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MR Imaging of the hip

F.M. Vanhoenacker[1]

Learning Objectives

1. To discuss the technique of direct MR arthrography of the hip.
2. To review the intra-articular anatomy of the hip.
3. To discuss frequent intra-articular pathology of the hip.

Discussion

Technique

Although routine MR imaging of the hip and the pelvis is usually sufficient for the assessment of common clinical problems of the hip (including avascular necrosis, bone marrow edema or commonly encountered pathology of the greater trochanter), visualization of small intra-articular details requires joint distention. Direct MR arthrography is recommended in case of suspicion of labral and/or cartilage lesions or presence of intra-articular loose bodies. Our MR protocol consists of one coronal sequence (Dixon T2-WI) of the entire pelvis and a combination of fat suppressed T1-weighted sequences with a small field of view (14-16 cm) of the injected hip in three anatomical planes. Leg traction is applied. The coronal Dixon T2-WI sequence aims to provide an overview of the pelvis and to exclude any extra-articular pathology (greater trochanter pain syndrome, mass lesions, …). To optimize labral resolution, radial imaging may be added. Radial images are obtained with the use of gradient 3D sequences, and reconstructions tangential to the acetabular rim are performed at 10-15° increments around the joint.

MR anatomy

The normal labrum has a low signal intensity on all imaging sequences and has a triangular morphology. Variations in labral morphology include flattening, rounding, blunting, irregularity of the labral margins and labral absence. The joint capsule thickened area, a.k.a. the zona orbicularis. The acetabular notch is a focal deficiency of the bony acetabulum at the anteroinferior aspect, bridged by the transverse ligament. The fovea capitis is a rounded depression of the femoral head, devoid of articular cartilage. The ligamentum teres runs vertically from the fovea down to the transverse ligament.

Labral and cartilage lesions

Labral lesions may provoke hip pain and may be involved in the development of osteoarthritis. Labral lesions are most commonly located in the anterosuperior aspect. Tears can be oriented along the short or long axis of the labrum. Cartilaginous defects are frequently associated with labral pathology. MR arthrography has only a moderate sensitivity for detection of cartilage lesions, because of the thin articular cartilage of the hip. Cartilaginous abnormalities are much more frequent on the acetabulum than on the femoral head. Other associated lesions are perilabral cysts and morphological factors predisposing to femoroacetabular impingement.

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1. Department of Radiology, AZ Sint-Maarten, Duffel-Mechelen, University Hospital Antwerp, University of Ghent, Faculty of Medicine and Health Sciences.

Femoro-acetabular impingement

E. Oei[1]

Femoro-acetabular impingement (FAI) is a relatively "new" diagnosis for young adults with hip pain and restricted hip motion, described in full by Ganz and colleagues in the early 1990s. The hallmark of FAI is a developmental or acquired morphological abnormality of femoral head and/or acetabulum. This results in abnormal contact between femoral head or neck and labrum and acetabular rim, associated with chronic impaction at extremes of range of motion. As this often leads to labrum and articular cartilage damage, FAI has been suggested as a precursor of degenerative changes (early osteoarthritis).

FAI presents opportunities for advanced radiological imaging and for advanced surgical techniques. There is the possibility of altering the natural history of early degenerative joint disease and limiting progression to end-stage osteoarthritis if FAI is recognized and treated timely.

There are various etiologies of FAI: anatomical variation (acetabular retroversion, coxa profunda), secondary to pediatric hip disease (e.g. slipped capital femoral epiphysis), secondary to trauma (prior femoral neck fracture), secondary to surgery (periacetabular/femoral osteotomy), or without an underlying known cause ("primary FAI").

FAI typically manifests in active young or middle-aged patients with symptoms starting insidiously or after minor trauma. Clinical symptoms consist of groin pain during sports activities or prolonged sitting, often unilaterally, occasionally bilaterally. Mechanical symptoms such as locking, catching, or giving way may also occur. On clinical examination, FAI patients demonstrate decreased range of motion and painful limitations during flexion, internal rotation, and abduction.

