ESSR BSSR OXFORD 2005
Abstracts of Refresher Course

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AVOIDING ERRORS IN DIAGNOSING MENISCAL TEARS

A. A. De Smet
University of Wisconsin, Madison, United States

Although knee MRI has been used for the diagnosis of meniscal tears for two decades, recent studies on the accuracy of knee MRI still note a fair percentage of false positive and false negative interpretations. This presentation will review the MR criteria for diagnosing a meniscal tear including the criteria for diagnosing less common types of tears. In addition, the causes for false positive and false negative diagnoses will be reviewed with a discussion of ways to minimize these diagnostic errors.
At the speaker's institution, a "two-slice" touch rule has been used for the past decade for the diagnosis of meniscal tears [1]. Using the criterion that a meniscus is torn when it has signal to an articular surface or distortion on two or more images, an accuracy of >90% has been consistently achieved among seven musculoskeletal radiologists. The unique criteria for radial, peripheral, discoid and root tears will also be presented [2, 3, 4, 5].
Among the causes of false positive diagnoses of a meniscal tear are: 1) lack of familiarity with normal variants, 2) spontaneous healing of tears, and 3) arthroscopically missed tears [6]. Each of these causes will be reviewed and supplemented with selected arthroscopic videos.
The failure to diagnose a meniscal tear subsequently detected at arthroscopy remains an unsolved dilemma for radiologists as quite often the MR examinations show only minimal meniscal abnormality even in retrospect. A series of such false negative MR examinations will be shown with suggestions for improving one's diagnostic accuracy in these cases. The value of the lateral meniscal fascicles and posteromedial tibial bone bruises as indirect signs of a tear will also be discussed [7, 8].

De Smet et al AJR 1993;161:101-107
Magee et al Skeletal Radiol 2002;31:686-689
De Maeseneer et al Europ J Radiol 2002:41:242-252
Ryu et al AJR 1998;171:963-967
Lerer et al Skeletal Radiol 2004;33:569-574
Justice et al Radiology 1995;196:617-621
Kaplan et al Radiology 1999;211:747-753
Blankenbaker et al AJR 2002;178:579-582
Wright et al AJR 1995;165:621-625
Helms et al, AJR 1998;170:57-61
Magee & Hinson, Skeletal Radiol 1998;27:495-499
Helms et al AJR 1998;170:57-61
Magee & Williams AJR 2004;183:1469-73
Stark et al JCAT 1995:19:608-611
Tyson et al Skeletal Radiol 1995;24:421-24

Campbell et al AJR 2001;177:409-413
Kaplan et al AJR 1991;156:333-336

ANTERIOR CRUCIATE LIGAMENT AND POSTEROLATERAL CORNER

J. Hodler
University of Zurich, Orthopedic University Hospital Balgrist, Zurich, Switzerland

Anatomy

The anterior cruciate ligament (ACL) runs from the posteromedial aspect of the lateral femoral condyle in an anteromedial direction and inserts at the anterior tibia. There are an anteromedial and a posterolateral bundle. Distally, the ACL is fan-shaped. Its tibial insertion measures up to 3 cm in the anteroposterior direction.

The posterolateral corner is not consistently defined in the literature. However, most papers include the lateral collateral ligament, the popliteus tendon (running from the posterior tibial surface superolaterally towards the lateral surface of the lateral condyle), the arcuate ligament (a strong fibrous plate running from the dorsal joint capsule at the level of the femur inferolaterally over the popliteus muscle to the fibular head), the popliteofibular ligament (running vertically from the popliteal tendon to the fibular head) and the posterolateral joint capsule.The arcuate and popliteofibular ligaments are not as consistently present as the lateral collateral ligament and the popliteal tendon. In cadaveric studies they have been described in 24-80% and up to 98%, respectively.

Clinical aspects

The ACL is the most commonly torn ligament of the knee. In the USA, 80'000 ACL tears are diagnosed per year. ACL tears may occur as an isolated injury but are more commonly combined with additional abnormalities. Both the medial and lateral meniscus are involved in up to 70% of patients. Repair of the ACL without correction of the lesions of the posterolateral corner leads to stretching and failure of cruciate ligament repair.

Standard radiographs

Standard radiographs may indirectly indicate ligamentous lesions of the knee. There is an association between impression fractures of the lateral femoral condyle with ACL lesions, avulsion at the lateral tibial plateau (Segond fracture) with complex ligament injuries, avulsion of the tip of the fibular head with posterolateral injuries as well as fractures of the posterior tibial plateau with several types of ligament injury.

MR imaging

MR imaging is the best imaging method for evaluation of the ACL and the posterolateral corner. Sagittal images angulated into the ACL are typically employed. In addition, coronal, axial and angulated sequences have been recommended for the assessment of the ACL. T1-weighted, proton density and fluid sensitive sequences have been employed. The posterolateral corner is commonly assessed on coronal or slightly angulated coronal images. Fluid sensitive sequences such as STIR images are useful for detection of acute posterolateral corner lesions.

Sensitivities and specificities of MR imaging in recognizing ACL tears are 90% or better. Indirect signs may assist in the diagnosis of such tears, including typically located bone bruises (mid part of the lateral femoral condyle, posterior lateral tibial plateau), ventral subluxation of the tibia with "uncovering" of the posterior horn of the lateral meniscus and posterior buckling of the posterior cruciate ligament. Only few papers have evaluated the diagnostic performance of MR imaging in the assessement of the posterolateral corner, usually with small numbers of patients. Lesions of the lateral collateral ligament and the popliteus tendon are less difficult to detect than abnormalities of the arcuate and popliteofibular ligaments which are relatively thin and difficult to differentiate from surrounding structures.

THE DIAGNOSTIC IMPACT OF MRI OF THE KNEE

P.W.J. Vincken, B.P.M. ter Braak, A.R. van Erkel, J.L. Bloem
Leiden University Medical Center, Leiden, Netherlands

Physical exam is, with some exceptions such as the locked knee, not an accurate method to select patients for therapeutic arthroscopy. Negative predictive values of meniscal provocation tests such as McMurray and stability testing of the anterior cruciate ligament are fairly high (70-99%). Positive predictive values, however, are fairly low (5-50%). The fraction of arthroscopies that remain diagnostic rather than therapeutic is therefore approximately 50%. In other words: approximately 50% of patients having arthroscopy should not have had this invasive procedure.

The accuracy of MR imaging in selecting patients for therapeutic arthroscopy is in the 90% range. MR can thus be used to avoid arthroscopy in almost 50% of patients scheduled for arthroscopy based on physical exam.

Approximately 10% of patients with a negative MR (and positive clinical exam) will have persistent complains. These patients may have false negative MR results and should have arthroscopy when substantial symptoms persist for instance for 3 to 6 months.

The clinical outcome of patients that do not go to arthroscopy based on a negative MR (and positive clinical exam) is as good as that of patients that are selected to go to therapeutic arthroscopy based on a positive MR. The fraction of diagnostic arthroscopies decreases from approximately 50% to less than 20% when MR is used to select patients for arthroscopy. The total costs, from a societal perspective, will not rise. In fact there will be a small decrease in costs (€129) per patient.

Because of these data MR imaging is, from a society perspective, a cost effective test in patients with a high clinical suspicion of treatable pathology. When MR is also positive patients go to arthroscopy, when MR is negative despite a positive clinical assessment conservative treatment is the best choice as arthroscopy will be negative as well.

When clinical exam is negative, MR is usually not performed. We have to realize, however, that approximately 20-25% of patients with a negative clinical exam will have abnormalities shown on MR. The fraction of these patients (negative clinical exam and positive MR) that benefit from therapeutic arthroscopy is approximately 80%.

We also have to realize that not all meniscal tears are symptomatic. Horizontal tears in patients with osteo-arthritis frequently are asymptomatic tears. Treatment of these asymptomatic tears will not relieve symptoms that are caused by other abnormalities such as synovitis, bone bruise, etc.

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DETERMINING STABILITY OF INJURIES OF THE CERVICAL SPINE

WCG Peh
Singapore Health Services, Singapore, Singapore

Among spinal injuries, those affecting the cervical spine result in the highest rate of neurological deficits. Spinal instability involves two components, namely: mechanical and neurological. Instability indicates the potential for an injured spine to either deform mechanically or worsen neurologically. The spine can be considered to consist of three columns. If one column is damaged, the spine is stable; but if two or three columns are involved, the spine is regarded as unstable.
Radiographs, that are meticulously obtained and interpreted, form the basis for initial imaging evaluation of cervical spine injuries. Radiographs may be supplemented by CT or MR imaging in selected cases. Understanding the mechanism of injury aids in the diagnosis and management of such injuries.
Most classifications of cervical spine injuries are based on biomechanical studies of vectors of forces involved. Although usually complex, one vector of force usually predominates, producing injuries that can be grouped as axial loading and hyperflexion-hyperextension. The type and severity of injury produced depends on the position of the cervical spine at impact, and sequence, direction, magnitute and velocity of the applied force.
Axial loading injuries in the neutral position are: Jefferson fracture, simple compression fracture and burst fracture. Axial loading in hyperflexion produces hyperflexion sprain and hyperflexion teardrop fracture. Axial loading in hyperextension produces Hangman's fracture and hyperextension teardrop injury. Bilateral facet dislocation results from a purely hyperflexion force, unilateral facet dislocation from a hyperflexion force with rotation, while hyperextension injuries cause hyperextension sprain and hyperextension-dislocation. Odontoid fractures are classified as injuries of indeterminate mechanism.
In summary, prompt diagnosis of cervical spine injuries is important for preventing or containing cord damage. As proper treatment cannot be instituted before the abnormality is diagnosed, it is important to have an understanding of the radiological signs of injury, know the patterns produced by the various traumatic mechanisms, and recognise the features of cervical spine instability.

SPINAL TRAUMA IN THE IMMATURE SKELETON

VN Cassar-Pullicino
The RJAH Orthopaedic Hospital, Oswestry, United Kingdom

The growing, partially un-ossified, and relatively flexible immature spine is associated with a spectrum of injuries different to that seen in the mature skeleton.

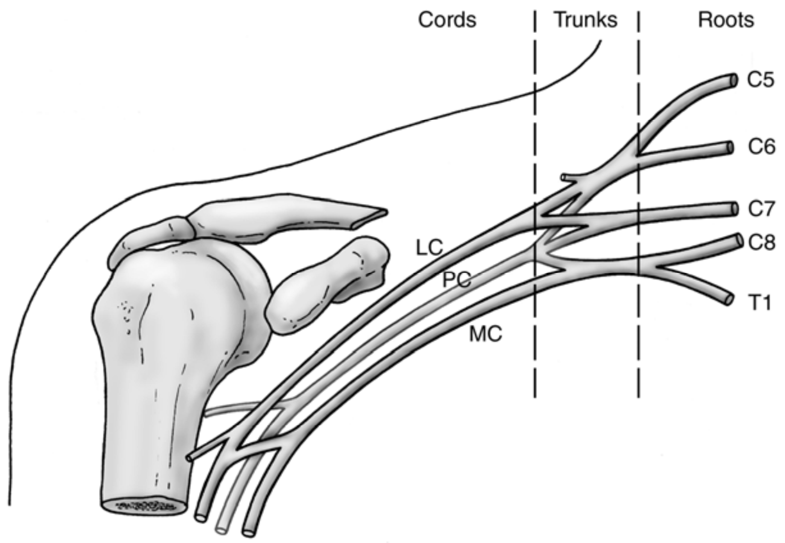
This presentation aims to define these differences and focus on the difficulties and challenges in evaluating trauma to the immature spine.
Cervical spine injury occurs in only 1-2% of paediatric blunt trauma patients and it can lead to severe morbidity or mortality. Thoraco-lumbar spine fractures are rare in this age group, occurring in 2-3% of all injuries in childhood. However, 25% of children with a spinal fracture have an associated neurological injury. Spinal cord paediatric injuries account 2-4% of all admissions to a spinal trauma centre. Certain injuries are unique to children including posterior limbus injuries, spinal cord injury without radiographic abnormality (SCIWORA) and spinal trauma in child abuse. The above statistics indicate the relative difficulties that face trainees and attending radiologists who are unlikely to have gained enough exposure to the radiological manifestations of paediatric spinal injuries.
The incidence of paediatric spinal injuries peaks in two age groups; children under 5 years old, or over 10 years. The paediatric spine achieves most of the adult radiographic features by age 8 (average). After this age, the fracture patterns fit into the adult classifications. Anatomic differences of the intervertebral disc and the vertebral body in children and adults are responsible for variations in the injury patterns in the two age groups. It is essential that the radiologist is familiar with the uniqueness of the osseous, ligamentous, cartilaginous (end-plate, physis, apophyses) and neurological anatomy of the immature spine to make a correct diagnosis. Assessment of the traumatised immature spine continues to present difficulties as evidenced by the over-estimation of non-injuries due to lack of familiarity with developmental variants, and the under-estimation of true injuries due to a lack of familiarity with the radiological features of trauma to the immature spine.

TRAUMA TO THE CORD AND BRACHIAL PLEXUS

JJ Rankine
St James's University Hospital, Leeds, United Kingdom

Recovery of neurological function following trauma to the spinal cord depends on the degree of cord injury. MRI can accurately distinguish between cord oedema, cord haemorrhage and cord transection and is useful for assessing the prognosis in the early stages of cord injury. It is essential prior to surgical reduction of a cervical spine injury, since intervertebral disc displaced into the spinal canal can worsen the neurological state, if it is not removed prior to reduction.
Injury to the brachial plexus in the adult is usually a closed injury and the result of considerable traction to the shoulder. Improvements in the care of patients with multiple trauma has meant that many patients who would have previously died, as a result of their multiple injuries, are surviving with injuries to the brachial plexus. Brachial plexus injury in the adult is therefore an increasingly common clinical problem, unlike obstetric brachial plexus injury where improvements in obstetric care have led to a reduction in the number of cases.
Recent advances in neurosurgical technique have improved the outlook for patients with brachial plexus injuries. Surgical options include nerve grafting, nerve transfer and most recently root implantation into the spinal cord (1). The choice of surgical procedure depends on the level of the injury and the radiologist has an important role in guiding the surgeon to the site of injury.

Traditionally brachial plexus injuries have been investigated with myelography, which more recently has been combined with CT. Initial studies in the use of MRI showed that MRI was not as accurate as CT myelography (2). Recent advances in MRI allow images of much higher resolution so that MRI can now match the diagnostic accuracy of CT myelography (3) (4).
This lecture will describe the anatomy and patho-physiology of traction brachial plexus injury in the adult. The neurosurgical options available will be described with emphasis on the information that the surgeon wants from imaging studies of the brachial plexus. The relative merits of MRI and CT myelography will be discussed.



Diagrammatic representation of the brachial plexus. LC lateral cord, PC posterior cord and MC medial cord.

References

1. Carlstedt T, Anand P, Hallin R, Misra PV, Noren G, Seferlis T. Spinal nerve root repair and reimplantation of avulsed ventral roots into the spinal cord after brachial plexus injury. J Neurosurg 2000;93(2 Suppl):237-47.
2. Carvalho GA, Nikkhah G, Matthies C, Penkert G, Samii M. Diagnosis of root avulsions in traumatic brachial plexus injuries: value of computerized tomography myelography and magnetic resonance imaging. J. Neurosurg. 1997;86:69-76.
3. Nakamura T, Yabe Y, Horiuchi Y, Takayama S. Magnetic resonance myelography in brachial plexus injury. J Bone Joint Surg Br 1997;79(5):764-9.
4. Doi K, Otsuka K, Okamoto Y, Fujii H, Hattori Y, Baliarsing AS. Cervical nerve root avulsion in brachial plexus injuries: magnetic resonance imaging classification and comparison with myelography and computerized tomography myelography. J Neurosurg 2002;96(3 Suppl):277-84.

THURSDAY AM 11:40 to 13:00
Rhodes Trust Theatre

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CHARACTERISTIC TUMORS OF THE EPIPHYSIS AND DIAPHYSIS

J Freyschmidt
Klinikum Bremen Mitte, Bremen, Germany

The majority of bone tumors and tumor like lesions either start in the metaphysis or they have a close topographic relationship to the metaphysis.
Purely diaphyseal tumor locations are extremely rare: The first differential diagnosis of hyperostotic lesions in that location is the **periosteal osteosarcoma** followed by the **osteoidosteoma**. If the latter is found in long bones its location is the shaft in 60-70% of all cases.
Typical diaphyseal lesions of the tibia with mixed osteolytic-osteoblastic components are the **osteofibrous dysplasia Campanacci** and the **adamantinoma**. Their differential diagnoses consist of various chronic periostitic changes.
Purely epiphyseal tumor locations are as seldom as their counterparts of the diaphysis. The first to be named is the **chondroblastoma**, which has a wide range of differential diagnoses including unusual **epiphyseal chondroma, osteoblastoma** and the **intraosseous ganglion**.
In children and teenagers **giant cell tumors** always originate in the metaphysis, but with increasing age the epiphysis is the prefered location.
The mentioned entities and their differential diagnoses will be discussed in detail during the course using projection radiography as well as advanced imaging methods.

NON-MALIGNANT MULTIPLE LESIONS OF BONE

R A R Green
Royal National Orthopaedic Hospital NHS Trust, London, United Kingdom

The aim of this lecture is to cover an approach to diagnosis, using not only plain film imaging but also demonstrate how other imaging modalities apply, and where ultimately a biopsy may be required to make the diagnosis.
Potential pitfalls in diagnosis and malignant transformation will be discussed.
Various conditions will be covered briefly, including examples falling within the following categories:
Bone dysplasia and dystrophy, infection, tumour / tumour-like conditions.

SURFACE LESIONS OF BONE

A.M. Davies
Royal Orthopaedic Hospital, Birmingham, United Kingdom

A large spectrum of tumours and tumour-like conditions has been described arising on the surface of bone. It is best to classify these conditions with regard to the transverse plane. The location can be categorised from centrally to the most peripheral as follows. Medullary (arising in the medulla of bone), endosteal/subcortical (arising from the inner aspect of the cortex, intracortical (arising from the cortex), subperiosteal (arising from the external aspect of the cortex), periosteal (arising from the periosteal membrane surrounding bone) and juxtacortical/parosteal (arising adjacent to the outer surface of the cortex). The differential diagnosis and imaging features of these conditions will be presented. Those conditions which cause generalised periosteal proliferation are excluded as are those which arise in the medulla causing secondary reactive changes in the periosteum.

Kenan S, Abdelwahab IF, Klein MJ, Hermann G, Lewis MM (1993) Lesions of juxtacortical origin (surface lesions of bone). Skeletal Radiol 22:337-357

Seeger LL, Yao L, Eckardt JJ (1998) Surface lesions of bone. Radiology 206:17-33

Maiya S, Davies AM, Evans N, Grimer RJ (2002) Surface aneurismal bone cysts: pictorial review. Eur Radiology 12:99-108

James SLJ, Davies AM (2005) Surface lesions of the bone of the hand. Eur Radiology DOI 10.1007/s00330-005-2715

ROLE OF DYNAMIC CONTRAST-ENHANCED MR IMAGING IN BONE SARCOMA

Dr. K. Verstraete
Ghent University, Gent, Belgium

Dynamic contrast-enhanced MR imaging is a method of physiologic imaging. During the first-pass of contrast medium, the enhancement rate provides information on tissue vascularization, perfusion and capillary permeability. During the second pass and later, further tissue enhancement provides information on the interstitial space. To display tissue enhancement versus time in tumor, artery and muscle, time-intensity curves of different regions-of-interest can be calculated. These curves can be used for tissue characterization or to narrow down the differential diagnosis, e.g. in giant cell tumor, enchondroma or chondrosarcoma. Other useful applications are monitoring of chemotherapy, indication of the best site for biopsy and detection of tumour recurrence.

THURSDAY PM 14:00 to 15:20
Nelson Mandela Theatre

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INJURIES TO THE POSTERIOR CRUCIATE

EVA LLOPIS
HOSPITAL DE LA RIBERA, VALENCIA, Spain

Renewed interest in injuries to the posterior cruciate ligament, PCL, and its associated structures has resulted in an increasing number of reports on the biomechanics, diagnosis and treatment. Radiologist must be aware of specific imaging features in order to improve diagnosis accuracy and aid to patient's management.

ANATOMY

The PCL, the strongest ligament in the knee, courses from the posterior intercondylar area of the tibia to the medial femoral condyle. New research studies have demonstrated that there are not complete separate 2 bundles. Instead they can be divided into 4 partially separate but functionally distinct fibber regions.

Biomechanically the primary function of the PCL is restraint posterior translation of the tibia.

INJURIES

PCL injuries comprise between 3 and 20% of all knee ligament injuries. Up to 60% of significant PCL injuries are associated with postero-lateral corner soft tissue injuries with poor prognosis. Injuries can affect a portion or the entire bulk of PCL, being the mid substance more frequently involved.

Partial or isolated PCL injuries are usually treated nonoperatively. MRI is very useful in acute tears but is only of limited value in chronic injuries, being its accuracy up to 60%. Even some injuries with PCL ruptures with marked instability become relatively stable with a so-called firm end-point at later follow-up, this seems to be a unique feature of PCL injury. Acute PCL injury develops a continuous ligament-like tissue.

Associated bone bruising may be present along the anterior tibia and posterolateral femoral condyle in flexed knee impact mechanism, whether after acute hyperextension mechanism contusions are at the anterior tibial and femoral surfaces.

Osseous avulsion injuries can occur at the femoral and tibial ligament attachment, they must be detected as acute surgical repair is advocated for displaced osseous avulsions.

Posterolateral corner soft tissue injuries are usually associated to PCL injury in high-speed accidents. Neurovascular injuries must be ruled out. MRI is essential in order to depict bone and soft tissue lesions so early surgery can be planned.

The postoperative appearance of the PCL graft is similar to the reconstructed ACL, showing mild to moderate signal intensity during the 1st postoperative year. The signal intensity and thickness of the graft decreased with time since surgery.

CONCLUSION

Improving the basic knowledge of the anatomy and biomechanics of the PCL will be helpful in making decisions on the existing confusion with respect to diagnosis, process of conservative healing, surgical procedures and post-surgery follow-up.

THE POSTEROMEDIAL CORNER OF THE KNEE
F.M. VANHOENACKER, UNIVERSITY HOSPITAL ANTWERP, BELGIUM

F.M. Vanhoenacker

[1] University Hospital Antwerp, Antwerp, Belgium, [2] Sint-Maarten Hospital, Duffel-Mechelen, Belgium

Learning objectives

1.To illustrate the magnetic resonance image appearance of the structures of the posteromedial corner of the knee.

2.To review the pathological conditions that may involve the posteromedial corner with emphasis on lesions caused by sports injuries.

Functional anatomy

Traditionally, the medial supporting structures of the knee have been subdivided into three layers, that include the superficial, intermediate and capsular layers. In the posterior third, the superficial and deep layers blend.

The main passive restraining structures of the posteromedial aspect of the knee are the superficial MCL, the deep MCL, the attachments of the semimembranosus tendon, the posterior oblique ligament and the posteromedial capsule (PMC). Oblique fibers are capsular condensations running posterodistally from the femur to the tibia.

In extension, the posteromedial corner appears to be an important functional unit in restraining tibial internal rotation and valgus.

Traumatic loss of this functional unit may allow unstable rotation of the knee joint.

Pathology

Trauma at the medial side of the knee may cause a variety of lesions, involving the meniscus, ligaments, bone marrow and cartilage. They may occur in an isolated way, but usually a combination of these lesions is seen.

Meniscus

The posterior horn of the medial meniscus is connected with the tibia by the posterior root ligament of the medial meniscus. Avulsion of this root ligament is an important finding which may lead to meniscal subluxation and bone marrow edema at the tibia. A ganglioncyst at the posteromedial tibia may alert the radiologist to the presence of an associated meniscal root ligament avulsion.

Meniscal cysts at the posteromedial corner of the knee are almost invariably associated with a horizontal tear of the posterior meniscus.

Ligaments

Medial-sided knee injury trauma may cause lesions of the posterior oblique ligament in the majority of cases, followed by an injury of the semimembranosus capsular attachment. Ligamentous injury is often associated with complete peripheral detachment of the meniscus.

Bone marrow

Bone bruise at the posteromedial corner of the knee is most frequently caused by a flexion - valgus - external rotation injury and less frequently by a hyperextension with valgus mechanism of trauma. The adjacent meniscus should be inspected carefully for meniscocapsular separation or posterior horn tear when a bruise is present on the posterior aspect of the medial tibial plateau. Other ligamentous structures at risk are the anterior (and posterior) cruciate ligaments and the medial collateral ligament. Moreover, when a bone contusion is seen, the radiologist should carefully search for an injury to the overlying articular cartilage and for linear fracture lines.

Bursae

Many bursae or recesses at the posteromedial corner of the knee may become inflamed or distended because of overuse from exercise or other repetitive trauma. They include the gastrocnemius - semimembranosus recess, the medial collateral ligament bursa, the pes anserinus bursa and the semimembranosus - tibial collateral ligament bursa. These structures are best appreciated on axial and coronal T2 weighted images.

Conclusion

MR imaging is the modality of choice to detect pathological conditions involving the posteromedial corner of the knee.

MR-arthrography may be indicated in specific situations.

References
1.Ruiz ME, Erickson SJ. Medial and lateral supporting structures of the knee. Normal MR imaging anatomy and pathologic findings. Magn. Reson Imaging Clin N Am. 1994; 2:381-399.
2.Robinson JR, Sanchez-Ballester J, Bull AM, Thomas R, Amis AA. The posteromedial corner revisited. An anatomical description of the passive restraining structures of the medial aspect of the human knee. J Bone Joint Surg 2004Br; 86:674-681.
3.Sims WF, Jacobson KE. The posteromedial corner of the knee: medial-sided injury patterns revisited. Am J Sports Med. 2004; 32:337-345.
4.Yao L, Lee JK. Avulsion of the posteromedial tibial plateau by the semimembranosus tendon: diagnosis with MR imaging. Radiology. 1989; 172:513-517.
5.Loredo R, Hodler J, Pedowitz R, Yeh LR, Trudell D, Resnick D. Posteromedial corner of the knee: MR imaging with gross anatomic correlation. Skeletal Radiol. 1999; 28:305-311.
6.Hayes CW, Brigido MK, Jamadar DA, Propeck T. Mechanism-based pattern approach to classification of complex injuries of the knee depicted at MR imaging. Radiographics 2000; 20:S121-S134.

IMAGING FEATURES OF ANTERIOR KNEE PAIN

T L Pope
Medical University of South Carolina, Charleston, South Carolina, United States

Anterior knee pain is a commonly encountered clinical scenario. The differential diagnosis includes cartilaginous abnormalities (eg., chondromalacia and abnormal patellar tracking), soft tissue abnormalities (eg., pre-patellar bursitis), tendinous and ligamentous aberrations (either directly involving the quadriceps tendon and patellar ligament or of their entheses), osseous pathology (symptomatic normal variants and rarely, infection and tumours of the patella and anterior aspects of the femur and tibia) and abnormalities of Hoffa's fat pad of the knee.
This presentation will outline and demonstrate the most common pathology of this anatomic region and stress the appropriate utilization of history, physical examination and imaging in the work-up of patients with this clinical syndrome. It is hoped that at the conclusion of this presentation that the participant will have a better understanding of the normal anatomy and pathology that can occur in the anterior aspect of the knee.

MRI OF THE POST-OPERATIVE KNEE

C Wakeley
University of Bristol Hospital Trust, Bristol, United Kingdom

The following topics will be discussed and illustrated.

Techniques: Ultrasound, CT and MRI. MR sequences and metalwork problems.
Menisci: Tears, re-tears, "signal conversion", and MR arthrography?
Anterior cruciate ligament reconstruction: Malposition, tunnel osteolysis, bio-absorbable screws, carbonfibre synovitis and bone dusts crescents.

Osteochondral transplantation grafts: MRI appearances.
Trochleoplasty: Pre-operative assessment. Post-operative appearance.

