Adaptive Sports: Practicality vs Reality

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Disclosures

- We have nothing to disclose

Schedule

- Andrea: Spinal Cord Injury and Traditional Rehab
- Jeremy: Track and Field and Adaptations
- Carina: Wheelchair Seating and Positioning
- Brad: Wheelchair Rugby and Pyschosocial

Spinal Cord Injury

Basics Before Recreation

Andrea Stump, PT, DPT, NCS

https://www.nature.com/articles/nrdp201718

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AIS Classification

- Sensory score
  - 0 = absent
  - 1 = impaired
  - 2 = normal
- Motor score
  - Range 0-5 based on MMT
- Anal reflex determines incomplete or complete

http://www.iscos.org.uk/sitefiles/International%20Standards%20Worksheet.pdf

- **A**merican Spinal Injury Association **I**mpairment **S**cale (AIS)

  Motor Level (lowest level key muscle groups with at least 3/5 strength)

  Sensory Level (lowest level of dermatomes with normal sensation)

  Neurologic Level of Injury (lowest level with both normal sensation and antigravity motor function on both sides of the body)
- If there is a complete injury, there can be a zone of partial preservation which refers to dermatomes and myotomes intact below the level of the Neurologic Level of Injury that remain partially innervated

Why is prognosis important

- Multiple formulas that can predict ability to ambulate and functional independence based on AIS, age and neuroimaging
- Critical to both prepare patients to return to an independent lifestyle while also providing hope for their goals of maximal independence and recreational potential

Our Role in Maximizing Function

AIS Scale = Predictive of Potential

AIS Scale ≠ Guarantee of Function

Role of Rehab Services:

- Impact of Intervention vs.

Spontaneous Neurological Recovery

https://depressedpessimist.wordpress.com/2013/01/18/recovery-expectations-vs-reality/

Systemic Effects and Secondary Complications

- Metabolic
- Gastrointestinal
- Genitourinary
- Integumentary
- Respiratory
- Cardiovascular
- Psychological
- Neurological
- Musculoskeletal

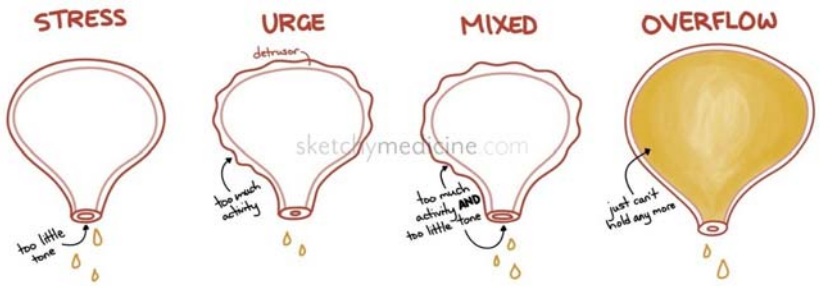
https://neupsykey.com/localization-of-lesions-in-the-autonomic-nervous-system/

Metabolic and Gastrointestinal Systems

- Reduced levels of and efficiency of insulin leading to increased risk for diabetes
- Less effective immune response – higher risk for illness
- Increased constipation, incontinence, hemorrhoids, reflux
- Slowed digestion and heartburn

Genitourinary

- Decreased bladder capacity and kidney function
- Increased risk of UTIs
- Increased risk of bladder cancer
- Increased sexual dysfunction



http://sketchymedicine.com/2012/02/stress-urge-overflow-and-mixed-incontinence/

Treatment

- Nutrition referral
- Hydration, diet and hygiene with cathing
- Standing program for improved alignment of digestive and urinary structures
- Area of referral to pelvic floor specialist
- Open communication regarding sexual techniques, positioning and function depending on the level of the lesion

Integumentary System

- Decreased collagen and elasticity; thinning of skin
- Increased sweating
- Decreased circulation
- Increased pressure injuries, bruises and skin tears

https://www.cubro.co.nz/cms/Pressure-Care-Injuries-Assessment

Treatment

- Prevention!
- Positioning and appropriate fit of seating and bracing
- Pressure relief education

Respiratory System

- Decreased respiratory capacity and vital capacity
- Loss of lung and chest wall compliance
- Increased sleep apnea
- Increased pneumonia

Treatment

- Incentive spirometry
- Deep breathing and postural stretching
- Binder/positioning

https://thoracickey.com/spinal-cord-injury/

Cardiovascular System

- Loss of arterial elasticity, decrease in stroke volume and gradual increase in blood pressure
- Orthostatic hypotension
- Autonomic Dysreflexia
- Increased risk of DVT/PE
- Obesity

