clients with epilepsy or seizure disorders. We have trialled the use of Supracor underlays, with carers reporting effective management of body temperature and perspiration.

And there's more about Sleep Solutions ....

The development of the Sleep Solutions service includes a number of other considerations, including the formation of professional links with others in the field and provision of information to clients and families, clinicians, and carers, about sleep and 24 hour postural care. We have implemented a 'sleep interest group' so that clinicians can meet and share questions and knowledge. We have developed fact sheets about sleep and 24 hour postural care, for clinicians and clients.

As the service evolves we are developing our use of meaningful outcome measures, and exploring opportunities for research. There is so much more to learn and to do!

What else in the world is happening about sleep?

The field of sleep for people with disabilities is relatively new. Knowledge and expertise still developing. Expertise exists in isolated 'pockets'. It is important that we get to share what we know and what we are doing.

It is expected that this instructional session will include opportunities for people to share what they know – to identify resources, contacts and links which will enhance our development of clinical practice and research in this area.

C4 -The Science of Interface Pressure Mapping – Updates for Clinical Application

Kim Davis, MSPT, ATP, Stephen Sprigle, PhD, PT

Introduction

Interface pressure mapping (IPM) has long been a useful assessment tool to augment the seating evaluation. Technological improvements in both hardware and software have made steady advances across manufacturers. Likewise, progress has been made in the scientific study of the clinical application of pressure mapping. This course will focus on the science behind IPM and recent research findings which influence clinical interpretation of the map. Phenomena such as creep, the effect of the mat and the influence of cushion materials will be highlighted. Additionally, reliability of specific metrics will be discussed, with a de-emphasis on the use of single sensel peak pressure values. Emphasis will be placed on the importance of using a consistent IPM protocol within your seating clinic to make relative cushion comparisons.

Background

There is growing demand internationally for a standardized clinical guideline for IPM, with respect to both data acquisition and interpretation. In fact, the ISO Work Group on Wheelchair Seating has established a Task Group to develop a Technical Report on this subject.[1] Much can be learned from current recommended protocols.[2,3,4] However there is still room for increased consistency across IPM systems and across clinical settings. Lack of a standardized protocol limits the ability to compare clinical research findings across studies utilizing IPM and may limit external validity. This in turn may slow the growth of evidence-based practice in the field of seating and wheeled mobility.

Data Acquisition

Establishing an international standardized clinical IPM guideline is no quick task. However, the work begins “at home”. The importance of following a consistent protocol within your own clinic cannot be over-emphasized. IPM is not an exact science, but its clinical usefulness increases greatly with consistency. One variable which should be controlled is “settling time” before an actual recording is done. Current protocols are not consistent in this regard, ranging from 6 to 10 minutes.[2,3,5,6] This settling time takes into account creep – of the sensor, the tissue and the cushion material. Sensor creep, inherent in most IPM sensor technology, is the tendency for the sensors to increase their reading over time, given a constant load. Corrections for creep are made during the calibration/equilibration process. However, this correction is most accurate clinically if the time frame utilized for creep correction during the calibration matches the time frame used during data acquisition. A mismatch of these times can be sources of error.[1] Some IPM systems allow manipulation of this time factor during in-field calibration/equilibration. Tissue creep occurs relatively quickly and consistently across cushions. By comparison, cushion creep is highly dependent on its make-up. Air cushions and cushions composed of high resiliency foams have a short settling time compared to those composed of viscous fluids/foams. Stinson et al studied the time required for the IPM values to “stabilize” using able-bodied subjects and found 6 minutes to be the recommended settling time before taking an IPM reading.[5] Study limitations sited by the authors include:

(1) Data from able-bodied subjects cannot be extrapolated to persons with disabilities. (2) Only average pressure and single peak pressure values were used in analysis; both measures have limitations as discussed below. An additional limitation of this study is the fact that only one initial calibration was performed and utilized throughout the 10-week study. This is not to say that the calibration was not accurate, but that readers cannot be certain of the level of accuracy. A subsequent study on the impact of sitting time by Crawford et al using subjects with Multiple Sclerosis concluded that = 8 minutes may be the optimal duration before IPM recording is done.[6]

Pilot data has been collected at Georgia Tech to further study the effects of mat sensor creep. Buttock models were used to eliminate soft tissue variability and a materials testing machine was used to apply a constant load. Measurements were taken at time 0, 1, 3, 5, 8 and 10 minutes. Up to a 51% increase in Peak Pressure Index (defined below) and up to a 44% increase in total force occurred over 1-8 minutes. The greatest increase occurred between time 0 and 1, while the least change occurred between 5 and 8 minutes. The latter supports Crawford and Stinson's findings of when IPM values "stabilize". However, it must be noted that "stable" measures occurring at the 5-8 minute time points, do not necessarily represent accurate measures.

The clinical take home message is to practice consistency within your clinic, if not across clients, at minimum within cushion trials for a given client. The limiting "creep factor" is that of cushion materials. The settling time should be determined based on the cushion trialed composed of materials with the most "time-dependent" properties - viscous fluids (e.g. Jay2) or visco-elastic foam (e.g. Tempur-Med). For example, a cushion set is comprised of a Roho Quadtro, a 3" HR foam cushion and a J2DC. The former two have a shorter settling time estimated at = 1minute. The J2DC, with its viscous fluid pad, has a longer settling time of about 5 minutes. When acquiring data on this set of cushions, the settling time should be 5 minutes, so that the effect of the sensor creep will be consistent across cushions - enabling the best relative comparison.

Mat Effect

A recent study was conducted at Georgia Tech to study how the presence of four commercially available IPM mats influenced interface pressure (IP), envelopment and immersion.7 A materials testing machine was used to load buttock models onto seven different cushions. The buttock models were instrumented with individual pressure sensors to compare measures with and without the mats present. Overall, magnitude, envelopment and immersion decreased after mat introduction, though the decrease in immersion was only about 1 mm and is unlikely to have clinical relevance. Mats hammocked across buttock contours, causing a decrease in IP magnitude and envelopment. Two of the IP mats had less effect on envelopment than the others. The cushion-mat interactions were significant for pressure magnitude and envelopment, indicating that the mat effect differs across cushion design. In other words, any one mat affected IP, but not to the same degree across different cushions.

Key Parameters for Interpretation

Of the above referenced protocols, there is agreement with regard to three key parameters from which to "rate" a map:

1. peak pressures (this does not equate to single sensel peak values);
2. distribution of pressure with regard to symmetry;
3. total contact area.

Peak Pressure:

Historically, single peak values have been used to rate cushions. Sprigle et al studied reliable, repeatable metrics for IPM – single peak values did not make the cut.[8] Rather, the researchers recommended use of a Peak Pressure Index (PPI), which was found to be repeatable. PPI is defined as the average of the highest recorded pressure values within a 9-10cm^2 area (the approximate contact area of an IT or other bony prominence). The number of individual sensels included in the calculation depends on the spatial resolution of the mat. For example, in Xsensor this includes nine sensels, for FSA and Conformat - four. Focusing on the grouping of peak sensels also lends to assessing another important measure: gradient of pressure. A high gradient from peak to adjacent sensels indicates poor envelopment of the bony prominence. Sprigle et al also note average pressure as a reliable metric, but do not advocate for its use clinically. It is not a volatile enough measure to perform relative comparisons of products. Further, it has minimal clinical worth – assessing average pressures, which in effect masks the distribution of the pressure, has little clinical relevance. The Coefficient of Variance, represented as a percentage, offers more insight with respect to evenness of pressure distribution – the lower the CoV the better.

Symmetry:

Optimization of pressure distribution symmetry, comparing right and left sides, is a key goal. Focus is placed on the symmetry of at-risk sites: the IT's and greater trochanters. This parameter highlights the importance of integrating IPM findings with a comprehensive physical evaluation. Problem solving with respect to asymmetrical IPM results cannot be accomplished absent of a postural evaluation. In fact, mapping the client while seated on a mat table is a useful means to combine the two: bony prominences can be clearly matched to peak pressures, asymmetries can be elucidated and the effect of manually providing postural support/correction can be assessed.[2,4]

Contact Area:

Contact area is representative of the goal to distribute the forces (body weight) over as large an area as possible. Given the defining equation of pressure (pressure = force/area), the larger the area, the lower the pressure given a constant load. Contact area can be represented by the total number of sensels under load. Sprigle et al further recommends establishing a minimum threshold of 5mmHg to represent load – this avoids inclusion of fluctuating non-zero values and minimizes the effect of noise (IPM sensors are generally less accurate at extreme low values due to the inherent effect of electrical noise).[8] Dispersion Index (DI) is another metric reported by Sprigle et al to have good reliability.[8] DI is the sum of pressure distributed over the IT and sacral regions divided by the sum of pressure readings over the entire mat, expressed as a percentage. Drummond et al found that "unacceptable" interface pressures occurred when >55% of the pressure was at the IT and sacral regions.[9] Though

DI and Contact Area are useful measure with respect to the focus of IPM interpretation on relative comparison of cushions, both are limited when comparing apples to oranges. In static cushions, effective pressure distribution is achieved either via envelopment or off-loading. Neither measure by itself represents a fair comparison if one cushion envelops and the other off-loads.[10]

Summary: Be consistent. Focus on relative comparisons. Respect your clinical mind.

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C5 The Evidence Basis of Passive Standing Programs: Prelude to a RESNA Position Paper

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Currently, there exists a paucity of information on the benefits of passive standing program for children and adults. Medical and educational professions, parents and patients are unable to consistently identify and apply evidence based outcomes of passive standing programs. Further information is needed to assist PTs (and others) in choosing appropriate clinical outcomes, duration and frequency of bouts and equipment.

People who cannot stand or walk on their own due to CP neuromuscular or cardiopulmonary dysfunction often experience negative consequences of inactivity and non-weight bearing. These sequela include but are not limited to; osteopenia/osteoporosis, muscle weakness/atrophy, muscle tightness/contractures, spasticity, constipation, urinary retention, decreased pulmonary clearance, and/or autonomic dysreflexia.

The ICF model emphasizes activity and participation. Passive standers can be excellent affordances to allow people who cannot stand on their own to improve function, activity and participation.

The literature review revealed distinct system effects from passive standing programs:

- Bone Density (moderate level of evidence)
- Range of Motion (low level of evidence)
- Hip Integrity (no evidence)
- Bowel Function (one single case study)
- Bladder Function (none – only one on bladder pressure)
- Spasticity/ Tone (moderate level of evidence but only for 30-45 minutes following intervention)
- Skin Breakdown (one study)
- Cardiopulmonary (no evidence)
- Gastro-Intestinal (no evidence)
- Circulation (evidence only in normals and animal models)
- Psycho-social indications (no evidence)

Review of types of equip
Case studies

If therapists, medical professionals, families and patients want to participate in passive standing programs and have their equipment funded my third party payors, the level of evidence will need to be improved. Clinicians agree on the benefits, but the scientific research does not reflect their experience. Please join the RESNA effort to document the effects of passive standing programs and contribute to the formation of a positional paper that professionals and patients can access easily.

Contraindications

In spite of the numerous benefits, a stander wheelchair may be contraindicated. A through assessment by a qualified professional is necessary. The variables to pay special attention to include but are not limited to:

- Existing contractures. The client may benefit from partial weight bearing even if he already has fixed contractures of the lower extremities. However, the amount of extension may have to be limited, especially in case of a client without sensation.
- Skeletal deformities. Both the sitting and the standing position have to provide appropriate support for stability and function, so special accommodations may have to be provided for people with significant deformities, especially if those deformities are not flexible.
- If the client has not been standing for a long time (i.e. years), it is recommended to suggest use of a loaner stander to assess standing tolerance.
- Check for blood pressure and dizziness while standing up, especially for new clients with recent injuries.

Join the RESNA Positional Paper contact Lauran Rosen

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D1 - Customizing Seating and Positioning for the Aging Population: Assisting in Restraint Reduction

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When prescribing seating and mobility devices, the support surface and chair design must address physical, perceptual, cognitive and social needs. However, in order to allow the person to then become functional and complete tasks a number of other factors must be accounted for. These include the task purpose, visual, motor and time requirements, environmental stimuli, location and accessibility. In the theory of occupation, the person's needs, desires, ability to make decisions and explore values must be considered. The occupation must be considered for its need for detail, pace and ability to change task and this is also affected by the environment that determines communication and flexibility for function. A secure and comfortable seated position must be created in order for a functional movement to begin. If this does not occur, a client will tend to slide out of position during function. As a result, the client no longer attempts activity and often restraints are applied to "hold" them in the chair. These changes occur more quickly in the geriatric population as the aging factor becomes more evident. As a result, often the elderly person "gives up" and assumes that they can no longer complete the function. Assistive technology needs to be provided that will maximize comfort and positioning and allow the elderly to continue to function in areas of identified need or want within their level of performance.

The seating system must provide stability, alignment and comfort in an effort to maximize function with minimum pathology as well as addressing the caregiver/facility needs. Improper seating, positioning and mobility devices can result in the aging population not realizing their potential, because they have not been provided with the opportunity to prove a difference in functioning as they age and change. This can create a withdrawal from society and needless suffering. Human beings are adaptive. When a system no longer accommodates changes in function, physical stature or psychosocial needs, the human body will likely adapt to the equipment, resulting in further deformities of postural realignment, in order to provide the necessary posture for function. In providing seating we therefore must assess the need proactively for the client's potential for change. Customizing equipment design, prescription and timeliness of assessment is important to help reduce potential changes in posture that can occur with in the normal aging process. Ensuring a good fit will ultimately preserve function and posture, reduce the use of restraints and promote a sense of well being and quality of life for our clients.

Specific issues and concerns for postural changes in the elderly include:

- **Asymmetrical postures:** It is essential to determine whether the pelvic obliquity, scoliosis or rib hump is secondary to the client's diagnosis or current positioning, e.g., sling upholstery, hemiparesis with reduced tone on one side, or a combination of both.

- **Kyphotic posture:** One of the most common postures observed when passing through long-term care facilities. Assessment findings would reveal, posterior pelvic tilt, loss of normal lumbar curve, rounded shoulders, thoracic kyphosis, and lower cervical flexion with upper cervical extension. This is created by the effects of gravity, loss of muscular tone, poor seating systems or inappropriate heights for foot propulsion
- **Multiple Diagnoses:** Often times we are not seeing a client who has just a CVA, or a fractured hip, instead, we may find a combination of a fractured hip with total hip replacement, plus Alzheimer's, +/- dementia as well as osteoporosis. The seating system must include objectives of providing comfort, function, prevention and maintenance with predicted changes over time.
- **Incontinence:** Commonly an issue with the elderly population, this, combined with inactivity, decreased nutrition and hydration, decreased elasticity of the skin tissue and muscle atrophy, is another contributor to the increased risk of skin breakdown with our elderly clients.

The direct benefits of seating the elderly in customized seating and mobility systems are:

- Reduced need for restraints – custom measured or molded systems accommodate a variety of postures and provide comfort
- Improved function – maximizing support and mobility
- Reduced nursing care – decreased need for repositioning
- Improved sitting tolerance from increased comfort
- Prevention/delay of structural deformities
- Improved respiratory function
- Improved swallowing
- Improved cardiac output
- Decreased risk of skin breakdown due to increased surface contact
- Improved visual field
- Increased social contact
- Improved gastrointestinal function
- Normalized muscle tone

Determining if your client requires a custom contoured surface is often seen as a challenge, but does not need to be. Customized seating can minimize the risk of peak pressures and shear on weight bearing surfaces, especially over bony prominences. It can also provide the best postural support and control where modular does not match the client's shape. By customizing the shape, it often decreases the need for additional lateral and anterior supports. Custom seating is good for prolonged sitting where postural support and pressure relief is required, or for clients with inadequate sensation. Specific shape contours can also prevent friction/shearing from occurring from downward migration often seen with modular systems. As a result, the client no longer needs to "hold on" and therefore this frees their hands for functional activity. Custom seating may often be one piece construction and therefore there are less pieces to lose. Accommodation and correction can be achieved as well as aggressive support where necessary. Due to the close contouring, there is also more proprioceptive input to the body which may assist in decreasing agitated movements.