THURSDAY PM 14:00 to 15:20
Lecture Theatre 4

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**PITFALLS IN THE DIAGNOSIS OF SOFT TISSUE TUMORS.
(MALIGNANT SOFT TISSUE TUMORS: ACHIEVING A DIAGNOSIS WITH MRI.)**

A.M. De Schepper[1], J.L. Bloem[2]
[1] University Hospital Antwerp, Antwerp, Belgium, [2] Leids Universitair Medisch Centrum, Leiden, Netherlands

1.**Incidence**. Although soft tissues constitute a large proportion of the human body, soft tissue tumors (STT) are rare, accounting for less than 1% of all neoplasms. The annual incidence of benign STT in a hospital population is 250, as compared to 3 per 100.000 for malignant ones. Moreover 80% of them can be classified into a limited number of diagnostic categories.
2.**Age and location**. Benign, and to a lesser degree malignant STT occur in preferential locations and in well defined age groups.
3.**Staging**. MRI is the best staging method for STT. The role of compartmental anatomy will be emphasized.
4.Grading. A combination of grading parameters guarantees the highest accuracy. The role of static and dynamic contrast MRI will be highlighted.
5.Tissue specific diagnosis. The best results in tissue specific diagnosis are obtained by combining clinical information, MR-morphology and MR-signal intensity characteristics. Tissue specific diagnosis of malignant STT remains difficult.
6.A **standardized MR-examination protocol** is mandatory both for diagnostic and research purposes.
7.MRI is the best method of detecting **recurrent tumors** after therapy.
8.Multi-institutional data bases for both radiology and pathology of STT are extremely valuable.
Things to remember.
1. Making frequently infrequent diagnoses is frequently erroneous.
2. Clinical information is of utmost importance in the diagnosis of STT.
3. Knowledge of compartmental anatomy is mandatory.
4. Dynamic contrast studies improve grading capability of MRI and consequently outcome results.
5. (MR) Pattern recognition is a valuable diagnostic tool, but has definite limitations.
6. SE T1-W Images before (and after) contrast administration and with fat suppression are a valuable part of the examination protocol of STT.
7. The value of systematic posttreatment MR-surveillance is controversial.
8. Close cooperation between radiology and pathology increases diagnostic accuracy.

BENIGN SOFT TISSUE TUMOURS OF THE HANDS AND FEET

P G O'Donnell
RNOH, Stanmore, United Kingdom

The majority of soft tissue lesions arising in the hands and feet are benign. A number of tumours are common in both regions, including giant cell tumour of the tendon sheath (GCTTS) / PVNS, haemangioma, lipomatous masses, neurogenic tumours and synovial (osteo)chondromatosis. Synovial disorders are frequent causes of a pseudotumour, and include ganglion cysts, tenosynovitis and lesions caused by inflammatory or crystal arthropathies (bursae, rheumatoid nodules, gouty tophi). Fibromatosis may be localized to the palmar (Dupuytren’s contracture) or plantar aponeurosis (plantar fibroma), with imaging often diagnostic in the latter and rarely required in the former: it may also present as a soft tissue mass which often has a poorly-defined “infiltrative” margin and heterogeneous signal, simulating malignancy.
Fortunately, benign lesions often exhibit characteristic imaging features, which may preclude the need for biopsy. These features may be visible on the plain radiograph (the lucency of fat, calcification of phleboliths / chondromatosis, bone involvement), ultrasound (origin from a tendon sheath or plantar fascia, compressibility / vascularity in a haemangioma, features of a neurogenic tumour), or MRI. Helpful features on MRI include fatty signal (lipomatous masses, haemangioma, plexiform neurofibroma), low T2 signal (GCTTS / PVNS, fibromatosis including plantar fibroma, chondromatosis, gouty tophi) and high T2 signal (synovial disorders including ganglion cysts, myxoid neurogenic tumours). Nerve sheath tumours may also exhibit other well-described features, including the split-fat sign, comet-tail extension into an adjacent nerve, and the target sign (on T2-WI).
The commoner lesions will be discussed, emphasizing the typical features; rare lesions which may mimic common tumours, and common lesions with atypical appearances, will be mentioned en route.

PSEUDOTUMORS IN SPORT
SUZANNE E. ANDERSON M.D.
DEPARTMENT OF DIAGNOSTIC RADIOLOGY, UNIVERSITY HOSPITAL OF BERN, INSELSPITAL, BERN, SWITZERLAND

S.E. Anderson
University Of Bern, Inselspital, Bern, Switzerland

The educational objective is to be able to distinguish some patterns of benign lesions in sports medicine that can be mistaken for neoplastic lesions on MRI.
Musculoskeletal pseudotumors on MRI are not infrequent due increased availability of MRI and expanding clinical referral basis. A forgotten past major or minor sport’s related injury, not immediately perceived as being related to the current clinical problem, may be the cause. Secondary infection, normal variants with overuse, body habitus, inappropriate training and use of equipment may complicate appearances. In other cases, characteristic locations and type of sporting activity may be

characteristic. Correlation with radiographs and with an appropriate clinical history the MRI diagnosis may be quite specific [1,2], eg, stress fracture of bone.
Pseudotumors may involve fat necrosis after minor trauma [3]. Localized myositis ossificans is a common MRI pseudotumor [1, 3, 4]. In acute and subacute stages, adjacent soft tissues edema may be prominent, which is unusual in primary malignant tumors that have not been previously biopsied or undergone intratumoral hemorrhage [1].
Tears and overuse of ligaments and muscles may cause MRI pseudotumors, eg. partial avulsion of the adductor muscles of the thigh [5]. Proximal adductor avulsions and intramuscular strains have been described.
Stress reactions and fractures may cause MRI pseudotumors. Specific sites and patterns are associated with specific sports activities eg. spinal pars defects of the thoracic and lower lumbar spine are characteristic in cricketers.
Muscle abnormalities are common MRI pseudotumors. MRI appearances of hematoma depends on the state of the hemoglobin molecule [2, 6]. It may sometimes be difficult to distinguish simple hematoma from hemorrhage into a malignant mass [2]. Abscess features include thickened peripheral increased signal intensity rim on T1.
Normal variants and their overuse, calcium deposition disorders [7] and foreign body reactions, hand pseudoaneurysms [8], may present as pseudotumors.
Pitfalls: Sports players may have real tumors. Ensure correlation with radiographs. Review all anatomical areas depicted on MRI for apparent incidental findings.
References:

Jelinek J, Kransdorf MJ. MR imaging of soft-tissue masses. Mass-like lesions that simulate neoplasms. *Magn Reson Imaging Clin N Am* 1995; (4):727-741
Kransdorf M, Murphy M. Masses that may mimic soft tissue tumors. In: *Imaging of Soft Tissue Tumors*. WB Saunders Company 1997; 373-420
Boutin R, Fritz R, Steinbach L. MRI of Muscle Injury. *Radiologic Clinics of North America* 2002; 40:333-362
De Smet AA, Noris MA, Fisher DR. Magnetic resonance imaging of myositis ossificans: analysis of seven cases. *Skeletal Radiol* 1992; 21:503-507
Anderson SE, Johnston JO, ODonnel R, Steinbach LS. MR imaging of Sports related pseudotumor in Children: mid femoral diaphyseal periosteitis at insertion site of adductor musculature. *Am J Roentgenol* 2001; 176:1227-1231
Dooms GC, Fisher MR, Hricak H, Higgins CB. MR imaging of intra-muscular hemorrhage. *J Comp Assist Tomogr* 1985; 9:908-913
Anderson SE, Bosshard C, Steinbach LS, Ballmer FT.Calcification of the lateral collateral ligament of the knee: a rare pathology and cause of lateral knee pain shown by MR imaging. *Am J Roentgenol* 2003; 181(1):199-202
Anderson S E, De Monaco D, Buechler U, Triller J, Gerich U, Dalinka M, Stauffer E, Nagy L, Niedecker A, Campbell R, Araoz PA, Steinbach LS. Imaging Features of Pseudoaneurysms of the Hand in Children and Adults. *Am J Roentgen* 2003; 180:659-664

SYNOVIAL BASED MASSES

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Tumour-like lesions of the synovium are much more common than true synovial tumours and benign lesions are more common than malignant lesions. Radiographs may detect an intra- or periarticular mass, mineralisation and bone involvement and should be the initial imaging technique. Ultrasound is useful as it has high accuracy in diagnosing the most common synovial lesions including ganglia and synovial cysts. CT is superior to MR imaging at detecting matrix mineralisation and cortical involvement and in selected cases both modalities may be complementary. However, MR imaging is usually required for optimal pre-operative staging.
The most common synovial lesions are ganglia and synovial cysts. Occasionally, cysts may be inhomogeneous due to internal septations or complications including haematoma, inflammation, gas and loose bodies. Pigmented villo-nodular synovitis is a tumour-like proliferative disorder of synovium of tendon sheaths or joints, characterised by areas of diffuse villous synovial hypertrophy or by a single lesion or cluster of nodular masses. On MRI, haemosiderin deposition within the synovium results in low/intermediate signal intensity (SI) on T2W but similar appearances can be seen in other causes of chronic haemarthrosis including haemophilia. Similar signal characteristics may also be found in amyloidosis, "burnt out" rheumatoid pannus, tophaceous gout and synovial osteochondromatosis. In synovial osteochondromatosis, synovial metaplasia produces multiple round intrasynovial cartilaginous nodules that may mineralise. The imaging appearances reflect the maturity of the nodules. On MRI, unmineralised lesions give an intermediate SI on T1W and a high signal intensity on T2W. However the majority of cases contain foci of low SI on both T1W and T2W due to calcification of cartilaginous nodules. Synovial haemangioma and lipoma arborescens are rare lesions most often found in the knee joint. On MRI, the former may show fibrofatty septations within an intra-articular mass but is otherwise non-specific. The latter has more characteristic appearances with fronds of fatty tissue projecting into the associated joint effusion. Synovial sarcoma presents in young adults as a fairly well defined lobulated inhomogeneous juxta-articular mass. Small lesions may be homogeneous, well-defined and slow growing and mistakenly passed off as benign lesions. Fewer than 10% are intra-articular in origin but articular spread from juxta-articular sites is common. Calcifications are found in up to 30% of cases and vary from fine stippling to dense opacities. On MRI, lesions are characterised by a fairly well defined lobulated inhomogeneous juxta-articular mass. Synovial chondrosarcoma is very rare and usually associated with pre-existing synovial Osteochondromatosis

THURSDAY PM 14:00 to 15:20
Rhodes Trust Theatre

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OSTEOARTHRITIS OF THE KNEE: WHAT'S NEW ON MR IMAGING

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The presentation is confined to grading at MR imaging of osteoarthritis (OA) of the knee and the new suggestions has been obtained in close collaboration with Andrew Grainger, Leeds, UK.

Background: Charles Peterfy and al. (2004) suggested a "Whole-Organ Magnetic Resonance Score (WORMS) of the knee in osteoarthritis" and in their excellent paper they asked for suggestions for further refinement of the WORMS in order to maximize its utility in clinical trials. In Aarhus, Denmark 87 patients with OA of the knee were followed during one year with repeated extensive clinical examinations and repeated MR imaging with Gd-contrast (blinded, randomized study of intraarticular injection of Hyalgan). At the assessment of the MR studies, we realized that some facets of "OA" were not covered in WORMS and that the grading of synovitis and bone marrow abnormalities were not sufficient for the registration of changes in follow-up studies.
Purpose: To present a grading or scoring system of OA of the knee at MR imaging, allowing registration of changes of abnormalities during treatment or during the natural course of the disease. And also a grading system from which, inflammatory conditions e.g. seronegative arthritis might be separated.
Results and suggestions for refinement of the WORMS scoring system:
A common rather than separate grading of cartilage deterioration and bone attrition.
Registration of cartilage destruction at none weight-bearing sites. This appears to be common and considered to be the result of synovitis. These sites are: a) the ventral intercondylar femoral groove, b) the most posterior/proximal aspects of the femoral condyles and c) medial patellar facet.
Measurement in centimetres of the extent of bone marrow abnormalities and grading of their signal intensities (SI) at STIR and T1 FS Gd-contrast enhancement.
Grading of synovitis at Gd-studies according to the suggestions from Leeds.
Registration and grading of enthesopathies/tendinopathies of the ACL, PCL, MCL, LCL as well as the patellar and quadriceps ligaments.
Conclusions
It is felt that our suggestions to the scoring system of "OA" of the knee are important for the understanding of the structural abnormalities, which may be related to the clinical situation of the patient. Also, they may allow an early separation of those cases, which resemble or could be diagnosed as arthritis.

DIFFERENTIAL DIAGNOSIS OF SPONDYLOARTHROPATHIES

V.V. Jevtic
Department of Radiology, Medical Faculty, Ljubljana, Slovenia

Seronegative spondyloarthropathies (SNSA) represent an important group of inflammatory rheumatic diseases. Concerning the affection of the axial skeleton the most important unifying pathoanatomic changes of SNSA, which are also the main differential diagnostic criteria to other vertebral diseases are as follows: 1) Inflammatory changes are frequently multifocal and asymmetric; 2) There is predilection for fibrocartilaginous articulations such as the discovertebral junction and the entheses ; 3) Enthesitis, an inflammatory enthesopathy is the hallmark of SNSA and is oftenly the first radiological manifestation of the disease; 4) An important diagnostic feature of SNSA is simultaneous existence of all reactive joint & bone capabilities, which include a combination of destructive and productive changes from the beginning of the disease. This is an important difference to rheumatoid arthritis (RA) and spinal infection in which these phases appear successively; 5) As a rule inflammation of the synovial joints, histologically similar to RA, is not so pronounced. Consequently destructive changes within the synovial joints are much less with the exception of psoriatic arthritis. Due to limited reactive capabilities of the interevertebral disc and the bone a spectrum of similar pathoanatomic changes, which include bone marrow edema and hyperemia, ingrowth of fibrovascular tissue, new bone production and bone marrow fat transformation may be seen in etiologically quite disparate diseases of the vertebral column-rheumatic, infectious, degenerative, metabolic, or traumatic. These similar pathoanatomic changes will be reflected in similar radiographic and MRI appereances. Therefore radiological differential diagnosis among various representatives of the SNSA as well as between SNSA and other spinal diseases may be difficult, especially at an early stage. The most frequently used imaging modalities in SNSA include radiography and MRI. The most important radiographic and MRI differential diagnostic features will be presented. The differential diagnostic features will be presented.

HANDS, WRIST AND FEET IN ARTHRITIS PLAIN FILM DIAGNOSIS

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Given that the hand and wrist and foot as well comprise multiple joints the first task when patient presents with a tender or swollen joint in this location is to establish which joint is involved. In the hand this is usually not a problem. However, in the wrist and parts of the footit may be impossible to accurately identify the location of the patient's symptoms clinically and imaging will often prove helpful. The location of the abnormality will narrow the differential diagnosis as will laboratory tests. When deciding on an imaging strategy it is helpful where possible, to decide in which structure or structures the problem is felt to lie. The possibilities would be that the symptoms arise from the joint itself, the periarticular soft tissues, or the adjacent bone. Occasionally, the pain may be "non-musculoskeletal" in origin, for example, a carpal tunnel syndrome or T1 root lesion. This distinction will usually dictate what type of imaging is most appropriate. If the abnormality is felt to be primarily articular or osseous, then conventional radiography will often prove to be the most useful first-line imaging modality. However if the problem is felt to be based in the soft tissues, ultrasound or MRI will often be more useful.
It is rare for chronic inflammatory arthritis to present as an isolated monoarthritis. However, dactylitis may occur as the presenting feature of seronegative arthropathies, most commonly either psoriasis or Reiter's syndrome. The abnormality seems to be combination of synovitis, tenosynovitis, and tendon insertion inflammation.
Where a septic arthritis is suspected, imaging should start with conventional radiographs. Depending on the stage of the disease there may be very subtle changes of soft-tissue swelling, or more extensive changes with joint space loss and bone erosion. It may be that no further imaging is required although, since joint aspiration is usually critical to identify the causative organism, the radiologist may have a role to play in guiding the aspiration with either fluoroscopy or ultrasound.

The seronegative spondylarthropathies have a predilection for large lower limb joints, often with involvement of only one or few joints. Clinical assessment should identify associated features such as psoriasis, inflammatory bowel disease, iritis, or spinal involvement. A small number of patients with spondylarthropathie present with an inflammatory enthesopathy (enthesis) affecting sites such as the insertion of the Achilles tendon or plantar fascia with or without associated arthritis. The inflammatory aetiology may be suspected by the presence of early morning stiffness or a rise in acute phase reactants, but these features are not invariably present. All foot joints can be involved in inflammatory arthropathies but confinement to one or two joints is more typical of the seronegative spondylarthropathies. Dactylitis (sausage toe) is typical of psoriatic and other spondylarthropathies, but is also seen in sarcoidosis, tuberculosis, and HIV arthropathies and in haemoglobinopathies.

Reactive arthritis can be particularly difficult to differentiate from septic arthritis in patients who have been treated with antibiotics without preceding synovial fluid culture. Rheumatoid arthritis (RA) usually involves the feet, ankles, and knees, but less often the hips, and never remains confined to a single joint. Early in inflammatory disease, radiographs will appear normal.

As the arthropathy progresses, radiographs reveal characteristic joint space narrowing and periarticular osteoporosis, but with less osteophytosis or subchondral sclerosis than in uncomplicated osteoarthritis (OA). Once the diagnosis of an inflammatory arthropathy has been established, imaging beyond radiographs is unnecessary, except in the assessment of complications such as infection or avascular necrosis where MRI or scintigraphy are the modalities of choice.

When used as a diagnostic tool in screening polyarthritis patients, the plain film views most commonly employed are the posteroanterior (PA) hands and feet radiographs. These films allow the visualization of a large number of peripheral joints, and reflect the cumulative damage to joints over time. In RA in particular, these plain film views have been extensively studied and play an integral part of RA assessment. Radiographic erosions and/or periarticular osteopaenia in hand and wrist joints are part of the American College of Rheumatology (ACR) diagnostic criteria for RA. However, early diagnosis and treatment are now the desired aims of RA management; plain film erosions, the most common abnormality recorded for RA, are infrequent in newly presenting disease and therefore lain film views are not sensitive tools for diagnosis.

Conventional radiography is currently still seen as the gold standard for assessment of disease progression in RA. There are a number of studies demonstrating that radiographic damage progresses continuously over at least the first 2 decades of disease. Importantly, the plain film changes have been shown to be prognostic and associated with poor functional outcome, in both small and large joints.

The early changes of synovitis in rheumatoid arthritis produce important but often nonspecific radiographic findings. Periarticular fusiform soft-tissue swelling of the fingers or metacarpophangeal joint results from capsular distension due to synovitis and effusion together with adjacent soft-tissue oedema. In the knee, elbow, and ankle specific signs on conventional radiographs are very sensitive at identifying the presence of a joint effusion or synovitis. The accompanying hyperaemia associated with the synovitis produces juxta-articular osteoporosis. The characteristic distribution of these changes without other specific bony changes may still be helpful in supporting or suggesting a clinical diagnosis of RA.

The hypertrophied synovial tissue may recede leaving no structural abnormality. With exacerbations of the disease there is eventually cartilage damage and destruction

resulting in generalized loss of a joint space. This contrasts with the segmental asymmetric joint space loss that is seen in osteoarthritis.
The early erosions of bone seen in RA are located at the so-called “bare areas” at the margins of the joint where there is no protective cartilaginous coating. These erosions tend to be symmetrically distributed and involve both sides of the joint. Some joints have relatively larger bare areas than others do and so erosions will be seen more commonly at these sides. The tibial sides of the second and third metatarsal heads and the lateral aspect of the fifth metatarsal head are characteristic sites of early erosive involvement in the feet as is the interphalangeal joint of the great toe.
The metacarpal and metatarsal heads have relatively large bare areas making them susceptible to bony destruction by proliferating synovium. Similarly, the joint capsule extends a considerable distance over the head of the proximal phalanx at the proximal interphalangeal joint, producing a large bare area, whereas on the other side of the joint the capsule inserts near to the margin of the base of the middle phalanx, so that the erosions on this side are small and more difficult to detect.
Early erosions in the hands and wrist occur typically on the radial aspects of the index and middle metacarpal heads, around the ulnar styloid, and on the ulnar aspect of the head of the little finger metacarpal. The erosions are first identified as focal areas of osteopenia with subsequent interruption of the subchondral bone plate resulting in a dot-dash appearance. Deeper areas of bone loss then develop with ill-defined margins. These may progress to severe panarticular damage and finally ankylosis or may become static and “heal”, developing a sclerotic margin. Fluffy margins to the erosions resulting from proliferative new bone formation are not seen and are a feature of the seronegative spondylarthropaties. Soft-tissue swelling, joint space narrowing, and juxta-articular or more regional osteopenia are typical accompanying features.
Subchondral cysts are frequently seen in RA. They are of varying size, the larger cysts sometimes being termed geodes. A pattern called “robustus rheumatoid arthritis” consists of numerous periarticular cysts in the hands, wrists, and feet and has been associated with patients who maintain a high level of physical activity.
Malalignment and subluxation of joints occurs as a result of damage to the tendons, ligaments, and joint capsule. Complete destruction of the joint surface may also be seen with reactive subchondral sclerosis and other features of secondary osteoarthritis. This occurs when there is extensive loss of cartilage and damage to the subchondral surface, continued use of the joint, but subsidence of the synovial inflammation. Secondary osteoarthritis may obscure the underlying rheumatoid process, particularly in joints such as the hip and knee. The possibility of underlying RA should therefore be considered whenever unusual sites or articular distribution of involvement are seen. For example concentric, rather than asymmetric joint space loss in the hip, or uniform tricompartment involvement of the knee with osteoarthritis (instead if being confined to the medial and patellofemoral compartments) may indicate previous rheumatoid involvement. Fusion of joints may occur, especially in the wrist and occasionally in the small joints of the hand or foot.
Fibrosis of the proliferated and hypertrophied synovial villi is seen in the late stage of the disease and, with elongation of these villi, they may become detached filling the joint with numerous “rice bodies”.
RA may involve any synovial lined structure and commonly produces a tenosynovitis of the hand, fingers, and foot. Subsequent involvement of the tendon itself can result in subluxation, entrapment, and rupture often in association with joint subluxation and malalignment. Although lobulated soft-tissue masses, areas of soft-tissue swelling, or

obscured soft-tissue planes may be identified with conventional radiographs, the demonstration of tendon abnormalities themselves will require other investigations such as ultrasound or MRI.
In the wrist progressive joint space loss often accompanies a prominent synovitis and tenosynovitis, with erosions typically being found around the styloid processes, the radial midportion of the scaphoid, and the waist of the capitate. Erosions of the proximal intermetacarpal joints are also typical.
Although non-proliferative marginal erosions are a characteristic feature of RA, destruction of cartilage, with concentric joint space narrowing and other atrophic changes, such as regional osteopenia and osteolysis, may be the dominant or only findings. This is especially so in the larger joints such as the elbow, knee, and hip, but may also be seen in the wrists, hands, and feet.
Radiographs of the hands and feet have been extensively used to standardize the assessment of outcome in RA, especially in early disease.
A number of scoring systems have been developed to quantify the radiographic changes in RA. Larsen, Dale and Eek described their system for scoring radiographic damage in 1977.
The other commonly used scoring system is that of Sharp, which was developed for the hands but has been modified to include the feet. In this modified system (as proposed by van der Heijde and now commonly used), joint space narrowing and erosions are scored separately.

MR & US IN EARLY INFLAMMATORY ARTHRITIS

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Diagnosis of early arthritis means to detect and document the first stages of the “inflammatory cascade” of rheumatic diseases, i. e. hyperaemia and edema of synovial tissue. In general, the term “early arthritis” is referred to as the first clinical presentation of Rheumatoid Arthritis (RA).
Indication: An early and definite diagnosis is required with view on modern treatment options which may offer a significant reduction of pain, joint destruction, and mutilation. MRI and US have been assessed as specialised investigation techniques for the primary diagnosis. They should be used if the results of clinical investigation and/or conventional radiography are equivocal (Fig. 1).

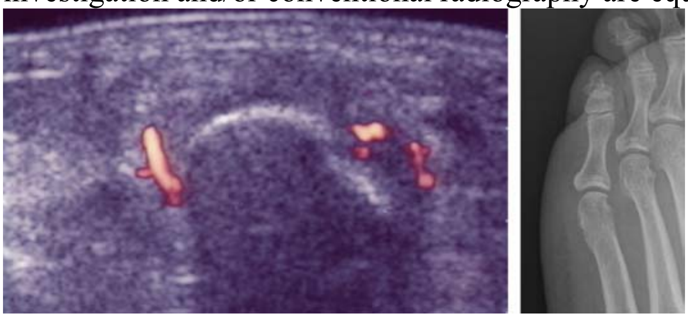

Fig. 1: Hypervascularised early RA manifesting on left 5^{th} MTP joint, scarcely visible on conventional radiogram.

Investigation: For US, there is no fully approved technique of investigation. The selection of image plains should depend on the given indication and documentation of certain anatomic sites has been recommended, if rheumatic disease is suspected. It is generally accepted that both hands should be investigated by using a high-resolution equipment with a Doppler mode. Other joints, especially of the ankle and the foot, should be included if necessary. Some institutions use contrast media in combination with transducers with a low mechanical index.

The MRI protocol varies depending on the anatomic region but should include at least a T1-weighted SE-sequence with thin slices, a T2-weighted fat-suppressed sequence and T1-weighted fat-suppressed sequences in two different planes after administration of Gadolinium-DTPA. The use of flexible synergy coils for investigating both hands simultaneously is helpful (Fig. 2). Some scientific publications about technical advances with units with 3 T field strength, MR-microscopy coils, or the application of superparamagnetic particles of iron oxide (SPIO) contrast media yielded promising results.

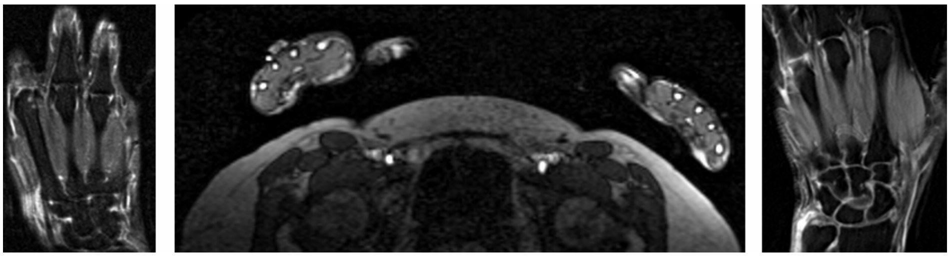

Fig. 2: Simultaneous imaging of both hands (scout view in centre of figure between images of right and left hand) in comfortable supine patient's position. Multiple effusions and erosions visible on both wrists and MCP-joints.

Interpretation: The anatomic spread of disease remains to be an important hallmark. Articular and periarticular manifestations may be visible as monarthritis or oligoarthritis (observed in 5 – 20 % of patients with RA), or polyarthritis. Within an afflicted joint, six factors influence the anatomic distribution of inflammation:

Thickening of the synovium at preformed recesses or plicae (interdigital parts of the MCP-joints).

Thinning of the hyaline cartilage covering or of the periosteum (bare areas, bursal projections).

Highly vascularised tissue (Testut's ligament between the radius and the scaphoid and lunate bones).

Subchondral non-infectious rheumatic osteitis.

Biomechanical instability due to capsule-ligamentous insufficiency (radial collateral ligaments of MCP-joints).

Paraarticular bursitis or tendovaginitis (flexor carpi ulnaris tendon, Baker's cyst).

Characteristic findings may be as follows:

Malalignment in the form of typical subluxations of joints is generally not observed in early arthritis.

Extra- or periarticular soft tissue abnormalities include tenovaginitis, bursitis, or a generally mild to moderate soft tissue edema.

Intraarticular manifestations are effusions, hyaline cartilage edema or destruction, or erosions.

Iuxatarticular bone edema may be found especially in seronegative forms of RA.

The differential diagnosis to other forms of inflammatory joint disease includes infectious arthritis, posttraumatic synovitis, osteoarthritis, and crystal-induced arthropathy.

Diagnosis: With US and MRI the specificity and the sensitivity in the diagnosis of early arthritis seems to be improved significantly. The use of these two modalities may reduce the time interval from the first onset of symptoms until the initiation of proper treatment. Due to improvements in therapy, Rheumatoid arthritis is "changing its face" especially in the early stages of disease. With view on the quantification of the severity of disease, scoring techniques have been defined for both US and MRI.