Treatment

- Endurance training with upper body ergometry, functional electrical stimulation of lower limbs or combination of the two can reverse cardiovascular abnormalities
- 30-45 minutes of moderate intensity upper extremity exercise 3 times a week for 8-12 weeks improve lipid and glycemic profiles
- Interval training 3 min moderate activity with 2 min or rest for one hour with target 70-80% of HRR. Completed 3 times a week for 8 weeks

Psychology

- Adjustment to life without verticality
- Support groups, peer mentors, counselors
- Vocational counseling
- Therapeutic recreation

http://www3.ha.org.hk/mmrc/aboutus5_1.htm

Nervous System

- Decreased strength, reaction time and fine motor skills
- Deterioration of gait or balance
- Increased cystic changes in spinal cord – syrinx
- Increased neuropathic pain and nerve entrapment
- Spasticity

Pain

- Stretching
- Medication
- Appropriate positioning

https://www.pinterest.com/kaf26/spinal-injuries/

Spasticity

- Condition in which muscles are continuously contracted leading to tightness, stiffness and spasms.
- Results from damage to upper motor neuron commonly leading to a disruption in normal information flow to the brain. Sensory input ascend then are sent back down the loop via motor cells causing a reflex muscle spasm
- Triggered by stretching, trunk movement, skin irritation, pressure sores, UTI, external perturbation, increased demand on body

Treatment

- Treated with stretching, strengthening, weight bearing, positioning, casting, bracing and ES
- Medical management
  - Oral- baclofen, tizanidine, gabapentin, benzodiazepines and dantrolene
  - Botox
  - ITB Intrathecal baclofen pump

Musculoskeletal System

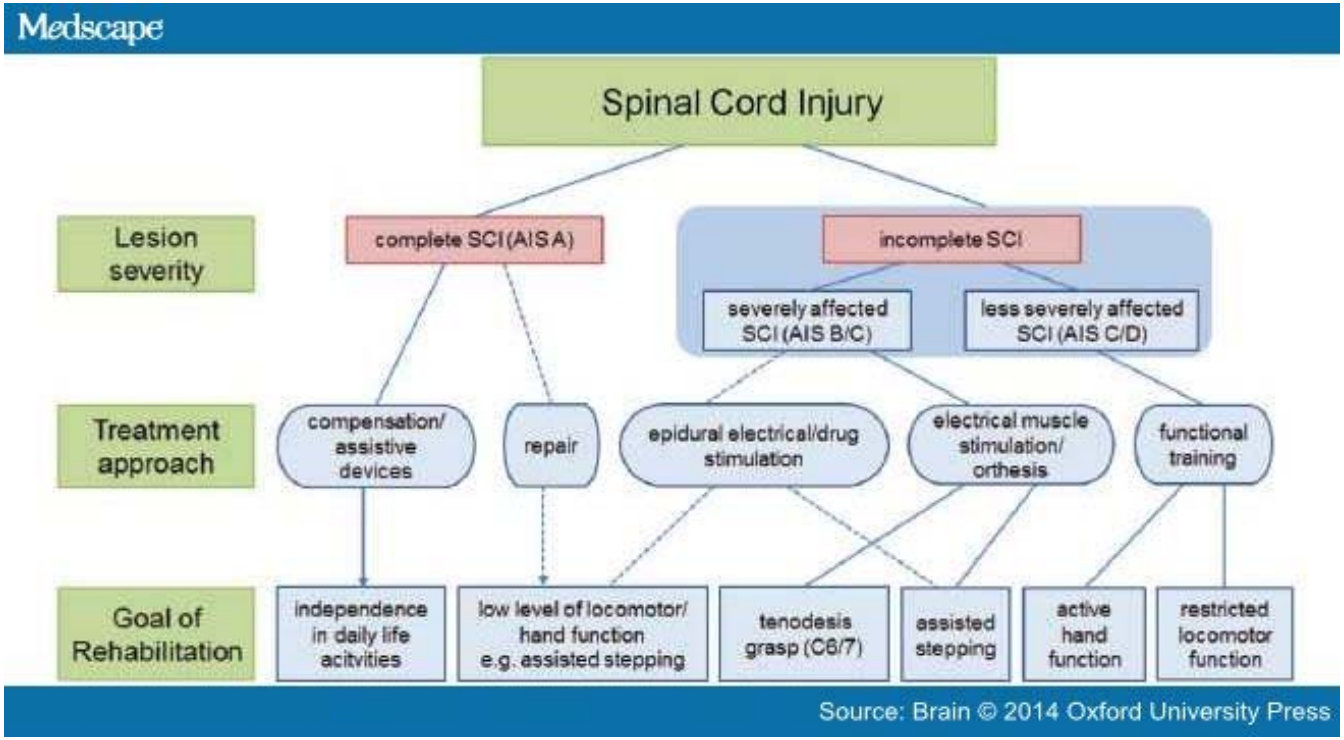
- Overuse injury
- Decreased muscle strength
- Increased stiffness and contracture
- Osteoporosis and fracture