When assessing a client for custom seating it is important to look for potential areas that may be affected by alterations in their seated position. This may include at risk skin areas, tonal changes or contractures from long term tonal changes, reflexes (normal/abnormal) and the client's use of reflexes in postural support, bony protrusions, respiratory and circulatory changes or changes in body position and orientation in space, incontinence, swallowing, eating, drooling problems, the client's ability to sit unsupported, and finally the client's ability to reposition or weight shift.

When completing a custom seating system, transfers and use of mechanical lifts and slings can become more difficult for care givers due to the close contact of the curvatures. It is important to consider how the transfer is completed prior to finishing a system in order to ensure that the transfer will be able to be completed and all slings can be removed after the client is in the chair. Custom seating can also impinge on catheter and condom drainage or urinal use if it is too contoured or these factors are not taken into consideration. Dressing a client can be more difficult if done in the seating system as the client cannot be shifted as easily. Custom seating systems are generally a little more difficult to move and place in/out of a mobility base, and therefore the transport of system must be addressed prior to determining the type of seating to be completed. Lastly, it is important that the ease of cleanliness and durability be addressed as the integrity of the system will be affected by the ability to maintain the general hygiene of the product.

When considering customized seating it is important to consider how the seating affects a choice or mobility base. The following are a few of the areas which may be considered when determining the type of seating and chair to be used:

- easy and frequent repositioning assists in easing pain. Dynamic tilt allows repositioning, but do not forget to assess how it may affect function, and who is trained on the use of such
- interaction with others can be increased through adjusted seat angles, back angles and ease of maneuverability
- body image and self esteem are affected by the cosmesis of the device. Consider cushion covers, too aggressive seating, high tech vs. low tech
- sitting tolerance as it is affected by comfortable seating vs. corrective seating.
- joints require active range to prevent stiffness. Seating should not be so restrictive as to eliminate the ability to reposition all body joints as able.

Prescribing custom seating

* be aware of basic posture and seating principles
* understand ergonomic and biomechanical principles for mobility
* complete a mat assessment
* test out and simulate posture and the support required to maintain that posture
* record wheelchair measurements after custom seating is complete to ensure fit into mobility base
* consider environmental factors and system functionality for the client and caregivers

Custom seating may begin at the basic level of adding carved foam support to an already pre fabricated back shell. This is good for the client who requires minimal accommodation to back curvatures, but the overall shape of the back shell provides adequate support. This may also be seen as customizing an off the shelf cushion by adding additional adductor, abductor or obliquity pieces, or carving back one leg trough for discrepancies. Again this is good for the client who is more actively mobile or needs minimal adjustments in shape to match their contour or maximize their surface contact. If more aggressive accommodation is required, then foam in place molding may take place. Again a regular back shell may be used, but by pouring the foam around the client, a closer contact to the exact shape is achieved. Foam in place is not recommended for aggressive correction as it is difficult to maintain client alignment during the foaming process. The next step may be to complete a fully scripted custom seat/back by taking measurements of the client and transferring this data to a prescription form, from which a fully customized seat/back will be manufactured. This type of seating is seen with the Precision Fit seating through PRM. Finally, full custom contoured shaping may be required for very asymmetrical postural seating and can be done through a variety of mediums but often includes a molding frame (PRM). This type of system has the advantage of allowing for full accommodation as well as differing degrees of correction where required.

By considering that humans are dynamic, and aging is a continual, ongoing process, customized seating systems can allow a client to more easily travel through life's many hills and valleys. This will allow for a full and complete life without restrictions imposed by their equipment or restraint use.

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D2 - Wheelchair Transportation Safety: Principles, Standards and Practice Risk Management

Douglas Hobson, PhD
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Abstract
Rehabilitation professionals have a responsibility to inform consumers about the risks associated with the products that they are recommending. Wheelchair transportation safety standards are now resulting in wheelchairs that are improving the safety of those who must use them as seats in motor vehicles. Failure to use products that meet the safety standards is resulting in increased injury and related lawsuits. This change in practice is having implications for not only product manufacturers and suppliers but also those recommending wheelchair products.

Learning Objectives
1. The risks associated with transport of individuals using wheelchairs in motor vehicles.
2. Wheelchair transportation safety standards and how to implement them in current practice.
3. Principles of wheelchair and wheelchair seating system crashworthiness
4. Considerations for liability risk management
4. How to locate additional resources related to wheelchair transportation safety.

Overview
This workshop will first provide attendees with a basic understanding of the physical aspects of motor vehicle crashes and the causes of occupant injuries. With this background, the basic principles of occupant crash protection will be reviewed along with a summary of how these principles have been incorporated into the essential design and performance requirements and associated test methods of voluntary standards for transit wheelchairs and for wheelchair tiedown and occupant restraint systems (WTORS). The steps involved in conducting wheelchair and WTORS crash testing and in evaluating and reporting equipment relative to design and performance criteria will also be described and illustrated using high-speed videos showing typical crash tests.

Attendees of this workshop will have a better understanding of why wheelchairs and WTORS that comply with the new standards provide increased transportation safety for wheelchair-seated occupants as well as a better understanding of what is involved in designing, testing and recognizing products that comply with the standards. They will also be better informed to share this important information with wheelchair users and other clinicians who participate in the wheelchair selection process.

Finally, examples will be shared of cases in which wheelchair users riding in motor vehicles have been injured and lawsuits have resulted. This information should help practitioners and consumers better manage the risks associated with this important aspect of assistive technology service delivery.

D3 - Power Wheelchair System Customization

Jacqueline Macauley, PT, ATP

Introduction

Technology is exploding exponentially as we continue into the 21st century. It appears that every week a new device is developed, or miniaturized to make our lives easier, more productive or more enjoyable. There is a generation who has never experienced life without a cell phone, laptop computer, HD TV, MP3 player, GPS….We have recognized the importance of the "Digital Age" and have embraced the concept of customization in many aspects of our modern lives. Has this revolution encompassed the DME industry or has it been left behind?

It could be argued, that while not leading the charge, the power wheelchair industry, has made significant technological strides that facilitate optimal function and performance while also incorporating a degree of personal choice. This is achievable through "system customization". The demand for increased capability is largely consumer driven, thus a unique collaborative opportunity exists between the end user, healthcare professionals and the wheelchair industry toward achieving the common goals of improving function and quality of life.

This presentation will attempt to explore and expand upon the following questions. For some of the issues raised no clear answer exists but they will encourage discussion and provide food for thought.

So, what is system customization?
How is it achieved?
Why is it important?
What functionality do our clients require as a medical necessity?
Are we, or should we be obligated to provide more?
What are the roadblocks we may encounter? Are they real or perceived?

System Customization of Power Wheelchairs

System customization of a power wheelchair for a client involves tailoring all of the components of the system according to the client's abilities, skills, needs and preferences with the goal of achieving optimal comfort, function and performance. This may include some or all of the following components:- the seating system itself, power seating, power base, drive controls, electronics and interfacing with assistive technology and the external environment.

The focus of this session will be on choosing electronics, configuring drive controls, programming options and access to independence through IR technology. It must be remembered, however, that seating the client is the essential first step towards an optimal outcome both in terms of skin protection and adequate postural support for task performance. Power seating is then considered to address a variety of individual needs, for example pressure redistribution, postural control against gravity, transfer assist etc. The base is chosen relative to the clients physical and medical needs and the drive wheel position, FWD, MWD or RWD must also reflect the client's needs/desires in terms of lifestyle, terrains encountered, accessibility and transportation.

Power Wheelchair Customization for Driving

System customization for operating a wheelchair is accomplished through the choosing the input device, mounting the input device and programming. It must be noted, that as technology is advancing, more options for all of these considerations exist. The electronics package itself is dependent on the requirements of the system. A chair that is fairly basic i.e. joystick only and single drive profile with limited power seating will require basic or non-expandable electronics. As a system become more complex, e.g. multiple drive profiles, several power seating functions, specialty controls for driving or the ability to interface with other devices a more expandable electronics package with increased capability is necessitated.

The input device is determined and mounted based on the the client's best point of control. This and also whether the input device is proportional or non-proportion is determined through the evaluation of the client's physical and cognitive abilities.

Arguably, the most effective way to tailor the chair to the user's needs is through optimal programming. For some clients, customization of programming involves no more than making a few changes to the speed and acceleration parameters. For a client with complex needs more critical attention may need to be focused on input device parameters, access to reverse driving, access to alternate functions and menu navigation. Programming can be achieved via a hand held programmer, computer based applications and in some cases through the display itself. Advances in technology is simplifying this process as many options are now software driven and as new features are added flash upgrades are available.

New Programming Capabilities for Joystick Users

While the ability to tailor the sensitivity of the hand control, adjust the throw and reassign direction is commonly capitalized upon to maximize safety and performance, some newer capabilities may provide even greater opportunity for success:

Switch joystick – ability to enable through programming, thereby eliminates the need for additional hardware. This is a useful option for a client that may have inadequate motor control to operate a proportional device but has the potential to transition to one.

Neutral Horizontal and Vertical – ability to increase neutral in either direction. A client who drives primarily using proximal control and has difficulty finding neutral, stopping and controlling turns may benefit from fine tuning this parameter.

Auto Mode – this is the ability to program a timed automatic entry into mode functions which can then be accessed by the joystick. It essentially is an automatic mode switch and is useful for a client that cannot access either a joystick or remote mode switch. This feature is also available with specialty controls.

Assignable buttons and ports – shortcuts to provide easy access to commonly used functions. This ability is often medically necessary as it can be less physically and/ or less cognitively demanding than several joystick commands (or switch hits) to navigate a menu to access the required function. Shortcut functions are also available with specialty controls.

New Programming Capability for Specialty Controls

Additional programming options and continual innovation of specialty controls themselves have opened up the possibility of mobility and independence to clients with severe disabilities that in the past were denied this.

Some newer programming options pertaining to specialty controls that warrant mentioning include:

Access to Reverse with 3 switch head array. While the use of Rim has been an industry standard it is a recent addition to some electronics. This allows a client to access reverse but also the menu via a series of mode switch hits. Programming the back pad to toggle direction when not driving is another option available. If neither of these methods is functional a third option is available, where a programmed time can toggle the direction when in non-driving mode. This is indicated on the display and the client chooses the desired direction by coming into proximity of the back pad. The indications for method of access are different and are based on client evaluation. The crucial point is that options are available to maximize the possibility for success.

Sip and Puff. Historically, traditional 4 pressure sip and puff systems that are dependent upon the ability to differentiate between hard and soft sips and puffs have presented a significant challenge to some clients. It is now possible, to operate sip and puff via single and double commands instead of hard and soft, thus providing at least an alternative if not a solution to this challenge.

Customization of the Display

The electronics available in today's market place often offer the added benefit of customization of the display, either to facilitate ease of use, or, to accommodate client preference. Display items can be listed according to feature in any desired order, the menu can be expanded or contracted depending upon the client's physical and/ or cognitive function and can be modified as needs change. The text itself can be customized to represent what is meaningful to a particular client. The display can be viewed in icons instead of text to accommodate the non reader; it can be viewed in a foreign language if this is a need or preference. It is also possible to enable the display to scroll through the selection items automatically with a programmable dwell time to accommodate time required for selection. This has been found to be particularly beneficial for sip and puff users.

EADL's

EADL functionality is another customizable feature of today's wheelchair electronics. Infrared technology allows the wheelchair user to control IR devices ex. TV, DVD, IR phone, in their environment directly from their chair, provided they are within line of sight. Mouse emulation is also possible via IR, requiring only a receiver attached to the computer. The IR signal being transmitted from the wheelchair can also interface with X-10 technology thus giving the user the ability to control lights, appliances etc. through their house wiring. With the use of appropriate transmitters, IR can also interface with RF devices, ex. garage door openers.

It can therefore be seen, that wheelchair technology has moved beyond just providing the basics, i.e. a seating system and a mobility device. The question then is "is access to the environment a medical necessity? And, if so, "who should be providing funding for it? A case

could be made to either support or refute this.
It could be argued that a client would require less attendant care if he could access his home independently and operate basic household appliances directly from his chair. The rebuttal could be that these functions might well be desirable but not medically necessary or that existing standalone technology exists to perform these functions. It could also be debated that while independence and quality of life issues are important, should public funds be apportioned to provide access to leisure activities ex. TV
Another concern is that, if funding and reimbursement for advancing technology is limited what will happen to research and development in this field. Have we come as far as we can?

Conclusion

Tailoring a power wheelchair to match the technology available to the client's unique needs and preferences is an inherent part of ensuring a successful outcome in terms of function, performance and independence. More options than ever before exist in terms of what can be customized i.e., input devices, programming parameters themselves, shortcuts, displays, IR capability…As a result, it is fair to say, that in the majority of cases some degree of customization will provide a solution to allow some degree of mobility and independence for even the most challenged individual.

D4 - Beyond the Owner Manual:
Essential Education & Training for Manual Wheelchair Users

Kendra Betz, MSPT, ATP

Individuals who use a manual wheelchair (mwc) as a primary means of mobility require comprehensive education and training that extends far beyond the information provided in the wheelchair Owner Manual or User Guide. It is a known fact that mwc users often experience upper limb pain and injury that can result in significant functional impairment with a negative impact on quality of life (1). Specific skills training and education can decrease the risk of injury while optimizing functional ability and independence which ultimately supports the mwc user to lead a healthy and productive lifestyle.

What's in that manual wheelchair Owner Manual anyway? While highly variable from one manufacturer to another, the information in the manual is valuable and should be reviewed with the mwc user and any individuals who will be providing support surrounding wheelchair use. Most manuals provide a diagram of major wheelchair components and accessories, instructions for basic operations, guidance for adjustments inherent to the product, general maintenance procedures and warranty information. Awareness of topics covered in the manual promotes efficient management of the wheelchair and encourages safe operation which is a critical consideration relative to risk management. For understanding the nuts and bolts (literally) of the manual wheelchair, recommendations are consistent with the age-old adage, "when all else fails, read the directions".

Awareness of the information contained in the Owner Manual is critical, however much of what the client needs to know is not contained there. Necessary education and training for mwc users is both directly and indirectly associated with actual wheelchair use. Topics directly pertinent to wheelchair use include wheelchair selection and configuration recommendations, accessories & options, mobility progression ranging from basic propulsion to advanced skills, pressure management, transfer techniques, wheelchair management such as stowing in a vehicle and equipment maintenance. Topics that are indirectly pertinent to mwc users include exercise (targeted stretching, strengthening and conditioning), upper limb protective techniques, 24 hour positioning, environmental modification and travel. Too often, many if not all of these topics are neglected when manual wheelchairs are provided to either novice or experienced mwc users.

The aim of this session is to empower rehabilitation professionals to understand and provide the comprehensive client education and training that is critical for mwc users. Results of a comprehensive client evaluation and assessment must be incorporated into equipment recommendations and therapeutic interventions. Provision of thorough education and training for the mwc user requires expertise and collaboration from an interdisciplinary team. Specific recommendations for development and implementation of a mwc education and training program follow. Photos, video and case examples will be utilized during the presentation to illustrate key points.

Manual Wheelchair Selection & Configuration
Wheelchair technology options available, dimensions and configuration recommendations to include seat width and depth, front and rear seat to floor heights, back angle, back height, frame lengths, front rigging configuration, wheel base orientation, and wheel position. Example: Rear wheels forward in horizontal dimension, optimal orientation in vertical and lateral dimensions (2-11).

Accessories/Options
Wheels, tires, pushrims, armrests, side guards, cushions, back supports, push handles, luggage carriers, casters. Example: Ergonomic pushrims to address repetitive strain injury related to propulsion (12).

Wheelchair Mobility Progression
Basic propulsion, turning, varied environments, uneven terrain, inclines, thresholds, curbs, steps, stairs, advanced wheelie skills. Example: Propulsion with smooth long strokes that limit high impact on the pushrim and minimize frequency (1, 13).

Transfer Techniques
Wheelchair to and from varied heights and surfaces including vehicles, floor and other equipment to both directions. Emphasize upper limb protective strategies and biomechanically advantageous techniques (i.e. “keep it down” approach). Example: Transfers from a forward flexed position optimal (14), level or downhill transfers recommended (15).

Pressure management
Seating system selection & interface, skin compromise risks, pressure relief options. Example: Teach forward lean and side lean pressure release techniques.

Equipment Management
Basic functions, maneuvers and positioning, vehicle stow techniques, accessories/additional items. Example: Review and teach options in vehicle stow techniques for different frame styles.