THURSDAY PM 15:40 to 17:00
Nelson Mandela Theatre

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TENDON INJURY: MR AND US

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A wide spectrum of tendon injures following chronic overuse, direct trauma or a combination of pre-existing alterations and trauma are frequently encountered in clinical practice, as a result of occupational or sport related activities. In most of these abnormalities, US and MR imaging are equally effective in providing excellent diagnostic information on the severity and extent of the injury and helping the therapeutic decision-making. However, when US is used as the initial investigation after clinical assessment, it may provide information that avoid the needs for MR imaging in a relatively inexpensive and widely accessible way. Main benefits of US examination of tendons over MR imaging include the ability to perform a focused and dynamic examination directed towards symptoms or findings observed at physical examination, to assess tendon subluxation or dislocation that may not be present during MR imaging positioning, to allow a dynamic evaluation of tendon gliding during joint movement or muscle contraction, to detect intratendinous deposits of calcium hydroxyapatite or calcium pyrophosphate crystals, as well as to guide injections into the paratenon or the tendon sheath. Serial studies can also be performed with US in parallel with clinical follow-up. On the other hand, MR imaging has specific advantages over US to study deep seated or difficult-to-scan tendons, to image chronic avulsive injures and to monitor the intrinsic healing process after a tendon tear. Generally speaking, both US and MR imaging may be considered if the clinical diagnosis of a tendon injury requires confirmation. In most cases, these imaging methods produce substantially similar results. Given its timely, widely available and low-cost nature, we believe that with adequate equipment and training US can be regarded as the first-line imaging modality for the assessment of tendon injuries.

LIGAMENT INJURY:
US AND MRI

J Teh

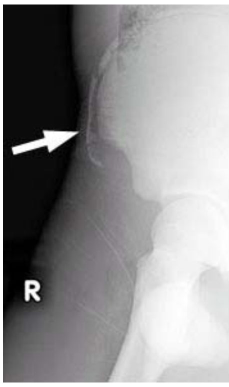
Nuffield Orthopaedic centre, Oxford, United Kingdom

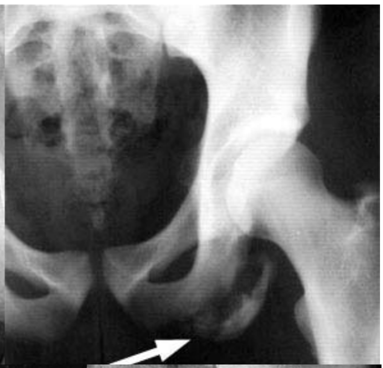
This lecture will outline the grading of ligament injury and review the imaging appearances of ligament injury on ultrasound and MRI, highlighting the advantages of each modality.
Ligaments are bands of tough fibrous connective tissue composed mainly of long, stringy collagen molecules, connecting bones to other bones. Ligaments limit the mobility of articulations, or prevent certain movements altogether.
A sprain is a wrenching or twisting injury to a ligament. Sprains are classified into the following 3 grades:
Grade 1 is a symptomatic stretch within the tensile limit but without failure.
Grade 2 exceeds the limits of tensile strength, with a partial tear of the ligament fibres.
Grade 3 is complete tear of the ligament fibres.
Ultrasound has the advantages of allowing dynamic assessment and being readily available and inexpensive. Its main disadvantages are that it cannot assess the deeper structures and bone and it does not allow an overview of the joint. It is also highly operator dependent.
MRI on the other hand allows a good overview of the joint and assesses bony changes well. In certain anatomical locations such as the wrist, the accuracy of assessment is improved by arthrography.
The ultrasound and MRI appearance of ligament injuries in the ankle, knee and wrist are discussed.

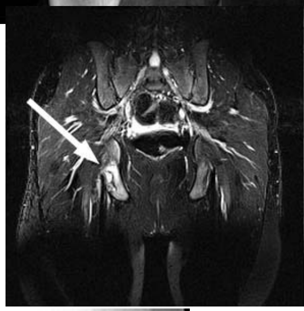
AVULSION INJURIES: DIAGNOSIS AND PITFALLS

AP Toms
Norfolk & Norwich University Hospital, Norwich, United Kingdom

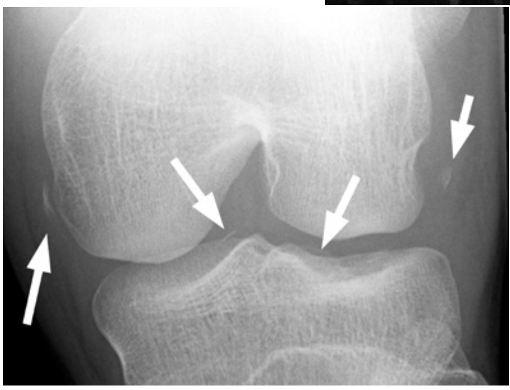
Learning Objectives: to understand the
Biomechanical principles
Functional sequelae and
Diagnostic challenges of avulsion injuries
Introduction: Avulsion injuries are common and occur at the enthesis. The enthesis can comprise either ligamentous or tendinous periosteal attachments.
Function: Avulsion injuries of the ligamentous insertions can result in joint instability. These are seen most commonly in the ankle and metacarpophalangeal joint of the thumb. Avulsion injuries of tendon attachments are more commonly associated with functional deficits.
Children: Avulsion injuries differ in the adult and paediatric populations. In children the apophyseal growth plate is the weakest component of the muscle-tendon-bone complex and therefore fractures through the physis are common. This is particularly the case around the pelvis where the largest muscles attach. Traction injuries can be acute, chronic or chronic-on-acute. Chronic avulsion injuries result in many of the so-called "normal variants" in the skeleton. MRI can be useful to distinguish acute from healed chronic injuries.



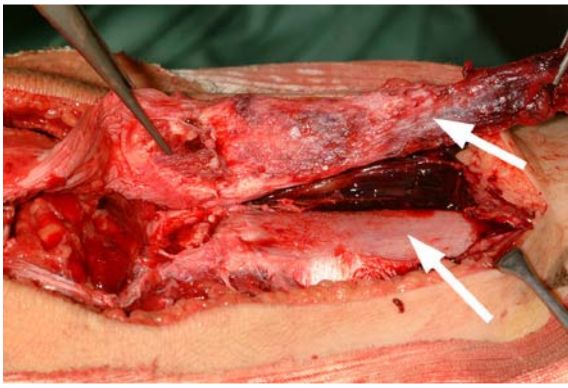




Pitfall: Chronic traction following an acute avulsion can result in periosteal new bone, with an aggressive appearance, which can be mistaken for a primary bone tumour.



Adults: Avulsion injuries in adults more commonly result in the separation of a thin rim of cortical bone. These "flake" fractures may be isolated injuries or may represent the only plain radiographic sign of more complex major trauma; particularly in the knee and the shoulder.



Complex avulsion injuries: Periosteum and hyaline cartilage adjacent to the enthesis can stripped off in what are termed “sleeve” avulsion injuries. Avulsion injuries in children can extend into the physis of adjacent joints.

Pathological: Avulsion fractures can result from both benign and malignant disease. Arthroplasty of the hip and knee can result in "stress risers" which may result in iatrogenic avulsion fractures of adjacent apophyses.

Conclusion:

Different patterns of avulsion injury in children and adults
Different functional consequences in ligaments and tendons
Pitfalls include
Failure to diagnose
Underestimating functional consequences
Misdiagnosing aggressive bone lesions

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TRAUMA PELVIS: HOW IMAGING AFFECTS MANAGEMENT
HENDRIK BOLTE, CHRISTIAN RIEDEL AND MARTIN HELLER
H. BOLTE, C. RIEDEL AND M. HELLER

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Injuries of the of the pelvic ring result from severe trauma as sustained mostly in traffic accidents. More than 50 % of the pelvic fractures are combined with injuries of the extremities, thorax, abdomen and head. Further the incidence of additional injuries to pelvic organs and blood vessels and the rate of complications are greater in patients with complex pelvic fractures. The mortality associated with pelvic fractures is about 10%, most fatalities being caused by hemorrhage. Therefore, the correct early diagnosis and classification of pelvic fractures is important for treatment planning and requires a profound knowledge of anatomy, the trauma mechanisms and imaging modalities. **Anatomy and Biomechanics:** The pelvis is a ring-like structure, the major function of which is transmission of the body weight to the lower extremities, and protection of the pelvic viscera. It is formed by the articulation of the two innominated bones and the sacrum. The innominated bones are joined anteriorly at the symphysis pubis and articulate posteriorly with the sacrum. Each innominate bone is composed of three elements, which join in the region of the acetabulum. The pelvic ring is stabilized by strong ligaments.Considering biomechanical aspects, the whole pelvis can be divided into the anterior and posterior arch. The posterior arch is the most important element for the stability of the pelvic ring. According to the kind and direction of forces special types of pelvic injuries can be expected:
- a.p. compression, the so-called “open-book” injury
- lateral compression, the most common mechanism of injury
- vertical shearing injuries, always an instable trauma.

Acetabular fractures are usually caused by a force directly e.g. to the greater trochanter. **Imaging and Diagnostic algorhythms**: Although CT is the most important technique for evaluating pelvic trauma and related injuries, plain radiographs are still the first diagnostic method (*a.p. radiograph of the pelvis, the Ala-view, the Obturator-view, the Inlet-view,* the *Outlet-view, and the lateral view of the sacrum and coccyx).*
CT is the most accurate and mandatory method to display the anatomy of the traumatized pelvis without superimposed structures. Besides a superior delineation of fractures of the posterior pelvic ring and disruptions of the SI- joint, CT also reveals indirect signs of fractures and soft-tissue or visceral damage. In addition, modern multi-detector row CT-scanners allow to perform a number of different image reformations for diagnostic purposes and for treatment planning. **Classification of pelvic fractures:** Basically, fractures of the pelvis are classified into stable and

unstable fractures. *Stable fractures* are considered those which concern the margins of the pelvic ring and isolated fractures of the anterior pelvic ring. Two-thirds of pelvic fractures are stable. According to the AO-classification they are called type A-lesions. In *unstable fractures* the structures of weight-bearing function of the posterior arch *and* its joints and ligaments are affected. According to the AO-classification these lesions are referred to type B- (in case of solitary rotational instability) or type C-lesions (in case of rotational and vertical instability). **Fractures of the acetabulum** are classified separately, because of their particular clinical and therapeutical implications.
Conclusion: The most important instrument for a precise diagnosis of pelvic trauma is CT. CT allows an unmistakably classification and directs trauma management, treatment planning and follow-up.

CALCANEAL FRACTURES IMAGING AND MANAGEMENT.
DR DOMINIC BARRON
LEEDS TEACHING HOSPITALS

D A Barron
Leeds Teaching Hospitals, Leeds, United Kingdom

This talk will cover the anatomy of this region, mechanism of injury, currently available imaging techniques, classification systems used and their relevance to management.
Calcaneal fractures represent 1-2% of all fractures with 75% intra-articular. The mechanism is usually compressive as a result of a fall from a height. Stress fractures shouldn't be forgotten.
Available imaging plain radiographs, Broden views, Direct coronal CT & volumetric CT, ultrasound, Nuclear Medicine & MRI.
Classifications
Sanders. This applies to the posterior facet of the subtalar joint
1/ Undisplaced intra-articular fracture
2/ 2 part fracture with displacement
3/ 3 part fracture with displacement
4/ 4 part fracture with displacement
A= Lateral fracture
B= Middle $1/3^{rd}$ frcature
C= Medial fracture
Zwipp. This is more inclusive but very complicated!
2 fragment / 0 joint # = 2 points
2 fragment / 1 joint # = 3 points
3 fragment / 1 joint # = 4 points
4 fragment / 1 joint # = 5 points
4 fragment / 2 joint # = 6 points
5 fragment / 2 joint # = 7 points
5 fragment / 3 joint # = 8 points
Soft tissue damage 0-4 points
Although widely accepted neither addresses managemnt and prognosis
Leeds Foot Surgeons
Posterior facet as per Sanders

Size of sustentacular fragment
Involvement of middle facet of subtalar joint, and calcaneocuboid joint.
Degree of fragmentation / widening of tubersosity
Peroneal tendon entrapment
Surgical Considerations
Restoration of height, length and WIDTH
Reconstruction of joints
Stable osteosynthesis
The sustentacular fragment is key

COMMONLY MISSED INJURIES OF THE UPPER LIMB

<u>N Raby</u>
Western Infirmary, Glasgow, United Kingdom

Injuries of the upper limb are in reality not commonly missed by radiologists. Some injuries are however overlooked by junior clinicians and the full extent of some injuries are only partially recognised by radiologists. This presentation looks at upper limb injuries within this context.
Injuries of the shoulder can be missed partly because of the variety of radiographic projections that are utilised in this region. Certain suspected injuries require an appreciation of the strengths and weaknesses of the various view in obtaining clear information regarding the suspected injuries.
Difficulties with elbow injuries are most commonly encountered in children with unfused epiphyses. Capitellar injuries in adults are usually recognised but may be underestimated on plain films. CT is very helpful in sorting out these problems.
In the hand and wrist metacarpal dislocations are commonly over looked. The rare capitate fracture often in association with other injuries is sometimes not appreciated. MRI of the painful post traumatic wrist will often reveal carpal and or radial fractures not visible on plain films. The scaphoid is the bone which continues to occupy much clinical and radiological time.This will be discussed.

COMMON MISSED INJURIES OF THE LOWER LIMB

<u>J M Elliott</u>
Musgrave Park Hospital, Belfast, United Kingdom

Injuries of the lower limb may be ‘missed’ at various stages of the diagnostic process. The initial and often only imaging undertaken following injury to the lower limb is conventional radiography and therefore this will form the basis for this refresher lecture.
Many injuries require prompt and accurate diagnosis to enable appropriate surgical management and these will be reviewed in an anatomical approach.
The choice of radiographs obtained is largely influenced by the information and localisation of the site of injury indicated by the referring clinician but often the abnormalities may be at the periphery of the film or would have been better demonstrated by alternative projections.

Significant internal derangement of joints may be indicated by the presence of apparently trivial radiographic findings requiring the use of further imaging such as MRI.
The presence of a single major identified injury on radiographs or MRI may distract from a thorough review of other potentially damaged structures and an awareness of the mechanisms of injury is likely to reduce the possibility of overlooking such associated lesions.
The use of 'fluid-sensitive' sequences in MR imaging enables the detection of bone marrow oedema that is a useful indicator of a sometimes-unexpected mechanism of injury.
An overlap of clinical and radiographic appearances also exists between trauma related conditions and findings that can mimic tumours

THURSDAY PM 15:40 to 17:00
Rhodes Trust Theatre

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INJECTING JOINTS – WHICH TECHNIQUE IS BEST?

TJ Marshall
[1] Norfolk and Norwich University Hospital, Norwich, United Kingdom, [2] University of East Anglia, Norwich, United Kingdom

Radiologists are increasingly using image guidance to target joints. Image guidance may be used for injection of contrast media before CT or MR arthrography. Local anaesthetic may be injected into a joint for diagnostic purposes in the investigation of symptoms thought to arise from a particular joint. A combination of corticosteroid and local anaesthetic may be injected under image guidance for therapeutic purposes into inflamed joints that are not easily accessible to clinically guided injections.
The different imaging techniques will be described and the relative advantages/disadvantages of each discussed with reference to individual joints.

References

Ficat RP, Philippe J. *Contrast arthrography of the synovial joints.* **New York, NY: Masson Publishing USA,1981 : 77–80**
Fluoroscopically guided injections into the foot and ankle: localization of the source of pain as a guide to treatment--prospective study. Lucas PE, Hurwitz SR, Kaplan PA, Dussault RG, Maurer EJ. **Radiology 204(2):411-5.**
Diagnostic value of intra-articular anaesthetic in primary osteoarthritis of the hip. Crawford RW, Gie GA, Ling RS and Murray DW.**J Bone Joint Surg Br. 80(2):279-81.**
CT fluoroscopy-guided interventional procedures: techniques and radiation dose to radiologists Paulson EK, Sheafor DH, Enterline DS, McAdams HP, Yoshizumi TT. **Radiology. 2001 Jul;220(1):161-7.**
Lumbar facet joint synovial cyst: percutaneous treatment with steroid injections and distention--clinical and imaging follow-up in 12 patients. Bureau NJ, Kaplan PA, Dussault RG. **Radiology. 2001 Oct;221(1):179-85.**

Computerized tomographic localization of clinically-guided sacroiliac joint injections. Rosenberg JM, Quint TJ, de Rosayro AM. **Clin J Pain 16(1):18-21**.
CT guided diagnostic foot injections. Saifuddin A, Abdus-Samee M, Mann C, Singh D, Angel JC. **Clin Radiol. 2005 Feb;60(2):191-5.**
Real-time MR-guided joint puncture and arthrography: preliminary results. Hilfiker PR, Weishaupt D, Schmid M, Dubno B, Hodler J, Debatin J F. **Eur Radiol. 1999;9(2):201-4.**
Fluoroscopy-guided intraarticular corticosteroid injection into the sacroiliac joints in patients with ankylosing spondylitis. Karabacakoglu A, Karakose S, Ozerbil OM, Odev K. **Acta Radiol. 2002 Jul;43(4):425-7.**

Computed tomography guided corticosteroid injection of the sacroiliac joint in patients with spondyloarthropathy with sacroiliitis: clinical outcome and followup by dynamic magnetic resonance imaging. Braun J, Bollow M, Seyrekbasan F, Haberle HJ, Eggens U, Mertz A, Distler A, Sieper J. **J Rheumatol. 1996 Apr;23(4):659-64.**
Safety profile of 185 ultrasound-guided intra-articular injections for treatment of rheumatic diseases of the hip. Migliore A, Tormenta S, Martin Martin LS, Valente C, Massafra U, Latini A, Alimonti A. **Reumatismo. 2004 Apr-Jun;56(2):104-9.**
Sonographically Guided Glenohumeral Joint Injection. Zwar RB, Read JW, and Noakes JB. **Am. J. Roentgenol. Jul 2004; 183: 48 - 50.**
Arthrography of the Shoulder: A Simple Fluoroscopically Guided Approach for Targeting the Rotator Cuff Interva. Dépelteau H, Bureau NJ, Cardinal E, Aubin B, and Brassard P. **Am. J. Roentgenol. Feb 2004; 182: 329 - 332.**
Percutaneous ultrasound-guided injections in the musculoskeletal system.
Adler RS, Sofka CM. **Ultrasound Q. 2003 Mar;19(1):3-12.**

MUSCULOSKELETAL INTERVENTION UNDER ULTRASOUND GUIDANCE

<u>DA Connell</u>
Royal National Orthopaedic Hospital, Stanmore, United Kingdom

Ultrasound affords superior spatial resolution of the superficial soft tissues and hence it is amenable to guiding injections into joints, tendons and ligaments. Needles placed along the line of the ultrasound beam afford good reflectivity and contrast nicely against the surrounding soft tissues. Injection is best performed using a linear probe with a needle running along the wide face of the probe such that the needle length is visible on the screen. Compound imaging, if available, can make the needle more visible. The needle should run relatively shallow and this involves penetrating the skin at a point proximal to the transducer. A steep needle course may result in poor visualisation of the needle as it approaches the point of concern.
It is best to penetrate the skin with the bevel up. The needle tip is then directed to the region of interest before rotating it 180^{o}. This places the bevel tip down for a free-flow injection into a bursa or tendon sheath. By shaking the contents of the syringe first, this allows air bubbles to form which may aid individualisation of the injectate. Informed consent should be performed particularly if an injection involves a tendon or tendon sheath as there is a small risk of rupture. Collections of fluid or collections in the presence of infection may be aspirated.

Common injections around the shoulder include injections into the subdeltoid and subcorocoid bursae. The needle can be directed into the middle of the two fatty echogenic planes and the needle rotated before freely injecting. Injection of the acromioclavicular joint should involve penetration of the dorsal capsule which may be thickened. Injections to the biceps tendon can be performed either within the bicipital groove or within the intra-articular portion of biceps. I favour the latter approach as this also allows good visualisation of the coracohumeral and superior glenohumeral ligament. Calcific foci within the rotator cuff are amenable to fragmentation and aspiration. This should be performed following a suprascapular nerve block/subdeltoid infiltration of steroid and local anaesthetic as calcium particles tend to incite an inflammatory response. The glenohumeral joint is also accessible and the posterior approach is favoured.

The injections around the elbow include the treatment of medial and lateral epicondylitis. These tendons may be bathed in steroid but note should be made that there is no scientific evidence to suggest that steroid does little than provide temporary relief and there is certainly no evidence to suggest it promotes healing. Healing techniques include dry needling which involves traumatising a tendon with a large bore needle to incite bleeding, collagen disruption and promote the healing cascade. Autologous blood may also be injected and preliminary research suggests that this is a useful technique. Injections into the joint are best performed using a lateral approach through the radio-capitellar joint. This is also the favoured approach for aspiration. Injections into the bicipital bursa and olecranon bursa may also be performed. Injections around the wrist including injections into the tendon sheaths of abductor pollicis longus/extensor pollicis brevis (de Quervain’s disease). The extensor carpi ulnaris tendon may also be injected, particularly in tennis players. Radiocarpal injections are best performed using a dorsal and radial sided approach with care taken to avoid the neurovascular bundle. The TFC complex should be avoided.

Injections into the hip joint are best performed by identifying the convex contour of the femoral head and directing the needle down onto the femoral head, just in front of the anterosuperior portion of the labrum. Muscle injections include the iliopsoas and piriformis injections. The anterolateral insertion of gluteus medius may be frayed or partially torn. Therapeutic treatment is to bathe this portion of the tendon in local anaesthetic and steroid before dry needling the tendon to incite some healing. Two or three injections may be required to provide symptomatic relief.

The medial collateral ligamentous complex is a recent area of interest in the orthopaedic community. Isolated tears of the deep meniscofemoral and meniscotibial ligaments are now appreciated. These ligaments may be dry needled and bathed in steroid and local anaesthetic. Proximal patellar tendinosis may also be treated with dry needling and/or an injection of autologous blood. Impingement syndromes may be treated by injecting dilute alcohol into the infrapatellar fat and steroid may be used to treat prepatellar bursitis. A Baker’s cyst aspiration is best performed with the patient lying prone and aspirating the cyst to dryness. Sometimes it is useful to inject a small amount of steroid and/or local anaesthetic to act as a sclerose into the wall so this tends to have a limited success. Parameniscal or tibiofibular ganglion cyst aspiration is best performed using a wide bore needle. It is not always necessary to aspirate the mucoid degeneration but it is necessary to puncture the wall on several occasions so that the ganglion may dissipate of its own accord.

Treatment for Achilles’ tendinosis can include dry needling or autologous blood injections. Paratendonitis can be treated by using a 10ml bolus of Marcaine and

stripping the tendon sheath for symptomatic relief. Steroid and local anaesthetic may be injected into the retrocalcaneal bursa and this treatment can also be used for the posterior impingement syndrome.
Injections into the intermetatarsal, metatarsophalangeal and interphalangeal joints is best performed using a small gauge (25 gauge) needle. The plantar aponeurosis may be bathed with steroid for symptomatic relief if the medial approach is favoured as it is the medial limb which is most commonly affected. An injection into the plantar fascia should be avoided or this may precipitate rupture. Morton's neuromas may be treated with an injection of steroid or alcohol into the centre of the lesion and this can be performed with the ultrasound probe either placed on the dorsal surface of the skin or the plantar surface.
Limited scientific evidence suggests that guided injections into structures provide better results than blind injections alone. Good results are dependent on a good ultrasound technique which requires keeping the needle visible at all times within the sonographic plane and this ultimately depends on technique and practice.
References
Connell D A, Bass C, Sykes C J, Young D, Edwards E (2003) Sonographic evaluation of gluteus medius and minimus tendinopathy. Eur Radiol13: 1339-1347
Edwards S G, Calandruccio JH (2003) Autologous blood injections for refractory lateral epicondylitis. J Hand Surg 28: 272-8
Krasney C, Enenkel M, Aigner N, Wlk M, Landsiedl F (2005) Ultrasound-guided needling combined with shock-wave therapy for the treatment of calcifying tendonitis of the shoulder. J Bone Joint Surg 87: 501-507

BONE BIOPSY: TIPS AND TRICKS FOR A SUCCESSFUL BIOPSY

A Saifuddin
Royal National Orthopaedic Hospital, London, United Kingdom

Bone tumours typically present with focal bone pain and a radiological abnormality. Careful assessment of the radiograph will optimally characterise a lesion and suggest the likely diagnosis in 70-80% of cases. Occasionally, CT/MRI will aid lesion characterisation by demonstrating occult mineralisation, fat or fluid-levels. Some tumours such as enchondromas and OO can be clearly characterised radiologically and biopsy is not required. The combination of radiography and MRI will characterise most non-neoplastic lesions that mimic bone tumours, such as Brodies abscess and bone infarction, while CT is useful for diagnosing stress fractures. Non-neoplastic lesions that are characterised adequately by imaging should not be subject to needle biopsy.
Tip 1: Don't biopsy something that doesn't need biopsy.
If a decision is made to perform biopsy, the approach must be discussed with the surgeon performing the definitive surgery, since the biopsy track must be excised at the time of surgery. This requires knowledge of surgical approaches. If the definitive surgery will not be performed in your centre, do not perform the biopsy.
Tip 2: Plan biopsy approach with surgeon who will perform definitive surgery.
Some tumours provoke an inflammatory response, which may mask the lesion. Also many aggressive tumours undergo spontaneous necrosis, while some benign or low-grade malignant tumours undergo dedifferentiation. Be aware of these possibilities

and ensure biopsy of viable and representative areas of the lesion. Pre-biopsy MRI is essential in planning the most appropriate site for needle biopsy.
Tip 3: Biopsy representative area of the lesion, avoiding necrosis, reactive changes and low-grade areas of dedifferentiated tumours, using MRI as guide
Tumours that are extensively haemorrhagic, such as GCT will not yield solid cores of tissue. This is suggested on MRI by the presence of low T2W SI in a radiographically lytic lesion. In this situation, aspiration will provide diagnostic tissue in approximately 90% of cases.
Tip 4: For lytic lesions, perform vigorous aspiration obtaining 5-10mls of clot.
High-grade malignant tumours typically have a large extraosseous component at presentation. Limiting biopsy to the extraosseous component, using a Trucut/Temno needle will provide accurate diagnosis in over 95% of cases.
Tip 5: For lesions with large extraosseous components, limit biopsy to soft tissue mass.
The final diagnosis depends upon the combined radiological and histopathological features. Always discuss the likely differential diagnoses with the pathologist.
Tip 6: Discuss radiological differential diagnosis with pathologist.

Thursday 7th July at 16:40 in Rhodes Trust Lecture Theatre

OPTIMISING SPECIMEN HANDLING

KGO Åström
Radiology, Uppsala, Sweden

In order to improve the result of musculoskeletal biopsy it is of importance to optimize specimen handling. Collaboration between the clinician, the pathologist and the radiologist prior to the biopsy procedure increases the possibility to predict the cause of the lesion, for instance whether it is a metastasis, round cell tumour (lymphoma, myeloma, Ewing sarcoma), primary malignant or benign musculoskeletal tumour or infection. The prediction might facilitate the selection of biopsy method and specimen handling. A high probability of a benign tumour or lymphoma or a sclerotic lesion makes fine needle aspiration biopsy (FNAB) less favourable.
Cytology: Commonly, smears on glass slides from fine-needle aspiration biopsies are air-dried or wet-fixed with ethanol. However, with a cytologist in attendance one or more of them could be fast stained, according to May-Grünwald-Giemsa and/or hematoxylin-eosin, for a rapid assessment of the specimen quality and diagnosis. Small amounts of cell aspirates on multiple slides are preferable. One method to ensure banking and multiple analyses of the material is a cytospin preparation. The cell aspirate is put into buffered saline, which can be used fresh or stored as frozen material. The cytospin preparation is performed from small amounts of the solution and provides cells for several analyses such as phenotyping using immunochemistry and different methods for genotyping.
Core biopsy: Specimens and clots from osseous blood have most often been fixed in 4% formalin, decalcified when needed, embedded in paraffin and then cut horizontally into thin sections. Immunohistochemistry for diagnosing secondary tumours and their receptor status can be performed on fixed specimens. Especially in small specimens it might be necessary to systematically stain for epithelial markers e.g. keratin before declaring the biopsy negative. One way to achieve better utilisation

of the material from a core biopsy of a tumour is to embed one specimen horizontally and another one vertically.
Fifteen years ago formalin fixation made it impossible to diagnose lymphoma because specific antibodies for T and B-cells didn't exist. Ten years ago sub-classification of lymphoma and diagnosis of primary musculoskeletal tumours were possible on fresh and frozen specimens but not always on formalin-fixed ones. During recent years new antibodies have made it possible to perform most immunohistochemical (IH) analyses on formalin fixed material. However, the antiobody reactions for lambda- and kappa antigens are still problematic after formalin fixation because of non-specific reactions in the tissue surrounding the cells. In most cases this can be overcome using flow cytometry (FC) or IH on fresh material. FC is a rapid, cheap and quantitative measurement. Pressed prep is put into a cell suspension and then a cytospin is performed. The slide is marked with antibodies. One 18 Gauge core biopsy from a biopsy gun is not sufficient for FC but two might be sufficient.
Some T-cell lymphomas are difficult to assess on morphology alone. In these cases a clonal rearrangement in some of the genes that code for the T-cell receptor is required for diagnosis. For PCR (Polymerase Chain Reaction) - based genetic diagnostic analysis of lymphoma, the success rate on formalin-fixed material is about 75%, however, on fresh material it is much higher. FISH (Fluorescence in situ hybridization) can be used for assessment of chromosomal translocations on imprints (see below). This method is cheaper and easier to perform than PCR-DNA assessment.
Another way to secure non-fixed cells is to do an imprint, e.g. to touch or roll the specimen on the microscopic slide and allow it to dry in air. Fast stain examinations can be done on imprints in the same way as the smears, thereby in most cases immediately confirming that the specimen is representative of the specimen and distinguishing between benign and malignant lesions. Stored imprints can be used for more sophisticated techniques including cytogenetics.
Lymphoma: See above (core biopsy). Fresh material is needed for a) imprints; b) flow cytometry, banking and formalin-fixed material is used for diagnostic stains.
Metastases: Almost all diagnostic can be done on formalin-fixed material. When immunohistochemically using Her-2 antibodies in order to select patients for trastuzumab (Herceptin$^{R)}$ treatment, it is of importance to know that the decalcification with use of nitric acid may falsly give one grade lower reaction. Formic acid is favourable. FISH is specific in showing the amplification of the Her-2 locus.
Musculoskeletal tumours: Most immunohistochemical analyses can be used on fixed material. Chromosome analyses require that the specimen be put directly into a recommended culture medium and rapidly transported to a cytogenetic laboratory. FISH or PCR preferably using fresh tissue are nowadays the common techniques for molecular analyses. A small sample can be better used as fresh tissue for multiple imprints using techniques such as FISH, immunochemistry and DNA. If **Electron microscopy (**EM) is planned the specimen is preferably put into glutaraldehyde. Formalin destructs some sub-cellular structures. Nowadays EM is seldom used since it is expensive and time-consuming. New techniques such as immunohistochemistry, and FISH have higher specificity.
Infection: Fresh aspiration and core materials can be used for microbiological analyses. Nowadays the material is often sent in sterile tubes within 2 hours. Routine cultures, direct microscopy and PCR could be performed. Pus can also be sent in a transport medium containing carbon. A specimen used for histopathology could also

be examined for inflammatory cells and stained according to Gram for non-specific inflammatory diagnosis, PAS for fungi and Ziehl-Neelsen for the diagnosis of tuberculosis.

