Northwestern Health Sciences University
Office of Continuing Education

Fédération Internationale de Chiropratique du Sport
The International Federation of Sports Chiropractic

Northwestern Health
Human Performance Center

Sports-related injuries of the

Thoracic Spine

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Overview

Included pathologies:

- Spinal cord injuries (SCI)
- Disc pathologies
- Spinal/rib fractures
- Musculo-ligamentous injuries

I. Epidemiology
II. Mechanism of Injury and Management
III. Case study

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General rule

- Following trauma, any unconscious athlete should be treated as having a co-existing catastrophic spinal injury

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Diagnostic workup – General

- In elite sports the threshold for imaging should be very low
- If **bony injury** is suspected, initial x-ray may fail to show pathology - follow-up by CT or MR
- For suspected **muscle injury**, the ideal imaging window is 2-48hrs after trauma as haematoma is formed but has not extended outside the involved muscle. MRI is modality of choice, sonography may be used for initial on-site detection

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I. Epidemiology

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I. Epidemiology

- Sports-related structural thoracic spine injuries are rare
- The most common cause for thoracic spinal complaints is most likely **mechanical** (e.g. joint restrictions, muscular dysbalance)
- Unfortunately, the epidemiology of this has not yet been established
- However, athletes show have a significantly higher prevalence of non-specific thoracic pain than controls [1]

[1] Fett, D. et al. Back pain in elite sports: A cross-sectional study on 1114 athletes. PLoS One 2017; 12(6): e0180130.

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I. Epidemiology

- **Spinal cord injury** (SCI) in the thoracic spine is an uncommon complication of trauma and are sports related in 7% of cases
- If SCI occurs, the thoracic spine and T/L junction are most often involved in snowboarding (57%), horseback riding (26%) and hockey (7%) [1]
- Other studies include rugby and diving as often involved sports [2]
- 24% occur in young males less than 15 years of age, incidence then decreases with age [3]

[1] Chan, C.W.L. et al. Epidemiology of sport-related spinal cord injuries: A systematic review. Journal of Spinal Cord Medicine 2016; 39(3): 255-264
[2] Boran, s. et al. A 10-year review of sports-related spinal injuries. Irish Journal of Medical Science;180(4):859–863
[3] Zigler, J.E. American Academy of Orthopaedic Surgeons. Spine Trauma. 2nd ed. Rosemont (IL): American Academy of Orthopaedic Surgeons; 2011, xxiii, p. 792

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I. Epidemiology

- **Thoracic disc herniations** are a very rare occurrence in sports
- Very limited data is available on the epidemiology
- Of all herniations, the thoracic spine may be involved in about 2% [1], 78% of them below T8 level [2] (image shows T8/9 level)