Equipment Maintenance:
Rear wheel alignment, caster function, tire pressure, equipment hygiene.
Example: Educate about effects of tire pressure (16-17) as well as rear wheel and front caster malalignment.

Exercise
Target approach for stretching & strengthening to combat effects of mwc use, conditioning for weight management. Example: Stretching of anterior musculature, strengthening of posterior musculature (1).

Upper Limb Protective Techniques
Propulsion, transfers, all activities from a seated position. Example: Reaching with the humerus externally rotated during elevation to avoid impingement.

24-hour positioning
UE support, postural alignment & gentle stretching, alternative surfaces. Example: Strategic pillow propping in bed to avoid direct pressure on shoulder (1).

Environmental modification
Home, work and leisure considerations. Example: Address computer work-stations for ergonomic support, kitchen organization for convenience and upper limb protection.

Travel & leisure:
Public transportation, hotels, mobility skills, equipment options. Example: Review process for air travel to include expectations, transfers to aisle chairs, equipment management. Provide strategies for hotels (i.e. removing bathroom doors to improve accessibility, furniture arrangement).

Clearly, there are many topics to be addressed surrounding education and training for mwc users that extend far beyond the wheelchair Owner Manual. Coordination of a thorough program requires an interdisciplinary team approach with the client maintained at the center of that team. Provision of comprehensive education and training to mwc users encourages optimized independence, pain and injury prevention, and improved quality of life.

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D5 - Seating and Mobility for Early Intervention

DELIA "DEE DEE" FRENEY, OTR/L, ATP, ATS
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Introduction:

This presentation will take a clinical look at seating and mobility for the birth to 3 year old population. Many babies and young children have been identified with neurological and orthopedic diagnoses that have seating challenges. The commercially available strollers and car seats often do not accommodate the infant with special needs. Premature babies are being treated in Newborn Intensive Care Units (NICU) around the country with uncertain outcomes for developmental milestones. Three case studies will be presented of infants/ children of different ages and disabilities and sizes.

Gross and Fine Motor Development:

Gross Motor: In development of normal children , from 6-10 months a child should be able to get to sitting without assistance, 7-8 months of age a child develops the ability to demonstrate balance reactions in sitting and 8-9 months will sit without hand support.

Infants who have independent sitting abilities will eventually sit hands free to allow manual skills to develop. Head and trunk control are key components to successful sitting and many of our special needs young infants are struggling to gain one or both of these skills.
Sitting is the position that enables an infant to have the ability to view the world and explore both visually and manually. Supported sitting is important especially for our physically challenged infants for fine motor, feeding, respiration as well as a factor in sensory experiences and exploration.

Fine Motor: In supported sitting, fine motor skills in supported sitting begin with grasping a rattle at 4 months and shaking a rattle at 6 months, securing a piece of paper at 5 months and grasping a cube at 6 months. These fine motor skills are tested sitting on a lap, facing a table. Sitting on a lap gives the infant a flexed supported position from head to toe. Full extension or high muscle tone can be reduced in a well flexed supported sitting position.

Unfortunately, the special needs child does not have the ability to independently sit and will often rely on hands to maintain a supported sitting position. They will either hold on to armrests, seat or other stabilizers.

Safe supportive sitting becomes a priority over performing any fine motor activities. Infants are often seen "posturing" head and neck muscles to fix their stabilized position which also makes it difficult for safe feeding.

Personal and Social :

At the 5-9 month level, infants lift arms to parent and they begin to play pat-a-cake. These skills require hands free supported sitting. Lifting arms is an anti-gravity movement that challenges head and trunk stability. Playing ball is a 9-15 months skill that may require 2 hands as does drinking from a cup beginning at 9 months.

Case Studies:

Clinical case studies will be presented to discuss the problems this young population faces.

The first infant is a triplet who has cerebral palsy spastic quadraparesis. He is a delightful social little boy who was born one month prematurely. His brother and sister are normally developing.

The second child has spina bifida and has an older brother with autism. She is an active child who is mobile on protective flooring but is not independently mobile outside in the community.

The third child has arthrogryposis and although she is older, her size is very small and finding a supportive insert is very challenging. She will be moving independently in a power chair.

Conclusion and Summary

Present size and future growth for seating and mobility pediatric equipment has been a challenge for both the clinician and the rehab manufacturer. The professionals and clinicians who work with these young children should work together. In a team effort, therapists should share some of their experiences and challenges to guide manufacturers in designing and producing supportive seating and interfacing them with appropriate mobility bases to meet the needs of this population.

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Plenary Session - To Push or Not to Push: An Interactive Discussion on Manual vs. Powered Mobility Choice

Kendra Betz, MSPT, ATP, Mark Schmeler, PhD, OTR/L, ATP

The decision to prescribe a manual wheelchair or a power mobility device is a challenging one. While the primary recommendation is to base the decision on functional need as identified by a comprehensive client evaluation and assessment, a wide range of factors play into the decision. In addition to the primary diagnosis, the disability specific prognosis, medical co-morbidities, and risks of secondary issues must also be considered. Not only is function surrounding the operation of the wheelchair a critical factor, mobility in and out of the device, skin protection, endurance, upper limb preservation, transportation, and accessibility and mobility in multiple environments must also be included in equipment selection considerations. To further add to the complexity of balancing client choice with clinician recommendations, eligibility guidelines from the designated funding source often heavily influence the form of wheeled mobility recommended. Fundamental to this challenging decision is the lack of objective definition of the term “functional” for the individual with a mobility deficit.

This session will feature an interactive discussion highlighting key considerations and thought provoking insights regarding the challenging decisions surrounding manual vs. power mobility recommendations. The audience will gain an increased understanding of evidence based practice in wheeled mobility, critical evaluation of various mobility options, recommendations for equipment trials, client education topics, and considerations for advocating for appropriate funding of optimal wheeled mobility devices. Individuals on a consumer panel will share their insights and preferences for their choice for a manual wheelchair or powered mobility device.

Questions that may be addressed via presentation & discussion are:

- Is there an agreed upon definition and/or determination of functional mobility?
- Does using a power wheelchair really result in client weight gain? Is pushing a manual wheelchair enough exercise to control weight?
- What are key considerations for a client transitioning from manual to power?
- What are the environmental considerations for recommending one mobility option over the other? (i.e. indoor maneuverability vs. outdoor varied terrain)
- What objective measures are useful for determining manual vs. power selection?
- What tools & programs exist to evaluate and teach wheelchair skills?
- What research is available to support one recommendation over another?

- What are the perspectives of consumers who have chosen one option over another?
- How should funding source guidelines be incorporated into recommendations?
- In addition to wheeled mobility, what is the impact of the manual vs. power choice on other functional skills? (I.e. transfers, pressure management, reaching, etc.)
- What is the correlation of pain & injury to wheelchair use? Will use of one option over result in different outcomes relative to pain?
- Are there recommendations for one choice over another relative to specific populations (i.e. age, length of time in wheelchair, disability specific considerations)?
- What are the perceptions and stigmas associated with manual vs. power mobility use? Are they the same or different for consumers, rehabilitation professionals, and the general public?
- When is it appropriate to consider alternative mobility options? (i.e. hybrid devices, accessories, mainstream innovative technologies)

Following this presentation and discussion, the audience will have 1) an increased understanding of the multitude of considerations for recommending and selecting one wheeled mobility option over another, 2) an improved awareness of what aspects of the decision are supported by published research and 3) a greater ability to provide comprehensive information to clients to facilitate their choice to pursue either manual or powered mobility options. While the recommendations to push or not to push are often challenging, consideration of the individual's unique needs, preferences, and comprehensive functional goals will guide this choice.

E1 - How Effective is Your Seating Prescription? Using Case Histories to Generate Evidence

Clare Wright, Noel McQuaid

Introduction

Any seating system can only be effective when it is appropriately matched to the needs of the user. Therefore we must be skilled at assessing and using assessment findings to prescribe the most suitable seating system for each individual[1,2,3]. In addition, we are expected to use evidence-based practice which supports our decisions and demonstrates the effectiveness of our prescription. This can play a crucial part in our justification for funding. However, while there is plenty of published material on the intended outcomes of seating and postural mobility equipment (improved function, comfort, mobility and reduced pressure and skin breakdown[1,4,5]) the evidence base is singularly lacking when it comes to the effectiveness of seating and postural mobility equipment on a more specific level i.e. do our clients measurably benefit from their seating systems and postural management equipment? We may all be pretty confident that they do, but how can we as busy therapists generate, and more importantly, record this evidence?

Generating Evidence

There are a number of levels of evidence which are considered worthy in establishing an evidence base. These range from meta-analyses of randomised controlled trials (the “gold standard” of research evidence) to anecdotal evidence. However using formal research to produce evidence can be a time consuming and difficult process. So how can we more easily generate the evidence we need?

Using Case Histories to Generate Evidence

Somewhere towards the lower end of the evidence hierarchy is expert opinion, which includes case histories. Some case history protocols are scientifically rigorous, but are time consuming to carry out. Others are simpler in their format, and reflect the good practice of logically recording assessment, setting goals, intervening and measuring outcomes. This is where the Leckey Case History Programme fits in. A complete package has been designed to assist busy therapists to systematically and logically record case history evidence and includes Cover letter, Introduction, Information Collection Guide, Case History Write-up Guide, Case History Report Form (figure 1), and Case History Consent Form.

LECKEY®

Case History Report Form

Child details (* required)

Therapist details (* required)

Product details (* required)

LECKEY®

Case History Report Form

Assessment details – complete before using the product

Date / /20

LECKEY®

Case History Report Form

Review Assessment

Date / /20

Figure 1

Aims and Objective Setting in Case Histories

One of the most fundamental aspects of an effective case history (i.e. one that demonstrates outcomes) is the ability to formulate appropriate aims and objectives. Aims are the equivalent of our therapy destination, while objectives are the steps needed to reach that destination. So in order to show outcomes, we need to be very clear where we want to go, and how we're going to get there. And in order to know whether we have reached our destination and/or interim stops (or not), objectives need to be specific, measurable, achievable, realistic and time-bound.

Practical Session

Therapists attending the workshop will obtain a hard copy of the Leckey Case History package and can apply it to a client on their caseload. Supported with practical examples and actual case histories, therapists will have the opportunity to discuss the package and consider the assessment, goal setting, outcome measures, review and recording processes in the context of their own clinical experiences.

Further Benefits of Case Histories

Therapists who have completed case histories previously have used them as evidence of their continuing professional development (continuing education units). They can also be a means of identifying areas for further formal research. Where case histories are completed on Leckey products (and where consent is obtained) we can publish them on our website - here they are available to assist other therapists and families who are looking for evidence-based information. Finally, the process of critical thinking used in the case history process will facilitate the development of skills which can be applied to any population, assistive technology, or indeed clinical decision, particularly where justification of funding is required.

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E2 - State of the Literature on Power Seating Functions: What is the Scientific Evidence?

Brad E. Dicianno, MD; Jenny M. Lieberman, MSOTR/L, ATP;
Mark Schmeler, MS, OTR/L, ATP, PhD;

Power seat functions are commonly prescribed to treat medical conditions and because consumers desire the ability to change body position independently. However, not all uses of these devices are medically appropriate, and reimbursement by insurance companies is often difficult to attain.

A wheelchair users' survey study[1] examined the utility of various wheelchairs and their features in users with Amyotrophic Lateral Sclerosis and found that tilt, recline, and elevating legrests were the most desirable features on a power wheelchair. Tilt and recline provide a means for gravity assisted positioning of the trunk or head[2, 3]. Postural alignment is especially important for children or adults with progressive or static scoliosis[4]. One benefit of proper alignment is enhancement of function[5], including reaching, balance, completion of ADLs, maintaining safe positioning during braking[6, 7,] and achieving developmental milestones8. A standing device can also increase vertical ADL access.

Proper postural alignment may also aid in maintaining vital organ capacity and has several physiological implications[5, 9]. Using a combination of tilt, recline, and power legrests can help to manage orthostatic hypotension[2]. Visual orientation, speech, alertness, arousal, respiration, and eating can also be enhanced[3, 10] due to proper positioning[2, 11]. Some bowel and bladder management techniques require supine positioning[12]. Wheelchair standing devices can also decrease the incidence of urinary tract infections and facilitate bowel and bladder function[20]. With standing, users note a decrease in constipation and an increase in the ability to empty one's bladder[21-22]. This is essential due to the frequency of UTI among wheelchair users[23]. Elevating legrests are also often necessary to manage edema[15]. They are most effective when used in combination with tilt to allow elevation of the legs above the heart.

Positioning may also be necessary in order to improve transfer biomechanics. Better position not only reduces the need for assistance but also reduces the risk of injury to caregivers[13, 14]. Seat elevators can also facilitate transfers between surfaces of different heights which may decrease strain on the upper limbs[35]. There is also a lower rate of contraction and torque applied to the pathologic joint when transferring from a higher surface[36-38]. Reaching overhead can result in shoulder pain[39] and can directly impact muscle load[40-41]. Raising the overall seat to floor height with a seat elevator can discourage overhead reach, thus decreasing strain and load.

Offering a client the ability to change joint angles can allow independent management of tone. Because tilt systems maintain joint angles and thus muscle fiber length, they are often useful in those with spasticity[2]. Clinicians should consider recline systems on a case by case basis for management of spasticity since in some individuals they can increase tone in the spine extensors[3]. A wheelchair standing device can also be used to manage tone[20-21].

Static seating systems can sometimes lead to contractures, especially in the hamstrings[3]. Power elevating legrests are often medically necessary to manage contractures or orthopedic deformities[15]. Elevating legrests can provide passive range of motion to the joints[3]. Dynamic weight bearing, like that which occurs with a standing wheelchair device, has been shown more efficient in preventing bone density loss, another high frequent complication among those who utilize a wheelchair throughout the day[24-28]. The risk of fracture from osteoporosis is high once mechanical loading has been removed[29-31]. Incorporation of a dynamic standing program can increase bone density over a six month period[32], more than with supplement use or a static standing program[24].

Tilt and recline features provide the most pressure relief when used in combination. We will discuss the research on various angles in the research literature. A wheelchair standing feature can also decrease pressure on the ischial tuberosities[33-34]. Power features, when used to promote dynamic sitting tolerance, are useful to assume many essential daily postures. The concept of "dynamic sitting" is endorsed in the ergonomic field[16] and should be applied to wheelchairs. Additionallly, the number of transfers needed can be reduced.

Tilt, recline, elevating legrests, standing, and seat elevators have many medical purposes that can be justified with clinical and research literature. Provision of one or all of these features may improve an individual's overall quality of life by increasing function and reducing pain, and reducing or delaying secondary complications from long term wheelchair use[17, 18].

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E3 - Preparing Letters of Medical Justification - Are We the Best We Can Be? Can We Do Better?

Sharon Pratt, PT, Sunrise Medical

We have all learned that as funding changes, product changes and the role of the clinician becomes more critical in the world of getting necessary equipment for our clients - One thing is obvious. We must improve our skills in the area of justification and documentation with no extra time!

This interactive session will review key components that we should all consider that will support the need for Wheelchairs and Seating systems through Third Party Insurers. Some key principles will be reviewed and examples of some poor letters of justification will be shared. Audience participants will be invited to make corrections and leave the room with immediately applicable letter writing skills

Things to think about in preparation for putting together the documentation necessary to justify whatever it is that we are asking for funding assistance for…

Who will review the letter or request for funding?

Will this person have a medical background and will they have an understanding of the Durable Medical Equipment (DME) world that we live in every day?

Remember that the reviewers' primary role is to ensure that the coverage criteria/rules are met as well as to manage the budget. It is our job then, to write justification that clearly shows the client is eligible – meeting the rules – and we are asking for the least amount that is essential for this client to have the independence that this funding source provides for…

We must establish a professional appearance with the report – The letter should be clear, easy to read and to the point – stick to the facts and reduce the story is my theory!

Assume the reader knows nothing of the client, the condition, or the requested equipment. Prioritize information and keep the facts simple and focused. So often I have reviewed letters of medical necessity that were like a life story but never got to the point...