Tissue micro array: TMA can be performed on formalin fixed material using immunohistochemistry. Several cores (length up to 4mm, diameter 0.6 or 1mm) are obtained from donor blocks containing paraffin embedded tumour specimens. Then a recipient paraffin block may contain an array with as many as 500 to 1000 cores. The sections are 4µ and one recipient block can give 300 consecutive sections.

Microarray: The level of gene RNA expression is measured. In order to better understand heterogenous breast cancer biology for prognostication and therapy prediction microarray profiling is used on breast cancer patients. Microarray also might be of value to detect potential differences between primary tumours and metastatic lesions. Studies are also planned on musculoskeletal tumours (sarcomas). RNA expression analyses have been made on up to 33.000 genes. Good quality of RNA is important for studies on gene expression and 1-2 microgram is needed. RNA is not stable. It fragments in formalin. Fresh RNA also fragments over time. Frozen material or rapid transportation and ice bed is favourable. In many institutions the medium RNA-later is used for longer transports. This is a solution that inhibits enzyme degradation of the RNA. Studies are planned to validate whether or not paraffin-embedded tumours can be used.

Summary: Most diagnostics can today be performed on formalin-fixed material, however, the increased demand for banking of specimens and some specific analyses favour fresh or frozen material. Ideally, the specimen should be sent fresh to the pathology department. However, this is costly and requires good logistics with rapid and controlled transportation with staff members on duty for preparation of incoming specimens.

FRIDAY AM 08:30 to 10:10
Nelson Mandela Theatre

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MR IMAGING OF THE ROTATOR CUFF

J Kramer
Roentgeninstitute – Schillerpark, Linz, Austria

MR imaging is an excellent method for delineating normal structures as well as anatomic variants of the shoulder joint and it is especially usefull for the evaluation of shoulder lesions. Although conventional MR imaging in most cases enables an accurate diagnosis, frequently MR arthrography is needed for the detection and staging of subtle changes, especially, if no certain amount of joint effusion is distending the joint cavity and outlining intraarticular structures.

Cuff impingement is by far the most cause for a rotator cuff lesion. Therefore, the different types of impingement (primary, secondary, and internal impingement) are discussed and those alterations, which may cause an impingement symptomatic are demonstrated. Since impingement of the shoulder sooner or later leads to a lesion of

the rotator cuff, the pathologic signal alterations and the morphologic substrate of the involved tendons of the rotator cuff are demonstarted.
Although full rotator cuff thickness tears are detected by conventional MR imaging with high accuracy, diagnostic problems of the evaluation of partial thickness tears are faced and shown how they can be solved easily by using MR arthrography in those cases with an articular sided partial tear. Lastly, some entities, mimicking clinically a rotatot cuff tear, are demonstrated.

SHOULDER IMPINGEMENT SYNDROMES

J Beltran
S.U.N.Y. Downstate, Brooklyn, United States

Impingement Syndrome Impingement of Rotator Cuff on coracoacromial arch, accentuated during overhead activities
Impingement Syndrome: Types
Primary: Abnormalities in coracoacromial arch (osteophytes) and other external causes
Secondary: To rotator cuff and capsular dysfunction
Internal: Articular surface side (Posterosuperior, Anterosuperior, Entrapment of LHBT, GIRD)
External: Bursal side against CA arch (Coracoid imping.)
Internal Impingement Syndromes
Posterosuperior
Anterosuperior
Entrapment of the LHBT
GIRD (Glenohumeral internal rotation deficit)
Posterosuperior Impingement Syndrome
Anterior capsular laxity
Repeated stress anterior capsule
Partial articular surface RCT
Superior labral tear
Extreme abduction and external rotation
Non-athletic population
Superior partial articular surface tear
Contact posterior superior glenoid rim and rotator cuff in non-athletic population without laxity or instability
Anterosuperior Impingement (ASI) Forward elevation and internal rotation
Impingement between LHBT and pulley and superior labrum
Type I: Isolated SGHL lesion
Type II: SGHL lesion + partial articular side SST tear
Type III: SGHL + partial SScap T tear
Type IV: SGHL + SST + SScap
Common feature: LHBT Synovitis, Dislocation, Subluxation or Tear.
Entrapment of the Long Head of Biceps Tendon
Hourglass LHBT entrapped between humeral head and glenoid
Hyperplasic intrarticular LHBT
Forward elevation with elbow extended
Boileau et al. J Shoulder Elbow Surg 2004;13;249-57

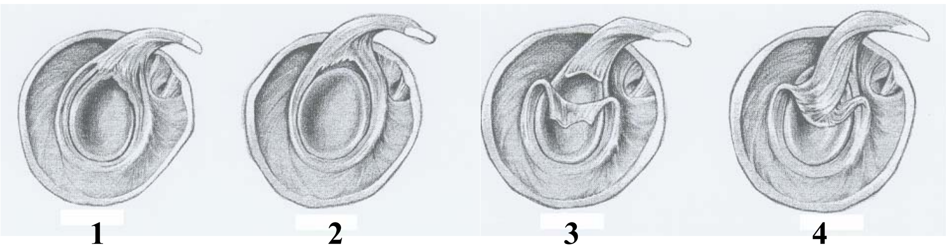
Glenohumeral Internal Rotation Deficit (GIRD) Fibrosis of the posterior capsule in throwers leading to internal rotation deficit.
Tennis, Baseball

SLAP LESIONS

Dr. K Woertler
Technische Universität München

SLAP (Superior Labrum Anterior to Posterior) lesions of the shoulder represent tears of the superior glenoid labrum that extend in an anterior to posterior direction. In arthroscopic series the incidence of these injuries varies from 4 to 10 %. Four different types of SLAP lesions have been described in the original classification by Snyder:

Type 1 - degenerative fraying of the superior labrum,
Type 2 - avulsion of the superior labrum and biceps anchor from the glenoid,
Type 3 - bucket-handle tear of the superior labrum with preserved biceps anchor, and
Type 4 - bucket-handle tear of the superior labrum involving the long head of biceps tendon.

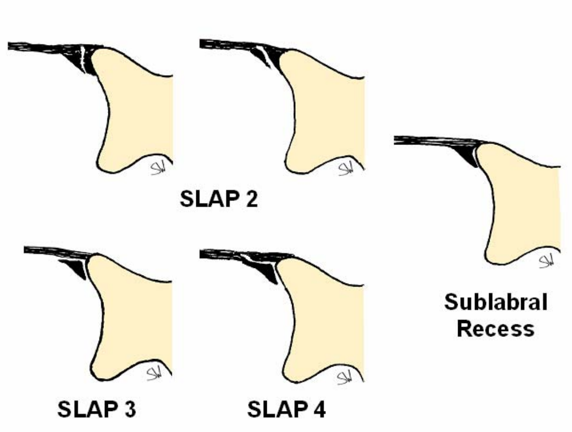


Classification of SLAP lesions according to Snyder (1990)

Whereas type 1 and 2 lesions are frequently found in overhead athletes (repetitive torsion of the biceps anchor), types 3 and 4 are thought to occurr more often after a fall onto an outstretched arm or onto a flexed elbow. Furthermore, type 2 lesions are typically observed in patients with anteroinferior shoulder instability, where they develop in association with lesions of the anteroinferior labro-ligamentous complex. Surgical treatment is indicated in all types SLAP lesions except type 1 lesions which are generally of no clinical relevance. Since type 2 and 4 lesions lead to instability of the biceps insertion, the are commonly treated by refixation. Type 3 bucket-handle tears do not impair the stabilizing function of the biceps anchor and therefore are usually not surgically reattached but treated by simple debridement.

Standard MR imaging is of limited value in the diagnosis of injuries of the superior labrum and the long head of biceps tendon. Most authors who investigated standard MR imaging of the shoulder with the use of fast spin echo sequences have reported low sensitivities (13-65 %) for the detection of SLAP lesions. MR arthrography has not only proved to be superior with regard to identification of SLAP lesions

(sensitivity 84-92 %, specificity 69-99 %), but also has been shown to be reliable in assessment of the stability of the biceps anchor and the detection of associated injuries.
SLAP lesions are usually best seen on MR arthrograms oriented in the coronal plane: Type 2 lesions show linear extension of contrast media into the superior labrum and the biceps anchor. This type represents the most common type of SLAP lesions but also the most problematic in terms of differential diagnosis. The majority false positive diagnoses of a type 2 SLAP lesion are caused by misinterpretation of a sublabaral recess as a tear. Sublabral recesses are very common anatomic variants with an incidence of 71-85 % in cadaveric studies. Criteria for the presence of a type 2 SLAP lesions rather than a sublabral recess include lateral or superior extension of the tear, medial extension with irregular margins or a wide separation, and medial extension posterior to the biceps insertion.
Type 3 lesions are characterized by a vertical and an additional horizontal contrast interface which separate the avulsed superior labrum (triangular fragment) from the intact biceps tendon.
Type 4 lesions additionally show extension of the horizontal component of the tear into the long head of biceps tendon. The bucket-handle fragment therefore is composed of the superior labrum as well as a portion of the tendon. It might be more or less displaced from the superior glenoid.



Appearance of SLAP lesions types 2-4 and sublabral recesses on coronal MR arthrograms.

Further Reading

Bencardino JT, Beltran J, Rosenberg ZS, Rokito A, Schmahmann S, Mota J, Mellado JM, Zuckerman J, Cuomo F, Rose D (2000) Superior labrum anterior-posterior lesions: diagnosis with MR arthrography of the shoulder. Radiology 214:267-271
Jee WH, McCauley TR, Katz LD, Matheny JM, Ruwe PA, Daigneault JP (2001) Superior labral anterior posterior (SLAP) lesions of the glenoid labrum: reliability and accuracy of MR arthrography for diagnosis. Radiology 218:127-132
Monu JUV, Pope TL, Chabon SJ, Vanarthos WJ (1994) MR diagnosis of superior labral anterior posterior (SLAP) injuries of the glenoid labrum: value of routine imaging without injection of contrast material. Am J Roentgenol 163:1425-1429
Smith AM, McCauley TR, Jokl P (1993) SLAP lesions of the glenoid labrum diagnosed with MR imaging. Skeletal Radiol 22:507-510
Smith DK, Chopp TM, Aufdemorte TB, Witkowski EG, Jones RC (1996) Sublabral recess of the superior glenoid labrum: study of cadavers with conventional nonenhanced MR imaging, MR arthrography, anatomic dissection, and limited histologic examination. Radiology 201:251-256
Snyder SJ, Karzel RP, Del-Pizzo W, Ferkel RD, Friedmann MJ (1990) SLAP lesions of the shoulder. Arthroscopy 6:274-279
Waldt S, Burkart A, Lange P, Imhoff AB, Rummeny EJ, Woertler K (2004) Diagnostic performance of MR arthrography in the assessment of superior labral anteroposterior lesions of the shoulder. AJR Am J Roentgenol; 182:1271-1278
Woertler K, Waldt S, Burkart A, Imhoff AB, Rummeny EJ (2003) MR imaging of variants of the superior labral-bicipital complex and SLAP lesions. Orthopade; 32:595-599 [Article in German]
Yoneda M, Izawa K, Hirooka A (1998) Indicators of superior labral detachment on magnetic resonance imaging and computed tomography arthrography. J Shoulder Elbow Surg 7:2-12

MRI OF SOFT TISSUE INJURIES OF THE ELBOW

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There are many ligaments and tendons around the elbow that can be injured during sports activity. Several patterns of injury result in predictable soft tissue insult.
The ulnar collateral ligament consists of three parts. The major ligament is the anterior oblique bundle, which is taut with extension, and inserts on the ulna along the medial aspect of the coronoid process- the sublime tubercle. The other components of the ulnar collateral ligament complex are the posterior oblique bundle and the transverse segment which bridges the ulnar attachments of the anterior and posterior bands. Rupture of the ulnar collateral ligament usually occurs in the flexed elbow with valgus stress. This ligament is injured in throwing sports. Most tears occur in the mid proximal fibers of the anterior bundle. Partial tears are diagnosed when there is focal disruption that does not extend through the full thickness of the ligament. Lateral compartment bone contusions may be present in association with acute tears of the ulnar collateral ligament.
The radial collateral ligament complex has three components, the radial collateral ligament proper, which extends from the lateral epicondyle of the humerus to the annular ligament, the accessory collateral ligament and the lateral ulnar collateral ligament (LUCL). The LUCL lies posterior to the radial collateral ligament, arising from the lateral epicondyle and extending along the posterior aspect of the radius to insert on the supinator crest of the ulna. The lateral ulnar collateral ligament provides the primary restraint to varus stress. Disruption of the lateral collateral ligament results in the recently described pivot shift phenomenon and posterolateral rotatory instability of the elbow.
Epicondylitis is characterized by abnormalities of the tendons that attach on the medial and lateral epicondyles of the distal humerus. It can be caused by repetitive movements of the wrist with pronation or supination of the forearm. Lateral epicondylitis or "tennis elbow" occurs at the origin of the extensor carpi radialis brevis. It is commonly associated with varus stress to the elbow. Medially, valgus stress produces abnormalities are seen at the origins of the flexors and pronator teres ("golfer's elbow").
Rupture of the distal biceps tendon is infrequent, accounting for 3-10% of all biceps tendon ruptures. It is usually caused by a single event, often 40 kg or more against resistance with the elbow in approximately 90 degrees of flexion or sudden forceful hyperextension against resistance. Tears occur at or near the distal insertion site on the radial tuberosity and can sometimes be difficult to clinically diagnose, especially in situations where the bicipital aponeurosis remains intact with minimal proximal retraction of the biceps. Distal biceps tendinosis is common and may precede a spontaneous tendon rupture. With chronic biceps tendon abnormality, one may see osseous proliferation at the radial tubercle, supinator muscle edema, and bursitis in the region of the distal tendon. Enlargement of the bicipito-radial bursa can result in compression of the posterior interosseous nerve. Swelling of the interosseous bursa compresses the median nerve.
Rupture of the triceps tendon is rare. It usually occurs from a direct blow or a deceleration force to the arm while the triceps is contracted, usually after a fall on an outstretched hand. Sports that rely on repetitive elbow extension such as bowling, pitching and weight-lifting can also produce triceps tendon disruption as can systemic

disease or steroids. Full-thickness tears are far more common than partial thickness tears. Axial and sagittal MR images are useful for evaluating tears of the triceps tendon. The triceps tendon can also sublux medially or laterally over both humeral epicondyles, producing a snapping sensation and ulnar neuropathy. This is best appreciated on axial flexion images obtained during MRI.

FRIDAY AM 08:30 to 10:10
Lecture Theatre 4

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STRESS FRACTURES AND SHIN SPLINTS. IMAGING DIAGNOSIS.

M Padron
Universidad Catolica, Murcia, Spain

Running related injuries are increasingly common and most often due to overuse and occur during the course of training.Stress reactions or fractures occur when abnormal repetitive stress is applied to normal bone.We review the biomechanical aspects of running as well as individual variations that may led to symptoms in runners.

Different imaging modalities and its importance in diagnosis are reviewed stressing the MRI findings in the early stages as the most efective technique for the evaluation of patients in whom there is clinical suspicion for stress fracture.Shin splints are a part of the continuum of fatigue damage in bone.Clinical significance of bone marrow edema and periosteal edema in runners is discussed.

Friday 8th July at 8:50 in Lecture Theatre 4

IMAGING AND NATURAL HISTORY OF MICROFRACTURES

K Bohndorf
Clinic for Diagnostic Radiology, Augsburg, Germany

Fractures of the bone results from mechanical injury. However, the force required to produce a fracture in bone depends on the strength of the bone itsself. Weakened bone due to osteoporosis is especially prone to fractures.
Because bone is a composite material and is also anisotropic the gross appearance of a fracture depends on the microstructure of the bone tissue. Bone’s most important features, in terms of fracture propagation are its many weak interfaces (cement lines) and the osteocyte lacunae and canaliculi dispersed throughout its structure. The osteocyte lacunae can act as sites of crack initiation, and the cement lines provide the major planes of fracture propagation. In the cortical bone the aliquiment of the cement lines is predominantly longitudial, surrounding the osteons. The distribution of the cement lines throughout the cancellous bone is irregular. The direction in which a load is applied also determines the direction of the fracture. Acutely, fractures of the

cortex often extend to the spongiosa, so that separation of cortical and medallary lesions often is not possible.
A classical response of medullary bone to acute injury is a bone bruise. Presumably, this relates to hemorrhage, vascular connective tissue and trabecular thickening at sites of fractures in the cancellous bone, the latter called microfractures. In principal, following an injury, an edematous phase occurs. This rapidly proceeds to a hyperemic phase as new blood vessels form and old blood vessels are activated.
Repeated stress to bone, as occurs e.g. in long-distance running, may result in the development of stress fractures or, in case of weakened bone, insufficiency fractures. The accumulation of microfractures eventually may lead to a complete fracture through the bone cortex.
Increased intramedullary signal intensities on STIR images or proton density/T2 weighted spin echo images after fat saturation are frequently identified at MRI in patients with acute musculoskeletal trauma. These findings correlate with reduced signal intensities in the bone marrow on T1 weighted spin echo images. These signal alterationes are commonly considered to represent a bone bruise following trabecular microfractures or are an accompanying feature of radiologically overt fractures.
It has been suggested that microfractures of bony trabeculae may lead to inadequate mechanical support of the subchondral plate and eventually to subchondral collapse and osteonecrosis. In long term follow-up studies of acute trauma of the knee in patients who showed a bone bruise on the initial posttraumatic MR examination, this could not be confirmed.
References
Roemer FW, Bohndorf K (2002)
Long-term osseous sequelae after acute trauma of the knee joint evaluated by MRI Skeletal Radiol 31:615-623
Tyrrell PNM, Davies AM (1994)
MRI appearances of fatigue fractures of the long bones. BJR 67:332-338
Anderson MW, Greenspan A (1996)
State of the art-stress fractures. Radiology 199:1-12.
Craig JG, Widman D, van Holsbeeck M (2003) M
Longitudinal stress fracture: patterns of edema and the importance of the nutrient foramen. Skeletal Radiology 32:22-27

BONE MARROW OEDEMA SYNDROMES

R.W. Whitehouse
Manchester Royal Infirmary, Manchester, United Kingdom

The ability of Magnetic Resonance Imaging to demonstrate change in the composition of the bone marrow has resulted in the recognition of “bone bruising” in otherwise occult bone trauma, and also the re-naming of transient osteoporosis as transient bone marrow oedema. With this change has come some confusion, with blurring of the distinction between transient marrow oedema and avascular necrosis. That a subchondral fracture may be present in transient marrow oedema, creating an MR imaging appearance of a low signal intensity line beneath the articular surface can further mimic the “double line sign” of avascular necrosis.
Marrow oedema syndromes at sites other than the femoral head (also usually in the lower limb) are now recognised, are demonstrated by MR imaging and provide a clue to the pathological process that may underlie previously occult causes of pain.

Transient osteoporosis of the hip, transient migratory osteoporosis and spontaneous osteonecrosis of the knee will be discussed and illustrated.
The aim of this lecture is to illustrate the imaging appearances of bone marrow oedema, describe and discuss the commoner syndromes and provide some practical suggestions for evaluating and describing marrow oedema syndromes.

SKELETAL TRAUMA IN THE IMMATURE SKELETON

KJ Johnson
Birmingham Children's Hospital, Birmingham, United Kingdom

Fractures and skeletal injuries are a relatively common occurrence in children. The radiologist needs to be aware of a variety of differences when imaging the paediatric skeleton, which include a different bone physiology, the presence of accessory ossification centres which can be confused with injury, the differences in mobility of children as they develop and the presence of unossified skeletal cartilage, which can make radiological interpretation difficult.
Children's bones are more plastic and compressible than adults and there is a relatively stronger periosteum, consequently incomplete and bowing fractures without cortical breaks can occur. Uniquely in children there is also a growthplate (physis) at the ends of the longbones that can also be fractured.
Certain fractures are characteristic for different paediatric age groups which reflects the variations in development and mobility of the growing child.
Fractures can occur at birth, but are rare during the first year of life. Fractures in young infants should raise the suspicion of inflicted non-accidental injury particularly metaphyseal (bucket handle or chip fractures) and rib fractures. With any fracture in a child under 18 months discussion with the referring clinician about the child's development and history of presentation is vital.
In the older mobilising child spiral fractures of the tibia (toddler's fractures) and injuries to the distal radius and ulna are common. These longbone fractures are often incomplete with the cortex remaining partially intact and are described as buckle and greenstick fractures.
In the older child the pliability of bone is reduced and therefore complete fractures are more common. The increased bone strength leaves the unfused growthplate as a relatively weak site so that growthplate injuries have an increased incidence.
Growthplate injuries are typically divided by the Salter Harris classification into five different types and recognising those injuries and their appropriate management is important.
Humeral supracondylar fractures are frequent in the older child. Additionally, around the elbow it is important that the radiologist has a knowledge of the normal development of the secondary ossification centres so that traumatic avulsion injuries are not confused with normal development.
Joint dislocation or ligament disruption is uncommon in children because of the relative strength of the ligaments compared to the underlying bone. An avulsion fracture is more common than a ligamental tear.

OSTEOCHONDRAL INJURY

M A Sampson

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Osteochondral injuries are an important type of musculoskeletal trauma that can lead to disabling arthritis if not recognized and treated appropriately in the early stages. Acute trauma to the articular surface may lead to focal damage to the cartilage layer alone or to the cartilage layer together with the underlying cortical bone with a variable amount of subchondral marrow involvement. Repetitive trauma may lead to stress fracture of the cartilage/bone subunit with tissue damage and healing leading to bony defects, free fragments and so called 'osteochondritis'.
Anatomy and biomechanical function of a joint are important for understanding particular patterns of osteochondral injury and the resultant imaging appearance. Common joints involved are the knee and the talus but osteochondral injuries may occur at any joint. Some consider endplate damage of the intervertebral discs to be a variant of osteochondral injury. This review will concentrate on synovial joints most commonly involved.
MRI is currently the modality of choice for the detection and staging of osteochondral injuries. T1 W imaging shows the change in cortical outline and the underlying marrow oedema as low signal in the fatty marrow; STIR and fat suppressed water sensitive sequences will demonstrate oedema as high signal centred on the damaged surface and T2 gradient images, volume PD and dual echo water excited imaging demonstrate the articular surface. CT and plain radiographs are useful in the acute phase to detect cortical damage, associated injury and the position of any osteal loose bodies. Contrast may be used in CT and MR imaging to more accurately define the joint surface morphology and to outline non ossified loose bodies but the combination of dedicated MR , plain radiographs and arthroscopy is the most commonly employed imaging strategy.
Various therapeutic interventions include surgical restoration of the articular surface by replacement of the fragment , removal of loose body, surface debridment, drilling and microfracture technique and transplantation techniques with chondrocytes and/ or grafts.

FRIDAY AM 08:30 to 10:10
Rhodes Trust Theatre

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SELECTING PATIENTS FOR VERTEBROPLASTY

I G Hide
Freeman Hospital, Newcastle upon Tyne, United Kingdom

This presentation reviews the indications and contra-indications for percutaneous vertebroplasty and the issues to consider when selecting which patient and which vertebral level(s) to treat.
Topics considered:
Indications
Contra-indications
Assessing the significance of a fracture

Alternative causes of back pain
Treating the severe fracture

THERAPEUTIC PROCEDURES FOR THE CERVICAL SPINE

A Chevrot, J L Drapé
université René descartes APHP, Paris, France

The very frequent therapeutic procedures involved in the cervical spine are based on steroid injections, (foramen, facet, disc), for pain relief in the following cases :
degenerative diseases
nerve root conflicts (post trauma)
inflammatory involvement (Rheumatoid disease, spondylarthritis)
We will not describe vertebroplasty nor the use of radiofrequency to remove small bone tumors or metastasis.
Asepsis
Asepsis is fundamental.for all aspects of the procedure and particularly for steroid injections.
Patient care
Premedication is not always necessary for an adult except in case of allergy
Local anaesthesia is contra-indicated in the cervical spine due to the risk of injection of neural structures (nerve roots, spinal canal and spinal cord, neural vegetative ganglions).
Needles and medications
20 to 22 Gauge. Water soluble neural and vascular tolerated iodine substances are used. Late acting steroids are chosen for the small size of the crystals.(hydrocortisol
Needle guidance
Under fluoroscopic unit. Or CT scan guidance.
Interventional techniques
Facet joints, C1-C2 injection, Foramen injection,Disc injection,Inter spinous process injection are described
Conclusion
These techniques are generally very safe and provide a great deal of pain relief to the patient as a day care procedure. The major draw back is the possible risk of iatrogenic infection which justifies the special precautions to be taken by the experienced operator.

LUMBAR PAIN MANAGEMENT

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HOSPITAL LA FE and NUEVE DE OCTUBRE, Valencia, Spain

After a correct and right guided treatment there are a 25% of recurrences in acute lumbar back pain cases. After three months of symptoms this problem is considered as a chronic disease that needs a special management. Nowadays is considered as a biopsychosocial problem that must be treated with interdisciplinary criteria.

Three different models are accepted , monotherapy (chemical, manipulative and surgery), multidisciplinary (based in intensive exercises), and reductionism (target-specific treatment after a pathoanatomical diagnosis).
There is not general agreement about which one has better evidence based results, but obviously as a radiologist I recommend the last one, because "the diagnosis must be the first", but unfortunately there are a lot of cases of lumbar back pain without anatomical probed lesions and many anatomical disasters without significative symptoms. Lumbar back pain still remain as a radiological enigma.
According to the reductionism criteria three points are the more frequent responsible of the pain, the zygapophysial joint, the intervertebral disc and the sacroiliac joint. Althought we cannot probe always the source of the pain, some type of tests based in injections can be useful to investigate their origin. If we have pain relief or significative increasing of the symptoms we can link easily the image and the symptoms and even planify the treatment.
In Bogduk (Nikolai Bogduk Royal Newcastle Hospital. MJA 2004;180(2): 79-83) opinion, the source of lumbar pain are: zygapophysial joints in 15-40%, sacroiliac joints in 20% and disc in over 40% of the cases.
To inject the joints or the discs we need only xRay as method of location, but the CT improves the procedure becoming it, a safe and easy method of investigation.
ZYGAPOPHYSIAL INJECTIONS
The test consist in the injection of local anesthesia and depot steroids into the joint space.

