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Magnetic resonance imaging illustration of sports injuries: A pictorial review

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Abstract
Magnetic Resonance Imaging (MRI) plays a vital role in sports medicine, providing with accurate diagnosis, prognostic value, and assessment of healing after an injury. Due to its contrast resolution and multiplanar imaging facility, it is considered superior to other imaging modalities for evaluation of injuries in sport. This article provides an illustrative MRI description of variety of sports injuries.

Keywords: MRI, sports injury, pictorial essay

Introduction
Magnetic Resonance Imaging (MRI) is a non-invasive imaging modality, based on principle of using strong magnetic fields to capture images of various anatomical regions.
It has inevitable role in sports medicine to evaluate injuries due to its multiplanar capabilities, superior soft tissue contrast, and sensitivity to osseous stress injuries. Being a non-ionizing radiation technique, MRI is the investigation of choice for most of the injuries in athletes, who may require multiple follow-up imaging during the course of management [1].
In elite athletes, MRI plays more extensive role as it can assess not only the type but also the precise extent of soft tissue and bony injury. MRI also helps in determining prognosis of the injury, planning rehabilitation and training programmes, and return to play (RTP) time [1].
This pictorial review aims to describe MRI features of various sports injuries in an illustrative manner to serve as a guide for sports physicians as well as radiologists dealing with athletes.

Bankart's lesion
Most shoulder dislocations (>95%) occur in the anterior direction and are usually traumatic [2, 3]. This causes loss of integrity of anterior ligamentous capsule, which often results in detachment of the anterior inferior labrum, known as Bankart's lesion [4]. Dislocations are common in collision athletes such as wrestlers and football players, and also in non-contact overhead athletes (baseball, tennis, volleyball, Swimming) due to repetitive trauma [5]. (Figure-1)

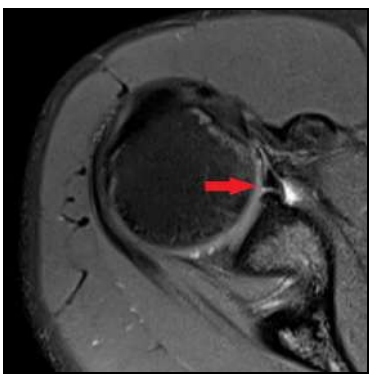


Fig 1: Transverse PDFS image showing hyperintensity in anterior glenoid labrum suggestive of Bankart's lesion in a 21 year old cricketer

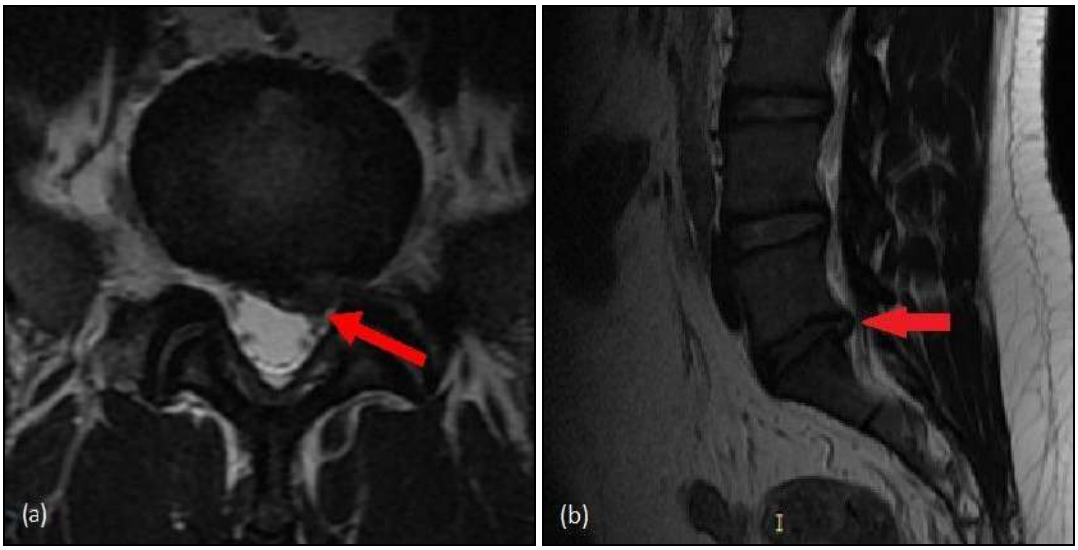
Supraspinatus tendinopathy

Supraspinatus tendinopathy can be caused by primary impingement as a result of increased subacromial loading, and secondary impingement due to rotator cuff overload and muscle imbalances [6]. It is common in overhead athletes due to repetitive overload caused during eccentric contraction in deceleration phase of throwing [7, 8]. The most common site being the watershed area, around 1 cm proximal to its insertion. (Figure-2)