Clarity is critical: An example of a paragraph supporting a skin protection and positioning cushion;

…….Susan, a client who presents with a 9 year history of Multiple Sclerosis had a Stage 2 pressure ulcer on her Right Ischial tuberosity in 1999. She now has a healed stage 2 pressure ulcer. She is therefore at the highest level of risk for recurrence. She collapses into a posterior pelvic tilt and right pelvic obliquity when sitting unsupported after 5 minutes……On evaluation she has no fixed postures. Susan therefore needs a cushion with a minimum of 21/2' of depth of immersion for optimal redistribution of load from the ischials to more tolerant surrounding areas. For pelvic stability, she needs a firm base of support that also maximizes her seated footprint in the area of her femurs. During simulation of multiple seat cushions and pressure mapping readings, she has the greatest surface contact area, greatest distribution of load and lowest peak pressures with the selected product. This is the minimum equipment essential for Susan. In the absence of this, it is my professional opinion that Susan will be likely to have a recurrence of her Pressure Ulcer………

This could be summarized as highlighting

- The equipment needed
- Assessment findings dictating the parameters necessary
- How everything else was ruled out – evidence
- The functional/medical consequences of the client not getting this recommended equipment

As opposed to… Susan presents with MS. She was diagnosed 9 years ago. She had a stage 2 PU in 1999 which is now healed. She presents as a sacral sitter leaning to her right side. She needs a brand xxx cushion for skin and positioning.

Can you see the difference? How many times do we see documentation like this?

Consider the Funding Source and the Rules it has in place.
Whether the funding source is Medicare, Medicaid, AADL, ADP, NHS, or a Private Insurance plan, there will be rules for defining what Durable Medical Equipment is and how to establish that the requested equipment is medically necessary.
We must also be prepared to explain that the recommended equipment is the least costly alternative.

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E4 - The Propelling Technique's Impact on the Positioning for the Elderly Wheelchair Clients

Maria Amnell

A wheelchair prescription consists of many steps. One very important step and unfortunately often forgotten is to analyze the individual's ability to propel the wheelchair in an effective and functional manner. A wheelchair is a mobility aid and should be adjusted for both comfort and function. With other words a combination of a supportive position for both activity and easy propulsion.
The young wheelchair client will most certainly train propelling skills, but for the elderly, this is usually not the case. The basic conditions for an elderly person are not the same and both the wheelchair settings and technique must be adjusted accordingly.

Our job is to provide the wheelchair client with a stable, comfortable and functional seating position, from which he/she can function. Consequently should mobility training (mobility pattern, technique and skills) be a natural part of a wheelchair assessment just as it is for a client starting to use leg prosthesis.

A correctly supported position will simplify the propulsion. But is the optimal seating position also the optimal functional position? As soon as the wheelchair client starts to propel, it will influence the position. The seated position should be dynamic and the propulsion should not have a negative affect on the posture.

Comfort is a very important feature for acceptance, endurance and function.
Discomfort and pain will influence the position and often results in immobility. How can we create comfort? A stable base and balanced trunk combined with an anatomically contoured seat/backrest are three important parameters. But probably time and variation are even more important. No position remains comfortable over time.

A wheelchair assessment should include a physical evaluation of the client. We need to evaluate joint mobility, deformities; rigid or acceptance for corrections, pain, trunk balance and muscle strength. This evaluation put together with your knowledge about the clients disability, personal needs, environmental challenges and the goals are a good base for selecting an appropriate wheelchair.

Before a wheelchair is chosen and adjusted you need to set goals together with your client and/or assisting persons. Practical goals what the client would like to achieve and manage with the new wheelchair. They are important for the following up and motivating for your client. A mix of both short and long term goals is recommended. In this way it will be easier for the client to become aware of the progress. Sometimes a short term goal has to be changed to a long term. Make shore you have an agreement with your client about any alterations.

Most modern wheelchairs are designed to enable adjustments for both the seat unit and the propelling unit. This gives us lots of opportunities, combinations and readjustment possibilities. But it also put higher demands on the therapist's skills. It isn't enough with anatomical and biomechanical knowledge, we also need a technical understanding and being able to use Allen keys, wrenches and screw drivers correctly.

If we look at the wheelchair adjustment from the propulsion aspect, what do we need to consider?

A person, who is using both push rims, needs to have the distance from shoulder to hand on push rim adjusted accordingly to his/her mobility and strength. The smaller distance the better reach, but at the same time it will put greater demands on the wheelchair user's range of motion. A larger distance can be more functional for an elderly wheelchair user with reduced functions.

Many elderly are only using the front part of the rim, which is sloping down. This result in a kyfotic mobility pattern often combined with sliding problems. The grip should start as high as possible on the push rim, be released so the arms can fall down and relax before the next grip. The arms should have a similar "swing pattern" as when walking with the exception that the arms will swing parallel. Also analyze the client's trunk mobility pattern. Make sure he/she is not pressing towards the backrest when propelling. If he/she is leaning heavily towards the backrest to improve the muscle power required for the propulsion, the wheelchair will be in a high risk of tipping posterior. I usually recommend the client to do a small forward weight shifting simultaneous when the arms extend. In this way the client will use the bodyweight to facilitate the "arm push" and the risk to tip over reduces considerably.

For clients with hemiplegia we must consider both adjustments for the arm/hand and leg/foot. This is a more difficult propulsion technique than using both arms. The coordination arm/foot required, can be difficult to perform after a brain injury.

The foot propulsion is more important than the hand. Therefore I usually recommend starting the propulsion training with just using the foot and adding the arm when the client has control over the foot work. Before you start the propulsion training, check the client's shoes. They must have a good fit and grip to the surface. Unfortunately the grip can change on different surfaces. Also make shore that the seat cushion accommodates for the height difference which is required to support the paretic leg/foot and at the same time allow the other foot floor contact. The seat height should be set so the client can put the heel on the floor, just in front of the wheelchair. The client must learn not to take long steps forward since it will influence the hamstrings tension which leads to a rotation and posterior tilt of the pelvis and finally results in a sliding forward position. The step should instead go further in under the seat.

Try to influence the client to use the lateral side of the foot. This will facilitate a normal position of the leg when "propelling". Clients using the medial side of the foot are in a big risk for inward rotation in knee and femur.

Sliding is a problem in most seating positions. An inadequate propelling technique will most certainly progress the sliding problem.
An able person may not see sliding as a problem because he/she constantly change and correct the position. A person using a wheelchair has the same needs to change the position. Sliding can be one way to relieve an aching hip, a tired back or to compensate for reduce balance. But have we analyzed the client's ability to correct the position? Correcting the position and transfer technique to and from the wheelchair are two important functions that also should be a natural part of the assessment.

No wheelchair client should be trained to correct the position by pushing towards the armrests if he/she at the same time can't flex the trunk forward and hold the head low in order to minimize the weight load for the arms and shoulders. A better technique which suits many elderly is to lean over to one side and simultaneous bring the opposite body half back on the seat by rotating the pelvis. Thereafter lean to the other side and repeat the procedure. This is a very gentle technique for the skin and power saving for the arms and shoulders.

Another reason that can make your client inactive or slide is that the wheelchair has too much rolling resistance. If he/she has to put in a lot of effort in order to propel, the trunk will be more involved which can trigger spasticity, involuntary movements or force the client to compensate by using the backrest as a support when pushing the hand rims. A client who is foot propelling may chose to go reverse instead of forwards, which force him/her to rotate the trunk and head in order to see where to go.

There are many factors that influence a wheelchair's rolling resistance. The two most important are the horizontal setting of the rear wheels and the tyre air pressure.
The rear wheels are sometimes set further back for safety reasons. But what are the consequences? How will this influence the client's ability to propel and secondary the seat position? I would like to claim that a client who can improve the propelling technique will also reduce the risk for tipping over and manage to have the rear wheels set further forward. With propelling technique training you can achieve a "win-win situation"; an improved technique with less effort will save energy for other activities and the risk of developing secondary injuries is reduced. The wheelchair should of course be equipped with anti tippers.

Pneumatic rear wheel tyres need to be inflated regularly, both for safety and wheelchair performance. When the air pressure diminish the wheel lock grip also diminish which can have catastrophic consequences when doing transfer to another seat. With an uneven air pressure in left and right tyre, the chair will constantly move to one side when propelling. When we bike ride, we usually pump the tyres at proximally 75 - 80% of the total air pressure left. By then we experience it heavy to pedal. At the same time it is not unusual to see elderly wheelchair clients with only 50-60 % air pressure left in the tyres. I always recommend solid tyres for clients who can't inflate the tyres themselves or don't have anyone that will do it on regular basis.

The rear wheel camber angle is not often discussed when we choose a wheelchair for an elderly person.
But just a few degree of camber will have several positive effects on the wheelchair performance and propulsion. The chair will be easier to turn, the push rims are closer to the body and the wheelchair stability is increased.

When the client has a good understanding of the technique you can continue by training practical skills such as to propel around a corner, making turns, passing a cerb, open and close a door. The degree of skills depends on the client's personal abilities and needs.
But did you know that the most trying part when propelling is to get the motionless wheelchair into motion? The client can save a lot of energy from just being able to keep the chair in motion, instead of doing "stops and starts".

Why is training wheelchair propulsion technique for elderly clients not as common as gait training with clients starting to use leg prostheses?
Is it because we therapists lack the knowledge and experience from propelling a wheelchair in an ergonomically and energy saving way?
How can we adjust the wheelchair correct and train a person with a Stroke or Parkinson if we haven't analyzed and examined the client's abilities to propel?
How can we expect the client to remain in a proper position if we don't analyze his/her mobility pattern? A child with cerebral palsy, an adult with spinal cord injury and an elderly with a stroke do not have the same physical conditions and abilities for propulsion. We need to do thorough physical evaluation and set relevant goals to combine the most appropriate mobility pattern with the wheelchair settings. And remember, an adjustable wheelchair can always be readjusted if the first setting doesn't function as expected or if the client's conditions will change.

Our ambition is to create the best for the client. A proper position which allows activities such as easy propulsion will also reduce the risk for secondary injuries. It is very common that elderly wheelchair clients develop pressure sores, a kyphotic back, pain, and reduce the tolerance for a seating position. Also internal complications may arise. A poor position has negative affects on breathing, digestion and bladder control. All these complications are common geriatric symptoms that might appear due to other reasons. But a poor position in an inappropriate wheelchair will unfortunately speed up the negative development.

There are many aspects to consider, both physically and environmentally.
In most cases we need to compromise. But it doesn't mean that the result will be poor, if you and your client are aware of how and why specific choices are made.
As long as we focus on the client's comfort, mobility and function we can't go wrong.

A college once said: "A wheelchair should fit like a shoe".
I would like to add that when you try a pair of new shoes, you also stand up and take some steps. Because you know that when walking, your opinion about the shoes might change. You want to feel stability and comfort. Simultaneous you try to put your mind in the environment where you will use the shoes. You can say this is the technique you should adapt for the wheelchair assessment.

My advice to all wheelchair prescribers is to adjust a wheelchair to your own needs. Analyze and improve your propelling technique, both for arm and foot propulsion. Train practical skills in order to understand the technique. Then it will be much easier to analyze the wheelchair client's mobility pattern, adjust the wheelchair accordingly and give adequate instructions. Who would like to take driving lessons from a person with no experience from car driving?

References, in no particular sequence:

Åke Norsten, wheelchair user and instructor, Rehab Station Stockholm
Bo Lindqvist, wheelchair user and designer, Etac
Countless of courageous wheelchair users
My own and colleagues experience and analyze

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Bengt Engström, Ergonomic Seating, a true challenge. Posturalis books

F1 - Writing Effective Justification Letters – A Common-Sense Approach

Les Smith, Senior Occupational Therapist
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For therapists new to the area of positioning and mobility, writing justification letters can be a daunting experience. This instructional session will employ a common-sense approach to writing justification letters. Examples of sound and poor justification letters will be presented. Participants will learn how to use guidelines, knowledge of the clients, clients' goals and common-sense when justifying medical equipment to a funding source.

F2 - A Case Study of Dakotah: Dramatic Difference Between Seating and Positioning in an Everyday Wheelchair vs. a Sports Wheelchair

Mary Beth Kinney, ATS, CRTS; and Kay Koch, OTR/L, ATP

Dakotah is a young woman with a muscle disease of unknown diagnosis; it most resembles limb girdle muscular dystrophy. She has weakness and joint contractures with secondary respiratory involvement. This session will describe her background and history, the exams and tests used to identify this diagnosis, and other demographics attributed to this type of muscular dystrophy. This session will focus on her mobility, seating and positioning needs in her everyday power wheelchair and in her power sports wheelchair.

Dakotah has been in a power wheelchair since she was 11 years old. She underwent a spinal fusion with Harrington rods in 1999. She is currently followed by cardiologists for cardiac arrhythmia. In 2003 she was hospitalized with pneumonia. In 2004 she started playing power soccer. She is currently attending college and has some attendant care to assist with her physical needs. She uses a different chair for everyday and has another power wheelchair for power soccer.

Her passive range of motion is restricted at all end ranges with severe contractures in her hips and knees bilaterally. All sensation is intact. She is dependent for all transfers. These factors influenced her seating and positioning needs.

In her everyday wheelchair, Dakotah is dependent upon her power tilt for repositioning, and pressure relief. She also uses the tilt for balance due to the weakness in her trunk musculature. She drives with a joystick and uses a separate switch to access the power tilt. Dakotah uses a contoured pressure-relieving cushion combined with a solid curved back. She uses laterals when she is fatigued and has having difficulty sitting upright.

In her power soccer wheelchair Dakotah needed a vastly different seating system. She did not want the option of sitting in different positions as she does in her everyday wheelchair; instead she requested a specific position that she would remain in when she played soccer.

At the first consultation, Dakotah was placed in the position she desired to be in while playing soccer. Mock trials of available seating components were tried. Dakotah specifically requested adductors with attaching hardware in addition to a pelvic belt to secure her lower body. Dakotah needed to keep her trunk over her thighs to stabilize her upper body. The challenge was to keep her body in this position as she actively played soccer.

Multiple options were considered for Dakotah.A foam in place back kit was ordered with the intention of filling in the large gap behind her back. The foam in place did not fill out enough to provide the stability needed. We then ordered a foam block that could be carved around the space behind her back. The foam could not be kept in a fixed position and caused Dakotah to have too much movement in her upper body. She did not feel the stability she needed to perform her best on the court.

The third trial included a solid, curved back with hardware that could lock in two positions that proved to be what Dakotah wanted in her positioning in her power soccer wheelchair. Different chest straps were tried as well to keep Dakotah's trunk against the back. Dakotah was able to drive her power soccer wheelchair at high speeds with sharp turns. She felt confident to be an aggressive player on the court.

The positioning trials lasted over two months with input and ideas from her coach, a teammate and five co-workers from Mobility Designs. Although Dakotah is pleased with her positioning in both her wheelchairs, we are ready to address any seating and positioning changes she may need as her physical needs change.

The session will have pictures of her equipment with time for feedback and suggestions from attendees.

F3 - Understanding Home Care and Therapeutic Mattresses (Support Surfaces)

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Introduction

Support Surfaces (therapeutic mattresses) are used in hospitals, care facilities and in the home. The National Pressure Ulcer Advisory Panel (NPUAP) defines a support surface as: "A specialized device for pressure redistribution designed for management of tissue loads, micro-climate, and/or other therapeutic functions."

Just as there are differences in the design, fabrication and function of wheelchair seat cushions, there are wide ranges of products that fall into the support surfaces category. Support surfaces are made from many of the same materials that are used in the seat cushions that you are probably familiar with. They include foam, air, gel, water and other materials used as a sole material or in combinations. In addition, there are numerous powered systems that provide alternating pressure, low air loss and postural movement as well as pressure redistribution.

Unlike wheelchair cushions, some models of support surfaces are available as add-on units that are placed on top of a standard mattress. These are called mattress overlays and are commonly used to upgrade the standard mattress with improved protection and support. This concept is a bit foreign to those of us who deal primarily with wheelchair cushions. It is not a bad idea, but is a remarkably different thought process than we are used to. It would be like adding a second layer on top of a standard cushion. There is no reason why that would not work, but it is hard to imagine it in the wheelchair cushion world.