Anatomically, moreover the bony elements in this region we found the joint space, closed by the joint capsule that is covered with the synovial membrane, and the yellow ligaments. The sensibility of this area is controlled by the accessory nerves rami located over the posterior neural arch. Radiologically the only well referred point is the joint space.

Using directly fluoroscopy or CT we can insert the needle into the joint. To avoid morbility, very thin needles must be used, however sometimes is difficult to drive it. I to solve it, I recommend the double cannula needles used in the anesthetic spinal approaches. With this type of needle, the skin, subcutaneous tissues and the muscles are surpassed with a thick cannula and the thin part is guided directly to the joint without obstacles. (25-27 G needles).
Normally the capsule have a very limited capacity and only 1-1.5 cc. can be injected. If we use conventional X ray, to probe if the needle is, placed in , we need inject some iodined contrast , however if the needle is into the joint probed by CT it is not necessary to inject contrast.
The morphological information obtained is not very significative, but in some cases gives us the complete justification of the symptoms.
Normally the capsular recesses are limited and cannot protrude into the neural channel. In some diseases, mainly, degenerative processes, we have synovial proliferation that can compress directly the spinal root, this injury can justify the pain.
We know that the pain can be also unchained by the synovial pinchement. The synovial sensibility is controlled by the recurrent nerve and their stimulation produce a referred pain. We cannot probe the synovial involvement because it is not visible, therefore there are symptomatic joints without anatomical lesions, however the presence of subchondral bone degenerative changes and signal increase image in MRI examinations are very suspicious of them.

This type of provocative test and treatment can be used so much in cases with anatomical lesions, as without radiological manifestations. The clinical symptoms are the key to decide the treatment.
The number of the levels that shall be injected depend on the symptoms, normally, two levels are needed to cover the recurrent nerve territory. Usually 0.5 cc of local anesthesia and steroids in each joint is the recommended dose.
The waited effect is double. As a provocative test, a transitory total pain relief, becoming symptomless for two-three hours if the result is positive. As a treatment, the loss of symptoms for several weeks. To determine if the steroid is effective almost we must wait for one week.
The result is considered very good if the patient remains symptomless over four weeks, and poor result if the pain reappears before four weeks.
In cases of positive test, but poor result we recommend to repeat the procedure after two weeks of the initial injection.
In cases with very important degenerative picture we can add alcohol to improve results. After this type of treatment we have not obtained adverse complications.
One variant of this test can be obtained making the injection in the recurrent nerve territory, that cross the neural arch near of the joint facet. The objetive in this type of treatment is to eliminate the information and avoid the painful sensation. In this type of approach have been used alcohol and radiofrequency. The radiofrequency neurotomy is one emerging procedure, used by the neurosurgeon teams, probably this procedure could be a attractive alternative.
The zygapophysial pain is a very frequent side effect in failed back surgery syndrome. Probably the pain is unchained by overload in the limitant free levels. The active treatment with targeted injections is a very promising possibility, although it is not an universally successful method.
As resume , the referred pain can be treated effectively injecting steroids and other drugs. We have observed that results are better if we inject inside the joint, but this affirmation is not shared by other groups and can be, matter of an open discussion.
In the differential diagnosis of zygapophysial joint pain must be included the sacroiliac joint.

SACROILIAC INJECTIONS

Same technical criteria that in the zygapophysial joint can be used in the sacroiliac joint.

We recommend the direct approach to the superior portion of the joint, using the same mixture with local anesthesia and steroids. Could be useful the arthrogram to probe if the needle is in the joint cavity, but sometimes if we use CT this step is not necessary.

The most common finding is the presence of mild degenerative changes, but this test can be used without radiological probed lesions.
Sacroiliac pain and lumbalgia is a very common symptom when lumbo-sacral transitional malformative changes are presents. Frequenly in these cases we have an extra-joint between the hypertrophic transverse process and the iliac bone. In these cases is useful moreover inject the sacroiliac joint, inject into the new joint.

The results obtained are poorer than the zygapophysial joints, but can be used as a valid test.

The alcohol is recommended mainly in very important degenerative cases. I have never used alcohol in this type of test, probably because I have never seen cases which made me doubt about the origin of the pain .

DISC INJECTIONS

Discal injections were included in the lumbalgia diagnosis some decades ago. There are not general agreement about their use and indications, and probably never will be accepted without objections.

In our protocol of lumbalgia management we include the discography as a provocative test always after a doubtful MRI examination.

Nowadays technical problems to make the discal punctions are minimal. Very good systems of localization and very thin and flexible needles, allow us to come to the disc using the postero-lateral approach with minimal morbility. If we use fluoroscopy, to avoid the root punction, the needle must be positioned in the junction between the anterior third and the rest of disc.

CT or fluoroscopy can be used as method of localization but always conventional images and CT must be included in the examination because so much axial, as sagital projections are necessary to understand the discal ruptures.

The morphological criteria to classify the lesions were established in the Dallas consensus meeting. Six types of discal images are considered. The grade 0 corresponds to a non ruptured anulus fibrosus, whereas, grade V corresponds to a complete rupture with leakage of contrast or disc hernia. The discography allowed us discover that between both extremes there are other lesions, as radial an circunferencial discal fissures without peripheral ligament lesion.

These morphological criteria are useful to decide some types of treatments, but the most important information, that give us the discography is the presence or absence of pain. The discal pain can be present without the existence of hernia. A symptomatic disc, shows us that changes in the pressure can be responsible of the lumbalgia, with independence of the type of the lesion.

Some groups recommend the MRI as the best method or gold standard, to investigate the lumbalgia origin, but unfortunately this is not true. The MRI is a very good method to investigate morphological discal changes, but the correlation between image and clinical symptoms is poor. The presence of apparent root compression or the loss of fat recesses can be founded without significative symptoms and patients without anatomical lesions, sometimes suffer important lumbalgia.

There is not correlation between “black disc” and symptoms, however the better correlation is founded between the “white disc hernia” and positive discography, and probably this is the only specific MRI finding about the disc pathology.

In the protocol of lumbalgia management the role´s discography could be double:

First, as a method to investigate the source of the pain. Is useful in cases with lumbalgia but full normal MRI discal images, and in cases with “black disc” but confusing clinical symptoms.

Secondly as a method to planify the treatment. To know the integrity of the anulus fibrosus, is useful before decide the number of levels that shall be included in the surgical arthrodesis, a ruptured cannot be a limitant level, or before the intradiscal electrothermal therapy (IDET), percutaneous coagulation of the disc using flexible electrodes. Their objetive is to stick the internal fissures, responsibles of the discal pain. Could be a promising procedure but not yet universally accepted.

The discogenic pain also can be also founded in the failed back surgery syndrome. Radial and circunferencial fissures are the consequence of the overload in the limitant endplates that produce failure fatigue fractures. Nowadays, provocative discography could change the prognosis of them. Many of these patients have treatable lesions, only recognizable if we include in our protocol other procedures than the , xRays ,CT or MRI.

There are some papers published about the intradiscal injections of steroids and anesthetic products as a procedure of diagnostic test and treatment in painful discs. I never treated patients with therapeutical intradiscal injections, however we have very good experience with peripheral infiltrations. We have treated patients with foraminal compromise due to discal hernia. To make this treatment the CT is the best tool to localize the herniated disc. A double way can be used, perpendicular, crossing the yellow ligaments or using the oblique way, able to arrive quickly to external face of the foramen. The drugs must be injected outside the hernia.

In the same line of investigation we can inject in the neural sheath. Sometimes per accident we touch the neural root trying arrive to the herniated disc. Being useful the same way and procedure we can explore the neural root.

PERINEURAL INJECTIONS

The foraminal involvement can be responsible of the neural sheath inflammation. This lesion is very difficult to probe, but the MRI could be a useful tool.

In some cases with probed radicular pain we founded increase of signal after gadolinium injection, this sign was published some years ago but remains as a incidental finding not included in the normal protocols of study.

Without probed anatomical lesion the peri-neural injection is a very powerful instrument in the treatment of several radicular pains.

The neural sheath punction technically is not more difficult that the zygapophysial or foraminal injection. The same double cannulas must be used and CT or fluoroscopy can be used as method of localization.

Injection of some contrast must be used to probe the needle localization, but the clinical answer is the better indicative guide. A mild electric-like sensation must be referred by the patient when the neural sheath is localized. To avoid blind punctions we prefer use the CT as method of localization without contrast injections.

The same mixture of steroids and local anesthesia, and the same dose as in the zygapophysial joints can be injected.

The waited results are a complete blockage of the root with sensitive and motor anesthesia for several hours. In case of positive answer, after twenty four hours the local pain decrease progressively remaining symptomless for an undetermined period of time. There are not predictive signs to make a good forecast.

Targeted injections can be a powerful tool in the radiologists hands, probably after the discovery of the discal hernia image, these new radiological guns represent the most important expectative in the lumbalgia management.

The training period for these procedures is very short and I encourage the joung radiologists to use them. I assure you that the results are excellent.

REFERENCES

Atlas SJ, Keller RB, Wu YA, Deyo RA, Singer DE.
Long-term outcomes of surgical and nonsurgical management of lumbar spinal stenosis: 8 to 10 year results from the maine lumbar spine study.

Spine. 2005 Apr 15;30(8):936-43.
Bogduk Nikolai, Clinical Update, Management of chronic low back pain, MJA 2004; 180 (2): 79-83
Bogduk N, Karasek M. Two-year follow-up of a controlled trial of intradiscal electrothermal anuloplasty for chronic low back pain resulting from internal disc disruption. *Spine J* 2002; 2: 343-350.
Brodke DS, Ritter SM. Nonsurgical management of low back pain and lumbar disk degeneration. Instr Course Lect. 2005;54:279-86.
Cohen SP, Salahadin A. Lateral branch blocks as a treatment for sacroiliac joint pain: a pilot study. *Reg Anesth Pain Med* 2003; 28: 113-119.
Dreyfuss P, Halbrook B, Pauza K, et al. Efficacy and validity of radiofrequency neurotomy for chronic lumbar zygapophysial joint pain. *Spine* 2000; 25: 1270-1277.
Delgado-Lo Pez PD, Rodri Guez-Salazar A, Castilla-Di Ez JM, Marti N-Velasco V, Ferna Ndez-Arconada O. [Role of surgery in spinal degenerative disease. Analysis of systematic reviews on surgical and conservative treatments from an evidence-based approach.]N eurocirugia (Astur). 2005 Apr;16(2):142-157. Spanish.
Fritzell P, Hagg O, Wessberg P, Nordwall A, Swedish Lumbar Spine Study Group. 2001 Volvo award winner in clinical studies: lumbar fusion versus nonsurgical treatment for chronic low back pain. A multicenter randomized controlled trial from the Swedish Lumbar Spine Study Group. *Spine* 2001; 26: 2521-2534.
Laslett M, Oberg B, Aprill CN, McDonald B.
Zygapophysial joint blocks in chronic low back pain: a test of Revel's model as a screening test.
BMC Musculoskelet Disord. 2004 Nov 16;5(1):43.
Maigne JY, Aivaliklis A, Pfefer F. Results of sacroiliac joint double block and value of sacroiliac pain provocation tests in 54 patients with low-back pain. *Spine* 1996; 21: 1889-1892.
McGuirk B, King W, Govind J, et al. The safety, efficacy, and cost-effectiveness of evidence-based guidelines for the management of acute low back pain in primary care. *Spine* 2001; 26: 2615-2622.
Moneta GB, Videman T, Kaivanto K, et al. Reported pain during lumbar discography as a function of anular ruptures and disc degeneration. A re-analysis of 833 discograms. *Spine* 1994; 17: 1968-1974.
Ng L, Chaudhary N, Sell P.
The efficacy of corticosteroids in periradicular infiltration for chronic radicular pain: a randomized, double-blind, controlled trial.
Spine. 2005 Apr 15;30(8):857-62.
Sach BL. Dallas Consesus Coference. Discography.. Spine 1987;12:287-94
Truumees E. Spinal stenosis: pathophysiology, clinical and radiologic classification. Instr Course Lect. 2005;54:287-302.

: Laslett M, Oberg B, Aprill CN, McDonald B.
Zygapophysial joint blocks in chronic low back pain: a test of Revel's model as a screening test.
BMC Musculoskelet Disord. 2004 Nov 16;5(1):43.
PMID: 15546487 [PubMed - in process]
4: Truumees E.
Spinal stenosis: pathophysiology, clinical and radiologic classification.
Instr Course Lect. 2005;54:287-302.
PMID: 15948457 [PubMed - in process]

5: Brodke DS, Ritter SM.
Nonsurgical management of low back pain and lumbar disk degeneration.
Instr Course Lect. 2005;54:279-86.
PMID: 15948456 [PubMed - in process]
6: Delgado-Lo Pez PD, Rodri Guez-Salazar A, Castilla-Di Ez JM, Marti N-Velasco V, Ferna Ndez-Arconada O.
[Role of surgery in spinal degenerative disease. Analysis of systematic reviews on surgical and conservative treatments from an evidence-based approach.]
Neurocirugia (Astur). 2005 Apr;16(2):142-157. Spanish.
PMID: 15915304 [PubMed - as supplied by publisher]
7: Atlas SJ, Keller RB, Wu YA, Deyo RA, Singer DE.
Long-term outcomes of surgical and nonsurgical management of lumbar spinal stenosis: 8 to 10 year results from the maine lumbar spine study.
Spine. 2005 Apr 15;30(8):936-43.
PMID: 15834339 [PubMed - in process]
8: Ng L, Chaudhary N, Sell P.
The efficacy of corticosteroids in periradicular infiltration for chronic radicular pain: a randomized, double-blind, controlled trial.
Spine. 2005 Apr 15;30(8):857-62.
PMID: 15834326 [PubMed - in process]
9: Laslett M, Oberg B, Aprill CN, McDonald B.
Zygapophysial joint blocks in chronic low back pain: a test of Revel's model as

PERCUTANEOUS MANAGEMENT OF MSK NEOPLASM

W.R. Obermann
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The technique of RF ablation consist of provoking a local concentrated electrical current in a process giving ions to move quickly which gives local heating. The local heating destructs the process. Depending the type of needle and type of machine the destruction can be small to large.
For small lesions the Radionics-RFG 3 C RF-lesion Generator System, Burlington USA can be used. Most suitable needle is the 145-mm-long dedicated Sluyter-Mehta 20 gauge thermal ablation cannula with a 5-mm-long non-insulated tip (Radionics). The radio-frequency thermal ablation probe (SMK-TC 15;Radionics) which is a 15-cm-long, straight, rigid electrode with a diameter of 1 mm should be inserted in that needle. The probe should be connected to the generator which in turn is connected with a grounding pad on the skin of the patient (as close as possible to the treatable lesion). The maximal destruction provoked by this needle is a sphere of about 1 cm in diameter.
For bigger lesions the RITA machine suitable (RITA Medical Systems, Inc. Mountain View USA). This machine can deliver more power. For bone lesion they use a StarBurst SDE needle (16 G diameter) 12 cm long through a partly insulated 11 gauge introducer needle of 6 cm. The Needle can destruct an elliptical sphere of 2 by 1 cm or when the array antenna's are deployed a sphere of 2 by 2 cm.
In bigger bone lesions (lytic) also more powerful needles (needles with longer antenna's) with or without introducer needle can be used (14G 11, 15 or 20 cm long RITA Starburst XL needle). They can destruct a sphere till 5 cm in diameter. With the Rita system the ground pads (two) should be placed far from the lesion.

Indications for RF ablation in the musculoskeletal system are:1) osteoid osteoma (mostly smaller than 1 cm, sometimes bigger and in tubular bones sometimes elongated ((till 3,5 cm)), 2) osteoblastoma, 3) chondroblastoma, 4) recurrent- giant cell tumor, chordoma and chondrotumor, 5) metastatic bone lesions and 6) small arterio-venous malformations.

The procedure should be done under general anesthesia or spinal anesthesia. The procedure is performed under CT-guidance, preferable with a multi-slice scanner. After localization of the lesion the tumor can be reached by the Bonopty coaxial bone biopsy system (Radi Medical Systems, Uppsala, Sweden) in case of small lesions such as osteoid osteomas. For bigger lesions the tumor should be reached by the 11 G introducer needle by RITA.

The anatomical safest route should be taken which means sometimes a longer route through more bone.

The seize of the lesion should be well considered and depending the volume of one coagulation action the needle should be replaced for another coagulation action etc. till the whole volume is destroyed. Important is to make the destruction somewhat bigger than the seize of the lesion. Near vital structures like in the spine this can be difficult. For benign small lesions in the spine like osteoid osteomas and osteoblastomas the Radionics device and needles are most suitable to perform very precise coagulations in which the 5 mm bare tip needle and probe should stay away 5 mm from vital structures. With the Radionics device mostly a temperature of 90 degrees Celsius for 4 minutes should be pursued for each needle position. With the RITA device temperatures between 85 and 100 degrees with different durations are advised by that firm. Also track ablation can be done.

Of both systems and procedures examples will be shown.

Alcohol ablation is a technique in which 96 % alcohol gel (ethibloc) is injected in an Aneurysmatic Bone Cyst (ABC) or Solitairy Bone Cyst (SBC).

This technique is especially usefull if vascular embolisation is not possible or has failed or as a primairy alternative. Ethibloc is an alcoholic solution of zein (corn protein) which has thrombogenic and fibrogenic properties. The treatment can be done under fluoroscopy or better under CT-fluoroscopy. By using 18 G spinal needles the lesions can be approached by drilling the needles (by hand) inside the lesion. The injection of the gel should be carefully watchd in order to avoid extravasation. After the procedure there is often an painful reaction especially if the whole lesion was filled. The lesion will be filled in with solid material and at the end calcify.

References:

Pinto CH, Taminiau AHM, Vanderschueren GM, Hogendoorn PCW, Bloem JL, Obermann WR. Technical considerations in CT-guided radiofrequency thermal ablation of osteoid osteoma: tricks of the trade. AJR 2002;179:1633-1642.

Organ LW. Electrophysiologic principles of radiofrequency lesion making. Appl Neurophysiol 1976;39:69-76.

Tillotsen CL, Rosenberg AE,Rosenthal DI. Controlled thermal injury of bone:report of a percutaneous technique using radiofrequency electrode and generator. Invest Radiol 1989;24:888-892.

Garg NK, Carty H, Walsh HP, Dorgan JC, Bruce CE. Percutaneous Ethibloc injection in aneurysmal bone cysts. Skeletal Radiol 2000;29(4):211-6

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TFC INJURIES

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The distal radioulnar joint is important in function of both the wrist and the entire upper extremity. Significant loads are transmitted to the forearm through the distal ulna by the triangular fibrocartilage complex (TFCC). The anatomic relationships between the distal radius, ulnar head, and carpus are precise, and even minor modifications in these relationships lead to significant changes in load and resultant pain. The TFCC consists of the articular disc (also called the triangular fibrocartilage, TFC), the dorsal and palmar radioulnar ligaments, the ulnocarpal meniscal homologue, the dorsal and palmar ulnocarpal ligaments, the sheath of the extensor carpi ulnaris tendon, and the capsule of the distal radioulnar joint. Some authors include the ulnar collateral ligament as a component of the TFCC .
Triangular fibrocartilage complex abnormalities have bee classified by Palmer in Class 1: "Traumatic" and Class 2: "Degenerative":
Class 1: Traumatic
A - Central perforation
B - Ulnar avulsion with or without distal ulna fracture
C - Distal avulsion
D - Radial avulsion with or without sigmoid notch fracture
Because the periphery of the TFCC has good blood supply, tears in this region can be repaired. In contrast, tears in the central avascular area must be debrided, as they have no potential for healing.
Class 2: Degenerative.
A - TFCC wear
B - TFCC wear with lunate and/or ulnar chondromalacia
C - TFCC perforation with lunate and/or ulnar chondromalacia
D - TFCC perforation with lunate and/or ulnar chondromalacia and LT ligament perforation
E - TFCC perforation with lunate and/or ulnar chondromalacia, LT ligament perforation, and ulnocarpal arthritis
With increasing age, defects and communication within the triangular fibrocartilage and the interosseous ligaments increase in frequency. Many of these defects have no clinical significance. Radial sided communicating triangular fibrocartilage defects described in the literature as post-traumatic (Palmer classification type IA and ID) are commonly seen bilaterally and in asymptomatic wrists. In a population of 56 patients (age, 16 to 52 years; mean, 32 years) with isolated triangular fibrocartilage lesions communicating defects were noted in 36 (64%) of 56 symptomatic and in 26 (46%) of 56 asymptomatic wrists. Twenty-five (69%) of 36 communicating defects were bilateral. Almost all communicating defects were noted radially. Noncommunicating defects were noted in 28 (50%) of 56 symptomatic wrists and in 15 (27%) of 56

asymptomatic wrists. Eleven (39%) of 28 noncommunicating defects were bilateral. Noncommunicating and communicating defects of the triangular fibrocartilage near its ulnar attachment have a more reliable association with symptomatic wrists than the radial communicating defects.

TENDONS INJURIES OF WRIST AND FINGERS

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GOAL

Wrist and finger tendons are particularly prone to injury in sports activity. The three common sites for pain in the wrist and hand are the first dorsal compartment (De Quervain's tendovaginitis), the flexor carpi radialis tendinitis, and digital flexors (trigger finger). We will develop less common tendon injuries where imaging is particularly useful.

WRIST TENDONS

- Flexor tendons: The onset of a carpal tunnel syndrome during sports activity needs imaging with US or MRI to identify an accessory muscle, a tendon anastomosis, a proximal insertion of a lumbrical muscle, or a non-union of the hamulus.
- Flexor Carpi Ulnaris: Imaging may depict an acute calcifying tendinitis close to the pisiform or a bursitis. It is a common problem in racquet sports with instability of the pisiform revealed on stress plain films.
- Extensor carpi radialis: Tendinitis of the extensor carpi radialis tendons are favoured by Fiolle's carpal boss. Imaging may depict an os styloideum and associated bursitis.
- Extensor pollicis longus tendinitis or « Drummer boy palsy » may be caused by an undisplaced wrist fracture. Rupture or tendonitis usually occurs within 8 weeks of injury but may occur later.
- Extensor Carpi Ulnaris: Overuse ECU tendinitis is common in tennis players and may be considered as normal. It is favoured by a negative ulnar index. A rupture of its retinaculum is an acute injury with development of a subperiosteal pouch. A dynamic imaging (US or MRI) may be useful to depict a tendon instability.

FINGER TENDONS

US and MR imaging appear particularly helpful for the closed ruptures of finger tendons. They locate the level of the rupture, assess the amount of retraction, and the quality of the tendon ends.

- Flexor tendons: The rugby finger is not always associated with a bone avulsion and some cases of two-level ruptures have been reported. Imaging may assess the percentage of injured tendon in lacerations with partial tears.
- Extensor tendons: Injuries of the extensor hood (Boxer knuckle) are explored with dynamic imaging with flexion of the MCP joint to highlight a rupture of a sagittal band and a tendon instability. Boutonniere deformity is a difficult clinical problem and imaging may distinguish a rupture from a lengthened callus of the median band of the extensor tendon.
- Postoperative tendons: Management of failures of a tendon suture is difficult and may benefit of an imaging which can diagnose a new rupture, a lengthened callus or adhesions with extensive scar tissue.

LIGAMENT INJURIES OF THE WRIST AND FINGERS

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Learning objectives: To appreciate the essential anatomy and injury mechanism of wrist and finger ligaments. To demonstrate the value of imaging methods in assessment of different injuries of wrist and finger ligaments.
Wrist and fingers are one of the most common areas where ligament injuries in sports occur, especially in contact sports, racquet sports, and gymnastics.
Wrist ligaments can be classified into extrinsic and intrinsic ligaments. Extrinsic ligaments originate in the forearm and insert into the carpal bones. Intrinsic ligaments are short interosseous ligaments that originate from and insert into the carpal bones. Wrist ligaments stabilize the carpus to the distal radius and ulna. The radioscaphocapitate and arcuate ligament are the primary stabilizer of the distal carpal row. The proximal carpal row is stabilized by the radiotriquetral, radiocarpal, the ulnolunate –triquetral and the ulnar collateral ligaments.
The scapholunate and lunotriquetral ligaments are important intrinsic ligaments that bind the proximal carpal row and injuries are a commune cause of chronic wrist pain and instability. They are complex structures, having both tree zones: dorsal, central and volar. In association with injuries to extrinsic ligaments (radioscaphocapitate, radiolunotriquetral, radioscapholunate, radiolunate) progressive perilunate instability develops. Lunotriquetral injury in association with injuries to the triangular fibrocartilage complex, the radiolunotriquetral, ulnotriquetral and dorsal radiotriquetral ligament causes lunotriquetral instability.
MRI criteria for diagnosing ligament injuries include discontinuity, fluid signal traversing the ligament, morphological alteration as fraying, thinning, irregularity and elongation or scattered area of high signal intensity within the structures. High resolution MRI and MRI arthrogram improve direct delineation of the ligaments and detection of small tears, which can occur at multiple sites and may be missed with conventional MRI.
Finger ligament injuries may occur involving the ligamentous support of the MCP and PIP joints as isolated events or associated with fracture.
At the MCP joint partial or complete tears of the collateral ligaments are well imaged by MRI which allows to role out intraarticular ligament interposition. For injuries of the ulnar collateral ligament of the first MCP (“skiers thumb”, “breakdancer´s thumb”) US and MRI are both accurate in differentiation of Stener lesion. Injuries of the sagittal bands (”boxer knuckles”) are well imaged with US and MRI especially in flexed position.
At the PIP joint, partial or complete tears of the collateral ligament can be assessed by MRI and US. In complete rupture associated avulsion of the volar plate has to be excluded. Criteria for ligament injuries are discontinuity, detachment, thickening or thinning, elongation and wavy contour.
The flexor annular pulley system (A1-A5) is critical for tendon function and can be assessed by US in questions of stenosis (“trigger finger”) or under forced dynamical examination in case of suspected pulley rupture (“climbers finger”) by US and MRI. The amount of pulley rupture can be depicted well by US, using measurements of the phalanx tendon distance before and after applied resistance on the fingertip of the examined finger during forced dynamic examination

Summary
X-ray is still the most frequent performed imaging study in hand injuries, important in case of associated fracture and carpal instability. MRI is used to assess lesions of the capsules and ligaments in traumatic injuries and clinically equivocal cases with negative results at x-ray. Arthrography and/or dedicated MRI helps to assess suspected ligament injuries to the hand and wrist. US can allow for information regarding ligament alterations as ganglion cysts at the wrist and hand and allows assessing various ligament injuries of the finger.
References:
Boutry N, Larde A, Demondion X, Cortet B, Cotten H, Cotten A. Metacarpophalangeal joints at US in asymptomatic volunteers and cadaveric specimens. Radiology. 2004;232(3):716-24.
Clavero JA, Alomar X, Monill JM, Esplugas M, Golano P, Mendoza M, Salvador A. MR imaging of ligament and tendon injuries of the fingers. Radiographics. 2002;22(2):237-56.
Connell D, Page P, Wright W, Hoy G. Magnetic resonance imaging of the wrist ligaments. Australas Radiol. 2001;45(4):411-22.
Hergan K, Mittler C, Oser W. Ulnar collateral ligament: differentiation of displaced and nondisplaced tears with US and MR imaging. Radiology. 1995;194(1):65-71
Klauser A, Frauscher F, Bodner G, Halpern EJ, Schocke MF, Springer P, Gabl M, Judmaier W, zur Nedden D. Finger pulley injuries in extreme rock climbers: depiction with dynamic US. Radiology. 2002;222(3):755-61.
Pfirrmann CW, Theumann NH, Botte MJ, Drape JL, Trudell DJ, Resnick D. MR imaging of the metacarpophalangeal joints of the fingers: part II. Detection of simulated injuries in cadavers. Radiology. 2002;222(2):447-52.
Steinbach LS, Smith DK. MRI of the wrist. Clin Imaging. 2000;24(5):298-322.
Theumann NH, Pessis E, Lecompte M, Le Viet D, Valenti P, Chevrot A, Bittoun J, Schnyder P, Resnick D, Drape JL. MR imaging of the metacarpophalangeal joints of the fingers: evaluation of 38 patients with chronic joint disability. Skeletal Radiol. 2005;34(4):210-6.
Zlatkin MB, Rosner J. MR imaging of ligaments and triangular fibrocartilage complex of the wrist. Magn Reson Imaging Clin N Am. 2004;12(2):301-31.

IMAGING THE INJURED SCAPHOID.