Fig 2: Coronal PDFS image showing mild hyperintense signal involving supraspinatus tendon close to its insertion suggestive of supraspinatus tendinopathy in a 19 year old weight-lifter

Lumber disc herniation

Displacement of disc material, nucleus pulposus or annulus fibrosus, beyond the intervertebral disc space is referred as herniation of disc or prolapsed intervertebral disc. It is common in gymnasts and American football linemen [9, 10]. It can also occur as an acute injury in weight-lifters. The strenuous movements of tackling, and repeated lumbar flexion, twisting and bending are the common contributing factors [10]. (Figure-3)



(a) (b)

Fig 3: (a) Disc level axial view showing posterior and left paracentral herniation of L5-S1 disc extending into left antero-lateral epidural space causing mild ventral sac indentation with left traversing nerve root compression in a 23 year old weight lifter (b) Sagittal view of same MRI showing mild diffuse posterior bulge of L4-L5 and L5-S1 disc

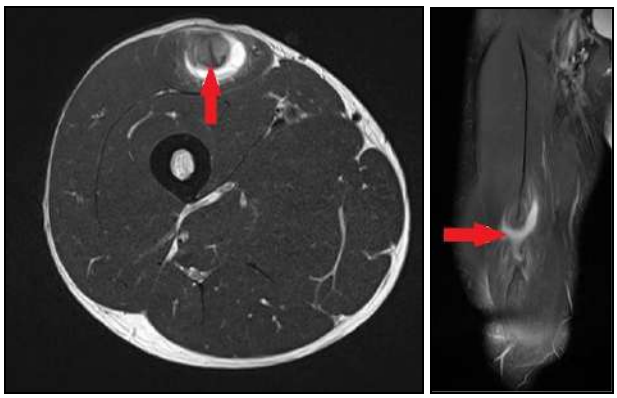
Limbus Vertebrae

Limbus vertebra is formed from an intrabody herniation of disc material during childhood or adolescence [11]. It is because of chronic stress, trauma, or congenital abnormality specially during ossification which can cause the herniation of the nucleus pulposus between the ring apophysis and the adjacent vertebral body. It is most commonly present at the anterosuperior margin of a single vertebral body and prevalent among athletes, particularly under back loading in flexion like gymnasts or weight lifters [12, 13]. (Figure-4)

Fig 4: Sagittal T2 image of 18 year old weight lifter showing herniation of nucleus pulposus through the superior end plate of L4 vertebra, suggestive of Limbus vertebrae

Degloving Rectus Femoris Injury

Rectus femoris injuries occur most commonly at the distal muscle-tendon junction of the quadriceps tendon [14]. Intramuscular degloving injuries of rectus femoris are described as the injuries of the muscle belly where the inner bipennate muscle is separated and dissociated from the superficial unipennate muscle without involvement of myofascial junction, myotendinous junction, or the intratendinous region [15]. It is a relatively new pattern of muscle belly strain observed in athletes specially football players and sprinters, and accounts for only 9% of all rectus femoris injuries [15, 16]. (Figure-5)



(a) (b)

Fig 5: (a) Axial T2 image shows dissociation between inner bipennate and outer unipennate fibers of rectus femoris and no involvement of central tendon in a 22 year old 800m athlete. (b) Coronal T2 image shows Central Tendon is not ruptured along the entire length. Circumferential intermuscular dissociation of inner bipennate and outer unipennate fibers of rectus femoris

Anterior Cruciate Ligament (ACL) injury

The typical ACL injury occurs with the knee externally rotated, 10°- 30° flexed and in valgus position. Therefore, common mechanisms are cutting manoeuvre and single leg landing [17, 18]. It is frequently seen in pivoting sports like football, basketball, netball, soccer, handball, gymnastics, downhill skiing. ACL injuries are more common in females because of certain anatomical, hormonal and biomechanical factors [19]. (Figure-6)

Fig 6: Normal dark signal band of ACL poorly defined in sagittal PDFS image suggestive of high grade ACL tear in a 23 year old 400m athlete

Medial Collateral Ligament (MCL) injury

Isolated MCL injury occurs with a valgus force in a flexed knee. MCL injury can be contact or non-contact. Rotational mechanisms usually result in multiple ligament injuries [20]. Contact sports such as soccer, American football and skiing carry higher risk [21]. Majority of Grade III MCL injuries are associated with a cruciate ligament tear, most commonly involving the ACL [22]. (Figure-7)

Fig 7: Coronal STIR image of 18 year old judoka showing hyperintense signal involving proximal half of MCL reaching upto femoral insertion with accompanying fluid, suggestive of intermediate to high grade MCL tear

Meniscal injury

Meniscal lesions are the most common intra-articular knee injuries. Acute meniscal tear occurs as a result of sheer stress generated during knee flexion and compression combined with femoral rotation which exceeds the ability to resist these forces, as in cutting/twisting movements [23]. Discoid meniscus is an abnormal, disc or oval shaped meniscus, present in about 13% of the Asian population and is more likely to be injured [24]. Most of the meniscal tears are longitudinal or radial whereas discoid meniscal tears are often horizontal [25]. (Figure-8, 9)