Background

In the US, support surfaces are funded by private insurers and by the Medicare system. They are currently divided into three funding categories, Group 1, Group 2 and Group 3.
On seeing these groupings for the first time, one could logically assume that the group 1 support surfaces would be widely different and inferior to group 2 surfaces and that the group 3 surfaces would be even better. In reality, there are many group 1 surfaces that can do an excellent job in managing skin integrity. The Medicare groupings describe a combination of physical and performance characteristics. A good guideline for sorting out the products within the groupings can be found on the website for the Wound Ostomy and Continence Nurses Society (WOCN). The information can be located using the following link: http://www.wocn.org/pdfs/WOCN_Library/Fact_Sheets/medicare_part_b.pdf

Another organization that has a primary focus on support surfaces is the National Pressure Ulcer Advisory Panel (NPUAP). Their website www.npuap.org contains a great deal of information on support surfaces, clinical care and other issues.

The NPUAP has provided quality educational programs, valuable educational materials, expert opinions and consultations on policy issues impacting wound care, and focused attention to research needs in this specialized field. With the support of the manufactures, they created the Support Surface Standards Initiative (S3i). Their work has produced a Terms and Definitions document that is up to date and a valuable tool and have funded work in the development of testing fixtures and protocols. This work is now being shared with the international community that has formed an ISO working group for the development of standards for all variants of support surfaces.

Currently the NPUAP is working with similar organizations world wide as well as fully supporting the international efforts to develop standards for support surfaces. Much of the work that has been done relative to the development of standards has had it's beginning as a working group supported by the NPUAP.

Regulations

There are a series of new regulations under consideration in the US and Canada. One of these is the addition of much more stringent fire regulations. Tests have been developed to subject a support surface to the type of flame source found in burning clothing. In the US, home mattresses will be required to withstand this difficult test. At this writing, it is unclear if the therapeutic support surfaces will be excluded from this requirement.

The problem with adding strict flammability requirements for support surfaces is the same as it is for wheelchair cushions. Flammability is and issue, but in many instances, the change in materials that will allow a cushion or mattress to pass the flammability regulations will also negatively impact the therapeutic properties of the device.

Skin Ulcer Incidence in Hospitals

Another regulation is scheduled for implementation in the US in October of 2008. This regulation cuts additional Medicare reimbursement for skin ulcers that occur post-admission for a hospital stay. This regulation is in response to the disturbingly high number of patients that develop a skin ulcer AFTER they are admitted to hospital.

There are understandably mixed feelings about this new regulation but it is generally accepted as a good idea that may indeed improve the quality of care for at risk patients.

Summary

Therapeutic support surfaces are used in inpatient and outpatient settings. The combination of materials, technology and design produce devices that can significantly decrease the incidence of skin ulcers.

Acknowledgements

Thanks should be given to the following:
1). The National Pressure Ulcer Advisory Panel (NPUAP, @ www.npuap.org?)
2). Wound Ostomy and Continence Nurses Society (WOCN @ http://www.wocn.org)
3). Hickory Springs Manufacturing, (www.hickory springs.com)

F4 - Selecting the Appropriate Seat Cushion – Is it Really That Much of a Challenge?

Sharon Pratt, PT, Sunrise Medical

It seems that the process involved in selecting clinically appropriate seat cushions for our wheelchair seated clients has switched gears somewhat from a purely artistic approach to perhaps a more evidence based or science based thought process. This is a welcome change in our industry and one we should all embrace.
Regardless of what funding source we are accessing, we have to be accountable with our documentation of the assessment, goal forming and product selection process.
We've done the hands on evaluation and collected the facts. The goals have been defined. We have heard the science - Now what?

This session will take participants through the critical steps of cushion selection. We will take into consideration body shapes and sizes as well as the science of materials. There will be opportunity to use practically and interpret clinically concepts such as immersion, envelopment and magnitude of pressure. Pressure mapping, product and case examples will be used to demonstrate the value of this information to everyday clinical decision-making.

What are we often focusing on when selecting an appropriate wheelchair cushion?

- Stability
- Skin Integrity
- Function
- Comfort and
- Will it be paid for?

Some of the Mechanical Properties that we should think about are

- Load deflection
- Loaded contour depth
  Load redistribution
- Envelopment
- Off-loading and redirection
- Interface Pressure Distribution and
  Heat & Water Vapor Dissipation

What does contour and horizontal stiffness mean to the clients tissue?

- Repositioning or daily activity applies a lateral load to the tissue
- Its often required for a sense of “Functional Stability”
- If the cushion does not accommodate the tissue over time potentially undesirable loading may occur

In Clinic, How can we use this knowledge?

- What style of product do we choose?
- How much maintenance and adjustment is required for it to function consistently over time?

Foam might be the perfect solution…
- What's the life expectancy of this foam?
- What happens if the clients shape changes?
- What happens if the foam breaks down and changes the shape relationship?
- Consider how long it’s required to last?
- What changes are predicted to occur with the client?

Maybe Fluid is the choice…
- Do I have the right amount of viscous fluid?
- When tried – is the client “in it, or on top of it?
- When using air, can the client do the required maintenance consistently?

Load redistribution
The ability of a cushion to manage loads on the buttock tissues impacts tissue health and comfort

Techniques used include:
- Envelopment
- Redirection of forces (including off-loading)

Envelopment
- Capability of a support surface in deforming around and encompassing the contour of the human body.
- An enveloping cushion should have the ability to encompass and equalize pressure about irregularities in contour due to buttock shape, objects in pockets, clothing, etc. Redirection of forces & off-loading
- Choosing where to apply loads on the body is commonly used in prosthetics and orthotics
- Several cushion designs use this approach to reduce ischial loading
- Isch-Dish; Ride Designs
- Contoured systems
- Any system with ‘reliefs’ in a region

Let’s take a look from a clinical perspective at what these terms mean and how we can evaluate cushions in these areas.
- Immersion
- Envelopment
- Magnitude

Immersion
- How far does the client sink in?
  Tools we have to determine this…
- Visual inspection of how much the pelvis, thighs and trochanters are immersed into the cushion
- Pressure Mapping

Envelopment
- How intimate is the shape formed with the clients shape?

What tools have we to determine this?
- Hands and eyes - its difficult to actually feel or see the shape formed when under load
- Pressure Mapping
- Looking specifically at color distribution and gradient

How much does this matter when …..
…Anything that interferes with the conformation is placed over top of the conforming material?
- Chuck pads
- Slings
- Diapers
- The list goes on…..!!!! – We see this in every day clinical practice

We MUST take this on as part of our role in the education of the consumer and caregiver
Magnitude
- How well has the cushion distributed the pressure
- The goal is usually to decrease the pressures on the IT's and spread to areas that can take load

Tools to determine this…
- Pressure Mapping
- Where is the risk site and how high is the pressure there?

Redirection of forces
- Choosing where to apply loads on the body
- Generally we try to redirect load from areas less tolerant
  e.g. the ischials, sacrum and load the areas tolerant of load
  e.g. the posterior thigh, feet and thorax

The BIG Questions –
- Can the client tolerate load for long periods of time on these areas?
- Does the client consistently get put into this shape that has been created for them
- If they need to move – can they?

Is Heat a Problem In Seating?
- Heat is a major non-pressure risk factor for pressure ulcers (Kokate 1995)
- Superficial ulcerations constitute 58% of all pressure ulcers (Barbenel et. al., 1977)

Heat's Effect on Skin
- Heat related metabolic stress in skin increases 43% from 28°C to 34°C (Arrhenius 1889)
- At 28° sudor appears as the body tries to cool itself (Brengelmann and Brown, 1965)

Moisture Lessons Learned
- Sudor, (sweating) Begins at 28°C skin surface temperature
- Moisture changes the mechanical properties of skin
- Decreases resistance to deformation, abrasion
- Increases friction

Heat and Water Thoughts..
- Is the cushion material an insulator or conductor of heat?
- What are the variables? – Clothing – climate- etc
- Is the cushion moisture resistant with and without the cover?
- Is there moisture trapped around the skin surface?
- Incontinent covers – pads – diapers?

Heat…
- The more weight shifting that a person does, the greater the heat dissipation

So, when a client is experiencing and reporting a lot of sweating discomfort the clinical responsibility is to educate and be aware of the impact of the selected materials
- The better the cushion is for envelopment, immersion and magnitude, the bigger the challenge it can be for heat and moisture issues
- Add incontinence to this ……
- There is a greater need for increased frequency of weight shifting

Clinical Summary…Immediately applicable take home messages
- Must do a thorough hands on evaluation of the client for success
- Take the cushions apart and understand how they perform – evaluate them too!
- Take a look at surface tension and have clarity on immersion, envelopment and magnit tude
- What happens when the cover is put back on?
- Don't be afraid of pressure mapping – but learn to use it correctly
- Have a clear understanding of the clients lifestyle choices

Which Cushion to Choose?
- Think about level of stability needed
- What happens when the client moves?
- Level of risk for skin issues?
- Depth of immersion capabilities? - Contact area provided?
- Envelopment - Even pretty colors….
- Magnitude - No red - ?? – Remember – color means nothing
- How easy it is to customize?
- Can the client carry out all functional activities on the selected product
- IS IT COMFORTABLE? …For the client!!

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F5 - Meaningful Modifications

Richard J Escobar, BS, ATP

Introduction:

Assistive devices are being developed every day that greatly enhance a person's life. However, some of these devices may not be considered a necessity to a person's health or well being. Medical justification, especially for recreational equipment, may be very difficult to obtain. However, research has shown that bicycles, tricycles, scooters and walkers provide exercise that can boost confidence, inspire self esteem and help the entire cardiovascular system1. Recreational or exercise equipment is very important to a person's well being but may be the most difficult to get funded.

Background:

Modifications can be as simple as adding a piece of foam over a sharp edge to prevent a minor injury, to a very complex solution preventing a serious wound. No two people are exactly alike; therefore customization or modifications are often needed to optimize function and comfort in many assistive devices. Companies are continually making great strides for supplying off-the-shelf solutions to fit as many people as possible, however funding can still be an issue. If you are unable to receive funding for this equipment, you will need to either self-pay, hire an individual or gather resources and facilitate it yourself. The information provided below is to assist you with acquiring the tools and resources possibly needed and some ideas and plans to self implement the development of an assistive device modification.

Tools of the Trade:

Expensive tools usually work better, however inexpensive tools very seldom get borrowed or stolen. Tool kits can be purchased from auto parts or hardware stores or through the Internet. Listed are desired hand and power tools I recommend;

+wrench set	+hammer	+pliers	+center punch	+metal files
+screwdriver set	+ratchet	+sockets	+Allen wrenches	+wood files
+staple gun	+hacksaw	+awl	+tape measure	+square
+electric drill/bits	+jigsaw	+angle grinder	+bench grinder	+heat gun
+propane torch	+scissors	+gloves	+safety glasses	+dust mask

The tools listed, plus assortments of drill bits, jigsaw blades, grinding & cutting wheels, hacksaw blades and files, will give you plenty to work with. For some of the larger projects, gas, stick or mig welding equipment would be used for the fabrication process. Of course a band-saw, mill and lathe would also add to your enjoyment, but is not necessary.

Materials

Materials for a project can be purchased from your local hardware store, lumber yard or through the Internet. The following websites give good descriptions of various materials and their uses.

+Baltic birch plywood, a good material for indoor use: www.alliedveneer.com
+Aquatek, marine plywood material for outdoor projects: www.alliedveneer.com
+Kydex, very durable plastic material: www.plastxworld.com, www.complexplastics.com
+ABS, plastic material www.tapplastics.com, www.professionalplastics.com
+Polycarbonate, very hard clear plastic www.interstateplastics.com, www.usplastic.com
+Velcro, hook and loop fastener products www.velcro.com

The Actual Work:

There is a catch of course. Who is going to do the work? Most of the projects listed are not that difficult to do. None of the projects I did used any type of lathe or mill to make a special part. The majority of the modifications were done using simple hand and power tools. It just takes some time and effort on your part or the person you have found to do the job. Need help? Colleges or universities are always looking for projects for their engineers. Other possibilities include trade schools, high schools, scouts, senior citizen centers, non-profit organizations, friends, neighbors or relatives.

Some Plans:




Hand-powered tricycles *
These tricycles were made to give mobility to children who were unable to get funding. Besides providing good exercise, these tricycles helped to promote the child's self- esteem. Welding speeds up the fabrication, however it's not necessary.

* Drawings and instructions for these will be provided.

Joystick controlled go-carts

Go-carts boost confidence, giving the individual independent powered mobility. These are modified powered wheelchairs with frame & seating changes. The electronics are relocated allowing for a lowered seating position. Welding would be needed for these.

Scooters & tricycles

These provide good exercise and fun for the kids.

Prone crawlers*

These crawlers provide great exercise while giving mobility to very young children.

Modified toys and switches

Many toys do not provide handles at a good height for children using standing mobility device like walkers. Another problem is that the toy may fall to the floor making them difficult to pick up. Here are various types of switches and battery interrupters.

Walker seats and trunk supports
These components were made to enhance the comfort and functionality of various walkers. They were designed to meet the specific needs of each individual.

Exercise equipment
These provide exercise from a stationary seated position.

Leg Floaters
These are used to obtain a better leg position and give more air flow for tissue healing.

Wheelchair Seating
Custom seating modifications shown are for providing comfort, posture and safety.

Additional modifications will be shown (e.g. a positioning unit for the iGallop (from Brookstone), head and footrest modifications and much more.)

Summary

If you cannot get funding for a desired piece of equipment nor have the funds to purchase it, make it yourself or find someone who will. There are many schools looking for projects for their students to work on. Also, plenty of people are out there just waiting for a meaningful project that will help someone else. You just need to locate them.

References:

1. © 1998-2008 Mayo Foundation for Medical Education and Research (MFMER). Mayo Clinic staff, Jul 26, 2007

G1 - To Seat or Not to Seat? That is the Dilemma

Scott Pickett, ATS

Introduction:

The field of assistive technology and its prescription is one that requires us to make many important choices. Many of these choices are not clearly defined by the academic world and therefore those persons prescribing assistive technology are often presented with a dilemma. One of the most common among these is the decision to do aggressive corrective seating and positioning (most often in a wheelchair) or to do minimal correction and adopt the "Let em' Fly" philosophy. Both are valid philosophies applied by the brightest minds in our industry and many classes are presented each year including case studies to promote both concepts. The problem for most of us is that making the decision to seat or not to seat can have long lasting effects on our client's functional abilities and orthopedic condition either positively or negatively depending on what we decide. The concept of properly evaluating a client is not unlike a risk/benefit analysis in any other industry as we try to determine what the most likely result would be of each course of action considered before we make any decision or provide any equipment. Of course this would all be much easier if we just had a time machine or crystal ball!

The Client:

Clients with mild orthopedic and tonal abnormalities often do not require seating systems with components that are aggressive enough to negatively affect function. As tone, reflex patterns and/or postural deformity increase, the need for more aggressive positioning components can start to interfere with functional goals. As the severity of a client's problems increase further, the risks of skin integrity problems and loss of function increases and often sitting tolerance decreases making the components of a wheelchair seating system even less effective. The clients that most often present us with this seating dilemma are the ones with the most functional goals along with the most severe physical complications.

The Wheelchair:

The wheelchair and its seating system is one of the most often provided types of equipment used to help support an abnormal posture or orthopedic deformity and at the same time it is asked to allow movement to help facilitate function. These two goals are often in conflict and many times one goal is sacrificed for the benefit of the other. When did the wheelchair stop being a mobility device and start being an orthotic device? At times it would appear that we ask too much of the wheelchair and forget about its primary function.

Many forces act on a person's body 24 hours a day but during our waking hours we may be affected by these forces to a greater extent. Gravity is the one constant force that affects us all 24 hours a day, however, it has a much more negative affect to our orthopedic condition when we are upright in either a sitting or standing position. Changes to our orientation in space by the use of tilt and/or recline systems can alter the affects of gravity to lessen its negative affect and even allow us to use gravity as a beneficial tool to aid in positioning but doing so may limit a person's visual field or compromise feeding, swallowing or respiration.

Tonal, movement and reflex patterns are also at their highest levels during the waking hours which complicate and sometimes limit our ability to do aggressive corrective or accommodative seating in the wheelchair.

The amount of time that a person spends in a wheelchair varies greatly between clients but generally the more severe the physical problems that a person has the shorter their sitting tolerance. This means that they spend a much larger percentage of their day somewhere other than in their wheelchair making it extremely important to look at what other positioning interventions are being used during their 24 hour day. The Chailey approach to 24 hour positioning is a well recognized philosophy and John and Liz Goldsmith from the UK along with many others have long been proponents and pioneers in the area of alternative and sleep positioning.

