SPORT INJURIES IN SCI PATIENTS

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Definition of “Disability”

“Those who are confined to a wheelchair, deaf, blind, or missing a limb, those who have only one of a paired set of organs, or those with behavioral, emotional and psychological disorders that substantially limit a major life activity.”
# Types Of Disabilities

## CONGENITAL
- Amputees
- Spina Bifida
- Cerebral Palsy
- Erbs Palsy
- Muscular Dystrophy
- MS / ALS
- Visual / Hearing

## ACQUIRED
- Amputees
- SCI
- TBI
- Polio/ Post Polio
- Myopathies
- CVA
- Visual / Hearing
Spinal Injury

<table>
<thead>
<tr>
<th>Age at Time of Injury</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-90</td>
<td>1.0%</td>
</tr>
<tr>
<td>61-75</td>
<td>4.4%</td>
</tr>
<tr>
<td>46-60</td>
<td>9.2%</td>
</tr>
<tr>
<td>31-45</td>
<td>19.4%</td>
</tr>
<tr>
<td>16-30</td>
<td>61.1%</td>
</tr>
<tr>
<td>0-15</td>
<td>4.9%</td>
</tr>
</tbody>
</table>
Causes of Spinal Cord Injuries

- 36.8% Road Traffic Accidents
- 41.7% Falls
- 11.6% Sport
- 4.2% Knocked Over/Collision/Lifting
- 2.7% Sharp Trauma/Assault
- 3.3% Trauma (Not Specified)
SCI in sports

11.6%

By Sports Activity

<table>
<thead>
<tr>
<th>Sport</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diving</td>
<td>66.0%</td>
</tr>
<tr>
<td>Football</td>
<td>6.1%</td>
</tr>
<tr>
<td>Snow Skiing</td>
<td>3.8%</td>
</tr>
<tr>
<td>Surfing</td>
<td>3.1%</td>
</tr>
<tr>
<td>Trampoline</td>
<td>2.6%</td>
</tr>
<tr>
<td>Wrestling</td>
<td>2.3%</td>
</tr>
<tr>
<td>Other Winter Sports</td>
<td>2.3%</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>2.2%</td>
</tr>
<tr>
<td>Horseback Riding</td>
<td>2.0%</td>
</tr>
<tr>
<td>Other</td>
<td>9.6%</td>
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</tbody>
</table>
Prospective, multicenter follow-up observational study. To investigate the changes in participation and sports practice of people after spinal cord injury (SCI) and their impact on perceived quality of life (QoL). 4 years after the first rehabilitation hospitalization, 403 patients, 83.4% male; 39% was tetraplegic.
How physically active are people with SCI?

From SHAPE-SCI study (n=693) evaluating leisure time physical activity (LTPA) in people with SCI:

50% of adults with SCI engage in no LTPA whatever!
Spinal Cord Injured Athletes

- Motor loss
- Sensory loss
  - Pressure sores
  - Lack of awareness of injury
- Loss of autonomic control
  - Bladder
  - Bowel
  - Sweating
- Effects on cardiac function in exercise
  - (T1-4 sympathectomises)
- Respiratory function

- Temperature control
- Dehydration
- UTI / stones
- Autonomic dysreflexia (at or above T6)
Is exercise an important therapeutic priority for individuals with SCI?

- Surveyed 681 individuals with SCI
- 96.5% of respondents considered exercise to be an important aspect of functional recovery
- Of this 96.5%, almost 20% did not have access to exercise
Strength training benefits

• Increase Bone Mineral Density
• Improve Glucose Metabolism
• Reduce Resting Blood Pressure
• Avoid Muscle Loss
• Reduce Body Fat
• Reduce Arthritic Pain
• Reduce Low Back Pain
Affective benefits

• Enhances Self Esteem, Confidence, Independence
• Positive attitude towards physical activity and active lifestyle.
• Enhances Socialization
• Relieves Stress
• Emotional Stability
Sport participants were 4.75 and 7.00 times as likely to have high CIQ and QoL scores.