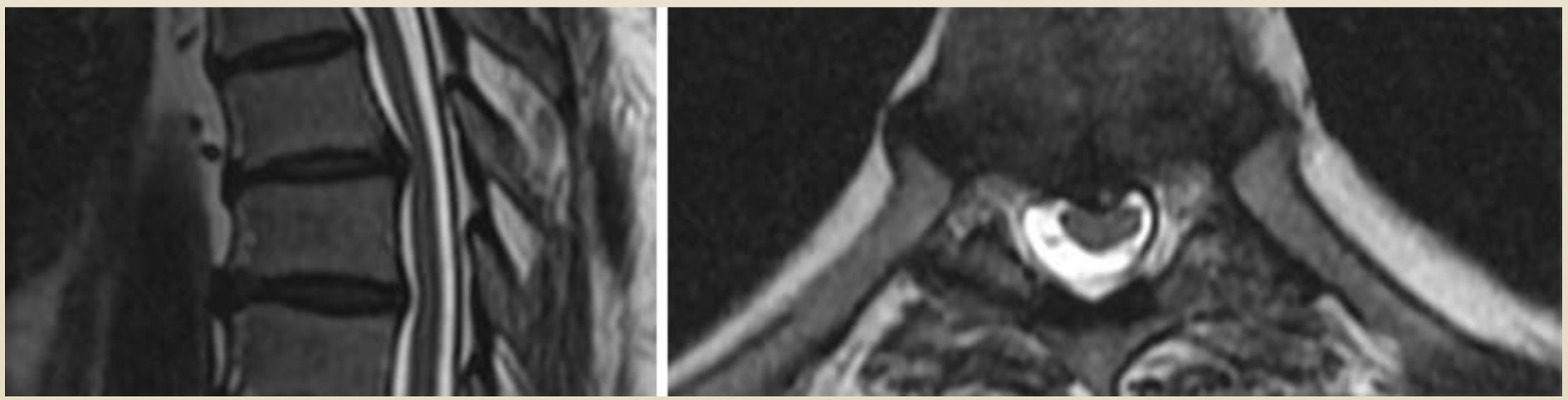

Image: A. Ruhe

[1] Gray, B.L. et al. Disc herniations in the national football league. Spine 2013; 38:193-198
[2] Vanichkachorn J.S., Vaccaro A.R. Thoracic disk disease: diagnosis and treatment. Journal of the American Academy of Orthopaedic Surgeons 2000; 8: 159-169

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I. Epidemiology

- **Rib fractures** are the most common thoracic injury in contact sports
- May be a stress fracture due to overuse in sports such as rowing [1]
- Here, 8-16% of elite rowers are affected, 86% of fractures occur at ribs 4-8
- **Sternal fractures** are seen in 3% of blunt chest trauma, epidemiology in sports is unclear

[1] McDonnell, L.K. et al. Rib stress fractures among rowers: definition, epidemiology, mechanisms, risk factors and effectiveness of injury prevention strategies. Sports Medicine 2011;41(11):883-901.

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II. Mechanism of Injury and Management

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II. Mechanism of Injury and Management

- **Spinal cord compression** is most likely due to trauma and associated fractures or associated with wear and tear resulting in disc pathology
- Segmental **nerve root compression** is also possible by the same mechanisms
- Management depends on many factors and may range from conservative care and rehabilitation to emergency surgery

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II. Mechanism of Injury and Management

- **Musculo-ligamentous injuries** are often caused by violent rotational or bending forces
- Symptom onset is often delayed by 12-24h due to the inflammatory cascade

- Chronic overuse injuries may occur from sustained high-repetition activities (e.g. rowing [1])

[1] Hosea, T. M. et al. Rowing Injuries. Sports Health. 2012; 4(3): 236-245.

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II. Mechanism of Injury and Management

- **Management** depends on the underlying cause and may e.g. include rest, activity modification, stretching, taping, chiropractic/physical therapy, nonsteroidal anti-inflammatory drugs (NSAID), and muscle relaxants

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II. Mechanism of Injury and Management

- **Spinal fractures** have often been reported in winter sports where high velocity impacts are likely [1]
- Main mechanism is compression (95%) while distraction (4%) and rotation (1%) are rare causes
- Wedge (47%), incomplete burst (22%) and endplate (16%) fractures are the most common compression-type fractures

[1] Gertzbein, S. D. et al. Thoracic and Lumbar Fractures Associated With Skiing and Snowboarding Injuries According to the AO Comprehensive Classification. American Journal of Sports Medicine 2012; 40(8): 1750-1754.

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II. Mechanism of Injury and Management

- Spinal fractures may range from isolated transverse or spinous process fractures to major injuries such as unstable vertebral body fracture-dislocations
- Mainly stable injuries, neurological impairment is uncommon
- Stress fractures involving spinous processes, transverse processes, or ribs may result from overuse activities