Standers:

Standers are another daytime positioning device that can be very beneficial to our clients. This type of intervention does however suffer from the effects of gravity although on different parts of the body and since it is also a daytime use device it is affected by the higher levels of tonal, movement and reflex patterns. Some models do limit mobility and possibly function however mobile standers and wheelchairs with standing functions are available to help eliminate this shortcoming. This device is usually prescribed for use over a very limited portion of the day so it cannot replace the positioning functions of the client's wheelchair entirely.

Sleep Positioning Systems:

Sleep positioning systems have some benefits that cannot be achieved in any of the other types of equipment. The negative affects of gravity are much reduced and gravity can more easily be used as a beneficial positioning force. One of the biggest benefits from sleep positioning is that since it is used when the client is asleep the negative tonal, movement and reflex patterns are greatly diminished or eliminated. The system does not have to fight against these negative forces and therefore can be more successful with less risk of skin integrity problems. A relaxed body is much easier to hold and correct. Another benefit of sleep positioning is that there are no functional goals to conflict with the client's positioning goals. Our clients are not expected to think, work or communicate while they sleep. Time is another benefit of sleep positioning as many of our clients spend more time in bed than in their wheelchair. We no longer have to try to overcome many hours of poor positioning at night with a few hours of aggressive positioning in the chair during the day.

Different options such as Symmetrisleep, Dreama, Chailey, Leckey and the Moonlight systems are now commercially available to make sleep positioning more repeatable, more effective and easier to use.

Dynamic Seating Systems:

Although not a new concept, dynamic seating has recently seen some major advances in usability, adjustability and commercial availability. For many years a clinician has been required to decide whether to hold their client aggressively for positioning or to forego aggressive positioning to allow the client more freedom of movement for function. Dynamic seating systems are a way to allow the client to be positioned more aggressively and still allow them freedom of movement in a controlled manner. The results of a recent study by Dr. Michael Hahn at the Montana State University will be presented at this conference. The study reports on the efficacy of use of the new dynamic seating system called the Kids Rock Active wheelchair (invented by Wayne Hansen of Kid Kart fame) on a population of pediatric patients with Cerebral Palsy. The preliminary results of the study and the anecdotal information provided by parents who's children were involved in the study appear to show significant benefit to the use of dynamic seating in areas of range of joint motion, muscle strengthening, bowel and bladder function and social interaction. Some subjects even started sleeping through the night for the first time.

Summary:

It is important to remember after this discussion that every client is an individual and each case that you deal with must be given the same in depth consideration. 24 hour positioning is a concept that is thought by many to complicate the lives of the caregivers to the point that they are overwhelmed and I feel that it could not be further from the truth. 24 hour positioning and all of the other interventions discussed are a way to help spread the workload of corrective positioning equipment over a much longer time span and possibly reduce the complexity of the equipment that can be the most difficult to deal with. Also, the decision to do corrective positioning at any time during the day is always one of risk/benefit analysis. Many of my clients have fairly significant deformity, contracture and spasticity but have no positioning components on their wheelchair at all. They are very independent and functional because they have no support and their condition does not seem to change much over the years. I also have clients that, despite having incredibly aggressive positioning components on their wheelchair, their condition continues to decline each time I see them. Remember to always analyze the risks and benefits of both using a component or piece of equipment and NOT using that same component.

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G2 - Custom Seating Fabrication Controls & Techniques Assuring Successful Outcomes Before You Build

Richard Pasillas

There are a myriad of steps to undertake before a custom seating system is either fabricated, mixed or measured. From the needs assessment, the mat analysis and the funding appraisal, all impacting factors are itemized and weighed in relation to a person's physical requirements and their affect upon the shape, structure, composition and cost of the finished product. However, the manner in which this collated data is converted into custom build specifications is critical to achieving, in three-dimensional form, what the assessment team envisions as fulfilling the positioning and functional needs of their client.

An itemized list of components combined with relative angles, body measurements, photographs and/or a plaster mold remains insufficient to successfully complete this transformation, if the production staff is not also in-tune with the image of how the finished product should be structured. Both ends of this service delivery spectrum must share the same perspective of what constitutes appropriate alignment and orientation, relative to the forces of: gravity, ischemia, motion and stability. This collective approach should be grounded in the principles of consistency and repeatability, so that any person can start and any other person can finish the fabrication process, whilst at every step, yielding the same results within benchmarks of quality, composition and the effectiveness of form.

Whether our clients present with high-tone, low-tone, asymmetric or surgically altered physical profiles, this fundamental philosophy of consistency and repeatability must also include rock solid agreements regarding: how posture is quantified as being "the best possible arrangement" for the client; how a mold is oriented and aligned for production; what constitutes balance, equilibrium, stability and the perceptions of comfort or discomfort; how pressure is partitioned to prevent ischemia producing conditions; and which transitory forces will eventually interact with these, sometimes divergent, variables.

It is clear that without group consensus regarding the afore mentioned factors, no band of co-workers can produce a steady flow of clinically successful seating environments. However, depicting through visual language, a blueprint of intent, will make it easier to pinpoint the framework for "best practice" by diminishing all confusion between an intangible list of clinical goals and their transformation into physical form. Building a group language that brings instant recognition to both form and function can also create a level of teamwork that promotes efficiency and expertise from start to finish.

Consider for a moment, that the pelvis can move or migrate in twelve distinct directions within the confines of a wheelchair. If all team members acknowledge that only 10 of these movements can be influenced, restricted or controlled by the seat cushion and also understand which topographic structure can moderate which movement (and to what degree of benefit) then each member can readily decipher which combination of shapes provide the optimum configuration for any given client. Their conclusions are further reinforced by the assurance of quantifiable results no matter the size or shape of the cushion and no matter the size, shape or diagnosis of the client. The dimensional and material specification may change from client to client but the expected performance parameters will remain predictable.

The same is true regarding the design and shape of the backrest. If we know the complexity of the physical distortions and the force controls required to create anatomical stability, equilibrium and balance, then we should also know that only a few combinations of contoured shapes will produce the desired results. Being able to discern how, when and where to apply a preventative measure, a diversionary channel or a corrective force is not only crucial to the structural elements of a safe and secure seating environment but also brings clarity to the details of the fabrication process itself.

Let's consider again, that we want to neutralize a lateral flexion bias created by scoliosis, pelvic obliquity or neck distortion. In spite of popular belief, temporal pads, trunk pads, hip guides, pommels and the anti-thrust wedge may block movement and may enhance stability, but they do not diminish the imbalance created by destabilizing forces. To accomplish that goal we must first find the correct line of gravity within which equilibrium and certain stability are established. Furthermore, the obverse of disclosing this point of balanced harmony is recognizing under which circumstance a supporting buttress will introduce more harm than good. In other words, we can't merely interject these posture altering interventions at will, but as professionals, we are obliged to temper their inclusion with practical limits and concrete reasoning for implementation. As an industry we must establish and adhere to a kind of "Posture Diversion Protocol" that distinctly specifies: how much time, over what range of distance and to what degree of pressure, can an enhanced alignment or diversionary force be safely applied to a mal-aligned posture without endangering the skin integrity, orthopedic health or functional abilities of our clients.

Beyond the made-to-measure and foam-in-place fabrication techniques are the processes that require a full-body mold. There is no doubt that the body mold (either plaster or digital) is an excellent tool for recording the enhanced realignment of a given client. Unfortunately, the second most common misunderstanding within the industry is that the finished mold represents the most optimal postural alignment for that subject. That, however, may not always be true, especially when physical distortion and tonal imbalance are difficult to decipher within the short time frame of a posture enhancing simulation.

Now, consider all the techniques and devices promoted within this industry that are intended to dramatically "tip" a person's body alignment to one side or the other (either during or after the molding process). The implication is that, sometimes, optimal head and shoulder alignment requires additional gravity force that is unattainable using conventional positioning techniques. This inability to laterally tweak body posture beyond an applied counterforce of three-point-pressure is further undermined by the practice of plumbing the mold for vertical alignment before it is removed from the simulator. In reality, the best method is to determine the bridge-point of equilibrium so that no physical exertion is required to maintain a long-term sense of quiet repose. The ideal location to make that determination is from the posterior aspect of the mold, after it is removed from the simulator. From that vantage point, structural indicators within the mold can be used to easily plot the bridge-point of equilibrium. When the determination of optimum alignment is approached in this manner the end result is that contact pressure is more accurately repartitioned over a broader area of support and all other positioning pads become reduced to secondary directional guides rather than primary motion inhibitors. Looking more broadly, the risk of ischemia producing contact pressure is virtually eliminated.

Through these and other interconnected strategies we assure to our clients and all other participants, a uniformity of service in the approach, execution and delivery of any custom fabricated seating system. At the same time we can rest assured that by this detailed methodology we consistently factor in the most important, physically intrinsic and environmentally extrinsic variables, affecting cushion shape, orientation and performance. The ultimate goal for these controls and techniques is to consistently hit the high marks of excellence and best practice with every custom seating challenge we encounter, especially the most challenging and complex.

The Topographic Delineation Fabrication Process, Posture Diversion Protocol, and perspective on Selective Repartitioning (of ischemia producing pressure) are just a few examples of creating a language and philosophy of quantifiable consistency for translating assessment data into production protocols. How the provisional teachings of this industry evolve to incorporate these precepts is still uncertain. However, what is clear is that this integrated team approach is easily transportable to any working arrangement and there is no doubt that instilling a cohesive agreement amongst all participants within the chain of hands-on involvement is a highly reliable mechanism for assuring successful outcomes before the product is built.

G3 - The Development of International Standards and Testing Methodologies for Support Surfaces

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Introduction

There is currently an international working group that is focused on the development of international standards for support surfaces. This is a new working group that has been formed as a part of the International Organization for Standardization (ISO). Members of this group come from many countries and disciplines. The group consists of researchers, designers, clinicians, therapists, wound care nurses and manufacturers. The early stages of the development of international standards for support surfaces is making good progress thanks to the past and current efforts of groups in the US and worldwide.

It is important to know that the development of testing methods and protocols is ongoing but is in the beginning stages and is not complete or ready for adoption by funding or regulator agencies.

Background

There are a number of characteristics of a support surface that could be measured as part of standard. The initial work in this area has identified some of these properties such as the ability to distribute pressure, control heat and water vapor transmission, and control the magnitude of shear force transmitted to the user. Products intended for use by people at-risk for pressure ulcers should meet minimum performance criteria for these characteristics as well as a minimum level of durability.

Tests designed to differentiate between support surfaces will need to be applicable on several general types of surfaces including: elastic foam, viscoelastic foam, fluid filled, low air loss, and alternating pressure surfaces. Recent efforts of the National Pressure Advisory Panel (NPUAP), European Pressure Advisory Panel (EPUAP), The International Organization for Standardization (ISO), RESNA and other organizations have resulted the development of a list of potential test methods and terminology that may be appropriate for evaluating support surface performance. When these tests are developed they will work to characterize performance and durability. The proposed tests will need to be validated in multiple laboratories worldwide prior to being recommended for use by regulatory bodies or funding agencies.

Test Development

Some of the areas of measurement that are candidates for development as part of a standard are:

Immersion	Measures the ability to distribute pressure (how far does the person sink into the support surface?)
Envelopment	Additional measurement of pressure distribution and the degree of conforming to body shape (How well does the support surface conform to the shape of the person?)
Microclimate	Heat and Water Vapor Transmission (Does the support surface create or control heat and moisture?)
Shear	A Horizontal Stiffness and Sliding Resistance test would measures the sliding resistance of the person on the support surface .
Lifespan Testing	Measures the stability of the properties of the support surface with use. Not only durability or lifespan, but also control of bacterial contaminants, resistance to urine and fecal exposure flammability other environmental factors.

A good deal of work has been started in the US and other countries, notably Germany, Japan and the UK. The National Pressure Ulcer Advisory Panel (NPUAP) has spearheaded work here in the US. Their organization formed the Support Surface Standards Initiative working group (S3i). They have produced an excellent Terms and Definitions document that helps us all speak the same language. It can be found on their web site (wwwnouap.org). In addition they have supported the beginning research in the development of test fixtures and procedures.

One very important NPUAP accomplishment is the development of a series of test dummies for use in testing. The dummies are anthropometrically correct versions of a 50% adult male, a 95% adult male and a 5% adult female. Some preliminary testing has started to explore the use of the 50% adult male dummy. There are several labs in the US that have a current version of the dummy and are using it to help develop some of the methods of testing outlined above.

Adult Male Dummy

Some development has begun on measuring immersion, envelopment and microclimate. These tests springboard off of similar work developed as part of the ISO Wheelchair Seating Standard (ISO 16840) and similar efforts in Japan and Germany.

The draft immersion test uses the NPUAP adult dummy and measures the depth of immersion into the support surface at six points, three on the torso and three on the pelvis segment. Measurement is performed using a digitizing arm and has produced some encouraging data in preliminary trials. The measurement points are set up in a triangle and by analyzing the data it is possible to determine depth of immersion and also orientation of the body segments.

Measuring envelopment is more difficult. One of the promising concepts is to use imbedded pressure sensors on a shaped indenter. The pressure sensors will measure the amount of contact and pressure between the indenter and support surface showing both contact area and load.

Microclimate testing for seat cushions has been under development as part of ISO 16840. It was included in part 2 of that standard as one of a battery of tests. It was recently pulled from part 2 with work proceeding as ISO 16840-7 and will be a stand alone part of the standard. The test fixture for support surfaces may evolve to a different shape, but the principles of use will probably remain the same. The German working group has also developed a microclimate test fixture that shares many of the same concepts.

Microclimate test fixture

The proposed testing for shear testing also comes from work completed in ISO 16840-2. That standard has a test for horizontal stiffness and sliding resistance. This test will be adopted for support surfaces with the probable inclusion of a different indenter shape and a much larger test fixture.

Lifespan testing is an important area for the standard. Much work has been done in this area for other products and the group working on this element of the support surface standard has a good deal of information and procedures to draw from.

Summary

Although much work has been completed over the past few years, the development of an ISo standard for support surfaces has really just begun. Several potential tests have been identified for possible development, validation and inclusion into the standard but it is important to understand that the work is not complete and is not ready for adoption by regulatory or funding agencies,

Acknowledgements

This work could not proceed without the dedication and support of a group of individuals, organizations, and manufacturers. Without their generous support the standard effort would not be possible.

G4 - Linking Patient Coverage Criteria with Clinical Justifications for Seating and Mobility Products

Elizabeth Cole, MSPT

Many Medicare coverage policies require the patient to meet specific functional and medical criteria to qualify for certain seating and mobility products. These criteria may stipulate that the patient have a certain type of disability, specific diagnoses or certain functional capabilities. It is important to be aware of these criteria in order to justify the most appropriate equipment for our patients. It is also important to recognize that many of these criteria do not involve every aspect of the patient's functional needs. For example, some criteria are diagnosis driven. A patient may, in fact, have one of the qualifying diagnoses, but may actually have functional capabilities that enable them to use a lower cost alternative. On the other hand, some criteria are much less specific. It may be difficult to objectively demonstrate that the stated criteria are met, but you can show that the patient requires specific features that are only available on this type of product. We must make sure that our patients meet the required criteria, but we must also still make clinical decisions based on our best judgments of medical necessity. This session will discuss some of the current Medicare coverage criteria and appropriate clinical justifications for a variety of manual, power and seating product categories.

Mobility Devices

To qualify for any mobility device under Medicare's guidelines, the patient must have a limitation in mobility that prevents him/her from completing daily activities within the home. Choosing the most appropriate mobility device is a process of eliminating all lower cost alternatives as sufficient solutions to accommodate this functional limitation. We should first consider a cane or walker, then a manual wheelchair, then a scooter and finally a power wheelchair. Does this mean that the patient must be totally non-ambulatory to qualify for a manual wheelchair or even a power wheelchair? Or that a patient must be totally dependent in manual mobility to qualify for a power chair? No, the patient may in fact have some ability to ambulate, however, if he/she is unable to complete daily activities around the home safely, in a timely manner and without injury or medical complications while ambulating, then wheeled mobility may be appropriate. Similarly, a patient who can marginally propel a manual wheelchair may qualify for a power chair if manual mobility is non-functional or unsafe.