http://www.days-eye.com/shoulder-muscle-diagram/posterior-view-for-showing-bones-joints-tendons-pinterest-shoulder-muscle-diagram-triangle-rhomboid-miner-upper-limb/

Therapeutic Interventions

- Range of Motion
- Prone positioning
- Weightbearing
- Electrical stimulation can increase activation
- Gait training (when appropriate)

- Transitional movement training
- Wheelchair skills training
- Static and dynamic balance in sitting and standing
- Muscle strengthening and endurance training to shoulder and trunk



https://www.medscape.com/viewarticle/822225

Importance of Posture

- Balance, stability and control for propulsion
- Pressure management and weight distribution
- Vision and communication
- Respiration and digestion
- Body image and self-perception

What is good posture?

- Three normal curvatures of the spine
- Allows for appropriate muscle alignment
- Decreases risk of fractures
- Pressure distribution
- Fatigue reduction and muscle efficiency
- Reduction in pain

https://www.aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating/design-assets/nested-content/print-module?module=302289

Posture following SCI

- Common deficits
  - Functional scoliosis
  - Cervical protrusion
  - Excess thoracic kyphosis
  - Loss of lumbar lordosis

Shoulder pain

- 81% in tetraplegia, 58% in paraplegia; 50% will report pain lasting at least one year
- Manual wheelchair 31-73%, power wheelchair 50%
- Most often due to poor mechanics of transfers, propulsion, overhead reaching or hilly terrain due to mechanical subacromial impingement
  - Trunk stability has large influence on shoulder pain
- Outcome measures:
  - Wheelchair Users Shoulder Pain Index (WUSPI)
  - Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)

Treatment

- Use of STOMPS protocol or Van Stratten
- Education on transfer techniques, energy conservation, wheelchair propulsion and posture
- Assess cervical and scapulothoracic regions
- Referral to seating and positioning clinic – change weight of chair, axle placement, smart drive vs e-wheels
- Injections and surgery is often least preferred due to inability to treat underlying cause of pain
  - Total immobilization and disuse of arm post surgery takes away mobility

Optimizing movement

- Wheelchair propulsion
- Transfers – level height, positioning of arms
  - Unilateral pain – transfer toward painful
  - Bilateral pain – vary direction
  - Consider use of board, dump of seat, set up
- Reaching – accessibility in the home, use of reacher
- Ambulation – lower leg strength inversely related to upper limb demands
  - Consider forces through shoulder vs wrists and bracing

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Jeremy Finton

Track - Roadracing

Real Deal

- General knowledge impacts
  - Sport Specific knowledge as able body and transitioning that to persons with a disability
    - Born with disability and adjusting
    - Newly Injured and adjusting
- PT/OT Effect
  - Exposure and buy-in
  - PT/OT involvement outside “work”
  - Athletes perspective to Proper procedural vs real life practicality

Real Deal

- Industry Potential
  - Captive User
  - Product Testers
  - Promoter for Products
  - Marketing

Real Deal

- Participation Prohibitives
  - Costs to participate
    - Sport specific Equipment
    - Training equipment (roller, gloves, tires)
  - Time
  - Accessibility to training locations

Chair Styles, Positioning, Energy Conservation

- Why does it matter?
  - Athlete understanding of Example of chair as new injury vs experienced user
    - Beginner athlete to seasoned athlete
  - Picking one vs another based on function.
    - Chair types or brands
    - Zipp wheels vs spoke
- Footplate
  - Users: some single leg amputee's, limit range, SCI (c5/6)

Chair Styles, Positioning, Energy Conservation

Kneeler

- Users: Para's, amputee's, higher function SCI's
- Most traditional and functional
  - Complaints are often breathing, pressure, numbness

T51 Jeremy Finton

Kneeler

- Transfer

T54 Kaylee Hurley

Chair Styles, Positioning, Energy Conservation

- Why does it matter?
  - Athlete understanding of Example of chair as new injury vs experienced user
    - Beginner athlete to seasoned athlete
  - Picking one vs another based on function.
    - Zipp wheels vs spoke
- Hybrid
  - User: Lower SCI's
  - Configuration: Kneeling plate and also has footplate. (Axle bar removed)

Energy Conservation- Tetraplegia perspective

Back of chair Transfer (Jeremy@van)

Side transfer?