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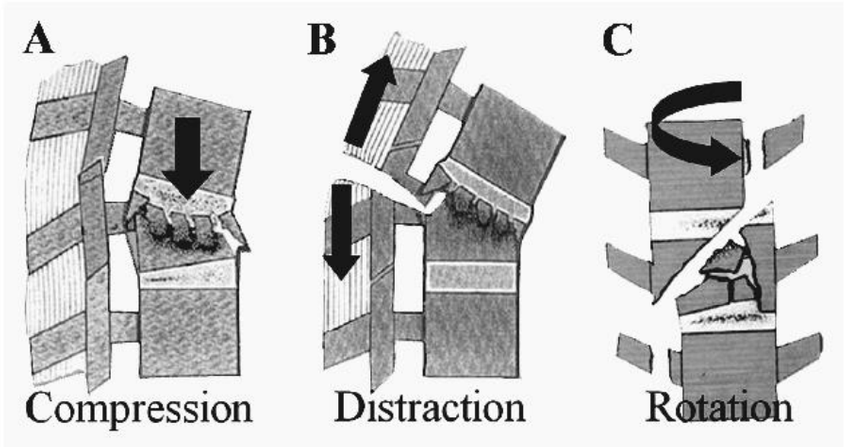
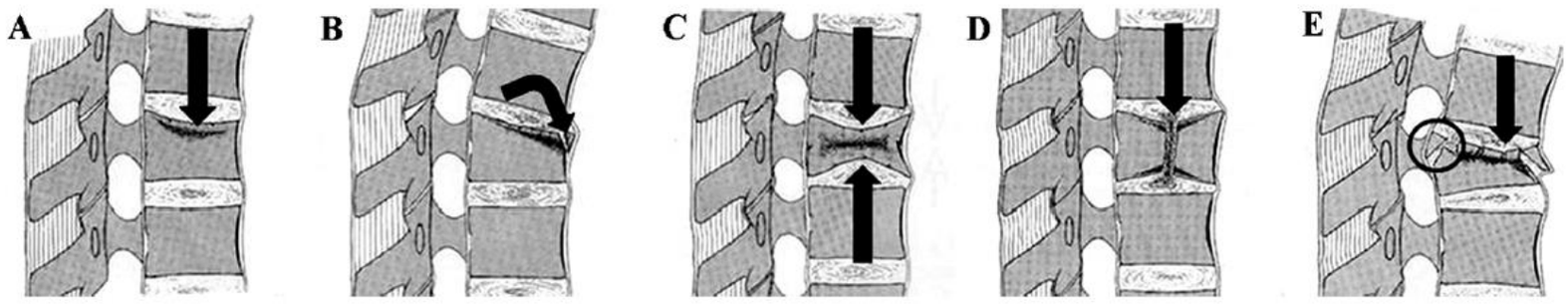
II. Mechanism of Injury and Management





Compression fractures

A: endplate, B: wedge, C: collapse, D: split, E: burst

Image: Magerl, F. et al. A comprehensive classification of thoracic and lumbar injuries. European Spine Journal 1994;3: 184-201.

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Screencaps: SRF – Schweizer Radio und Fernsehen 2013

- Burst fracture T4, the 24 years old player is paraplegic since

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II. Mechanism of Injury and Management

Management

- Initial on-site management is stabilization (e.g. spinal board)
- Due to the inherent stability from the ribs and sternum, thoracic compression fractures rarely require operative treatment [1,2]
- Surgery required if fracture is unstable and/or neurological s/s
- External, such as a Jewett/Minerva brace or custom-made thoracic orthoses/lumbar sacral orthosis are usually unnecessary

[1] Horton WC et al. The role of the sternum, costosternal articulations, intervertebral disc, and facets in thoracic sagittal plane biomechanics: a comparison of three different sequences of surgical release. Spine. 2005; 30:2014-23.
[2] Watkins R et al. Stability provided by the sternum and rib cage in the thoracic spine. Spine. 2005; 30:1283-6.

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II. Mechanism of Injury and Management

Management

- RTP after spinal injury is complex and, at times, difficult to enforce
- Injuries and operative treatment involving the transitional regions of the cervicothoracic and thoracolumbar injuries likely to produce altered biomechanics, thereby delaying RTP [1]
- Amateur and professional athletes should be treated equally

[1] Burnett MG, Sonntag VK. Return to contact sports after spinal surgery. Neurosurgery Focus. 2006; 21:E5..