It is important to document that all lower cost alternatives have been tried and/or considered before providing the product selected for that patient. The details required in this documentation can vary depending on the patient's diagnosis and functional capabilities. For example, in the straightforward case of a patient with C4 complete quadriplegia, it would be unnecessary to document that a cane, walker, manual wheelchair or scooter have been ruled out, as the need for power is quite obvious. On the other hand, in the case of a patient who is partially ambulatory but needs a power chair due to, say a cardiac condition or severe arthritis or respiratory limitations, we need to document the definitive reasons why he/she cannot complete daily activities using a cane, walker or manual wheelchair. These reasons should be specific to that patient and to their individual functional activities, limitations and capabilities.

Lightweight Manual Wheelchairs

Although SADMERC hopes to have a new code set for manual wheelchairs in place within the year, we are currently limited to codes that were established using the technology of the early 90's. The criteria for some of these codes are easy to meet, while others are somewhat non-specific and difficult to match to today's products. It is fairly straightforward to qualify for a standard or lightweight manual wheelchair. Any patient who meets the basic coverage criteria for manual mobility qualifies for a standard manual chair. To be eligible for a lightweight manual chair under Medicare, the patient must be unable to self-propel in a standard wheelchair in the home and must be willing and able to self-propel in a lightweight wheelchair. This may be due to decreased strength, endurance, cardiopulmonary health, age or other medical complications.

For a highstrength lightweight chair, Medicare criteria states that the patient must be able to self-propel, spends at least 2 hours per day in a wheelchair and cannot use a standard or lightweight chair to perform frequent ADLs. It is important to document why the patient cannot use the lower cost alternatives. Do they lack the strength or endurance to push the weight of a lightweight throughout the day? Do they experience pain when attempting to complete their daily activities using a lightweight? Since the weight difference between these 2 chairs may be small, this may be difficult to justify and document quantitatively. It might be easier to justify the highstrength lightweight based on features required by the patient that are unavailable on a lightweight wheelchair. This could include a specific seat or back size required by this patient to achieve and maintain optimal posture and function. Or this patient might require a specific seat to floor height for transfers or foot propulsion, or a seat to back angle for postural maintenance or control.

Medicare's eligibility for an ultralightweight manual wheelchair is based on individual consideration, so how do we justify these products for our patients? We might document specifically why the patient is unable to propel the weight of a highstrength lightweight chair to perform their daily activities, however, as above, this might be difficult to objectively measure. Instead, we might look at the features available on the ultralightweight which are not found on the highstrength lightweights, including an adjustable axle plate, a specific seat and/or back size, a specific (or adjustable) seat to back angle or back angle. Documentation should include the diagnosis, duration of the condition and the prognosis as well as the patient's abilities and limitations that relate to seating and mobility. The degree of independence in the wheelchair and a description of routine activities performed from the wheelchair should also be listed. The specific features required should be noted along with what these features do, why the patient needs these features and exactly how they will improve this patient's function.

Power Wheelchair Bases

Medicare has given us 5 Groups of power wheelchairs which are differentiated by performance characteristics such as speed, battery range, obstacle climbing and stability on an incline. Each group is divided into several subgroups, which include patient weight, type of seating and power seating options. To qualify for any power wheelchair under Medicare guidelines, the patient must have a limitation in mobility that prevents completion of daily activities within the home and we must rule out a cane, walker, manual wheelchair or scooter as insufficient to accommodate this limitation. Again, the patient may in fact have some ability to walk with an assistive device or limited ability to propel a manual wheelchair, but is unable to complete ADLs around the home safely, in a timely manner and without injury with these modes of mobility. It is critical that all of these lower cost alternatives have been tried and/or considered before a power chair is prescribed.

Under Medicare, no further criteria are required for either a Group 1 or Group 2 power chair with a Captain's seat. How do we differentiate between the two if the criteria are the same? A Group 1 chair might be sufficient for the patient who just needs basic mobility to go short distances on level surfaces, usually indoors. This person might be partially ambulatory and only require power periodically throughout the day for certain functional activities or for longer distances. Group 2 power chairs might be appropriate for the patient who requires power mobility much or all of the day for functional activities. These clients might have a light to moderate activity level and may encounter mildly challenging terrain. They may also have impairments that require (or will require) power seating, rehab seating or a drive control other than a joystick. This might include many of our patients who require power due to cardiopulmonary conditions, orthopedic conditions such as arthritis, obesity, age, balance, stability or endurance issues.

To qualify for any Group 3 power chair, the patient must have a neurological condition, a myopathy or a congenital skeletal deformity and must be evaluated by a licensed certified medial professional experienced in seating and wheelchair evaluations. However, this does not mean that any patient with one of these conditions should automatically receive a Group 3 power chair. There are patients with these diagnoses whose medical needs could be sufficiently and appropriately met with a Group 2 power chair. An appropriate patient for Group 3 chair is generally dependent on power for all mobility both indoors and outdoors. They may have a more active lifestyle and require additional speed, battery range and/or performance to meet their functional needs. Significant physical limitations caused by neurological, orthopedic or muscular conditions might require the additional durability, as well as the powered and non-powered seating options, suspension and drive controls of the Group 3 chairs.

Group 4 power chairs are not covered by Medicare, since the differentiating performance factors are not considered to be necessary for mobility within the home. However, these chairs may be appropriate for non-Medicare patients who are using the chair all day, every day, both indoors and outdoors and who lead active lifestyles that might involve school, work and/or personal and community activities. These clients require higher speeds, longer battery ranges, more powerful motors and increased stability over challenging terrain to allow them to safely complete their daily activities in a timely manner. Group 5 power wheelchairs are pediatric chairs. To qualify, a patient is expected to grow in height.

The subgroups for weight capacity (standard, heavy duty, very heavy duty and extra heavy duty) are based on patient weight. It is important to note that to qualify for a power chair in a specific weight category, the patient must be within that weight range at the time of evaluation. Under Medicare, there is no allowance for any potential weight gain or loss if the patient is close to the minimum or maximum.

Power Wheelchair Seating

Medicare recognizes two basic types of seating styles – Captain's seats and "rehab seats" (seat frames which accommodate sling upholstery or solid seats and backs). There are no additional criteria to qualify for a Captain's seat. However, these systems range from small "one-size-fits-all" scooter-type seats to those with higher quality foam, and some contour and positioning options. It is important to match the patient's specific seating needs to the best type of Captain's seat. In general, appropriate clients for this seating have some independent movement and are not at risk for skin breakdown. They are able to maintain optimal posture and balance and perform functional activities while sitting in standard seat sizes with minimal contour and positioning.

Rehab seats provide many more positioning options, ranging from a simple solid seat and back to a complex system with lateral, medial, anterior and posterior secondary supports. They are available in multiple sizes and often include an adjustable seat-to-back angle. Rehab seats are appropriate for the more involved client who requires specific seat and/or back sizes, a specific type of cushion and back, positioning supports, seat to back angles and/or contours for function, posture and comfort. They are generally using the power chair for all mobility needs throughout the day.

It is critical to recognize that to qualify for a rehab seat, the Medicare patient must also require a skin protection and/or positioning cushion. Here is where it can get "sticky", since eligibility for cushions and backs are, for the most part, diagnosis driven. Any patient can qualify for a skin protection cushion if there is a past history or a current skin breakdown. However, if they are only at risk for breakdown due to absent or impaired sensation or an inability to perform a functional weight shift, they must also have one of Medicare's specific "qualifying diagnoses". Similarly, to qualify for a positioning cushion, the patient must have significant postural asymmetries due to a specific list of qualifying diagnoses. If a patient does not have one of these diagnoses, they will not be eligible for these cushions and backs. It is important to include in the documentation not only the specific diagnoses for that particular patient, but also the specific reason why they require this type of support surface. Do they require a skin protection cushion because they are unable to perform a functional weight shift? Or because they have decreased sensation? What specific postural abnormalities will be addressed by the positioning cushion? Remember that if a patient does not qualify for a skin protection and/or positioning cushion or only needs a general use cushion, he/she will not qualify for a rehab seat on a power chair.

The only powered seating systems currently covered by Medicare are tilt, recline or tilt and recline combinations, and the clinical criteria for any of these options is the same. To qualify, the patient must be evaluated by a licensed certified medical professional experienced in seating and wheelchair evaluations. In addition, he/she must be at high risk for a pressure ulcer and unable to perform functional weight shifts or must use intermittent catheterization and cannot independently transfer or needs tilt and/or recline to manage spasticity. How do we choose the correct system when the Medicare criteria are the same for any tilt and/or recline system? Again, we must look at each patient's specific needs. Although they may technically qualify for a combination system, the power seating needs of many patients can be sufficiently met with tilt only or recline only. A combination system would be appropriate for the patient who cannot achieve adequate pressure redistribution with tilt or recline alone. It might also be appropriate for the patient who uses tilt for the primary means of weight shift because of tone or postural issues, but also requires recline for periodic changes in position and/or ADLs.

Our ultimate goal is to provide the equipment which will best meet our patient's functional and medical needs. In order to do this we must be aware of the required criteria and correlate this with our best clinical decisions based on sound evaluations. The key to demonstrating this to our funding sources is through our documentation. It should be clear through this documentation exactly how this particular patient meets the criteria and specifically how this equipment will meet their clinical needs and improve their function. It is important to remember that the medical reviewers have never seen this patient. It is up to us to provide sufficient details to demonstrate the specific medical need for the prescribed equipment.

Plenary - Darius Goes West: Working as a Team To Provide a One of a Kind Wheelchair

Kay Ellen Koch, OTR/L, ATP

Inspired by MTV's popular "Pimp My Ride" show, 15 year old Darius Weems and his dedicated group of counselor-friends at the Athens, Ga.-based Project Reach organized an expedition via RV from Athens to Los Angeles and back. The odyssey's multiple aims included publicizing Duchenne Muscular Dystrophy demonstrating that youth like Darius can achieve beyond others' limited expectations. Their ultimate goal was to reach Los Angeles and convince MTV's hit show, "Pimp My Ride," to customize Darius's wheelchair. The emerging moral here is that you can trust in the kindness of strangers but not in certain cable networks.

The kindness of strangers back in Atlanta, Georgia included a custom rehab technology company, a manufacturer's rep, and a custom car designer. While Darius was on his adventure a wheelchair was being "pimped" for him. The team collectively made sure the wheelchair would be a perfect fit, while adhering to the manufacturer's warranty and the creative direction of the custom car designer. Additions to his required seating system and power tilt included custom made spinners, a Play Station 2, a cell phone, 13 inch flat screen television, and a stereo system complete with speakers encased in a custom made, and custom painted shell. What was created was truly a "pimped- a- plenty", one of a kind accessorized and customized wheelchair. Even the shroud was painted Lamborghini orange.

The team worked tirelessly to produce this wheelchair in 3 weeks.
Darius' ultimate wheelchair ended his ultimate road trip. The crowd including national and local celebrities gathered to watch the unveiling. Tensions mounted as the last minute touches were put on the power wheelchair. The CRTS had measured Darius over 3 weeks ago, and the wheelchair was set based on these measurements. There could be no certainty that Darius would fit into the wheelchair and that he could access the joystick. Even in the best situations, a final fitting allows adjustments to be made. Since this was a total surprise to Darius, the final fitting was to take place in front of hundreds of people, who were not familiar with the intricacies of providing custom mobility. The delivery went smoothly, Darius not only fit into the custom wheelchair, but could access the joystick and drive it right away.

This epic journey is captured in a documentary, Darius Goes West. To date this movie has won an unprecedented 25 film festival awards. All profits from the documentary will be donated to Charley's Fund for DMD research in hopes of finding a treatment or a cure for this disease.

This session will show you the wheelchair, and clips from the film.

For the first time since this disease was described by French neurologist, Guillaume Duchenne during the 1860's, scientists are inching closer to a major breakthrough. A Dutch biotech firm, Prosensa is conducting human clinical trials of a therapy called exon skipping. This approach would transform DMD into the much milder form of Becker muscular dystrophy. Another biotech company in the United States, Asklepios, is conducting a replacement therapy trial that aims to get a healthy copy of the defective gene into all the body's muscle cells.

‘Quality of life is currently the only “treatment” for DMD’ (1), and a fully loaded pimped out one of a kind power wheelchair helps too.

(1) The Darius Goes West story is a feature-length documentary created and directed by Logan Smalley, a recent special education graduate of the University of Georgia who is now pursuing his Ed.M. at Harvard University.

www.dariusgoeswest.com

www.charleysfund.org

www.mdausa.org

www.prosensa.eu

www.askbio.com

www.mobilitydesigns.com

www.quantumrehab.com

Poster Presentation - Rocking Chair Exercises as a Training Method for People with Physical Disabilities

Marju Huuhtanen, Kristiina Niemelä

ABSTRACT

The purpose of this instructional session presentation is to demonstrate the rocking chair exercises as a training method for people with physical disabilities.

The rocking chair exercises and training is registered trademark (Keinutuolijumppa®). There are ten different movements:

1. Lift the knees up one after the other.
2. Do a "skip".
3. Straighten the knees one after the other.
4. Straighten both your knees at once and press the soles of your feet on the floor one after the other.
5. While rocking press your heels and toes on the floor by turns. As you rock backward lift both your knees up.
6. Hold your back away from the chair, hands on the top of thighs.
7. Lift your knees up and push your knees down with your hands.

Shift your weight forward, keep your hands on the arm rests. Push your hands against the arm rests and raise your bottom away from the chair.

8. Keep your right knee straight. At the same time lift the bent knee up in time with the rocking.
9. Raise one arm up from the front and straighten the opposite knee.
10. Place one foot on the foot rest, the other on the floor. As you rock backward, lift your legs up and then bring the other foot down on the foot rest.

The exercises could be put into practise without expensive equipments and staff in home and institutes. It is possible to do alone or in a group. It is fun, simple, safe, comprehensive and suitable for everyone without skill or fitness affirmation. There are many variable elements in the program. There are movements for all muscle groups, different purposes (relaxation, exercising, stretching). The intensity and duration are adjustable. The effectiveness of the rocking chair training is under evaluation at the moment.

Poster Presentation - I Love My New Chair, But How Do I Get Inside My House?

K. Paul Jensen

ABSTRACT

Seating and Positioning is an important first step to restoring mobility and functionality. Assuring that the equipment selected for the patient enables the functionality desired is usually the first priority of the end user. A wheelchair of any type that does not allow the user to perform the activities he wants to engage in is likely to sit in the corner. A wheelchair that cannot even get through the front door of the home will likely stay in the car or the garage.

Residential homes are not required to follow the ADA Accessibility Guidelines. Most residential homes are not built with wheelchair use or disability in mind. For a new wheelchair user, many times the first home accessibility expert to enter the home is their therapist or wheelchair supplier. Regardless of formal training in home accessibility, these are usually the first people to walk through the rooms of the wheelchair user's home with an idea of the space needed to function in a wheelchair and are viewed as experts.

Presentation will provide guidance to therapists and suppliers on how to perform an effective home evaluation, how to make effective suggestions for modifications of a home, and how to help a homeowner prioritize the home modifications that are needed.
Presentation will illustrate modifications requiring remodel or construction of the home as well as available products that can be used in the home.

Poster Presentation - Evaluating the Characteristics of a New Wheelchair's Adjustable Back Support

Shigeo Nishimura, Tatsuo Hatta

ABSTRACT

A new seating system that features an adjustable back support has been developed to suggest a new sitting posture. We have proposed the "Active Balanced Seating" system as a new seating concept for wheelchairs. The goal of the system is to ensure the proper alignment of head-neck. To investigate which back support features provide proper head-neck alignment, we compared two new adjustable back support wheelchairs with a conventional wheelchair. One of the new wheelchairs (Nissin Medical Industries, NA406D) had a tension adjustable sling seat with back support pipes tilted at 10 degrees at a height of 240 mm from the seated reference point. The second new wheelchair (NA406A) had straight back support pipes. The conventional wheelchair (NA123U) had straight back support pipes with a fixed sling seat. 25 able-bodied university students participated, each sitting in each of the three wheelchairs in five ways (with or without adjustment). The adjustment was individually adapted for each person from the view point of the system with the emphasis on finding the most comfortable position. The back view of was scanned with the TRiDY non-contact 3-D measurement system (JFE-techno-research) and an exact 3-D model was constructed using RapidForm2006 (INUS-technology). The side view of the 3-D model was selected for measurement. We measured the angle of the back support. The pressure pattern of the seating surface was measured with FSA (VERG INC). Three major structures were identified from the 3-D model of the two new wheelchairs, namely the angles of the thoracic line, pelvic line, and lumbar line. However in the conventional wheelchair, only two structures (thoracic and pelvic line) were identified. The localization of the center of pressure was found on a point on the lumbar line of the new wheelchairs. We speculate that the combination of these angles contributes to the proper alignment of the head and neck.