Fig 8: Longitudinal hyperintense signal seen in peripheral third of posterior horn of medial meniscus on PDFS sagittal image of 29 year old judoka extending across its articular surface suggestive of grade III tear

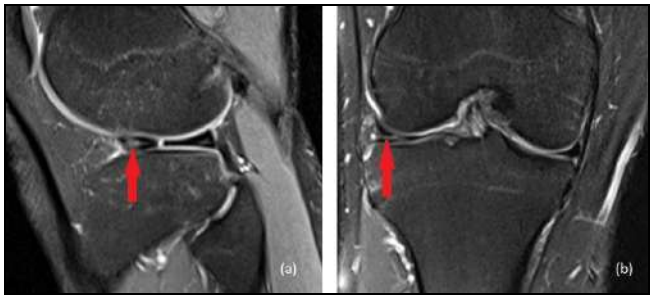


Fig 9: Incomplete discoidal lateral meniscus with linear horizontal hyperintense signal on PDFS image of 17 year old shot put athlete in anterior horn and body of lateral meniscus with extension into articular surface in both sagittal (a) and coronal (b) view suggestive of Grade III tear

Chondromalacia patellae

Chondromalacia patellae is a degenerative condition that causes softening, swelling, fraying, and erosion of the hyaline cartilage underlying the patella and sclerosis of the underlying bone [26]. It is usually described as an overuse injury caused due to altered biomechanics. It is common in athletes with increased Q angle; tight hamstrings, tensor fascia lata, gastrocnemius, weak quadriceps, patella alta, and excessive pronation of foot [27]. (Figure-10)

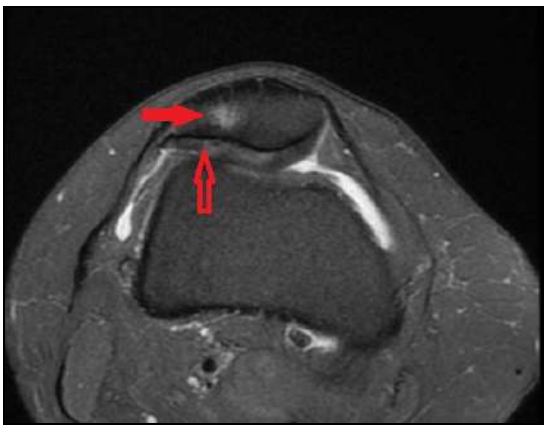


Fig 10: Axial PDFS image of 28 year old Fencer showing subchondral marrow oedema (solid arrow) involving posterior articulating surface of patella along lateral facet with thinning of patellofemoral cartilage (empty arrow) suggestive of Chondromalacia patellae

Osnaviculare syndrome

Accessory navicular is the second most common accessory bone in the foot. Os naviculare syndrome is symptomatic accessory navicular in athletes performing repeated jumping and sprinting [28]. Three types of accessory navicular have been described [29].

Type 1 (30%) – small, round, or oval shaped separate ossicle embedded within the posterior tibial tendon

Type 2 (50%) – larger, triangular or heart-shaped ossicle adjacent to navicular tuberosity and connected to native bone by a synchondrosis (Figure-11)

Type 3 (20%) – cornuate or hooked navicular, formed by fusion of accessory bone with the navicular

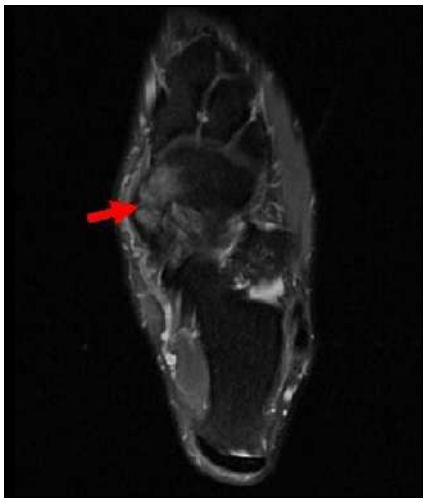


Fig 11: Large accessory ossicle lying adjacent to medial side of navicular bone, in line of insertion of tibialis posterior tendon suggestive of accessory navicular, with associated marrow oedema involving both accessory navicular as well as navicular bone on STIR image of a 22 year old javelin thrower

Conclusion

Though MRI has become gold standard for diagnosing sports injuries because of its unparalleled soft tissue contrast, it is imperative that the result must be interpreted by an experienced sports physician in conjunction with clinical evaluation. At the same time follow up MRI needs to be interpreted with caution before determining RTP. The role of MRI in clinical and research field in sports medicine has expanded even further in recent times particularly due to introduction of 3-T scanners and advancements in coil technology.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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