Individuals who participated in sports prior to SCI were more likely to participate in sports post-SCI.

Participation in sports after SCI is associated with increased community integration and QoL and should be recognized as an **adjunct to current SCI rehabilitation programs**
I act, therefore I am: Athletic identity and the health action process approach predict sport participation among individuals with acquired physical disabilities

Marie-Josée Perrier, Shane N. Sweet, Shaelyn M. Strachan, Amy E. Latimer-Cheung

Psychology of Sport and Exercise 13 (2012) 713–720

Health Action Process Approach (HAPA) model
Athletic identity is the extent to which people identify themselves as athletes
Correlates and determinants of physical activity in persons with spinal cord injury: A review using the International Classification of Functioning, Disability and Health as reference framework

Christine Fekete, Ph.D., and Alexandra Rauch, B.Sc.

Swiss Paraplegic Research, Guido A. Zich Institute, 6207 Nottwil, Switzerland
Role of sports medicine team

- Medical Examinations
- Prevention of Injury
- Diagnosis of Disease
- Treatment
- Awareness
- Medical Classifications
Categories of Disabled Athletes

• Amputations
• Blind or Visually Impaired
• Cerebral Palsy
• Deaf or Hearing impaired
• Intelligently Impaired
• **Spinal Cord Injuries**
• Les Autres – (Those who do not fit in the above categories)
Competition

- Local, regional, national and international
- Paralympics Games
- Deaflympics
- Special Olympics (Intelligently Impaired)
History of the Paralympic Games

• 1948 Guttman’s Stoke Mandeville Games in the UK – ‘taking part’ -16 athletes

• 1960 First ‘Paralympic games in Rome with 23 countries and 400 athletes

• 1988 First true linked Modern Paralympic games in the same venue as the Olympic Games (Seoul)

• 2000 Sydney Paralympics 127 countries and 4000 athletes took part with global TV coverage of 1.1billion.
The increasing Global participation

- **2004 Paralympic games**
- Cumulative TV audience worldwide 1.862 billion

- **2008 Paralympics**
- 140 countries
- Global cumulative audience of 3.8 billion
Paralympic summer sports programs

- Archery
- Boccia
- Cycling
- Equestrian
- Football 5-a-side
- Football 7-a-side
- Goalball
- Judo
- Powerlifting

- Rowing
- Sailing
- Shooting
- Swimming
- Table Tennis
- Volleyball (sitting)
- Wheelchair basketball
- Wheelchair fencing
- Wheelchair rugby
- Wheelchair tennis
Paralympic Winter sports

- Alpine Skiing
- Biathlon
- Cross Country Skiing
- Ice Sledge Hockey
- Wheelchair Curling
Recreation sports
What should we expect when treating disabled athletes?

• The great worry amongst therapists and doctors is that injuries and illness will be very high or unduly complex.

• Patterns of injury vary a little with the different sports:
  – more upper limb injuries in wheelchair users
  – increase in lower limb trauma in visually impaired athletes
Musculo-skeletal Injuries in disabled athletes

Nick Webborn – BPA data on file Athens Paralympics
Illness in disabled athletes

- Co-morbidities
- Pressure sore management
- UTI
- Autonomic dysfunction
Type of Injuries (wheelchair athletes)

Wheelchair propulsion
- Shoulder and wrist pain
- Entrapment neuropathies

Sport related
- Basketball (70%)
- Racing (60%)

Acute trauma
- Concussions
- Fractures
- Sprains

Overuse
- Sprains, tendinitis
- Shoulder impingement

Secondary problems due to disability
- Autonomic Dysreflexia
- Heat intolerance-Thermoregulation
- Low bone mineral density
- Urinary tract infection
- Skin breakdowns, ulcers, pressure
Review