Poster Presentation - "Parents' Perception of Wheelchair Selection:" A Qualitative Research Study

Teresa E. Plummer

ABSTRACT

Occupational and physical therapists assist parents in the decision making process of choosing the most appropriate mobility device for their children. The purpose of this study was to begin a dialogue with parents of children who use mobility devices and to explore their inherent decision making process. Qualitative methods were utilized to garner the parents' perceptions of the issues considered during their experiences of wheelchair selection. Information was collected from face to face interviews with 3 mothers. Data analysis revealed several themes shared by all of the mothers. They felt that therapists should be well informed of equipment choices, and make decisions based on the desires of the family. The mothers of children who utilized power mobility felt that seat elevators were very helpful in assisting a child to gain independence. All of the parents felt that the environment presented barriers to mobility. This poster presentation will outline the process of data collection and analysis, presenting the details of the findings.

Poster Presentation - Characteristics of the Seating Buggy's Seating Surface Developed for Severely Disabled People

Tatsuo Hatta, Shigeo Nishimura

ABSTRACT

The objectives of special seating systems for the severely disabled are generally to promote functions of the users. Recently, it has been shown that the Seating Buggy (developed by S. Nishimura) produces functional head-neck alignment for the severely disabled. The Seating Buggy is a wheelchair for the severely disabled and features a wide adjustment range from heights of 120cm to 170cm. Its seating surface is comprised of a sling-seat. Various interface materials are currently in clinical use. The sling-seat of the Seating Buggy and various interface materials were adjusted based on the "Active Balanced Seating" system in a clinical setting. With the Active Balanced Sitting system, the alignment of the head and neck takes precedence over that of the pelvis, which is contrary to conventional seating concepts.
To examine the relationship between the head-neck alignment of people with profound disabilities and the Seating Buggy's seating, we measured its seating surface with the TRiDY non-contact 3-D measurement system (JFE techno-research). Twenty one subjects whose head alignments were poor were used for the purposes of this investigation. The seating surface was adjusted by a seating expert from the viewpoint of the Active Balanced Seating system. Three major structures were identified from the 3-D representation of the Seating Buggy. The angle was measured with reference to the perpendicular line of the 3D representation. The backsupport pipe was fixed at an angle of 26 degrees. The angle of the thoracic line (25.2±8.38 degrees) was approximately the same as pelvic line (27.8±13.1 degrees), and parallel to the backsupport pipe. However, the angle of the lumbar line was by comparison about two times greater (52.5±12.4 degrees). It was therefore suggested that an appropriate head-neck alignment for users of the Seating Buggy requires properly adjusting the combination of seating surface angles.

Poster Presentation - Outcomes of an Expert vs Usual Care Intervention for Manual Wheelchairs

Frances Harris

ABSTRACT

The importance of the assistive technology (AT) device acquisition process is well documented. Service delivery has been cited as a key factor in the high rates of device nonuse or abandonment, accidents, and fraud and abuse. This paper reports the results of a quasi-experimental study that compared a "multifactorial" intervention (IG) with a "usual care" (UCG) intervention among 84 veterans at the Durham VA Medical Center. Post-intervention assessments were conducted at 2-weeks, 3-months, and 6-months.

The IG intervention required on average 30 more minutes of therapy compared to the UCG. The IG reported more frequent wheelchair use than the UCG for up to 6-months after the intervention itself (p,0.01). More persons in the IG reported any use of wheelchair inside the home (p=0.008) and there was a trend to more use outside the home (p=0.091). Exploratory descriptive analyses showed a greater proportion of the IG implemented diverse home modifications (e.g., 25% of the IG vs 14% of the UCG reported a ramp), and fewer reported difficulty performing tasks inside the home (e.g., at 6-months 50% of the IG and 27% of the UCG reported difficulty). Slightly fewer persons in the IG reported experiencing environmental barriers outside the home, and when they did experience barriers a greater proportion reported being able to overcome the barrier (e.g., 18% of the IG and 22% of the UCG reported curbs were a barrier to them, but 100% of the IG group reported being able to overcome curbs when encountered compared to 25% of the UCG).

These data may help AT providers and managers to better meet client needs. In addition, they provide insurers, social policy experts, AT users and other stakeholders with evidence-based data to assist in decision-making regarding appropriate treatments for specific clinical needs.

Poster Presentation - Telerehabilitation and Service Delivery: A Tool for Clinicians

Linda van Roosmalen, Mike Pramuka

ABSTRACT

In the field of Tele-Health and Tele-Medicine, technology such as remote monitoring, remote visits using phone and/or video has been the key to success. In the field of Tele-Rehabilitation it is less obvious how the use of various technologies can affect rehab service accessibility, effectiveness, quality and usefulness, due to the complexity and variety of clinical services provided in the field of "rehabilitation".

To clarify how telerehabilitation can benefit clinicians and clients that respectively provide and receive rehabilitation services, a framework is presented on the complex network of potential technologies and how they link to various rehabilitation applications, practices and reimbursement policies.

A web-based database on telerehabilitation was developed by the RERC on Telerehabilitation at the University of Pittsburgh. This database functions as the basis of the knowledge based tool. The ultimate goal of the tool is to provide clinicians with applied research knowledge to effectively select and match a specific service application (e.g. speech therapy, seating assessment etc.) with an applicable technology (e.g. video conferencing, tape recorder etc.) or vice versa, based on state-of-the art research and literature, case studies and existing and innovative technologies. The tool will also guide clinicians on the varying reimbursement policies across states that have addressed telerehabilitation.

ADDITIONAL INFORMATION

After presenting the need for telerehabilitation and the background on some of the issues related to telerehabilitation, a demonstration of the use of the tool will be given to the audience. Interested individuals will be able to try out the tool and give input on how to we can improve it.

Poster Presentation - Body Weight Support Gait Therapy and Functional Electrical Stimulation for a Toddler with T12 Spina Bifida

Ginny S Paleg

ABSTRACT

Introduction

Body Weight Supported Gait Therapy (BWSGT) is a technique in which the child is supported in a trunk and pelvic harness over a treadmill and a trained therapist moves the legs and feet in the best possible pattern. This evidence based approach has been successful in children with cerebral palsy, Down syndrome, spinal cord and brain injuries.

Methods

Child wore bilateral solid AFO's and was placed in a Mobility Research Diaper Harness tightened firmly and unweighted 40% using a Walkable System and Mobility Research Treadmill. Her feet and legs were moved by the therapist for 8 minutes at .8mph. During the FES arm of the intervention, hamstrings and gluteus maximus were externally stimulated using a thumb trigger (EMPI pv 300 with trigger use program #5). Therapist activated the stimulation at heelstrike.

Intervention

- (age 12 months) was 6 weeks of BWSGT (Lite Gait Walkable with diaper harness), 3x/week for 8 minutes at .8 mph.
- 8 weeks later (age 16 1/2 months) she received 6 weeks of BWSGT with FES, 3x/week for 8 minutes at .8 mph.
- Intervention occurred at her daycare as part of her Early Intervention Program (provided through Montgomery County Schools).

Results

During 6 weeks of BWSGT alone, child gained partial motor control (hip flexors) and ability to sit independently. During 6 weeks of BWSGT w/ FES, she gained full sensation, partial motor control (hamstrings & toe flexors) and ability to take steps with HKAFO's. One year later, with 1x/wk PT, child could ambulate with RGO's and walker for 50 feet with close supervision.

Conclusions

Child with T12 spina bifida gained unexpected function after functional electrical stimulation (FES) and body weight support gait therapy (BWSGT). The role of patterned neural activity, specifically FES and BWSGT, in regeneration and recovery of function in children with spina bifida therefore warrants further investigation References

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Acknowledgments
Special Thanks to Lauran and her family, the staff at her daycare -FICCC (which is run by the ARC and for children who are medically fragile and require nursing care), and her medical team at Kennedey-Kreiger Institute in Baltimore, MD; Dr. McDonald, Dr. Sardowski and Karen Good, PT. The following equipment manufactures donated items to Lauran: Rifton, Sunrise Medical, AES, Easy Stand, Convaid, Leckey, Snug Seat and Columbia. Mobility Research donated the Walkable, harness and treadmill.

Poster Presentation - Product Recall - Positive Outcomes of a Corrective Action Programme

Elaine Murray, John Tiernan

ABSTRACT

Product safety is a key parameter for consideration for product manufacturers, service providers and in particular the end user. International standards, regional directives, and national legislation outline requirement that each manufacturer strives to meet.

The Enable Ireland, Eastern Regional Postural Management Service, (ERPM) is a manufacturer and supplier of custom made seating devices. As part of a programme of ongoing product design ERPM became aware of the fact that the grade of upholstery material used in some of its seating systems was less resistant to flame than originally intended. Presented with the evidence that the products may have been unsafe the service embarked on a challenging journey which included a programme of corrective action.

The objective of this presentation is to demonstrate the steps taken from initial identification of risk to completion of product upgrade for service users seating systems.

The programme of action presented will include the:-

- clarification of legal requirement with Irish medical devices regulatory body.
- risk assessment process.
- identification and verification of corrective action method.
- tracing of products requiring corrective action.
- set up of communication programme with service users, partners and staff.
- securement of additional resources to conduct the programme.
- corrective action management plan.
- review of corrective action plan.

The learning and the many other benefits gained from the experience will be shared to demonstrate the positive gains from what initially appeared to be a negative, daunting challenge.

Poster Presentation - Developmental Level and Pre-requisite Skills Required for Successful Switching and Scanning to Effectively Access Assistive Technology

Rachael L McDonald

ABSTRACT

Paper Presentation: Developmental level and pre-requisite skills required for successful switching and scanning to effectively access assistive technology

The aim of the session is to review current on practice and evidence for the development of skills for non-direct access to assistive technology via switching and scanning. The research idea began with exploring the pre-requisite skills for successfully driving, however when explored further, the issues are wider than purely wheelchair driving, but common to accessing technology via switch scanning.

The purpose of the session is to review current practice and provide a model for further investigation regarding provision of switching for scanning for children with severe and complex motor difficulties.

Scanning is one of the most common and efficient ways to access complex pieces of assistive technology - be that communication devices, powered mobility or environmental control.. However, research has suggested that the skill of scanning itself is not as simple as it seems: 50% of typically developing 4 year olds will be unable to use row-column or linear scanning to access computer programs - even with training. It appears that the type of scanning is of less importance than the ability to 'scan' in the first place. Furthermore, switching is often provided as a method to operate complex assistive technology, and is often unsuccessful. This session will draw on the clinical and research skills of the presenters in order to review the perceptual, cognitive and attentions skills required to access technology, and provide a synthesis of available information to guide practice. Firstly, we will provide a critical review of the literature, and attempt to answer questions presented as to whether or not switching and scanning should be taught to children with complex disabilities as separate skills in their own right. We propose a research project to look at pre-requisite skills for successful technology access through scanning, which together with a model governing this will be presented.

Poster Presentation - Measurement of the user's load on the PSDs for a long period of time

Hideyuki Hirose, Takanori Aikawa, Kazuma Nakai

ABSTRACT

Background

The government required the creation of new standard for the components of Postural Support Device (PSD) in Japan. The provisional standard was created in 2004, based on the ISO/CD 16840-3 standard has several issues regarding some of the evaluation procedures. The research object is to investigate the loads on PSDs in daily activities.

Methods

Subject is Cerebral Palsy and Tetraplegia (24 years old, male, Height:155cm, Weight:40Kg) with strong extension pattern over the whole body and selected to have destroyed several PSDs. He spent daily living on PSDs with W/C for about 13 hours a day in his group home and a day care center every days and is helped by caregivers and his parents.

Wheelchair has a tilt mechanism and PSDs including a head, a back, two lateral trunk, an anterior trunk, an anterior pelvic , a medial knee and two foot supports.

Experiment design

We prepared the same type PSDs and wheelchair installed loads measurement equipments he uses in daily and measured the force for 8 hours (10am-6pm) with sampling frequency 200Hz.

Loads measurement devices is Data logger with amp, Battery and sensors (acceleration meter and strain gages in head support and force transducers in right and left lateral trunk supports and in pelvic belts.

Results

1) Subject's spacity become stronger cared by caregivers.
2) Head support during meal, repeat 10Kg load for sagittal plane.
3) Lateral support: repeat 8kg load for inward by add. movements of his upper extremity.
4) Lateral support and repeat average 10kg load (the maximum: 20kg) for downward.
5) Anterior support, belts: Maximum 30-40Kg load

Poster Presentation - The Use of Botulinum Toxin Type A (Botox®) to Facilitate Seating in Patients with Multiple Sclerosis

Noorshina Virani, BScPT MD FRCPC, Linda Jablonski, BScPT

ABSTRACT

Spasticity is common in those with MS and is often the most important factor leading to disability. Increased tone can interfere with all activities of daily living, and must be addressed before external seating systems and devices can be effectively utilized. If not managed in a timely and appropriate fashion, spasticity can lead to severe contractures, compounding disability, and leaving surgery as the only viable option to facilitate seating. It may also lead to skin breakdown and discomfort, which may perpetuate spasms, shifting the patient in their wheelchairs and requiring them to be repositioned several times daily. The result is increasing caregiver burden and injuries that can be costly and detrimental to the wellbeing of the individual with spasticity, and those who look after them. The use of Botulinum toxin has proved to be one of the most effective means of reducing focal spasticity, especially when combined with an interdisciplinary approach, incorporating the skills of qualified physical and occupational therapists. This poster identifies 2 case studies in the long-term care setting, where the use of Botox® was instrumental in reducing lower extremity tone to facilitate ease of transfers and seating comfort. Notable improvements in tone as assessed by the Modified Ashworth Scale, and improved passive range of motion, were identified as positive outcomes. Perhaps most importantly, caregivers and patients reported improved wheelchair seating capability. The case studies also highlight adjunctive therapies employed; namely exercise, the use of manually applied weights for stretching, and positioning devices allowing for maximal muscle relaxation to be realized. Ultimately, achieved goals included the prevention of skin breakdown, contracture formation, and the need for surgery, while enhancing the patient's seating capability and quality of life.

Poster Presentation - Wheelchair Participation in Individuals with Spinal Cord Injury

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ABSTRACT

Introduction: There more than 36 000 Canadians living with spinal cord injury (SCI) over 50% of whom use a wheelchair as their primary means of mobility. Although wheelchairs are intended to facilitate mobility and social participation, inadequate equipment and environmental barriers may, instead, curtain these activities.

Objective: To describe the type of wheelchair participations and the level of satisfaction among a sample of community living individuals from Vancouver with SCI who use wheelchairs as the primary means of mobility.
Methods: A descriptive study of 51 individuals was conducted. Information on participation goals and satisfaction with these goals was collected using the Wheelchair Outcome Measure (WhOM). Subjects identified participation goals at home and in the community and rated their satisfaction with their performance of these activities on an eleven point scale from 0 (not satisfied at all) to 10(extremely satisfied). Participation goals were coded into ten activity categories.

Results: In this study, 37% (n=19) of subjects were female, 64% of subjects had tetraplegia, and the mean age of all subjects was 43.7 (SD=10.7). Subjects had been using a wheelchair as their primary source of mobility for 5.7 years on average and most (66%) used manual wheelchairs. The most common indoor participation goal category was self care with 74 self care participation goals being identified. The most common outdoor participation goal category was active leisure with 64 participation goals identified. Mean scores and standard deviations of satisfaction with performance of participation goals for indoor and outdoor were 6.8 (SD=2.1) and 7.3 (SD=1.7) (out of 10) respectively.

Conclusion: Individuals who use wheelchairs have a wide variety of participation goals that they want to achieve with their wheelchairs. Given the relatively modest satisfaction scores it appears that there is room for improvement with satisfaction level for both indoor and outdoor participation.

We would like to acknowledge and thank AEL for

in part sponsorthip towards the Syllabus.

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