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II. Mechanism of Injury and Management

- **Sternal fractures** and **dislocations** are rare rare due to the elastic recoil of the ribs which suspend the sternum [1]
- Usually associated with contact sports (hockey, football, rugby) [2]
- Potentially associated injuries take precedence (e.g. injury to spine and CNS, cardiac contusion and dysrhythmias)
- Diagnosis by chest x-ray, ultrasound or CT
- Cardiac monitoring

[1] Gatzoulis MA. Section 7, Thorax. In: Standring S. ed. Gray's anatomy: the anatomical basis of clinical practice. 40th edn. London: Elsevier, 2008:917–26
[2] Caine D. J. et al. (ed), Epidemiology of Injury in Olympic Sports, 2009, Oxford: Wiley-Blackwell.

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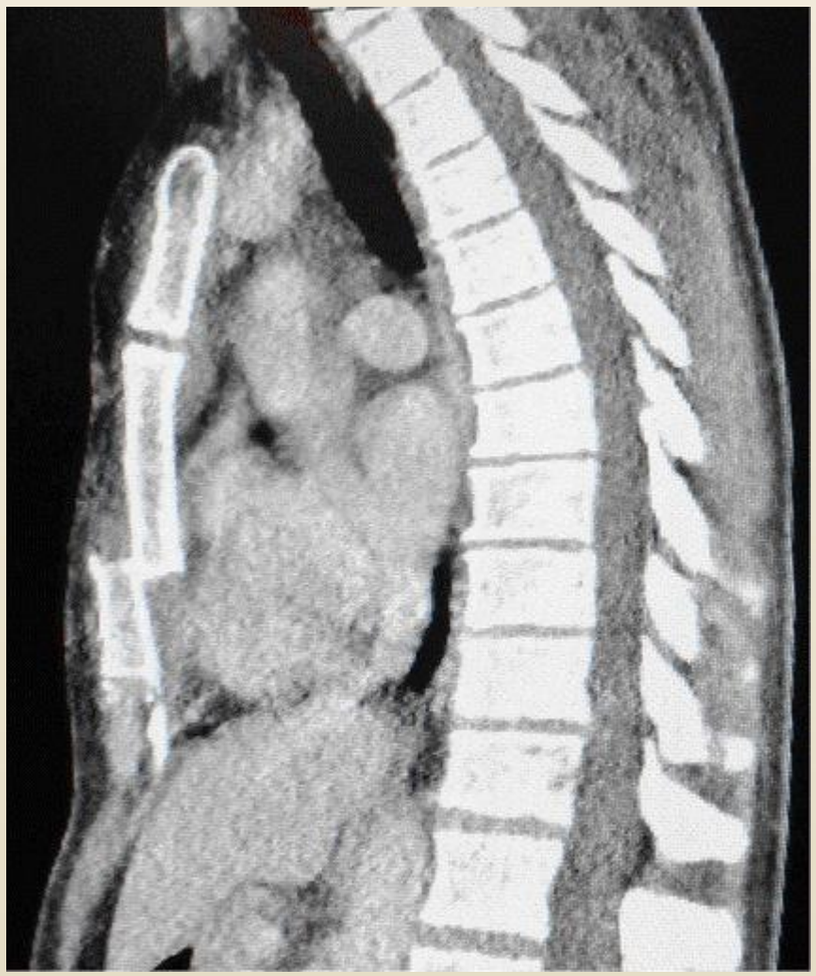
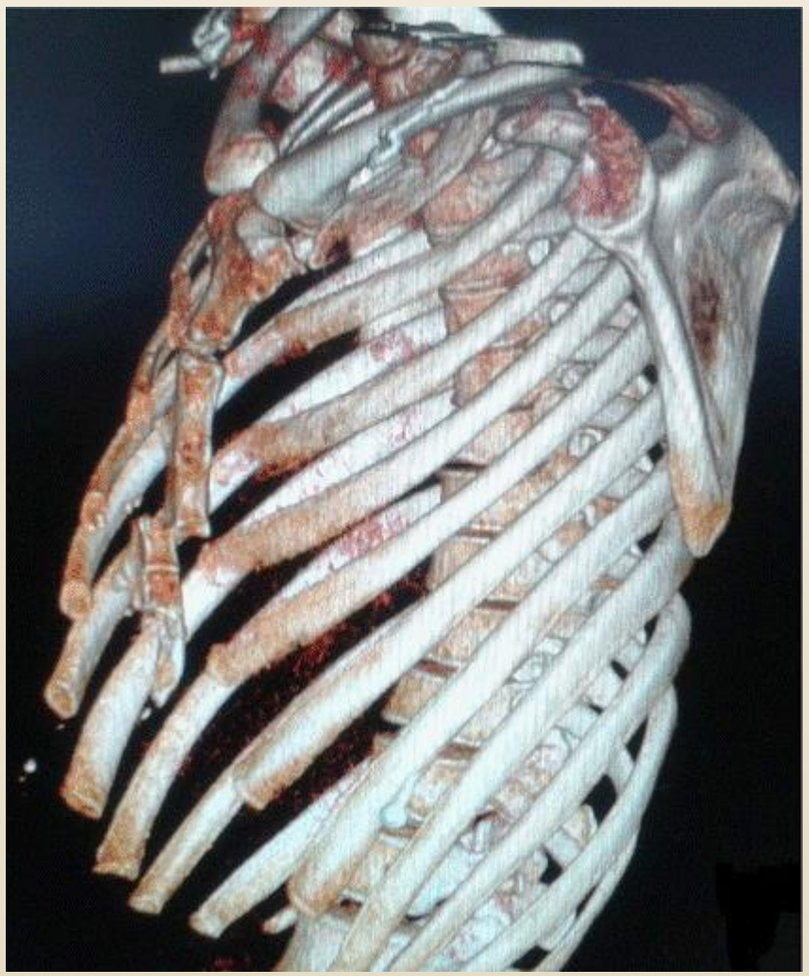
II. Mechanism of Injury and Management