Seating and Positioning for Sport vs Everyday Chairs

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Goals for Standard Wheelchair Seating

Goals

- Pressure distribution
- Protection of skin
- Good posture and prevention of muscle imbalances
- Decreased shear forces

Standard Areas of Pressure in Standard Wheelchair

- Ischial tuberosities
- Coccyx
- Trochanters

Standard Positioning

- Buttocks back in the seat
- Midline position of pelvis
- Trunk upright and midline
- Shoulders upright and midline position
- Head upright and midline

Standard Positioning

- Seat Width- slightly wider than the user's widest point
- Seat Depth- ending 1-2 inches past the popliteal fossa
- Seat Height- footplates should be a few inches from the floor

Standard Positioning

- Pelvis
  - Slight anterior tilt
  - Thighs and femurs loaded instead of ischial tuberosities
- Trunk
  - Shoulders centered over axle
  - Natural spinal curves

Cushion Selection

- Proper pressure distribution
- Decreased shear
- Proper positioning
- Comfort
- Heat distribution

Propulsion in Everyday Chair

Propulsion

- Three key factors influence forces on upper extremities during standard propulsion (Rankin 2012)
  - High force requirements
  - Repetitive postures
  - Extreme joint postures

Propulsion

- Three factors influence upper extremity demand the most
  - Cadence
  - Contact angle
  - Peak force

Recommendations for Propulsion

- Users should incorporate long smooth push strokes (large contact angles)
- Reduce cadence
- Minimize peak hand rim force

Muscle Requirements

- Biceps
- Brachioradialis
- Triceps
- Demonstrate both large amounts of positive and negative energy during push and recovery
- Infraspinatus
- Latissimus dorsi
- Mid deltoid
- Lesser extent

Propulsion Types

- Arc
- Single Loop Over
- Semi Circular
- Double Loop Over

Sport Chair Seating

Optimizing Sport Chairs

- Several factors can optimize performance in sport chairs (Mason 2013)
  - Seat positioning
  - Rear wheel camber
  - Wheel size
  - Hand rim configuration
    - Increased width of hand rims can increase stroke frequency and decrease push time (Costa 2009)

Issues with Research

- Often optimization studies are done with able bodied athletes
- Differing levels of abilities make it difficult to standardize research studies

Player Perceptions of Configuration (Mason 2010)

- Performance Indicators
  - Stability
  - Initial acceleration
  - Maneuverability
  - Sprinting

Areas of Wheelchair Configuration

- Seat height
- Fore-aft seat position
- Seat bucket
- Seat backrest
- Wheel size
- Rear wheel camber
- Hand rims

Areas of Configuration

- Non researched
  - Frame
  - Chair length
  - Footrest position
  - Strapping
  - Castor wheels
  - Tires

Crossover Between Sports Chairs and Everyday Chairs (Cooper 2014)

- Minimizing weight while maintaining stiffness
- Minimizing rolling resistance
- Optimizing sports specific/everyday performance

Seating and Positioning

- Increasing Dump
- Leg Positioning

Seating and Positioning

- Trunk Position
- Pressure

Wheelchair Rugby and Psychosocial Effects of Sports

Brad Burns

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Objectives

1. Overview of Wheelchair Rugby
2. The importance of proper fitting and chair selection
3. The Biopsychosocial benefits of persons with SCI in sports

Wheelchair Rugby

How it’s played

https://www.youtube.com/watch?time_continue=61&v=tSzFmIWgVsM

Wheelchair rugby

Invented by a group of quadriplegic athletes, who were looking for an alternative to wheelchair basketball. The sport they created, incorporates some elements of basketball, handball and ice hockey

