

## Trauma and Sports Related Injuries of the Spine

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- The majority of injuries affecting the athlete are self-limited and related to strains and contusions, though some can be devastating and life threatening.
- The demand of high-intensity sports places a constant load on the vertebral column and several studies have demonstrated a higher prevalence of spinal abnormalities in athletes than non-athletes and the number and extent of injuries has been directly correlated with the length in years of sports activity. [8]
- Spinal injuries are common events in the professional athlete, and due to the increased popularity of recreational athletic activities, the occurrence of sports-related spinal injuries in the general population has increased. [20]
- Spinal injuries may involve the structural elements (bones, discs, ligaments) and/or neural elements (brachial plexus, nerve roots, spinal cord).
- MRI is the study of choice to evaluate and aid in the subsequent treatment of patients with neurological symptoms, as it is able to reveal subtle bone marrow, soft-tissue, and spinal cord abnormalities not apparent on other imaging modalities.

### CERVICAL SPINE: TRANSLATION & STABILITY

1. Stability is a key structural determinant of whether a player requires conservative rehabilitation or surgical treatment in order to return to play.
2. Stability is dependent on the integrity of the ligaments, the intervertebral disc and bony elements.
3. Hyperextension, hyperflexion, and axial loading are the primary mechanisms of ligamentous and osseous injury, ultimately impacting the stability of the spine.
  - a. Severe cervical spine injuries are commonly a result of an axial load applied to the straightened spine (“spear” tackling) [22]
  - b. Injury leading to subaxial instability typically starts posteriorly at the interspinous / supraspinous ligaments and with increased load, may extend to the facet joints resulting in capsular disruption. Sufficient force imparted to the cervical spine will tear the posterior longitudinal ligament, and rarely will injury propagate to involve the anterior longitudinal ligament [21]
4. Osseous impairment and spinal instability
  - a. Most traumatic causes of atlantoaxial instability are due to odontoid fractures
  - b. Facet, lamina, pedicle fractures
5. Stable fractures
  - a. Typically involve the vertebral body, spinous and transverse processes

### LUMBAR SPINE: SPONDYLOLYSIS OF THE LUMBAR SPINE

1. Common cause of pain in the adolescent athlete
2. Due to the developing skeleton, patients in this age group are susceptible to injuries at the pars interarticularis and have been described in 3 classic patient types [5, 15]

- a. Unique ossification centers in the posterior elements create cartilage-bone interfaces where higher stresses are seen [16]
- 3. Typically occurs at the L5 vertebral level and less commonly at L4 [12, 13], though may be seen at higher levels with certain sports
- 4. Unilateral versus bilateral pars defects and degree of slip
  - a. Bilateral pars defects will develop symptomatic progression in only a small percentage of subjects in long-term follow-up studies [1]
  - b. Other studies indicate that a higher pelvic incidence may be associated with a higher degree of slippage [7]
- 5. MR is an effective first-line imaging modality for diagnosis of juvenile spondylolysis, with supplemental limited CT imaging for confirmation in indeterminate cases and assessment of healing [2]
  - a. MR has the ability to detect stress reaction on STIR imaging
  - b. MR technique
    - i. 2 to 3.5 mm slice thickness
    - ii. Studies in the literature often use a slice thickness of 5mm on MRI
- 6. Pedicle fracture and retrosomatic defects as mimics

#### HNP & IMPINGEMENT

- 1. Disc pathology is the most common cause of impingement of the spinal cord and the nerve roots at varying levels (intrathecal, neural foraminal or extra-foraminal nerve roots)
- 2. A recent study demonstrated a high return to play in professional athletes with productive careers following lumbar disc herniation [10]
- 3. NASS task force lexicon [11]
- 4. Developmental spinal canal stenosis [3, 23], particularly in the cervical spine.
  - i. People with underlying stenosis are more likely to impinge their canal in the setting of trauma due to transient subluxations or in extremes of flexion/extension
  - ii. Not itself a contraindication to participate in sports
    - 1. Episode of neuropraxia → relative contraindication
    - 2. Abnormal cord signal, instability or compression of the cord → absolute contraindication [7]
  - iii. What is the definition of “stenosis”? [9, 14]

#### TRANSIENT QUADRIPARESIS & STINGERS

- 1. Bone and disc pathology, and transient subluxation can result in cord injury
- 2. Important to differentiate transient quadriplegia from stingers.
  - a. The transient stingers or burners arise from compressive or traction injuries to the roots or the brachial plexus, typically are unilateral and often need not be imaged [22, 4]
  - b. If symptoms are bilateral, there are recurrent events, or persistent symptoms, a central cord lesion should be considered and MR imaging obtained [4, 19]
    - i. Typically, there will be no spinal cord edema. However, MR may identify developmental stenosis, disc herniation/osseous productive change causing a functional spinal stenosis
    - ii. Dynamic MRI in flexion / extension can also be used to further evaluate for any stenosis, although its clinical utility has not yet been proven

- c. Controversy exists over return-to-play guidelines for athletes following an episode of transient quadriparesis. Typically, athletes can RTP with stingers after symptoms resolve

#### NERVE ROOT AVULSIONS

1. Uncommon, but important to recognize
  - a. Advances in nerve grafting technique
  - b. MR imaging as a screen
  - c. Role of CT myelography

#### VASCULAR INJURY

1. Vertebral artery dissection
2. Fracture extension into the transversalis foramina

#### OTHER SOFT-TISSUE INJURY

1. Hematoma
2. Muscle strains and contusions

#### CHRONIC / OVERUSE

1. DDD
2. Facet joint synovitis/arthrosis
3. Enthesopathy of C1
4. Sacral fractures: Female athletes

#### TUMOR DDx

1. MRI is a valuable tool in discerning benign from malignant etiologies of back pain.
2. Primary muscle and osseous pathology

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