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Imaging of the scaphoid is challenging mainly for two reasons: First, the scaphoid is double-obliquely located with respect to the orthogonal radiographic planes. Second, the fracture cleft may be incomplete, and the fragments are often non-displaced immediately after the injury, thus being occult for radiological detection.
The imaging methods applied in the diagnostics of the injured scaphoid are offering different information:
Conventional radiograms (CR): Generally, projectional X-ray's are accepted for the base-line survey of the injured wrist. In case of a suspected scaphoid fracture, the standard dorso-volar and lateral radiograms are mostly complemented by four special views with the aim to project the fracture cleft perpendicular to the film plane. Special

modifications are the magnifying (microfocus) technique and the Ahlbaeck views. All these X-ray projections are suffering from insufficient detection rates of about 60-70% for visualizing scaphoid fractures early after the accident. The most accepted solution of this limitation is to repeat the radiograms 10-14 days later after resorption zones at the bony fragment margins have developed.

Conventional tomography: Meanwhile, trispiral tomography is completely replaced by CT.

Bone scintigraphy (BS): Technetium-99m scans are highly sensitive for the detection of wrist fractures, the scaphoid included. In the past years, scintigraphy has been often performed to detect scaphoid fractures when X-ray's have been equivocal. If the bone scan is negative, a wrist fracture is ruled out properly. Major drawbacks of scintigraphy are the lack of anatomical information and problems in differentiating fractures from bone bruises. Therefore, positive bone scans have to be complemented with additional radiograms.

Computed tomography (CT): In recent years, multi-detector CT technique has enabled high-resolution depiction of the carpal osseous morphology. According to its double-oblique alignment within the wrist, the scaphoid is preferably tacquired in a sagittal-oblique plane parallelly to its long-axis (the pronated hand is overhead and in a 45^0 oblique position). Coronal-oblique MPR are performed subsequently. Compared to X-ray's, high-resolution CT is beneficial for three reasons: a) The detection rate of non-displaced scaphoid fractures is significantly higher. b) Its unique capability for precisely depicting displaced fragments makes CT a usefull tool for therapy planning (fracture staging). c) CT is excellent in determing the fracture healing by early identifying the ossified callus.

Magnetic resonance imaging (MRI): Without any doupt, MRI is the most sensitive method for detecting osseous as well as soft-tissue lesions of the injured wrist. The hyperintense bone-marrow edema on PD-/T2-weighted, fat-suppressed or STIR images is highly suggestive for an injury of the signal-compromised carpal bone. For differentiating a scaphoid fracture (i.e. macroscopic osseous disconnection) and a scaphoid contusion (microtrabecular disconnection with bone marrow edema = "bone bruise"), it is essential in non-displaced fractures to verify a hypointense fracture cleft that is running transcortically at least at one scaphoid site. This is not the case in the presence of a bone bruise. In displaced scaphoid fracture, there is mostly a hyperintense effusion at the widened cleft. However, MRI is less useful in depicting small bony fragments and comminuted zones in comparison to CT.

Ultrasound (US): With the use of high-frequency probes (12-20 MHz) scaphoid fractures may be detected by means of a step at the osseous surface and/or a parossal hematoma. Currently, the diagnostic accuracy of US is unclear.

Due to the different capabilities of the modalities presented above, several diagnostic algorithms have introduced in the past, two old-fashioned strategies as well as two newer ones:

The repeated CR strategy: If initial X-rays are inconclusive for suspected scaphoid trauma, the oldest strategy is to immobilize the injured wrist and to repeat the radiograms 10-14 days later. In case of present fracture, resorption zones should have developed at the bony fragments. Delayed diagnosis and 12 X-ray expositions are obviously disadvantageous.

The combined CR and BS strategy: In the past, traditionally both methods have been performed within the first post-trauma days. In case of a negative bone scan, a scaphoid fracture is clearly ruled out. However, bone scintigraphy is suffering from detailed anatomic leading to the necessity for additional CR and CT diagnostics.

The second-line MRI strategy: Several reports have demonstrated the high sensitivity and superiority of MRI in detecting scaphoid fractures early. For that reason, many radiologists prefer MRI in wrist imaging immediately after the X-ray screening. Obviously, not any scaphoid fracture should be overlooked with this approach. Care must be taken not to mistake a bone bruise with a fracture. But, the requirement of many hand surgeons to depict all the osseous details of a scaphoid fracture (small cortical and comminuted fragments included) is really not feasible with MRI. In this setting, a CT exam is necessary in addition to the already performed CR and MRI procedures.
The second-line CT strategy: On the base of the above considerations, we use the following approach at our institution. The number of X-ray views is limited to three expositions, the dorso-volar, the lateral and the Stecher's views. In patients suspicious for scaphoid fracture, but negative X-ray surveys as well in patients with proven fractures in CR imaging, a high-resolution CT exam is performed to detect occult scaphoid fractures and to determine to complete extent of bony destruction, respectively. In equivocal cases, thick-slice MPR (2mm) have often proved to be helpful. To our experience, only about 5% of all scaphoid CT procedures must be complemented by an additional MRI. This modified approach is specifically designed for avoiding many double-examinations (MRI and CT) and for providing a base-line for sufficient therapy planning and the follow-up.
A prospective study is required to evaluate the real significance of CT and MRI in acute scaphoid fractures.
Unlike acute fractures, it is generally accepted that non-unions of the scaphoid should be examined using a multi-modality approach: a) Primarily, CR gives a first survey about the presence of carpal osteoarthritis and the carpal height. b) CT is essential for the depiction of the scaphoid morphology (non-union cleft, osseous pseudo-cysts, humpback deformity, osteoarthritis). c) Contrast-enhanced MRI provides unique information about the viability of the proximal scaphoid fragment.
Key words: Bone scintigraphy – computed tomography – conventional radiography – fracture – magnetic resonance imaging – non-union – scaphoid – wrist.
References: Breitenseher MJ et al.: Radiology 1997;203:245. Carlander P: Eur Radiol 1993;3:413. Cerezal L et al.: AJR 2000;174:141. Hauger O: AJR 2002;178:1239. Herbert TJ et al.: J Bone Joint Surg 1984;66B:114. Hunter JC et al.: AJR 1997;168:1287. McNally EG et al.: Eur Radiol 2000;10:1926. Munk PL et al.: AJR 1997;168:779. Posner M et al.: J Hand Surg 1988;13A:175. Tiel-van Buul MMC et al.: Eur J Nucl Med 1993;20:159.

FRIDAY AM 10:40 to 12:30
Rhodes Trust Theatre

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THE NATURAL HISTORY OF LUMBAR DISC DEGENERATION

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Herniation of the nucleus pulposus may be contained by the outer fibres of the annulus, a protrusion or extrude through the annular fibres but remain in continuity with the rest of the nuclear tissue.
Some herniations separate from the disc and migrate in the epidural space as a sequestration. These differences are important as they may affect the natural history of disc herniation.
The position of the disc herniation is also important as small central herniations do not compress the nerve roots and may therefore be asymptomatic. Whereas similar sized postero-lateral herniations may result in sciatica.
Longitudinal studies have demonstrated that protrusions particularly in asymptomatic subjects may remain unchanged for significant time where as some extrusions and particularly sequestrations have been demonstrated to resorb. Disc material may produce inflammatory mediators such as TNF alpha which produce an inflammatory response and in particular lead to resorption of the herniated disc material by macrophages from the epidural space.
Contrast enhanced MR may demonstrate enhancement around the rim of sequestrated disc due to the neo-vascularisation and macrophage infiltration. Prediction of resorption of sequestrated disc material using contrast around the disc remains speculative however.
Symptoms of sciatica may resolve without observable changes in size of the herniation and may also persist despite satisfactory resolution on MR.
Rapid resolution of a disc herniation may be due to resolution of an epidural haematoma associated with the rupture. Tears in the posterior annulus may be present without accompanying herniation of disc material. They may be seen on the MR associated with a focus of high intensity in the posterior annular fibres (HIZ).
These high intensity zones in posterior annular tears of the disc would appear to have a less predictable natural history.
Evidence suggests that there is limited relation between the presence of the high intensity zone (HIZ) and symptoms and longitudinal studies indicate a very variable natural history with some improving and many remaining unchanged for periods of a few years.
These changes do not appear to have any significant relationship with alteration in symptoms.

IMAGING LOW BACK PAIN – WHAT IS THE EVIDENCE?

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Acute low back pain resolves spontaneously within 6 weeks in >90% of patients. There is general agreement that diagnostic imaging (plain radiographs, CT and MRI) are not routinely indicated for non-specific low back pain (1). If conservative management fails then MRI or CT can be considered as disc herniation is best demonstrated by these modalities but arguably this should only be done after referral to a specialist (2). Chronic back pain is defined as pain of more than 12 weeks duration. Again imaging is not recommended for the diagnosis of chronic back pain unless a specific cause is being sought. MRI is considered best for imaging radicular symptoms, discitis or suspected neoplasm (1). The exception to this rule is if there is a

“red flag”, that is, the patient <20 or >55 years of age, previous history of cancer, suspected infection, recent violent trauma, constant progressive pain with no relief from bed rest, prolonged use of steroids, IV drug abuser or HIV positive, systemically unwell, unexplained weight loss or widespread neurological symptoms (1). When a “red flag” is suspected then MRI is probably the most useful modality (2).
Patients with chronic low back pain respond best to an intensive, multidisciplinary, biopsychosocial rehabilitation aimed at restoring function (3). Arguably patients being subjected to this treatment do not require imaging and may only derive a very small benefit from such reassurance (4). Clinicians, particularly those individuals not specialising in back care do derive considerable reassurance from CT and MRI although the investigation rarely changes their management (5). Patients who are being subjected to an intervention such as fusion, discectomy, or laminectomy ought to have to CT or MRI to confirm the diagnosis and more importantly the level of the disease requiring intervention.
As large numbers of patients develop low back pain a non - selective policy of imaging has a huge implications for health care resources. It is important to ensure that imaging is appropriate, is justified and has an impact on patient management and outcome. This has been a challenge for the imaging community. The guidelines on the management of low back pain are clear and it is now important to ensure that imaging is carried out only where necessary and where there is a clear gain for the patient and society.
European Commission Research Directorate General. COST B13 Management Committee. European Guidelines for the management of low back pain. 2005. www.backpaineurope.org (accessed 20th June 2005)
RCR Working Party. Making the best use of a department of Radiology: Guidelines for Doctors (fifth edition) . London: The Royal College of Radiologists, 2003
Guzman J, Esmail R, Karjalainen K, Malmivaara A, Irvin E, Bombardier C. Mulitdisciplinary bio-psycho-social rehabilitation for chronic low back pain. Cochrane Database Systematic Review 2002; 1, CD000963
Gilbert FJ, Grant AM, Gillan MGC, Vale L, Campbell M, Scott NW, Knight D, Wardlaw D. Influence of early MRI on the management and outcome of patients with low back pain – a multicenter randomized trial. Radiology. 2004;231:343-351.
Gillan MGC, Gilbert FJ, Andrew J, Grant AM, Wardlaw D, Valentine NW, Gregori AC for the Scottish Back Trial Group. Influence of Imaging on Clinical Decision-making in the Treatment of Lower Back Pain. Radiology 2001; 220: 393-399.

BENIGN VERSUS MALIGNANT COLLAPSE

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Vertebral fractures are a common clinical entity and are caused by trauma/osteoporosis or malignant infiltration. It is of prognostic and therapeutic importance to determine the reason for the fracture. Especially in elderly people with a clinical history of malignancy it may be difficult to differentiate between an acute osteoporotic and a neoplastic fracture in x-rays. Only the destruction of a pedicle and/or an osteolytic/osteoblastic destruction of the vertebral body is a definite sign of malignancy. Fracture site is also of importance since osteoporotic fractures usually do not occur above the 7th thoracic vertebral level. CT can help in establishing the diagnosis by confirmation of soft-tissue in the fractured vertebral body. An intravertebral vacuum is a sign for the osteoporotic nature of the vertebral body. MRI is the most sensitive and specific modality for the determination of both fracture types. Acute osteoporotic fractures typically show a band-like bone marrow edema adjacent to the fractured end-plate. The edema can be more extensive, however if small fat islands still are present on T1-w SE images, neoplasia can be ruled out in most cases. Neoplastic vertebral fractures usually affect the whole vertebral body. Paravertebral soft-tissue and an infiltration of the posterior elements are signs for malignancy. However, also acute osteoporotic fractures can show an extensive edema that leads to a complete signal alteration of the fractured vertebral body. In those cases diffusion-weighted imaging proved to helpful. Acute osteoporotic fractures usually show iso-hypointense signal on diffusion-weighted SSFP sequences whereas neoplastic fractures show hyperintensity. This is mostly due to an increased diffusivity of water protons in edema in contrast to densely packed tumor cells. Another reliable sign is the presence of a so called "fluid sign". It is present in about one third of acute/subactute osteoporotic fractures and constitutes a circumscribed osteonecrosis adjacent to the fractured end-plate. It is a linear or wedge shaped fluid-like hyperintensity on T2-weighted SE sequences. With the help of all these features, in most cases, a definite diagnosis can be established. Follow-up examinations can support the thesis of an osteoporotic fracture by monitoring the regression of the edema. Only in few cases biopsy has to be performed.

PRIMARY TUMOURS OF THE SPINE

A COTTEN
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A wide variety of primary bone tumours can involve the spine and cause significant morbidity. CT and MR imaging are frequently both useful for an accurate description and characterization of the lesions and for an optimal treatment planning.
The aims of this presentation are to (1) present the principal primary bone tumours that affect the spine, (2) report the main features that may allow their correct characterization, (3) indicate the features that have to be described in the report, and (4) present some diagnostic pitfalls.

FRIDAY PM 13:20 to 15:00
Nelson Mandela Theatre

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LABRA AND ACETABULAR RIM

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The acetabular articular surface is a C-shaped concavity covered with hyaline cartilage. Its peripheral edge is deepened by a rim of fibrocartilage - the acetabular

labrum - which encloses the femoral head beyond its equator, increasing thus the stability of the joint. The labrum is continued across the acetabular notch as the transverse ligament, which, unlike the labrum, has no cartilage cells. The central non-articular part of the acetabulum is occupied by a pad of fat (the Haversian pad). The articular cartilage of the femoral head and acetabulum produces a thin, smooth, uniform intermediate signal on MR imaging. The signal is higher on STIR, gradient-echo and fat-saturation images. Applying sequences with normal resolutions, the two surfaces are inseparable and only large abnormalities are visible. High resolution cartilage specific MR imaging techniques, indirect and direct MR arthrograms, allow for more accurate assessment of the articular surfaces. Tears of the acetabular labrum have been recognized as a cause of mechanical pain of the hip. Such tears are known to occur in association with acute dislocation of the hip or a twisting injury during sporting activities. Labral tears have been also described in association with dysplastic hips, Legg-Calve-Perthes disease and osteoarthritis. MR arthrography appears more sensitive than conventional MR imaging in the depiction of labral lesions. Normal variants such as labral sulcus, absence or thickening of the labrum, emphasize the need to know the MR imaging appearance of the asymptomatic acetabular labrum. This feature implies that the approach to diagnosis in hip labral abnormalities should be undertaken with caution and full understanding of the patient's clinical history and physical findings. The classification of Czerny and Hofmann can be used for assessment of the acetabular labrum, differentiating three stages of post-traumatic (IA, IIA and IIIA) and dysplastic lesions (IB, IIB and IIIB).
The most common abnormalities of the labra include detachments, intrasubstance tears, and perilabral cysts with or without associated tears. Most abnormalities occur along the anterior and superior portions of the acetabular labrum. Rarely tumours, infections and osteonecrosis can involve the labra. Acetabular rim abnormalities include cartilage defects and osteochondral injuries.

Learning objectives

To understand the anatomy and mechanisms of degeneration and injury of the labra
To know the most appropriate MRI technique for imaging the acetabular labrum
To be familiar with the anatomical variations and the findings that are commonly seen in asymptomatic population
To be familiar with the most common disorders of the labra and acetabular rim

HIP/GROIN PAIN: OVERUSE SYNDROMES

<u>JC Healy</u>
[1] Chelsea and Westminster Hospital, London, United Kingdom, [2] Imperial College School Of Medicine, London, United Kingdom

In the elite athlete hip overuse syndromes frequently present with hip/groin pain. Diagnostic confusion may lead to inadequate treatment and prolonged periods of inactivity. This presentation will review the causes of hip/groin pain secondary to overuse syndromes focussing particularly on the utility of MRI.
A range of overuse aetiologies can lead to hip/groin pain. They can be separated into osseous, articular, and musculo-tendinous pathologies.
Osseous causes of hip pain include: stress responses/occult stress fractures; osteitis pubis; apophysitis/avulsion injuries.
Articular causes of hip/groin pain include: osteochondral lesions; femoroacetabular impingement/labral tears; AVN; post traumatic synovitis.

Musculotendinous causes of hip/groin pain include: paratendinitis/snapping hip syndrome, bursitis: adductor tendinopathy; muscle strains; piriformis syndrome. Occasionally pain may be referred from the **lumbar region**.
This presentation will illustrate examples in each category and review the most common causes of hip/groin pain in each group. It is important to accurately identify the cause of pain in the elite athlete in order to optimise patient management and ensure minimal "down-time".

BURSAL DISEASES AROUND THE HIP.
PD. DR NICOLAS THEUMANN, LAUSANNE-SWITZERLAND

N Theumann
CHUV, Lausanne, Switzerland

The hip joint, much like the glenohumeral joint, boasts one of the widest ranges of motion in the human body, with its greater trochanter serving as the main attachment site for strong tendons, facilitating complex movement such as postural gait. This complex motion is achieved with the sophisticated attachment architecture of the abductor mechanism in the trochanteric surface and its three interposed bursae. Despite the importance of the integrity of the greater trochanteric structures for normal gait, reports describing the tendon insertions and the bursal anatomy are sparse. Although pain over the lateral aspect of the hip has been commonly attributed to a trochanteric bursitis, the spectrum of pathologic abnormalities about the hip has broadened with the identification of entities such as rotator cuff tears of the hip, a term referring to a tear of the gluteus medius or minimus tendon. Despite similar clinical presentations, treatment of tears or bursitis can be different, emphasizing the need for accurate diagnosis.
The objectives of my presentation is to (*a*) describe the normal MR imaging appearance of the attachment sites of the abductor mechanism ,(*b*) to analyze the location, extent, and appearance of the bursal complex of the greater trochanter and (*c*) to show some of the encountered pathologies .

FRIDAY PM 13:20 to 15:00
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CRITICAL APPRAISAL OF BONE DENSITOMETRY IN CLINICAL PRACTICE

G Guglielmi
Department of Radiology, Scientific Institute Hospital "Casa Sollievo della Sofferenza", San Giovanni Rotondo, Italy

CRITICAL APPRAISAL OF BONE DENSITOMETRY IN CLINICAL PRACTICE
Prof Giuseppe Guglielmi,

Department of Radiology, Scientific Institute Hospital “Casa Sollievo della Sofferenza”, San Giovanni Rotondo, Italy

Measurements of Bone Mineral Density (BMD) of the axial and appendicular skeleton constitutes an important aspect in the diagnosis and follow-up of metabolic bone diseases, particularly osteoporosis. Over the past several years, a number of non-invasive techniques have been developed to more sensitively quantitate bone density at a number of skeletal sites and relate the measurements to age-matched control subjects. The two X-ray based methods of non-invasive BMD assessment most widely used are quantitative CT (QCT) and dual X-ray absorptiometry (DXA). QCT uses general purpose CT scanners to provide true volumetric BMD (in mg/cm3), generally of purely trabecular bone of the mid vertebral body. QCT has the ability to measure selectively the trabecular compartment of the vertebrae and has therefore been recognized as the most accurate method of measuring BMD. In fact, QCT had the strongest correlation to age and menopause related bone loss and the highest sensitivity for distinguishing between normal and osteoporotic bone. QCT trabecular density measurements are substantially independent of anthropometric parameters. Three-dimensional or volumetric QCT techniques encompass the entire object of interest with stacked slices and can be used to improve spinal measurements and to extend QCT assessments to the proximal femur. Because a true and highly accurate spiral rendering is provided, important geometrical and biomechanically relevant assessments can be derived, such as cross-sectional moment of inertia and finite element analysis. DXA has gained widespread acceptance because of low radiation exposure, low cost, high precision and its ability to measure bone density at different skeletal sites, specially lumbar spine and proximal femur. DXA uses specially designed instruments to provide a projectional measurement of bone mineral content (BMC in g), area (in cm2), and areal density (in g/cm2). In recent years smaller, less expensive devices are available for appendicular skeleton measurements, forearm, calcaneus. DXA is size dependent, a particular problem in growing children and patients in whom disease has caused small stature. DXA measures integral (cortical and trabecular bone). DXA images must be carefully evaluated to ensure no artefacts are present which will falsely elevate or reduce BMD.

The WHO definition of osteoporosis (T-score below -2.5) is only applicable to DXA spine, hip and forearm; not to calcaneus nor to QCT.

The role of radiologist is crucial in diagnosis of fractures and radiographics features, in bone densitometry, in monitoring osteoporosis using bone densitometry, in the treatment of osteoporosis by percutaneous vertebroplasty, and in research (imaging of trabecular bone structure).

Learning Objectives:

Appreciate the technical differences between bone density methods, and the strengths and limitations of each techniques.

Learn of the artefacts which may cause inaccuracies in measurements

Be aware of interpretation of measurements, and the implications for managements of patients.

INTERPRETATION OF BONE DENSITY RESULTS

<u>C.R. Krestan</u>
Radiology, Vienna, Austria

Osteoporosis is associated with an increased fracture risk and is defined by the bone mineral density according to the WHO (World Health Organization) -criteria. The WHO has defined the interpretation of bone mineral density measured by DXA as follows; where the T-score refers to the peak bone mass of young normal adults and the Z-score shows the patient´s result as the deviation from the mean of age-matched controls:

T-sore > -1,0 = normal

T-score from –1,0 bis –2.5 = osteopenia

T-score ≤ -2,5 = osteoporosis

T-score ≤ -2,5 and fractures = manifest osteoporosis

The definition applies to DXA measurements made in the lumbar spine, the proximal femur and the forearm, but does not apply to other techniques or other anatomical sites.

Standard techniques:

1. DXA (Dual Energy X Ray- Absorptiometry) (lumbar spine + proximal femur)

Standardized values for BMD at a certain region of interest are calculated as g/cm².

For the lumbar spine nonfractured vertebrae (L1-4) are used (at least 2 nonfractured).

For interpretation of BMD at the proximal femur the femoral neck should be used.

The age-, sex-, and racially matched reference data base for each DXA-scanner are usually supplied by the manufacturer.

In calculating change over time, the absolute BMD values have to be used. To be statistically significant the change in BMD has to be 2.8 x precision, which is usually 1-2 % for DXA scanners. The average change of the BMD with during antiresorptive medication is 5-10% at the lumbar spine and 5% at the femoral neck.

For the interpretation of DXA results artefacts causing overestimation and underestimation have to be considered. Therefore conventional x-rays should be done in elderly patients for diagnosis or exclusion of degenerative changes.

2. QCT (Quantitative Computed Tomography) Lumbar spine

Is a volumetric method and has higher precision due to reduced influence by artefacts especially in the degenerative spine. Main disadvantages are higher costs and radiation.

Additional techniques:

Peripheral DXA, peripheral QCT;

Due to the high precision measurements at peripheral sites can be applied to longitudinal follow-up

Each bone densitometry report should include:

1. Technique (DXA, QCT) and scanner-type, manufacturer
2. Region (lumbar spine, femoral neck)
3. Projection (PA, lateral)
4. Absolute value (g/cm²)
5. T-score
6. Z-score
7. Interpretation according to WHO-criteria and supply of Z-score
8. General comment concerning the region of interest (degenerative changes, fractures..)
9. For serial scans: precision error of the local scanner

BONE DENSITOMETRY IN CHILDREN

<u>JE Adams</u>

University of Manchester, Manchester, United Kingdom

Professor Charles Dent at UCH stated that 'osteoporosis was a disease of childhood', so study of the skeleton during growth and development can provide insights into how peak bone mass might be optimised. Measurement of bone mineral density (BMD) is also relevant to assess how diseases affect the skeleton in children so that appropriate interventions can be made (1). Dual energy X-ray absorptiometry (DXA) is the most widely available bone density technique and has some advantages in children (very low radiation dose [1-6microsieverts], fast scanning [less than 1 minute], applicable to multiple skeletal sites, provides whole body and regional bone mineral content BMC, and body composition [lean and fat mass]). However, a limitation is that DXA provides an 'areal' (g/cm^2), rather than a volumetric, density (there is a depth of bone that is not taken into account), so the measure is size dependent. In small children the BMD will be under-estimated by DXA, and in large bones BMD will be over-estimated. This problem can, in part, be overcome by calculating volumetric bone mineral apparent density (BMAD), by assuming vertebrae are cubes or cylinders (2,3). Quantitative computed tomography (QCT) can be applied to the lumbar spine and peripheral sites (radius; tibia) and has advantages (true volumetric density [mg/cm3], so not size dependent, separate measures of cortical and trabecular bone, cross-sectional area of muscle and bone, from which can be derived biomechanical parameters [stress-strain index; moment of inertia]). The limitation of axial QCT is a higher radiation dose than DXA (90 microsieverts), although a low dose technique can be used. A useful guide (1) to bone densitometry in children is available from the National Osteoporosis Society (NOS).

References:

A practical Guide to bone densitometry in children (2004) National Osteoporosis Society, Camerton, Bath BA2 0PJ (www.nos.org.uk)
Carter et al (1992) J Bone Miner Res 7:137-145
Kroger et al (1992) Bone Miner 17:75-85

IMAGING OF BONE STRUCTURE IN OSTEOPOROSIS

H Genant
UCSF, San Francisco, United States

Noninvasive and/or nondestructive techniques can provide structural information about bone, beyond standard bone mineral densitometry (BMD). While the latter provides important information about osteoporosis diagnosis and fracture risk assessment, considerable evidence indicates that BMD only partially explains bone strength and fracture resistance. Quantitative assessment of macrostructural characteristics such as geometry and section modulus, and microstructural features such as relative trabecular volume, and trabecular spacing, number and connectivity may improve our understanding and ability to estimate bone strength and predict fractures. The rationale for imaging bone macro/micro structure, therefore, is to obtain information beyond BMD, improve fracture risk prediction, clarify the pathophysiology of skeletal disease, define the skeletal response to therapy, and assess biomechanical relationships.

The methods for quantitatively assessing the macrostructure of bone include, (besides conventional radiography) computed tomography, especially high resolution

computed tomography (hrCT) at 100-400µ and volumetric quantitative computed tomography (vQCT), and high resolution magnetic resonance imaging (hrMR) at 100-200µ. The strengths of these approaches include they are widely available, non-invasive and non-destructive methods, providing both macro structure and bone density information, are moderately precise and accurate, and permit serial measurement of most any body site, while their limitations include, for vQCT, the modest exposure to ionizing radiation and the lack of derived microstructural information and, for hrCT and hrMR, the provision of only approximations of microstructural parameters, with considerable threshold and resolution dependence. The methods for assessing the microstructure of bone noninvasively and/or nondestructively include, micro computed tomography (µCT) at 1-100µ, and micro magnetic resonance imaging (µMR) at 20-200µ. The strengths of the former, µCT, are the automated 2D and 3D evaluation, the nondestructive nature of the imaging, permitting mechanical or other testing of the sample, and the highly precise and accurate measurement, while the limitations are the high exposure to ionizing radiation, the requirements for invasive biopsy with large sampling errors or for animal studies, and the expense and limited availability of the equipment. The strengths and weaknesses of µMR are similar, except for the absence of ionizing radiation, and the greater complexity and expense of this technology.
Despite the considerable progress made in bone imaging over the past decade, a number of challenges remain. Technically, the challenges reflect the balances and trade-offs between spatial resolution, sampling size, signal-to-noise, radiation exposure and acquisition time, or between the complexity and expense of the imaging technologies versus their availability and accessibility. Clinically, the challenges for bone imaging include balancing the advantages of standard densitometric information versus the more complex architectural features of bone, or the deeper research requirements in the laboratory versus the broader needs in clinical practice. The biological differences between the peripheral appendicular skeleton and the central axial skeleton and their impact on the relevant bone imaging methods must be further clarified. Finally, the relative merits of these sophisticated imaging techniques must be weighed with respect to their applications as diagnostic procedures, requiring high accuracy or reliability, versus their applications as monitoring procedures, requiring high precision or reproducibility.