[1] Ahmad, K. et al. Fixation of sternal fracture using absorbable plating system, three years follow-up Journal of Thoracic Disease 2015;7(5):E131-E134

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II. Mechanism of Injury and Management

Sternal dislocations

- **Type I:** posterior dislocation of the body due to direct force (a)
- **Type II:** posterior dislocation of manubrium due to direct force to manubrium (here Cx hyperflexion) [1]

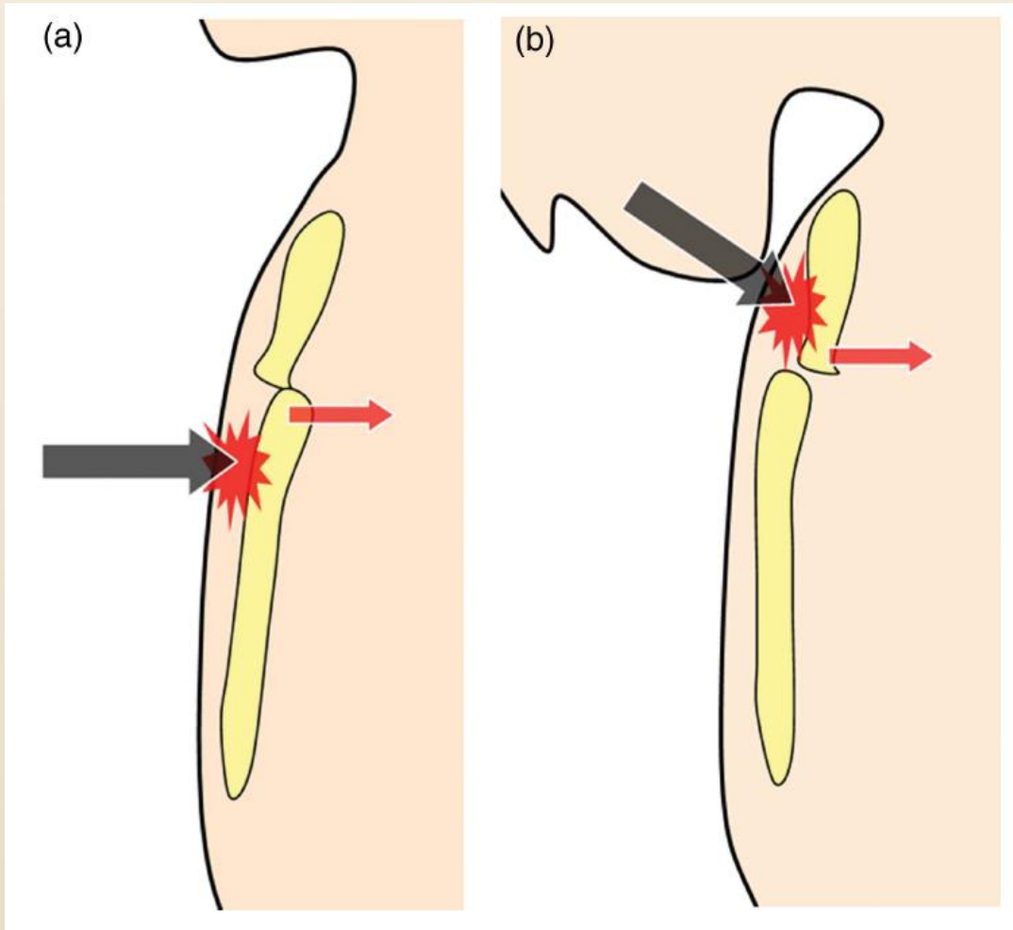

Image: Hayashi, D. et al. Thoracic injuries in professional rugby players: mechanisms of injury and imaging characteristics. British Journal of Sports Medicine 2014;48:1097-1101.

[1] Hayashi, D. et al. Thoracic injuries in professional rugby players: mechanisms of injury and imaging characteristics. British Journal of Sports Medicine 2014;48:1097-1101.

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II. Mechanism of Injury and Management

- **Management** aims at pain control, surgical fixation where necessary

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II. Mechanism of Injury and Management

- **Rib fractures** are most commonly a result of trauma
- May also be fatigue fractures from sustained high-repetition activities such as rowing
- Here, the posterior ribs are more commonly involved due to the pull of serratus anterior
- Most frequently occurs after time off competition/practice when endurance suboptimal

Gertzbein, S. D. et al. Thoracic and Lumbar Fractures Associated With Skiing and Snowboarding Injuries According to the AO Comprehensive Classification. American Journal of Sports Medicine 2012; 40(8): 1750-1754.

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II. Mechanism of Injury and Management

- May be associated intra-thoracic and intra-abdominal injuries
- Direct blow vs. compression of the thorax
- Pleuritic pain restricts ventilation
- Crepitus and hemoptysis may be present

Gertzbein, S. D. et al. Thoracic and Lumbar Fractures Associated With Skiing and Snowboarding Injuries According to the AO Comprehensive Classification. American Journal of Sports Medicine 2012; 40(8): 1750-1754.