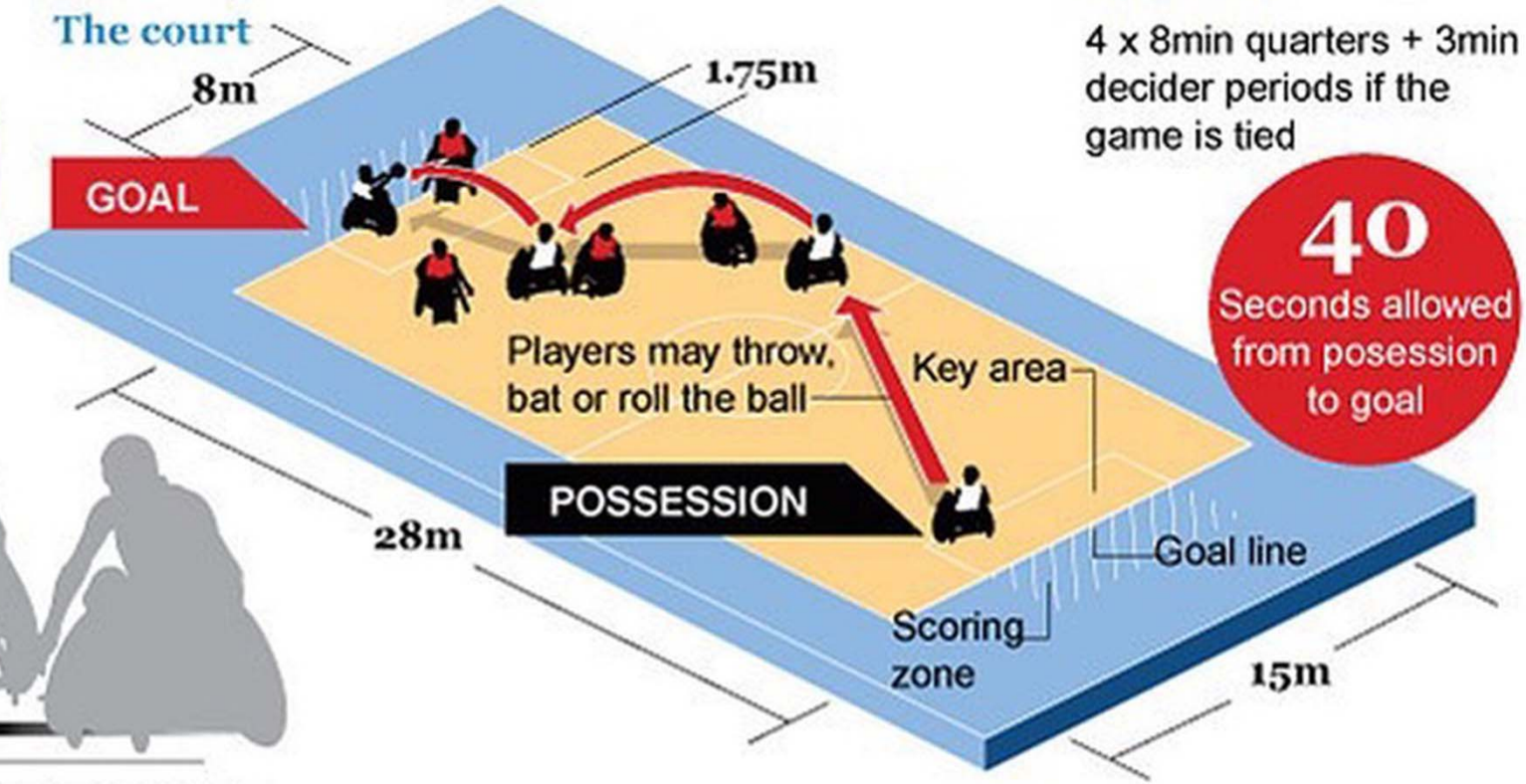
4
Players of mixed functionality per team

Duration

4 x 8min quarters + 3min decider periods if the game is tied

40
Seconds allowed from posession to goal

The court



For a goal two wheels must cross the goal line within the key area

Who can play

- Mixed team sport of males and females
- Open to individuals with impairment in 3 or 4 limbs
- Disabilities include spinal cord injuries, loss of limbs, cerebral palsy, muscular dystrophy, genetic conditions

Classification

All players must go through a classification process. This is a two part process which includes muscle testing and watching the player play.

- Low pointer 0.5-1.5
- Mid pointer 2.0-2.5
- High pointer 3.0-3.5

Defensive Chairs

Players with 0.5 to 1.5

Offensive Chairs

Players with 2.0 to 3.5

Custom fitting

- Chairs are custom fit to the athlete depending on their position and push style.
- This is why fitting is important to improve performance and reduce the effects of injury.

Push style determines glove selection

Psychosocial Benefits

- Psychological support
- Resources
- Sense of belonging
- Increase in school and work
- Acceptance

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