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ACHILLES TENDINOPATHY MR AND US

P J Richards
University Hospital of North Staffordshire, Stoke on Trent, United Kingdom

This lecture will cover the changing series on the aetiology of the Achilles tendonopathy, and a review of the literature. The serial appearances of the Achilles on MRI and ultrasound will be discussed. The pattern and distribution of power

Doppler vascularity within Achilles tendonopathy with be described along with tentative proposals for the upper limit of normal size. Our research group have provided the Visa-A questionnaire, which is a validated questionnaire for Achilles tendon disease and have correlated the ultrasound, MRI and bionic laboratory results in our latest research.

US AND MR OF POSTERIOR TIBIAL TENDON AND PERONEII TENDONS.

ES SILVESTRI, BB BARTOLINI
UNIVERSITY OF GENOVA, GENOVA, Italy

Knowledge of the basic anatomy of the posterior tibial tendon (PTT) and peroneii tendons is essential for accurate MR and US images interpretation and diagnosis. The posterior tibial tendon (PTT) inverts and plantar flexes the foot supporting the medial arch of the foot. At the ankle joint level, the PTT lies within the shallow medial retromalleolar groove. The PTT enters into the foot through the tarsal tunnel between the flexor retinaculum and the deltoid ligament. The main insertion site is in the medial aspect of the navicular bone, also termed navicular tubercle.

On both MR imaging and sonography, the distal posterior tibial tendon can appear heterogeneous in the navicular attachment. This appearance is due both to the fat interspersed between multiple small slips of tendon as they fan out to insert into the navicular bone and to the spring ligament insertion. Care must be taken examining this region. Applying pressure with the transducer to elicit symptoms in the site of a suspected abnormality can aid to distinguish normal asymptomatic heterogeneity from true symptomatic disease or injury, such as a tendon tear. In addition, the operator must take care to ensure that an accessory navicular bone is not misinterpreted as an abnormality.

A small amount of fluid within the tendon sheath is normal. A watershed area, most susceptible to injury, lies within the mid PTT at the level of the medial malleolus, where the tendon is subject to friction stress and ischemia. PTT can be evaluated at this level with both high resolution sonography and MR.

The peroneus longus and peroneus brevis are the lateral stabilizers of the ankle joint. As the peroneus longus and brevis tendons descend in the lower portion of the leg, they pass through a common peroneal tunnel, behind the lateral malleolus. A common synovial sheath contains the two tendons as they course behind the lateral malleolus but immediately above the inferior peroneal retinaculum, the sheath bifurcates into two individual extensions.

A retromellaolar groove, located about 1 cm above the fibular trip, is present in 80% of normal subjects. Flat and convex retromalleolar grooves are found in 11% and 7%% of subjects, respectively, and can predispose to lateral tendons dislocations and longitudinal tears.

The peroneus quartus, a common accessory muscle, is medial and posterior to the peroneus brevis tendon. The presence of a peroneus quartus can stretch the retinaculum and compress the peroneus brevis tendon against the fibula, leading to a split or tear of the peroneus brevis tendon. A peroneus quartus can also be confused with a longitudinal tear of the peroneus brevis tendon. Knowledge of the normal course and common insertion of the peroneus quartus into the lateral calcaneus can help one to avoid this pitfall.

The superior peroneal retinaculum forms the posterolateral border of the peroneal tunnel. The calcaneal attachment of the superior peroneal retinaculum is intimate with the calcaneal insertion of the calcaneo-fibular ligament. Sprain or rupture of the calcaneofibular ligament can be associated with superior peroneal retinaculum injury. Lesions of peroneii tendons include tenosynovitis, tendinosis, tears and dislocations. Acute tenosynovitis tipically occur when an athlete resumes to play after a period of lay-off. The cause is most likely related to increased stress around fixed pulleys such as the fibular groove, the peroneal tubercle or the undersurface of the cuboid bone. Other causes include enlarged tubercle, os perineum, inversion ankle injures and lateral malleolar and calcaneal fractures.

Tendinosis represents true overuse syndrome and can be a precursor of tendons rupture.

Acute and chronic ruptures occur in young athletes or can be related to degenerative changes in older patients. Peroneii tendons tears commonly occur in overuse syndromes in dancers, runners and competitive walkers and can develop in one or both tendons.

Subluxation or dislocation are more common in sport-related injures (skiers, ice skaters, basketball and soccer players).

T1 and T2 MR images in the sagittal and axial planes are best for assessment of peroneii tendons tears as well as longitudinal and transverse scans with US, In presence of peroneus brevis tendon tear, a charateristic C-shaped configuration of the tendon wrapped against the adjacent peroneus longus can be appreciated on axial images. Peroneus longus tendon can insinuate itself into the tear ant therefore prevent healing of the peroneus brevis tendon. There are anatomical variants which can simulate a tendon tear: a bifurcate brevis peroneus tendon and a peroneus quartus tendon. US dynamical examination of the proximal musculotendinous unit is helpful to avoid this pitfall.

Tears of peroneus longus tendon are associated frequently with fractures of the calcaneous.

Acute tears are related to sport injures and develop in the midfoot. Chronic tears are related to increase friction when the tendon curves around the cuboid bone or to a hypertrophied peroneal tubercle (present in 32% to)7% of asymptomatic subjects. Congenital absence, traumatic laxity or tear of the superior peroneus retinaculum allow instability of peroneii tendons with subluxation or dislocation of tendons. Recurrent snapping and popping about the ankle and positive provocative manouvres can provide clues to the diagnosis. US is very helpful in these cases because it can demonstrate the instability of tendons with dynamical manoeuvres.

Acute or chronic dysfunction of the PTT encompasses a spectrum of abnormalities such as tenosynovitis, tendinosis, partial or complete tear of the tendon. The most common condition consists of acute or subacute tenosynovitis secondary to overuse in the athletic population. On US or MR imaging, fluid is found within the tendon sheath with normal internal network. Tendinosis is depicted as thickening of the tendon. In severe cases is possible to demonstrate the internal changes due to the degeneration of tendon fibres such as hypoechic areas in US or signal heterogeneity in MR.

After this stage, a progressive continuum of microtears leads to a macroscopic disruption of the.tendon fibres.

PTT tears develop chronically in women in their fifth and sixth decades. The presence of an accessory navicular bone can predispose to the rupture. In 4% percent of the population, the bulk of the PTT inserts into an accessory navicular bone. Three types of accessory navicular bone have been described; a small separated ossicle imbedded

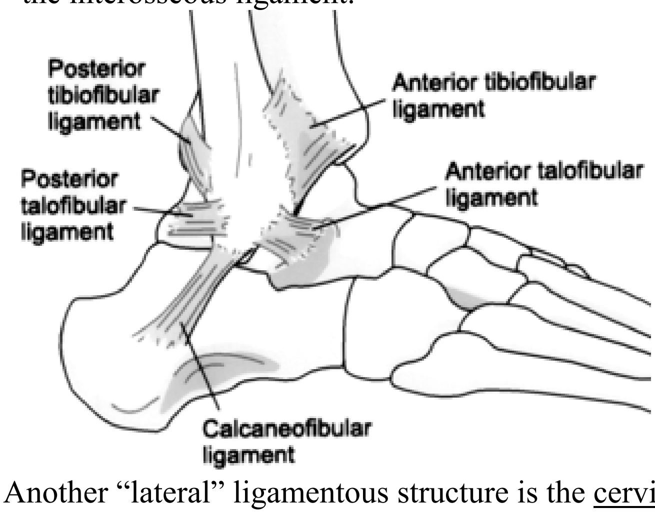
within the PTT(type1); a larger accessory ossification centre adjacent to the tubercle of the navicolar bone, connected with a fibrous or cartilaginous bridge (type2); and a cornuate navicular (type 3), The type 2 and type 3 have been associated with pathologic conditions such as PTT tear and painful os navicular syndrome due to the repetitive contractions of PTT as it inserts in the accessory ossicle. MR can well demonstrate reactive bone marrow signal abnormalities in the accessory navicular. Associated tears of the PTT may be also detected. In these cases US is not able to show the bone alterations in the PTT insertion level.
Chronic PTT ruptures are classified into three types: type1, partial tear with intrasubstance fibers discontinuity (longitudinal splits) and fusiform enlargement of the tendon; type 2, more severe partial tear with reduction of the calibre of the tendon.; type 3, complete tear with discontinuity of the tendon. Assessment of the different stages of PTT rupture is easily achieved using MR with sagittal and axial planes. A PTT tear showed using US must be confirmed by MR because with ultrasound is sometimes difficult to differentiate granulation tissue from tendinosis in partial chronic rupture.

LATERAL ANKLE LIGAMENTS: NORMAL, ABNORMAL AND IMPINGEMENT

M Shahabpour, M DeMaeseneer, J Demey
Academisch Ziekennhuis Vrije Universiteit Brussel, Brussels, Belgium

Normal anatomy
The lateral ligament complex or the lateral collateral ligament (LCL) includes 3 components:
- the anterior talofibular ligament (ATF)
- the posterior talofibular ligament (PTF)
- the calcaneofibular (CF)

The syndesmotic ligaments include:
- the anterior inferior tibiofibular ligament (ATIF)
- the posterior inferior tibiofibular ligament (PTIF)
- the transverse inferior tibiofibular ligament
- the interosseous ligament.



Another "lateral" ligamentous structure is the cervical ligament which is the anterolateral part of the subtalar ligament. This ligament runs in the sinus tarsi, covered by the inferior extensor retinaculum. (The interosseous talocalcaneal ligament is the posteromedial part of the subtalar ligament).

Diagnostic modalities

The diagnosis of lateral ligament tear is based on clinical history and clinical examination.

Standard X-rays help to distinguish fracture from ligamentous sprain

Comparative stress radiographs (inversion and anterior drawer tests) can help to evaluate ligamentous laxity (rather in chronic phase).

Ultrasonography is a good technique to appreciate the severity of the ankle sprain (in acute phase).

MR imaging allows the direct visualisation of the ligaments and the detection of associated lesions.

On MR images, the ATF and PTF ligaments are best visualized on transverse slices.

The CF is better evaluated on coronal planes.

The ATIF and PTIF are nicely shown evaluated on transverse views.

The components of the subtalar ligament are depicted on sagittal and coronal images.

Pathology

During an inversion ankle sprain, the ligaments are injured sequentially. The first ligament to tear is the ATF (the weakest), followed by the CF. The PTF rarely tears.

In acute trauma, a complete ligament tear appears as a poorly visualised ligament, often thickened with frayed and wavy margins and with increased signal intensity.

A partially torn ligament appears thinned but continuous with irregular outline.

Bone bruises, soft tissue edema and joint effusion are often associated to acute ligamentous injuries.

A chronic condition is suggested by a thickened ligament with a homogeneous low signal intensity, corresponding to scar tissue.

The pathological conditions of the different lateral ankle ligaments are discussed during the oral presentation.

Anterolateral impingement

After a tear of ATF or ATIF ligament, a chronic synovial hypertrophy or a post-traumatic fibrosis can develop consecutively to recurrent microtrauma. A small soft tissue mass can be detected in the anterolateral gutter, having sometimes a meniscoid shape. Chondral lesions can develop at the talus or the lateral malleolus, as well as bony fragments or osseous spurs.

Bibliography

[1] Huh YM, Suh JS, Lee JW, Song HT. Synovitis and soft tissue impingement of the ankle: assessment with enhanced three-dimensional FSPGR MR imaging.
J Magn Reson Imaging. 2004 Jan;19(1):108-16.

[2] Cerezal L, Abascal F, Canga A, Pereda T, Garcia-Valtuille R, Perez-Carro L, Cruz. MR imaging of ankle impingement syndromes.
AJR Am J Roentgenol. 2003 Aug;181(2):551-9.

[3] Robinson P, White LM. Soft-tissue and osseous impingement syndromes of the ankle: role of imaging in diagnosis and management.
Radiographics. 2002 Nov-Dec;22(6):1457-69; discussion 1470-1.

[4] Robinson P, White LM, Salonen DC, Daniels TR, Ogilvie-Harris D. Anterolateral ankle impingement: mr arthrographic assessment of the anterolateral recess.
Radiology. 2001 Oct;221(1):186-90.

[5] Kim SH, Ha KI. Arthroscopic treatment for impingement of the anterolateral soft tissues of the ankle.
J Bone Joint Surg Br. 2000 Sep;82(7):1019-21.

[6] Jordan LK 3rd, Helms CA, Cooperman AE, Speer KP. Magnetic resonance imaging findings in anterolateral impingement of the ankle.
Skeletal Radiol. 2000 Jan;29(1):34-9.
[7] Muhle C, Frank LR, Rand T, Yeh L, Wong EC, Skaf A, Dantas RW, Haghighi P, Trudell D, Resnick D. Collateral ligaments of the ankle: high-resolution MR imaging with a local gradient coil and anatomic correlation in cadavers.
Radiographics. 1999 May-Jun;19(3):673-83.
[8] Breitenseher MJ, Trattnig S, Kukla C, Gaebler C, Kaider A, Baldt MM, Haller J, Imhof H. MRI versus lateral stress radiography in acute lateral ankle ligament injuries.
J Comput Assist Tomogr. 1997 Mar-Apr;21(2):280-5.
[9] Verhaven EF, Shahabpour M, Handelberg FW, Vaes PH, Opdecam PJ. The accuracy of three-dimensional magnetic resonance imaging in the diagnosis of ruptures of the lateral ligaments of the ankle.
Am J Sports Med. 1991 Nov-Dec;19(6):583-7.
[10] Shahabpour M, Sintzoff S, Osteaux M. Lésions traumatiques de la cheville et du pied. In: L'Imagerie en évaluation du dommage corporel. S Sintzoff, ed, Springer-Verlag 1993 : 375-394.
[11] Shahabpour M, Handelberg F, Opdecam M, Osteaux M, Spruyt D, Vaes P, Verhaven E, Zygas P. Magnetic resonance imaging (MRI) of the ankle and hindfoot.
Acta Orthop Belg. 1992;58 Suppl 1:5-14.
[12] Zygas P, Shahabpour M, Libotte M. Dissection of the sub-talar ligaments and magnetic resonance imaging.
Acta Orthop Belg. 1992;58(4):442-7.
[13] Shahabpour M, Handelberg F, Libotte M, Osteaux M, Vaes P, Verhaven E, Zygas P. Lésions ligamentaires de l'arrière-pied : apports potentiels de l'IRM. In: Pied et Cheville. Morvan G, ed, Montpellier, Sauramps Medical 1991: 99-109.

DELTOID LIGAMENT, PLANTAR FASCIA AND OTHER LIGAMENT INJURIES

M COHEN, S BIANCHI, P SARRAT, B PICLET-LEGRE
Hopital St Joseph, Marseille, France

The aim of this presentation is to describe the normal imaging appearance of deltoid ligament, plantar fascia and other ligament as well as their main pathological changes.

Injuries of ankle deltoid ligament mostly follow eversion sprains and are rare compared with tears of lateral collateral ligaments. Imaging modalities are helpful in confirming the clinical diagnosis and in detecting associated lesions such as fractures of the fibula, ruptures of the spring ligament, lesions of the tibialis posterior tendon or flexor retinaculum.
Several other ankle and foot ligaments, including the anterior tibio-fibular, mediotarsal and tarsometatarsal ligaments and the plantar capsular-ligament toes complex, may be concerned by trauma or overuse related to sport. Imaging can differentiate ligament injuries from bone and tendon lesions that presents clinically with similar findings and is required for an accurate diagnosis to allow an early and appropriate treatment.

The plantar fascia is a major contributor in transmitting Achilles tendon forces to the forefoot and supporting the plantar arch. Pericalcaneal plantar pain, a frequent symptom in running or jumping athletes, is secondary to local inflammation (plantar fasciitis) or ruptures. Both conditions are due to chronic overuse rather than acute trauma and present with similar clinical findings. Medical imaging may differentiate them and is helpful in patients' follow-up.
Conventional radiographs remain the first-line modality to assess fractures and dislocations and can also depict indirect signs of ligaments injuries. Sonography is an ready, inexpensive, and non invasive imaging tool that allows accurate evaluation of superficial ankle and foot ligaments. It can dynamically assess ligaments during application of stress and detect some infraradiological stress fractures and even tiny intraarticular effusions. Its main disadvantage is the slow learning curve. MRI and MR-arthrography are more expensive and invasive but allows better evaluation of several ligaments including the sinus tarsi ligament complex and the spring ligament. They can also diagnose a variety of other bone and joint disorders associated or mimicking ligaments tears.
The choice between sonography and MRI in evaluation of deltoid ligament, plantar fascia and other ligament injuries depends on multiple factors including the clinical presentation, level of sport activity (amatorial vs professional), suspected injured ligament, availability of an experienced sonologist and economical considerations.

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CRMO SYNDROME

A.G. Jurik
Aarhus Universityhospital, Aarhus, Denmark

Chronic recurrent multifocal osteomyelitis (CRMO) is a relatively rare disorder mainly occurring in children and adolescents. It is clinically characterized by a prolonged, fluctuating course with recurrent episodes of pain occurring over several years, sometimes accompanied by skin disease, most frequent pustulosis palmoplantaris (PPP). CRMO is often multifocal and predominantly located to tubular bones followed by the clavicle, the spine and pelvic bones, whereas other locations are rare. Histopathological and laboratory findings are non-specific and bacterial culture negative.
Etiology and pathophysiology are unknown. Many findings indicate that CRMO is an autoimmune disease. It has clinical and radiographic similarities with pustulotic arthro-osteitis (PAO) of adults and may be a juvenile form of PAO. In accordance with this, CRMO can proceed to seronegative spondylarthropathy in adulthood and may be associated with other signs indicating autoimmunity (inflammatory bowel disease, psoriasis, PPP, etc.). It is, however, not excluded that CRMO can be caused by a slow growing unknown organism, not detectable by common culture.

Imaging findings: CRMO lesions usually present a picture suggesting subacute or chronic osteomyelitis at *radiography*, but tubular bone lesions can have rather characteristic features, being located adjacent to the epiphyseal cartilage plate. The radiographic features of lesions in other locations, e.g. the clavicle and the spine, are less specific and more difficult to distinguish from infection or malignancy. Supplementary *bone scintigraphy* is helpful to assess clinical silent lesions, and *MRI* for visualizing the local extent and activity of CRMO lesions. The MRI appearance of CRMO lesions in tubular bones and the spine is usually characteristic, whereas lesions in other regions may be non-specific.
Diagnosis: CRMO is often a diagnosis of exclusion unless accompanied by PPP. Diagnostic criteria are: 1) bone lesions with a radiographic picture suggesting osteomyelitis, 2) an atypical location of lesions compared with infectious osteomyelitis with a frequent involvement of the clavicle and often multifocal lesions, 3) no abscess formation, fistula or sequester, 4) lack of causative organism, 5) non-specific histopathological and laboratory findings compatible with subacute or chronic osteomyelitis, 6) a prolonged fluctuating course, and 7) sometimes accompanying skin disease.
Differentials: Include septic osteomyelitis, bone tumours, and metabolic disorders.
Conclusion: CRMO should be suspected in children/adolescents with atypical osteomyelitis. The diagnosis of CRMO is important in order to avoid unnecessary diagnostic procedures and initiate an appropriate therapy with non-steroidal anti-inflammatory drugs, and inform the patient about the relative benign course.

DIAGNOSIS OF MYOSITIS VS FASCIITIS

CE Hutchinson
[1] The University of Manchester, Manchester, United Kingdom, [2] Salford Royal Hospital NHS Trust, Salford, United Kingdom

The diagnosis of myositis and fasciitis is traditionally based on clinical finding and serological markers such as ESR and CPK. However there is crossover in the diagnositic features and the serum markers of disease are not reliable. Even biopsy of muscle with histological correlation does not reliably confirm the diagnosis in these patchy diseases. Part of the problem is that we are not dealing with a single diagnosis but multiple disease pathways.
With the wider use of MR imaging there are may features that can be recognised in the images associated with these conditions. The benefits of different imaging techniques will be discussed. T1W images T2W images STIR and fat sat imaging allow different information to be extracted.
The use of T2 maps and diffusion will be discussed. These newer imaging sequences also shed more light onto the diagnosis.
In addition ‘post processing’ of MR imaging can further help to assist in the diagnosis and follow up of these conditions.

IMAGING UNUSUAL ORGANISMS IN MSK SYSTEM

R Arkun
Ege University School of Medicine, IZMIR, Turkey

Osteomyelitis is an infection which has varied causes. Although, hemaatogeneous osteomyelitis is the most common type due to Stphylococcus aureus, different microorganisms can cause infectious changes bone and soft tissue. Osteomyelitis may be considered as pyogenic, tuberculous, sphylitic, viral, fungal and parasitic.
Among the musculoskeletal infections fungal and parasitic disease are not frequent as much as specific and nonspecific infectious disease. Both fungal and parasitic bone infections are rare disorders and incidence of the disease is related to geographic distribution, ethnic and and nutritional factors and occupation. Immunocompromise and ease of travel can lead to increased incidence. These are group of chronic disorders and delayed diagnosis is common because radiographs, computed tomography, isotope studies and magnetic resonance imaging are useful but don’t have specific signs for determination of infective fungal or parasitic organism which lead to the disease. Diagnosis is possible with a high index of clinical suspicition and aspiration or biopsy is necessary for definitive diagnosis.

SPINAL INFECTION

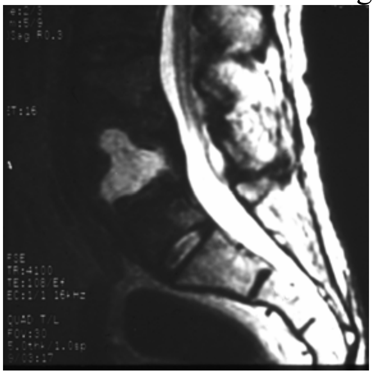
D J Wilson
Nuffield Orthopaedic Centre, Oxford, United Kingdom

Infection of the spinal column is fortunately rare but when it does occur the consequences to cord and nerve integrity and the stability of the bony structures may be profound. Early recognition is important if treatment is to be effective

Imaging signs
Early
Infection in the spine almost always arises in the disc space, which is a relatively avascular area that is commonly the focus for mechanical degenerative changes. It is most likely to be due to staphylococcus aureus infection. It is probable that primary haematogenous osteomyelitis may occur but this would rapidly involve the disc space given the proximity to the trabecular bone. Disc space narrowing, loss of clarity of the endplates and paravertebral swelling will be seen on plain films. However, plain films are often normal in the early stages. Nuclear medicine studies will be positive early although it might be necessary to resort to SPECT to identify detail of the abnormality. MR is very sensitive and reasonably specific, it is the imaging method of choice.
Intermediate
Erosion of the bone occurs at the margins of the disc. In the more indolent infection, typically tuberculosis, the erosion and cortical destruction creeps along the vertebral margins under the anterior longitudinal ligament. The term “tuberculous cares” has been employed.

Late
As with all types of osteomyelitis spine infections are associated with necrosis, cloacae, sequestra, soft tissue and bone abscesses. In the spine vertebral collapse may ensue often leading to root and even cord compression. Epidural abscess may also occur, generally anterior to the cord, related to infected material in the disc space. MR is the

method of choice in defining the extent and severity of the disease.



Biopsy

Image guided biopsy is often the best way to confirm the diagnosis. Most will use fluoroscopic or CT guidance after planning the site and approach from conventional MR studies. Specimens should be sent for both histological and microbiological analysis. Cultures are more likely to be effective from fragments of tissue and it is wise to use thicker needles.

Management

Surgery is the mainstay of treatment supported by high dose antibiotic therapy by intravenous infusion. The reconstruction of an unstable segments is complex and made difficult by the extent of retroperitoneal scarring. We have used a combination of percutaneous vertebroplasty and open surgery in a series of nine cases.

SATURDAY AM 08:30 to 10:10

Nelson Mandela Theatre

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IMAGING OF MUSCLE INJURY

PJ O'Connor
Leeds Teaching Hospitals, Leeds, United Kingdom

Muscle injury is one of the commonest indications for sports injury imaging. Overall muscle tears account for approximately one third of all sports injuries with the muscles most likely to be injured being fast twitch fibre predominant muscles traversing two joints. The most common mechanism of injury is loading during extension (eccentric loading).
This lecture describes the anatomy and imaging appearances of normal muscles using differing modalities. The mechanisms of injury, the rational, timing and imaging findings in muscle injury will be discussed. The implications and findings of common complications such as scar formation, muscle hernia and myossitis ossificans will be described.

IMAGING ATHLETIC PUBLAGIA

P Robinson
Leeds Teaching Hospitals, Leeds, United Kingdom

There has been little formal biomechanical evaluation of the exertional and stabilizing forces acting through the pelvis. Anatomically and functionally this area is extremely complex with considerable reactive forces acting through a number of mobile and fixed articulations, muscle groups, aponeuroses and ligaments. The pelvis contains the centre of gravity of the body and acts as the fulcrum for all athletic movement.
In acute athletic groin pain ultrasound is the initial technique of choice for diagnosing and grading muscle and tendon injuries. MR imaging can be used to confirm low grade injuries or where the field of view for ultrasound is limited (eg in athletes with a large muscle bulk).
The situation in chronic athletic groin pain (pubalgia) is more controversial with a number of aetiologies described. Although not exclusive to soccer (eg ice hockey and Australian Rules football) it has certainly been described more frequently in soccer players and is a significant problem estimated to comprise 10% of acute and 18% of chronic soccer related injuries. The increased incidence in sports that require constant cutting-in and kicking, may relate to chronic shearing forces when the player is in single stance.
There is no unifying theory how this complex process develops with different authors focusing on the symphysis pubis joint, the adductor longus enthesis, pubic subchondral stress fractures, lower abdominal muscle abnormalities as well as inguinal muscular and aponeurotic tears. There is also confusion over terminology with osteitis pubis and sportsman’s hernia encompassing many different potential conditions among different clinicians. In reality there is a lot of crossover with many or all of the above regions thought to be involved by chronic shearing forces acting through the symphysis pubis and soft tissues.
This lecture will review
Biomechanics of the anterior pelvis in relation to kicking sports

Theories on the pathogenesis of chronic groin pain (athletic pubalgia)
Imaging findings in symptomatic and asymptomatic athletes focussing on the use of ultrasound and MR imaging
Illustrate the application of these imaging techniques, to the relevant anatomy and important alternative pathologies.

PARS PRINCIPLES : CLINICAL ASPECTS OF PARS INTERARTICULARIS STRESS FRACTURES IN SPORT

P.A Bell
BUPA Wellness, London, United Kingdom

Stress fractures of the neural arch of the lumbar vertebrae (pedicle, pars, lamina, articular facet) are the commonest cause of back pain in the adolescent athlete. They cause significant morbidity and drop out. Multiple lesions at a single level, or multiple level involvement, are common. Imaging algorithms must balance diagnostic accuracy and ionising radiation. Clinical diagnosis is usually straightforward. Imaging will help define a level, or multiple levels, the location of the lesion (s) in the neural arch, and the potential for healing. Management involves defining causative factors, both extrinsic and intrinsic, and meticulous attention to biomechanical and technique issues, which maybe incriminated. Outcome is usually successful with conservative management, although in some cases surgery is required. The presentation will highlight lesions from around the neural arch , with reference to case studies of elite sportsmen and women

SPONDYLOLYSIS: WHICH IMAGING TECHNIQUE?

Rob Campbell
Royal Liverpool University Hospital, Liverpool, United Kingdom

Spondylolysis is a defect of the pars interarticularis. In the lower lumbar spine the majorities of cases are the result of ether a developmental disorder of childhood, or acquired as a stress fracture during adolescence (1). Spondylolysis may lead to long term complications of chronic low back pain (LBP), and spondylolisthesis. The choice of imaging modality is dependent upon certain clinical presentations.
Adolescents with low back pain (LBP)
Adults with LBP
Patients with secondary spondylolisthesis
In adolescents with LBP and spondylolysis, it is important to distinguish those patients with an acute stress fracture which may heal with appropriate treatment, and developmental defects which will not. Conventional radiography is unreliable for detection of acute stress fractures, and should be avoided because of radiation dose. SPECT has been widely used for identifying acute defects, but cannot distinguish between stress reaction and fracture, and will not identify cases of established non-union. MRI has been shown to be reliable at demonstrating complete pars defects, and distinguishing acute stress fractures from chronic non-union (2). MRI is also the best modality for diagnosing many other spinal disorders. CT remains the image modality of choice for follow up in assessment of fracture healing.

In adults, perhaps the question should not be "Which imaging technique?", but "Is any imaging required?". By adulthood spondylolysis will mostly be an established non-union whatever the aetiology, and may be present in up to 10% of the general population. Radiographs are reliable at detecting established defects, but management of patients with mechanical LBP should be conservative initially, and imaging is not routinely indicated. Only those patients with unremitting back pain who are being considered for spinal fusion or other therapeutic procedures require radiological investigation. MRI (and maybe discography) is the investigation of choice in this group, where assessment of the inter-vertebral disc is important, and where pars defects will also be readily apparent.