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II. Mechanism of Injury and Management

Management

- Rib fractures usually heal quickly and without complications
- Non-union is rare
- The focus should be on ruling out underlying injuries and monitoring the athlete for safe RTP
- Be aware of hemothorax laceration of lung parenchyma or the intercostal artery

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II. Mechanism of Injury and Management

Management

- Fracture of ribs 1-3: Consider vascular or neurologic injury
- Fracture of ribs 9-12: Consider liver, spleen or renal injuries
- See case study for a management example of a simple rib fracture

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II. Mechanism of Injury and Management

- **Disc herniations may** result from axial loading and rotation on a flexed spine, resulting in traumatic herniation of the nucleus pulposus
- Causative activities are locking, tackling, or other modes of contact
- Time loss of may be higher compared to herniations in the cervical and lumbar regions [1]

Image: https://chicagotonight.wttw.com

[1] Gray BL, Buchowski JM, Bumpass DB, et al. Disc herniations in the national football league. Spine. 2013; 38:1934-8

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II. Mechanism of Injury and Management

Management

- The vast majority of symptomatic thoracic herniations can be treated effectively with non-surgical modalities
- Symptoms usually remit over the course of several weeks to months
- Surgical intervention is recommended in the early stages in case of progressive neurologic deficits or myelopathy

[1] Gertzbein, S. D. et al. Thoracic and Lumbar Fractures Associated With Skiing and Snowboarding Injuries According to the AO Comprehensive Classification. American Journal of Sports Medicine 2012; 40(8): 1750-1754.

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I. Case Study

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I. Case Study

- A 27-year old elite hockey player was deliberately stabbed with the end of a stick ("Butt Ending") in the rib cage laterally below the protective gear
- Player completed his shift with obvious difficulty, no penalty was called
- Initial side-line examination revealed marked sensitivity to touch and pressure over the ribs with difficulty breathing
- Player was removed from the rink to the medical facilities

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I. Case Study

Examination

- On-site sonography revealed a swelling over the 6th rib with a step-defect of the cortical outline suggesting a rib fracture (which was later confirmed by x-ray)

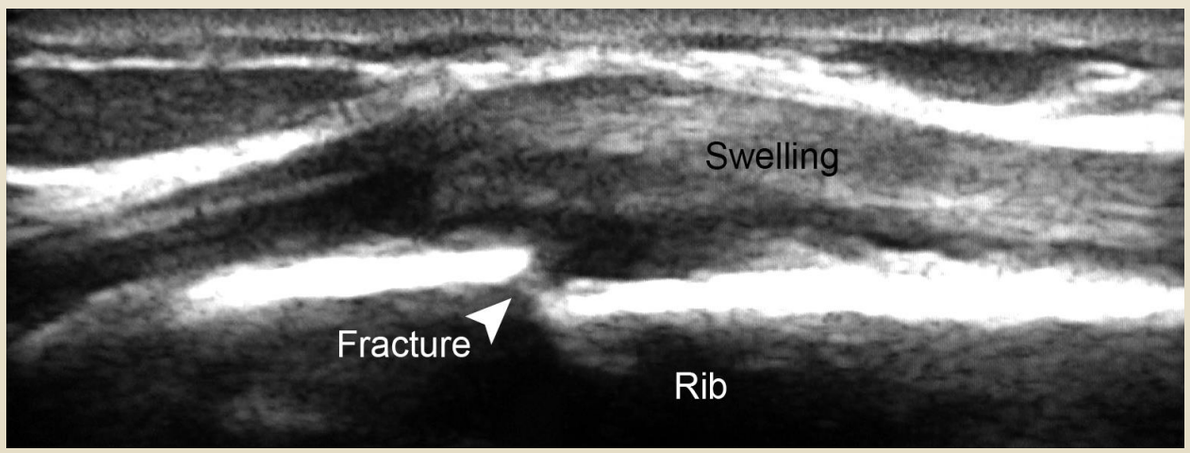

Image: A. Ruhe

- Examination in hospital did not reveal any internal damage

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I. Case Study

Management

- Player was removed from training for one week and put on analgesics and physiotherapy
- Return to practice with rib strap to help “splint” the broken rib and reduce chest wall motion during deep inspiration
- Off-ice practice (e.g. spinning, slide-board) until pain was sufficiently reduced for non-contact skating
- „Flak jacket“ protection for 4 days during practice on ice
- RTP after 2 weeks, pain-free by end of week 3

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