Case Based soft tissue imaging: Trauma

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This session will focus on trauma of muscle and tendon (and ligaments). Trauma of these structures will occur mostly during sports related exercises. Firstly we need to clarify "trauma". There is an acute and a subacute or chronic type of trauma. Examples of **acute** type of muscle injury are the "coup de fouet'-acute calf strain, the hamstring muscle injury in runners, the acute quadriceps muscle contusion in soccer players. When considering acute tendon pathology is the acute bicipital tendon rupture in an older athlete, the acute achilles tendon rupture. When considering acute ligamentous injury, one can think of ankle ligament trauma, retinaculum injury of the wrist.
However a very common type of injury is the chronic type, **overuse** injury of tendon especially. Due to repetitive microtrauma to tendons chronic injury occurs, with degeneration or tendinosis of the tendon occurs. Loss of cross-linking between collagen fibers, angiofibroblastic hyperplasia and reparative processes with collagen type 3 matrix production is seen on histology. Also associated ingrowths of nerve endings and rarely calcium depositions are seen.
The optimal MR imaging protocol is that protocol that answers the clinical questions that arise. You need to be in close contact with the treating physician (i.e. sports physician, orthopedic surgeon) in order to fully understand the problem. As a general rule of thumb one can say that fat suppressed imaging is the most important tool, used in at least two orthogonal directions, meaning the axial plane and a longitudinal plane. However, it also is advised to include T1 weighted sequences in order to correlate pathology (areas of high (water-like) signal intensity sequences) to true anatomy.

Acute muscle injury:
How do we do it? When evaluating an acute muscle injury, we always start placing a marker on the point of maximal tenderness. Then firstly a longitudinal (coronal or sagittal) imaging plane is chosen in which TSTIR and T1-weighted images are acquired. Active participation of the radiologist, with careful detection of areas of high signal intensity is necessary, since this location is the site of planning the next axial lices and these pathologies can be subtle. It is advised to included the opposite extremity in the Field Of View for comparison. After assessing the TSTIR one can plan the axial slices with fat suppressed intermediate or T2 weighted sequence with a high imaging matrix.
Were to look? Be aware of the fact that muscle injury will occur at two sites of preference, the weakest links in the chains of kinetics. These sites are the musculotendinous junction (MTJ) and the enthesis (bone-tendon insertion). There is an MTJ both proximal and distal in the muscle which are located deeply in the muscle. Since ethesis assessment is mandatory, clear evaluation of the bones that the tendon attach to is done. MRI can easily detect bone marrow edema as important sign of disruption. However, some caution concerning bone injury is advised. Small or even larger avulsion fragments are easily overlooked with MR. Since the presence of these

fragments may be the difference between conservative or operative therapy, we often additionally use MDCT to assess presence and size and location of avulsion fractures.
Why image muscle injury? Imaging muscle injury is of extreme importance in high performing athletes. There is growing evidence that imaging parameters hold information concerning healing of the lesions and thus prognosis. In evaluating both longitudinal and axial size of the lesion, on adjacent to the musculotendinous junction. These associations and prognosis are thought to relate to the number of muscle units disrupted, can estimate the volume of the muscle injury, the percentage of cross sectional area of abnormal muscle and the cranio-caudal length of muscle abnormality adjacent to the MTJ.

When you are involved in radiology of (high level) sports related injury, the role of imaging is defined as follows: 1) correct diagnosis at the start, enabling the tailored treatment strategy, with a choice between conservative treatment or surgical approach, 2) visual evidence for the athlete and the trainer/coach/manager. 3) prognosis for the athlete: when will he be able to return to the pitch. Expectations from the radiologists are defined as: A) Interest in sports and "feel" for the athlete. A minor injury can cause great distress. B) Knowledge of MSK physiology and biomechanics. This will aid in understanding specific areas of injury due to the normal sports related biomechanics. C) Expertise in MSK US and MRI. D) Availability within 24 hrs-5 days.
One needs to be aware of pitfalls in imaging the traumatized athlete. These are: 1) no direct relation between imaging findings and clinical symptoms: there is just imaging to show improvement. 2) Non-significant abnormalities. Asymptomatic athletes may have abnormalities without clinical relevance. Thus abnormalities will be found in the injured athletes without clinical significance together with abnormalities that are the results of the injury.

In the Case-Based teaching session the participant will learn various typical imaging findings of sports related soft tissue trauma. Optimal imaging protocols are described. Potential pitfalls are shown. Indications are discussed.

Suggested reading:

1) Imaging of Orthopedic Sports Injuries. 2007 .Eds F.M.Vanhoenacker et al.
2) Connell DA et al- Longitudinal study comparing Sonographic and MRI assessments of acute and healing hamstring injuries. AJR 2004;183:975-984
3) Orchard J et al-The management of muscle strain injuries: a early return versus the risk of recurrence. Clin J. Sports Med 2002 12:3-5
4) Slavotinek JP et al. Hamstring injury in athletes: using MR imaging measurements to compare extent of muscle injury with amount of time lost from competition. AJR 2002 179;1621-1628
5) Hellmann DB, Helms CA, Genant HK- Chronic repetitive trauma: a cause of atypical degenerative joint disease. Skeletal Radiol. 1983;10(4):236-42.
6) Helms CA-The impact of MR imaging in sports medicine. Radiology. 2002 Sep;224(3):631-5.
7) Major NM, Helms CA.MR imaging of the knee: findings in asymptomatic collegiate basketball players. AJR2002 Sep;179(3):641-4.