Similarly do patients with spondylolisthesis require any imaging? Surgeons will advocate radiographs in patients with LBP to ensure a listhesis is not overlooked. Does this matter? After all, surgical intervention would not be considered unless the patient had unremitting LBP persisting after a period of conservative therapy or had developed neurogenic symptoms secondary to spinal stenosis. In both cases MRI is the investigation of choice. Are there any justifications for the use of conventional radiography in patients with spondylolysis and mechanical LBP?

References:

1. Fredrickson BE, Baker D, McHolick WJ, Yuan HA, Lubicky JP. The natural history of spondylolysis and spondylolisthesis. J Bone Joint Surg Am 1984; 66:699-707.

2. Campbell RS, Grainger AJ, Hide IG, Papastefanou S, Greenough CG. Juvenile spondylolysis: a comparative analysis of CT, SPECT and MRI. Skeletal Radiol 2005; 34:63-73.

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CHRONIC LABRAL DAMAGE IN THE HIP AND SHOULDER OF SOCCER AND RUGBY PLAYERS

AJ Grainger
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AIMS: To discuss the mechanisms and imaging of injury to the glenoid and acetabular “rim” (labrum and adjacent articular cartilage) in football and rugby players.
Rugby and Soccer injuries are wide and varied and many injuries are common to both sports, particularly those relating to the lower limb. The variety of injuries makes it difficult to discuss them comprehensively in this talk and many of these injuries have been discussed elsewhere in this course. This talk will concentrate on two often neglected causes of chronic symptoms in these athletes.
It is now recognised that one cause of pain in the hip and/or groin in soccer and rugby players relates to damage to the fibrocartilaginous labrum, often associated with damage to the adjacent articular cartilage. Acetabular labral tears may occur acutely. However chronic degeneration of the labrum is also seen in professional players and may give rise to a pain of insidious onset which may be associated with restriction of movement and may impair athletic performance.
Labral damage and progressive chondral damage to the adjacent articular cartilage is widely recognised as an early complaint in patients with hip dysplasia. It is thought this results from shear stresses on the labrum resulting from the dysplasia leading to instability and anterolateral femoral head migration (1). More recently the concept of anterior impingement of the femoral neck on the anterior acetabular rim has been described. This is thought to result in impingement of the capsular and labral structures and resultant labral tearing and degeneration (2). It has been shown that certain morphological variants to the femoral neck predispose to anterior impingement (3). It is also postulated that athletes with an underlying irregularity of the femoral neck, who undertake activities involving repetitive adduction in association with rotation or flexion, may be at higher risk of impingement symptoms when compared with other subjects with similar neck morphology. Ganz et al have shown that anterior femoroacetabular impingement may well be a cause of early osteoarthritis in the non-dysplastic hip (4) and premature and increased incidence of osteoarthritis in soccer players and other athletes is well recognised (5-7).
Anterior femoroacetabular impingement can be recognised at MRI and MR arthrography. Labral degeneration is seen as increased signal within a thickened labrum and may be associated with paralabral cyst formation if a tear is present. Associated with the labral damage subchondral bone change in the form of marrow edema and cyst formation is typically seen involving the anterolateral acetabular rim and/or the lateral femoral head. Damage to the adjacent articular cartilage may also be seen. Changes in the labrum may also be seen at ultrasound. Although the acetabular

labrum has pain fibres (like the menisci of the knee) (8), synovitis is frequently demonstrated in the region affected and imaging guided injection of cortisone often proves beneficial at least in the short term. Ultimately surgical treatment is often necessary to allow full return to athletic activities and prevent early onset of osteoarthritis (1).These players will often present with relatively non-specific symptoms often relating to the groin, and intra-articular injection of local anaesthetic (which may be done at the time of MR arthrography) can help confirm the intra-articular cause of symptoms.

Soft tissue injuries to the shoulder in rugby union and rugby league players are common. These will most frequently result from acute physical trauma causing damage to the rotator cuff or labroligamentous structures. Usually these two pathologies can be distinguished clinically and in our practice rotator cuff pathology first leads to examination with ultrasound to confirm the presence and assess the extent of any cuff tear. If labroligamentous injury is suspected we prefer to undertake MR arthrography to evaluate the glenohumeral ligaments and labrum.

Labroligamentous injury may take the form of Bankart type disruption of the anteroinferior or posterior labrum following dislocation; or disruption of the superior labrum, involving the biceps anchor, as is seen in the SLAP lesions. SLAP lesions may again follow dislocations (typically the type V lesion combining an anteroinferior labral tear with the superior labral tear) although a fall on the outstretched arm has been reported as the most common mechanism of injury (9).

It may be rather more difficult to identify a cause for chronic shoulder pain without a specific traumatic event to stimulate it. In the over arm throwing athlete such as the cricketer, baseball or tennis professional internal (posterosuperior glenoid) impingement or occasionally subacromial impingement is often implicated. Glenohumeral internal rotation deficit associated with posteroinferior capsular contracture may be important in this and the development of SLAP lesions in the absence of acute trauma in over arm athletes (10). However in our experience this is unusual in rugby professionals who tend not to have an over arm technique except in the lineout. Nevertheless SLAP lesions are often suspected in this group of players and MR arthrography carried out.

It has previously been reported that posterior labral damage is relatively common in American football and lacrosse players (11). This has resulted in vague and non-specific symptoms and has been found in the absence of any specific precipitating injury. Mair et al found that the athletes in his series had posterior glenoid labral damage and that this was associated with damage to the adjacent articular cartilage in some cases (11). Using MR arthrography we have found similar findings in a group of professional rugby league and union players both in association with, and in the absence of other soft tissue pathology. These findings have been confirmed at arthroscopy. Mair et al speculated that the cause of the posterior labral and articular cartilage damage was chronic repetitive trauma resulting from posterior force applied to the extended arm with the shoulder flexed to around 90^{o}. Similar recurrent forces to the outstretched arm are sustained by rugby players as they fend of an imminent tackle and it seems likely that the same pattern of chronic posterior labral and articular cartilage damage may account for persistent and non specific shoulder symptoms seen in the absence of trauma in rugby players.

KEY POINTS:

Current and repetitive trauma leading to labral and articular cartilage damage in the hip and shoulder accounts for symptoms in the absence of specific trauma.

This damage is readily identified at MRI and MR arthrography.

REFERENCES:
1. Ferguson TA, Matta J. Anterior femoroacetabular impingement: a clinical presentation. Sports Med Arthoscopy Rev 2002;10(2):134-140.
2. Ito K, Leunig M, Ganz R. Histopathologic features of the acetabular labrum in femoroacetabular impingement. Clin Orthop Relat Res 2004(429):262-71.
3. Ito K, Minka MA, 2nd, Leunig M, Werlen S, Ganz R. Femoroacetabular impingement and the cam-effect. A MRI-based quantitative anatomical study of the femoral head-neck offset. J Bone Joint Surg Br 2001;83(2):171-6.
4. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. Clin Orthop Relat Res 2003(417):112-20.
5. Drawer S, Fuller CW. Propensity for osteoarthritis and lower limb joint pain in retired professional soccer players. Br J Sports Med 2001;35(6):402-8.
6. Lequesne MG, Dang N, Lane NE. Sport practice and osteoarthritis of the limbs. Osteoarthritis Cartilage 1997;5(2):75-86.
7. Klunder KB, Rud B, Hansen J. Osteoarthritis of the hip and knee joint in retired football players. Acta Orthop Scand 1980;51(6):925-7.
8. Kim YT, Azuma H. The nerve endings of the acetabular labrum. Clin Orthop Relat Res 1995(320):176-81.
9. Snyder SJ, Karzel RP, Del Pizzo W, Ferkel RD, Friedman MJ. SLAP lesions of the shoulder. Arthroscopy 1990;6(4):274-9.
10. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology Part I: pathoanatomy and biomechanics. Arthroscopy 2003;19(4):404-20.
11. Mair SD, Zarzour RH, Speer KP. Posterior labral injury in contact athletes. Am J Sports Med 1998;26(6):753-8.

TRACK AND FIELD INJURIES

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Academic Medical Centre, Amsterdam, Netherlands

Track and field events afford the athlete the opportunity to demonstrate capability in the most basics forms of physical prowess. The events enjoy a rich heritage, with traces of their origin to ancient times, as documented in records of the ancient Olympic games. It is a divers line of sports, including running, throwing and jumping. Furthermore modern track and field athletes fall into two groups, those that have basic *explosive* power requirements and those that emphasize endurance.

In track and field events a sports specific injury pattern can be distinguished. For instance one can think of the Javelin elbow, pole-vaulters stress fractures in spine and anterior tibia, dizziness in discus throwers and throwing fractures of the humeral shaft.

Inury in track and field can be caused by exogenous factors. Concerning exogenous factors, one can think of Running shoes and Orthotics, Blood doping, Diet, drugs, equipment and field conditions. Although these items are not all familiar to the radiologist, it may be helpful to be aware of these conditions in the specific athlete and whether a recent change of these conditions has been applied, that may account for the injury that you are dealing with.

For the purpose of this talk the following division is made:

Running, including sprints, relays, hurdles, middle distance, distance, Marathon, cross country and race walking.
Jumping, including long jump, triple jump, high jump and pole-vault.
Throwing, including Shot Put, Hammer Throw, discus, javelin
Combined events, pentathlon and decathlon
Ad A. Most common encountered injuries in running are stress fractures of tibia and fibula and muscle injuries , most often of the musculotendinous unit of the hamstring muscle complex. Whereas overstressing the musculotendinous unit in an attempt to accelerate typically injures the sprinter, the distance runner typically injures the unit merely by overuse in training. However in relay one may encounter injuries of hand due to baton exchange. In hurdles plantar fat pad contusion, plantar fasciitis or calcaneal fracture may be encountered and a specific injury of the medial knee, so called medial plica syndrome, is common.
Ad B. Most important injury is the “jumpers’ knee. However with the modern technique of back landing in pole vault, injury of the spine also is common. Also shoulder injuries do occur in pole vaulting.
Ad C. Injuries of the upper extremity, i.c shoulder, elbow and wrist are most common. However also due to the spinning one may encounter ACL lesions and dizziness.
Ad D. No specific injuries due to the combination.
Although as radiologists we are not trained in depth in biomechanics of movements, it is helpful, perhaps mandatory to get acquainted with the sport specific types of movements when handling injured athletes. The specific injury pattern easily is depicted, when one is familiar with the biomechanics of the specific sports. A sports radiologist then is an excellent partner for the orthopedic surgeon specialized in sports and biomechanics or the sports physician. Working as a team is very important in this line of work. Imaging is not a stand-alone procedure. It should be incorporated in a chain of healthcare in order to support our athletes most adequately.
Is track and field a good exercise for your body? L
In the presentation the audience will be given an impression of the most frequent encountered injuries in this specific sport. Focus will be given to the biomechanics of specific movement. The radiological appearance of the injuries will be demonstrated using plain film, US, MDCT and/or MRI. Special interest will be placed on injuries in former elite athletes. Finally future applications of MR spectroscopy in analyzing muscle status will be mentioned. The format used will be case based, with interaction of the audience.
References:
Sports Injuries by FH Fu and DA Stone. Lippincott Williams& Wilkins 2001. Chapter 41: Track and Field- JV Ciullo, JR Ciullo
Overuse injuries of the Musculoskeletal System MM Pećina, I Bojanić CRC Press 2004
Hamstring Muscle Complex: An Imaging review. G. Koulouris, D Connell. Radiographics 2005; 25:571-586
Catastrophic injuries in Pole-Vaulters BP Boden, P Pasquina, J Johnson and FO Muller. AJSM 2001;vol 29, No1 50-54
Lower-Limb Function among former elite male athletes. JA Kettunen, UM Kujala, J Kaprio, M Koskenvuo, S saran. AJSM 2001, vol 29, no1, 1-8
A “Functional biopsy” of muscle properties in sprinters and dsiatnce runners. GJ crowther, SA Jubrias, RK Gronka, KE Conley. Med Sci Sports Exerc. 2002 Nov;34(11): 1719-1724

CYCLING INJURIES

Carlo Faletti
CTO Hospital, Turin, Italy

Cycling has become a more popular sport, above all in the last few years, thanks to the evolution of specific equipment and the wide use of the mountain bike.
Unfortunately, the number of pathologies involved in this sport has also consequently increased , including, on the one hand, the traumatic lesions, and the other, the pathologies that originate from the bio-mechanics of the musculo-skeletal system itself.
Traumatic injuries often include multiple traumatic lesions. Noteworthy is the fact that in our Regional Trauma Centre (covering 4.5 million inhabitants) we have an average of 1.5 patients per day who present with cycling injuries!
The minor trauma have typical sites such as the ankle, hip and elbow etc.
In the wrist, one very common type of injury, in particular for mountain bike trauma, is that of the scaphoid or particular trapezium or hamate lesions.
Particular attention must be paid to the so called “negative” bone X-rays, that can be better diagnosed at MR, thus modifying the prognosis, above all that of being able to return to normal sports activities.
The most common pathology involved in this sport, as reported in literature, is, without doubt, that of the knee, with a prevalence for the tendon structures and musculo-tendon insertion points. The joint structures must not be underestimated , in particular that of the patella cartilage.
The hip and ankle may also undergo alterations in its joint components and musculo-tendon insertion sites are also frequently involved due to the particular incorrect use of the mechanical components of the bicycle and the modality of the athletic movements unique to this sport.
Therefore, we can say that traumas involving the cyclist’s musculo-skeletal system are unfortunately , more often than not due to other factors and not to the sport itself.
As cycling involves typically repetitive movements, the most likely pathologies are limited to the lower limbs and rarely do they include the other musculo-skeletal areas.
Therefore, it is a must to know the bio-mechanics of the peddling motion and the correct use of the bicycle itself

SATURDAY PM 13:00 to 14:00
Nelson Mandela Theatre

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SLIDING GANTRY MSCT
TOWARDS AN AFFORDABLE SOLUTION AND INCREASING EFFICIENCY IN AN EMERGENCY RADIOLOGY DEPARTMENT.

C.van Kuijk, MD PhD
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Radboud University Medical Center, Nijmegen, The Netherlands

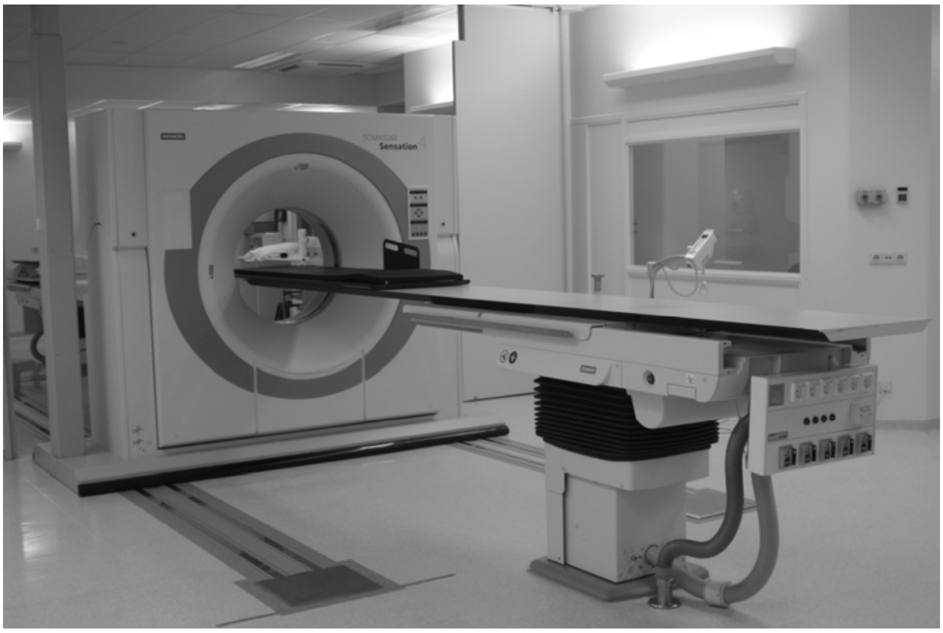
Trauma surgeons use the term “golden hour” to define the limited time window that is available that determines survival rate in severe trauma patients. Radiologists should use the term “diagnostic diamond minutes””

Until recently conventional radiography and ultrasound were used extensively to assess the damage in trauma-patients. CT examinations were only done in hemodynamically stable patients if immediate surgery was not deemed necessary by the trauma-surgeons. CT equipment is situated far from the emergency centre in a lot of hospitals; transport is cumbersome and potentially dangerous for the patient because of time delay and danger of losing valuable lines and tubes needed to ensure artificial respiration and controlling blood pressure. Until the installation of spiral CT scanners the CT examination itself took a lot of time. In hospitals were the CT equipment is next to the trauma-unit, transport is still necessary.

New developments have taken place over the last years:
1: The installation of multi-detector CT equipment facilitating ultra fast imaging with unsurpassed image resolution and isotropic multidirectional reconstructions.
2: The replacement of surgical procedures by image guided minimal invasive interventional radiology
3: New knowledge and experience with non-operative management of trauma related lesions of parenchymal organs
4: Growing evidence concerning the value of CT diagnosis in trauma-patients providing high specificity and sensitivity

From these developments the conclusion can be drawn that CT scanning is the modality of choice for diagnosing potential life threatening or otherwise disabling conditions in trauma patients. This directly means that a CT scanner should be in the trauma-room which also avoids any transport of these patients. However, in most trauma-centers the number and throughput of these patients prohibits an efficient and cost-effective use of a CT-scanner in the trauma-room.

In the Academic Medical Center in Amsterdam ,the Netherlands a new trauma center was build in 2003 and became fully operational in 2004. Inside the trauma-center a sliding gantry MDCT was placed that can be used in 2 adjacent rooms for maximal efficiency. This dual-suite sliding gantry concept provides cost-effective use of the CT equipment and can provide fast CT-scanning in trauma-patients. Also a new transport system was developed using removable radiolucent tabletops that can be placed on the radiolucent trauma-table and on transporttrolleys with a docking station for the life support equipment.
In short the imaging equipment comes to the patient and the tabletop facilitating rapid transport and imaging stays with the patient reducing the number of lift-overs. In this concept the patient is placed in a central position while the logistics move around this central position.
In this concept a patient can be resuscitated and diagnosed fully by the trauma-team including the radiologist within less then 30 minutes and put on transport to the operating theatre, interventional suite or intensive care unit.



3-TESLA MRI: MSK APPLICATIONS

P Lang
Harvard Medical School, Boston, MA, United States

3-Telsa MR systems are becoming increasingly available for MSK applications. The major advantages include improvement in spatial resolution for imaging small structures and small pathological lesions, faster imaging, all owing to improved signal-to-noise ratios, and imaging of less common species such as sodium and phosphorus. Imaging at 3T yields a significant improvement in signal-to-noise ratio, essentially doubling the SNR. Challenges, however, include changes in tissue parameters, namely T1, T2* relaxation time, technological problems resulting from magnetic field in homogeneity and power the position, potential issues with radio-frequency physics, specifically RF in homogeneity, compounded image artifacts such as chemical shift and susceptibility artifacts, and issues with patient safety for example in the presence of metallic implants.
Despite some of these challenges, 3T MRI offers a number of unique advantages. For example, parallel imaging using SENSE technology becomes possible with results in improvement in imaging time.
In this review, we will discuss the technical aspects of 3T MRI. An overview of the most promising clinical applications will be provided.

IMAGING OF THE CARTILAGE: FROM MR IMAGING TO CONVENTIONAL RADIOGRAPHS

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Cliniques Universitaires St Luc, Brussels, Belgium

Objectives:

* To present elementary cartilage lesions with emphasis on MR imaging with spiral CT arthrography correlation
* To provide an overview on radiological findings observed in cartilage lesions
* To stress target areas of the knee and hip joints where cartilage lesions start

Introduction

Hyaline cartilage is a thin connective tissue composed of a complex organized network of collagen fibers, large proteoglycans and water. Covering the articular surfaces of the bones, it provides smooth movements (low friction coefficient) and can resist high pressure. Cartilage disorders are mainly of degenerative or traumatic origin including physical and biochemical trauma (inflammatory diseases). Cartilage lesions generally progress slowly and clinical manifestations occur late in the diseases process. New therapeutic drugs are emerging which implies the need for a better assessment of cartilage lesions. However, in routine clinical practice, conventional radiograph (indirect imaging) is cost-effective in the setting of degenerative joint disease given the up to now limited treatment strategies. Direct imaging of the cartilage with MR imaging is mandatory when a direct treatment is planned.

1. MR imaging

MR imaging of the cartilage covers two main branches. The morphological approach used in clinical practice aims at providing information on several aspects of the cartilage including its surface, its substance and its neighbourghood. The quantitative approach used for research purpose aims at determining several parameters including the cartilage volume or thickness or biochemical composition (T2 measurements or T1 measurements after intraarticular contrast injection). It is likely that, in the future, these two approaches will join because cartilage volume assessment may be irrelevant to the disease course in a biomechanically preserved area.

Morphological assessment of the cartilage by using MR imaging, the imaging modality of choice, requires high spatial resolution and a sequence that is sensitive to alteration in water content (mainly T2 sequences or T1 with fat-saturation).

Target areas

MR imaging is the imaging modality of choice for the assessment of hyaline cartilage. The technical prerequisite include high spatial resolution (3D imaging with 1-mm-thick sections) and a sequence that is sensitive to alteration in water content (mainly T2-weighted sequences or T1-weighted with fat saturation). The 3 target areas to image in cartilage disease are (a) the cartilage surface, (b) the cartilage substance and (c) the subchondral bone marrow. Up to now, no single sequence enables accurate depiction of these three areas. Cartilage assessment implies assessment of the cartilage surface (interrupted? fibrillations?), the cartilage substance (abnormal signal intensity? substance loss?) and of the adjacent marrow (edema?).

MR imaging techniques

MR imaging can be used for quantitative and morphological assessment of the hyaline cartilage. Quantitative MR imaging techniques are used in clinical studies and for research purpose. Determination of T2 relaxation times, of T1 relaxation time after intraarticular injection of gadolinium, of cartilage volume and cartilage thickness mapping all enable valuable assessment of biochemical or physical characteristics of the cartilage.

Morphological assessment of the cartilage is performed in clinical practice and is less reproducible. In our practice, we use the fat-saturated proton-density sequence with a slice thickness of 1 to 3mm to assess the cartilage because it also enables assessment of the other components of the joint. It is sensitive to bone marrow changes and cartilage lesions show variable signal intensity. Dedicated sequences like the fat-saturated T1-weighted gradient-echo sequence in the 3D mode are commonly recommended. However, they do not enable assessment of the subchondral bone marrow and all cartilage lesions show decreased signal intensity.

MR imaging of the normal cartilage

Articular hyaline cartilage signal is low on T1-, intermediate on proton-density- and low on T2-weighted spin-echo sequences. It is low to intermediate on fat-saturated intermediate-weighted fast spin-echo sequence. MR imaging is the unique technique that enables assessment of the deep layer of the cartilage. However, one must take into account significant variations in the cartilage MR appearance depending on the used sequence, the articular area and the orientation of the articular surface with respect to the main magnetic field

*Chemical shift artifac*t secondary to error in spatial determination of water and fat components due to differences in Larmor frequency can interfere with the depiction of the water-fat interface in other words of the interface between cartilage (water-equivalent) and bone marrow (fat-equivalent). The real cartilage thickness is therefore difficult to assess on conventional SE sequences and the low signal intensity line at the interface between marrow and cartilage does not correspond to the subchondral bone plate but to an artifact.

Truncature artifact secondary to insufficient sampling can generate low signal intensity lines within the cartilage substance. *Magic angle artifact* induces increase in signal intensity of the cartilage in fibrillar structures when they show a 55° angulation with respect to the longitudinal magnetic field.

MR appearance of cartilage lesions

In theory, a cartilage defect is filled by articular fluid. Therefore, a cartilage defect should appear as a high signal intensity area on T2-weighted images and presence of fluid-like signal intensity in the cartilage on T2-weighted SE sequence is probably the most specific sign indicative of a cartilage defect. Unfortunately, this sign is not sensitive. Other sequences that are more sensitive to subtle alteration in the cartilage content must be used for better accuracy. Other signs suggestive of cartilage lesions include thinning of the cartilage and loss of the sharpness on the cartilage contours. On intermediate-weighted spin-echo images, the signal intensity of cartilage defects can vary from low to high signal intensity. In a series of 83 cartilage defects demonstrated at knee CT-arthrography, 70% of the defects showed an MR signal intensity that was higher than that of adjacent cartilage, 20% showed MR signal intensity equivalent to that of adjacent cartilage (lesions not seen on MR images) and 10% of lesions showed an MR signal intensity lower than that of adjacent cartilage. Lesions with MR signal intensity superior to that of normal cartilage were more extensive than those with MR signal intensity equivalent to or lower than that of adjacent cartilage.

Accuracy of MR imaging and spiral CT-arthrography

Accuracy of MR imaging for the detection of cartilage lesions varies greatly depending on the study population, the lesion classification system, the MR technique, and the statistics. To summarize, neither MRI nor CT-arthrography are able to detect superficial fibrillations without substance loss of the cartilage. Both techniques are highly accurate for the depiction of "down-to-bone" lesions. They show variable performance in the depiction of not "down-to-bone" cartilage defects. In a cadaver knee study, CT-arthrography was found to enable more accurate extent of the depth of the cartilage defect.

2. Conventional radiography

Conventional radiographs are not sensitive for the depiction of early cartilage lesions. However, in clinical practice, they frequently contribute to the assessment of degenerative disorders of the cartilage because of their delayed clinical presentation.

Technical prerequisites for optimal assessment of the cartilage by using conventional radiographs include (a) that the radiographic joint space represents cartilage thickness (stress applied on the articular surfaces: standing radiographs of the knee) and (b) that the x-ray beam is tangent to a relevant area of the joint (off-lateral view of the hip).

Cartilage abrasion

Cartilage abrasion is responsible for joint space thinning on conventional radiographs if the two articular surfaces are under stress (weight-bearing view of the knee) and if the x-ray beam is tangent to the area of cartilage abrasion. Therefore it may be mandatory to obtain several radiographs in the most adapted position (off-lateral view of the hip, transcondylar view of the knee). Marginal and subchondral changes (cfr infra) are of less importance in the setting of advanced disease of the cartilage

Focal cartilage defect

Conventional radiographs are not sensitive to focal cartilage defects because of the lack of joint space thinning. Reactive changes must be searched at the margins of the articular surfaces and in the subchondral bone adjacent to the abnormal cartilage.

a. Marginal changes

Marginal osteophytosis reflects focal reactivation of cartilage metabolism that leads to cartilage overgrowth in a non-stressed area and that converts to osseous formation. Marginal osteophytosis heralds chronic irritation of the knee and is therefore non-specific. Focal non-destructive diseases (osteoid osteoma) or metabolic disorders (acromegaly) can stimulate cartilage metabolism and secondary osteophytosis.

b. Subchondral changes

Geodes

When a cartilage defect is deep, adjacent subchondral bone can show complex modifications including bone resorption surrounded by bone sclerosis that leads to the formation of geodes. Even in the case of superficial cartilage lesions, bone resorption can be noted on CT images (not depicted on conventional radiographs).

Central osteophytosis

In the case of chronic large defect of the cartilage, the subchondral bone at the bottom of the defect frequently shows bony proliferation (because it is no more a stressed area due to the cartilage defect?). These central osteophytes are more specific of cartilage lesions than the marginal osteophytes. In non-weight-bearing joints (shoulder) central osteophytosis can involve the entire articular surface and do not have the same clinical significance.

Subchondral bone abrasion

In case of extensive wear of the cartilage, the bony surfaces become thickened due to bone-to-bone contact. The newly formed subchondral bone plate secondary to thickened trabeculae is less compact and its deep margin is less sharp than the normal bone plate. Recognition of this abnormal bone plate may be important to recognize advanced degenerative disease in joints in which the joint space appears normal.

Take-home points

1. MR imaging of cartilage is an on-going challenge that requests higher spatial resolution and better tissue contrast than what is obtained in routine clinical practice if the cartilage surface, the cartilage substance and the subchondral marrow are to be assessed.

2. The fat-saturated intermediate-weighted FSE sequence is an acceptable compromise for cartilage assessment in clinical practice.
3. Radiographs are not sensitive to early cartilage lesions. If properly obtained and analyzed, radiographs are cost-effective in the demonstration of advanced cartilage lesions.

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