Sports-related injuries in athletes with disabilities

K. Fagher¹, J. Lexell¹,²,³
Review

Sports-related injuries in athletes with disabilities

K. Fagher¹, J. Lexell¹,²,³

56% SCI patients

Injured body location

Abdomen/trunk/pelvis: 7%
Lumbar/thoracic spine: 33%
Head/neck/cervical spine: 20%
Wrist/hand/thumb: 26%
Forearm: 8%
Elbow: 33%
Upper arm: 31%
Shoulder: 47%
Upper extremity injuries: 73%
Ankle/foot: 24%
Lower leg: 13%
Knee: 26%
Thigh/hip: 25%
Pelvis/buttock: 11%
Lower extremity injuries: 65%

Range of injuries
Wheelchair injuries

- Limited research
- Increase injury rate with increased participation.
- No relationship between disability type, classification, or sex.
- Temperature regulation and pressure sores particular to SCI.
Dysreflexia

Sensory (pain) impulses enter the cord below lesion and sympathetic nervous system responds to local spinal reflexes with an excessive discharge which is uncorrected by feedback loop.
Signs & Symptoms

- Headache.
- Nasal congestion.
- Blurred vision.
- Spots in visual fields.
- Profuse sweating and flushing of the skin above the level of the lesion, especially in the face, neck, and shoulders.
- Bradycardia
- Elevated blood pressure
- Cardiac arrhythmias
Why is it important?

• Autonomic dysreflexia has been regarded as a medical emergency because of the severe rises in blood pressure that can occur with recorded values in excess of 300 mmHg.

• Reported complications in the medical literature include seizures, cerebral haemorrhage, cardiac arrhythmia and death.

• In the hospital setting it is treated as a medical emergency.
Causes of Autonomic Dysreflexia

- **Unintentional**
  - UTI
  - Blocked catheter
  - Constipation
  - Urinary calculi
  - Anal fissure
  - Skin infection or injury
  - Pressure area

- **Intentional**
  - Clamping catheter.
  - Tight leg straps.
  - Genital trauma.
  - Prolonged sitting in racing chair
  - “Boosting”
‘Boosting’

- Intentional induction of autonomic dysreflexia among quadriplegic athletes for performance enhancement”
  (tight leg straps, full bladder, sharp objects)

- Belief that boosted state could be controlled.
- Treadmill exercise capability improved.
- Increase in simulated race times of 9.7% in ‘boosted state’. -
- Equivalent in able-bodied performance:
  - 1 second off 100m record.
  - 4 seconds off 400m record.
  - 12 minutes off marathon record.
Neurological and autonomic level-dependent impairment in blood pressure regulation (SSR: sympathetic skin responses)

The highest injuries (cervical spine) and greatest disruption of SSR exhibit the most severe impairments in cardiovascular control.

Knowledge of the **degree of autonomic dysfunction** may improve the ability to predict individuals at risk and those who are most likely to gain a sporting benefit from boosting.
Thermoregulation in SCI

- Above the lesion
  - Sweating may be excessive
    (Sweat rate above level of lesion - can increase $\times 6$)
  - Drips off - ineffective for heat loss
- Below the lesion
- Basal sweat rate is unaffected by activity or ambient temperature
Risks of heat to Wheelchair Athletes

- Increases in core temperature up to 40.5 deg.
- Increases in heart rate.
- Risk of dehydration still likely to occur.
- Risk of heat illness increased and impairment of athletic performance.
- Most affected athletes – Tetras (high lesion)

**Symptoms**
Cramps, syncope, headache, nausea, dizziness
### Sport for Athletes with Physical Disabilities: Injuries and Medical Issues

<table>
<thead>
<tr>
<th>Heat Stress Level</th>
<th>Event</th>
<th>Indoor/Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Risk (Level 3)</strong></td>
<td>Athletics</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Cycling</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Equestrian</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Football</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Marathon</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Tennis</td>
<td>Outdoor</td>
</tr>
<tr>
<td><strong>Intermediate Risk (Level 2)</strong></td>
<td>Basketball</td>
<td>Indoor</td>
</tr>
<tr>
<td></td>
<td>Goalball</td>
<td>Indoor</td>
</tr>
<tr>
<td></td>
<td>Rugby</td>
<td>Indoor</td>
</tr>
<tr>
<td></td>
<td>Swimming</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Table Tennis</td>
<td>Indoor</td>
</tr>
<tr>
<td></td>
<td>Volleyball</td>
<td>Indoor</td>
</tr>
<tr>
<td></td>
<td>Yachting</td>
<td>Outdoor</td>
</tr>
<tr>
<td><strong>Low Risk (Level 1)</strong></td>
<td>Archery</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Boccia</td>
<td>Indoor</td>
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<tr>
<td></td>
<td>Lawn Bowls</td>
<td>Outdoor</td>
</tr>
<tr>
<td></td>
<td>Powerlifting</td>
<td>Indoor</td>
</tr>
<tr>
<td></td>
<td>Shooting</td>
<td>Outdoor</td>
</tr>
</tbody>
</table>
Managing thermoregulation

- Hydration strategies
- Pre-cooling strategies
- Interventions during competition
- Cooling vests, head and hand emersion
- Use of fans
Pressure sores

• Unrelieved pressure
  – Greater than capillary pressure (32 mm Hg)
  – Ischemia / Hypoxia / Loss of Nutrients
  – Friction & Shear Forces

• Location
  – Ischium/Sacrum/Troch/Heel

• Incidence
  • SCI = 25% - 66%

• Contributing Factors
Contributing factors

- Insensate areas
- Atrophy / Loss of padding
- Improper seating devices
- Aerodynamic body positions
- Containment straps
- Splash guards / Brakes
- Falls/collisions
Deep tissue injuries in 45% of players

Spinal cord injuries and daily life use of wheelchairs more likely to develop injuries, particularly in the sacral region.

A periodic medical check is necessary for players to maintain their sporting life.
Treatment - prevention

- Monitor skin closely
- Proper fitting
- Proper padding
- Friction reducing material on arms, chest wall, axilla
- Gloves
Nerve entrapments

• incidence of CTS (49% to 63%)
• Carpal Tunnel Syndrome increases with the length of time after the injury.
  • 27% 1 - 10 years from injury
  • 54% 11 - 20 years from injury
  • 90% 31+ years from injury

  – Ulnar neuropathy at wrist
  – Ulnar neuropathy at elbow
Treatment

- usually conservative, involving rest, immobilization, and NSAID
- most wheelchair users will not undergo any of these treatments due to loss of independence and mobility.
- Usually the condition worsens to the point where surgery is necessary to release the transverse carpal ligament.
- ice to the wrists for 20 minutes at the end of each day
- flexibility/strengthening program for wrist flexion/extension.
- gloves
Greater wrist flexion and extension increased pressure in the carpal canal

Clinicians should consider advising manual wheelchair users to take long smooth strokes when propelling a wheelchair as a possible way to reduce the risk of injury.
Concussions

- Traumatic Brain Injury (TBI)
  - Wear proper protective equipment
  - More common in rugby, basketball and racing
  - Ensure all equipment is maintained and safe
    - Wheelchairs and anti-tip bars
**Concussions**

*Maddock’s questionnaire* is a quick simple and practical tool which can be administered either on-field or on the sidelines.

- Which field are we at?
- Which team are we playing today?
- Who is your opponent at present?
- Which half/period is it?
- How far into the half is it?
- Which side scored the last touchdown/goal/point?

Any incorrect response indicates concussion and requires removal from the playing field for further medical evaluation.
263 wheelchair basketball players

**6.1%** in current season.

*Males*: 5.82% during the current season, and 14.36% during their athletic career.

*Female*: 6.67% and **30.6%**

Women were 2.5 times more likely to sustain a concussion than men.
Shoulder problems

Shoulder pain is epidemic among persons with SCI

Occurs upon initiation of most upper-extremity activities of daily living, including:

• transfers to and from the wheelchair,
• wheelchair propulsion,
• pressure relief,
• reaching,
• dressing, exercise/sport,
• most self-care activities
Epidemiology

In patients with paraplegia shoulder pain increases at 5 years (30% to 50%) and 20 years (70%) after SCI. 63% having rotator cuff injuries versus 15% of healthy control.

In patients with quadriplegia, occurs early on in the acute phase (0 to 5 years after SCI) and is found in 78% of patients within the first 6 months after SCI.

In 75% of patients, the term “weight-bearing shoulder” can hide real shoulder pathologies: simple tendinitis, subacromial bursitis rotator cuff tear, biceps tendinopathy Arthritis, avascular necrosis of the humeral head.
Biomechanics, pathophysiology

Motion represents a closed kinetic chain since the hand is fixed

The most mechanically demanding shoulder activities:
• wheelchair propulsion, sitting pivot transfers,
• push-up weight reliefs, sporting

**Free** propulsion: peak shoulder joint forces 46 N posterior and 14 N superior

**Fast and inclined** propulsion: peak vertical force increased > 360%, and the increase in posterior force and shoulder moments ranged from 107% to 167%.
Peak shoulder and elbow moments were significantly higher for weight-relief lifting than for reaching, level propulsion, and riding on a slope.

The high loads during ADL tasks might be a risk factor for overuse of the upper-extremity joint.
Risk factors

- tetraplegia,
- duration of SCI,
- older age,
- higher body mass index,
- use of a manual wheelchair,
- poor seated posture,
- decreased flexibility, and
- muscle imbalances in the rotator cuff and scapular stabilizing muscles.
The US findings were correlated with **age**, **duration** of SCI, and **weight** and showed a positive trend with the total Wheelchair User’s Shoulder Pain Index (WUSPI).

absence of pain does not represent absence of shoulder pathology, and pain may be a marker for future shoulder pathology.
Treatment

• Prevention

• Modification (wheelchair, sporting, activities, postural abnormalities)

• Conservative (rest, NSAIDs, corticosteroid injections, cold/heat, ultrasound application)

• Special exercise programs (stretching anterior and posterior shoulder and strengthening of scapular muscles and external rotators)

• Surgery
38 shoulders in 28 patients.

At operation injuries were more severe than in preop evaluation.

The mean satisfaction index in operated patients was 8.5 of 10.

Multidisciplinary approach (surgeon, physician, physiotherapist, and occupational therapist)
Checklist of preventive strategies to minimize shoulder pain in patients with SCI

- Bringing the patient to the shoulder-level environment
- Adapting the patient’s home environment
- Postural correction
- Specific shoulder muscle strategies
- Preventing weight gain and obesity
- Preventing muscle fatigue
- Endurance training
- Advising against deleterious sporting activities (e.g., bench press)
- Using technical aids (e.g., transfer board)
Elbow problems

17% of overuse injuries of the arm

Throwing and racquet sports

Lateral epicondylitis most common

medial epicondylitis,
cubital tunnel syndrome (ulnar nerve)
pronator teres syndrome (median nerve)
Wrist problems

Usually in wheelchair racing, racquet sports

Different types of tendinitis

De Quervain's Tenosynovitis
(In racing the wrist ends the propulsion in ulnar deviation)
Exercise and sport training in the disabled

Conclusions

Physical benefits
• general fitness
• cardiovascular conditioning
• cardiopulmonary endurance
• muscle strength
• flexibility
• postural control
• balance

Psychological benefits
• improved motivation
• self-confidence
• self-esteem,
• personal adjustment
• competitive spirit
• reduced anxiety
• reduced tendency to withdraw
Conclusions

- Safe environment
- Appropriate, well maintained equipment
- Individualization of training
- Warning signs of impending injury
- Warm-up, stretching, and cool-down
- Appropriate training prescription (mode, duration, frequency, intensity, progression)
- Surgery when indicated
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Marie-Josée Perrier⁴⁺⁺, Shane N. Sweet⁴⁺⁺, Shaelyn M. Strachan⁴⁻, Amy E. Latimer-Cheung⁴⁺⁺

Health Action Process Approach (HAPA) model
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