There are two distinct types of FAI: Cam type (prominence of the femoral neck) occuring typically in young, active males, and pincer type (acetabular overcoverage) typically occurring in middle-aged athletic females. Mixed types have also been described. The presence or either FAI type can be assessed on a variety of imaging modalities, including radiography (true AP view of pelvis and cross-table, frog leg, or false profile views of hips), CT and MRI. MRI or MR arthrography is especially useful to demonstrate soft tissue abnormalities associated with FAI such as labral tears, articular cartilage damage, and synovitis. Relevant measures to establish the radiological diagnosis of FAI include the alpha-angle (cam-type if > 55°) and center edge angle of Wiberg (overcoverage if > 39°). The cross-over sign is also a useful sign to suggest pincer type FAI. Bone abnormalities and normal variants associated with FAI include os acetabuli, herniation pit, and ischial spine sign.

FAI can be treated either conservatively (restriction of activities, non-steroidal anti-inflammatory drugs, injections, and physiotherapy), or surgically (artroscopic removal or bony excess, surgical disclocation, or peri-acetabular osteotomy). Adequate pre-operative imaging work-up is essential as it has been shown that FAI patients often do not benefit from surgery in the case of concurrent early osteoarthritis or labral pathology.

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1. Department of Radiology, Erasmus MC, University Medical Center Rotterdam, Dr. Rotterdam, The Netherlands.

Femoral head osteonecrosis: Strengths and weaknesses of MR imaging

B. Vande Berg

Strengths of MRI

MRI is the most accurate imaging modality in the work-up of clinically suspected femoral head osteonecrosis or at screening in asymptomatic patients at risk for avascular osteonecrosis. The T1-weighted SE sequence is superb for the detection of marrow osteonecrosis before any radiographic changes (Fig. 1). The demonstration of a lesion pattern consisted in an area of high signal intensity surrounded by a rim of low signal intensity is specific for femoral head osteonecrosis (Fig. 1).

MR imaging has added value in predicting the risk for the development of epiphyseal fracture in non-collapsed AVN lesion (ARCO 1-2). Actually the importance of the lesion size and its anatomic relationship with the acetabular roof are indicative of the risk for fracture development.

Weaknesses of MRI

Inter-observer reproducibility of the ARCO classification system has been demonstrated to be moderate to poor at MRI (1). MRI shows limitations in staging of femoral head osteonecrosis (Table). Actually, the detection of the epiphyseal fracture (ARCO 3) and of early cartilage damage (ARCO 4) appears limited on MRI (2). The added value of CT imaging for the detection of epiphyseal fracture (staging) is under evaluation (2).

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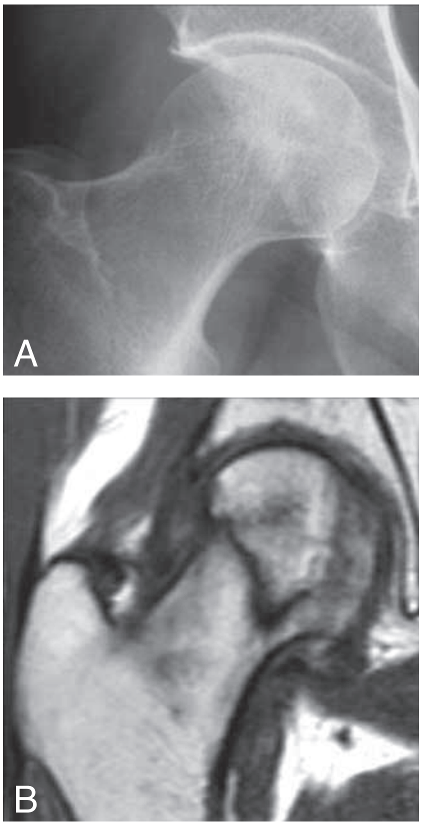

Fig. 1. — (A) Normal radiograph of the right hip. (B) Corresponding T1-weighted SE image obtained at the same time show femoral head osteonecrosis with a fat-containing subchondral lesion surrounded by a rim of low signal intensity. There is no fracture and the lesion is Arco stage 1. The lesion is large and the fracture risk is high. (C) Radiographs of the same hip obtained 10 months later demonstrated collapse of the femoral head (Arco stage 3).

Table. — ARCO Staging of femoral head osteonecrosis.

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
X-ray	Normal	Subtle sclerosis or bone resorption No fracture Normal joint space	Fracture (Femoral head deformity, Subchondral cleft) Normal joint space	Fracture Moderate joint space narrowing	Fracture osteoarthritis
MRI	Well delimited Fat-containing subchondral lesion	Well delimited Fat-containing subchondral lesion	Fracture Normal cartilage		

Department of Radiology IREC Cliniques universitaires Saint-Luc 10 avenue Hippocrate 1200 Brussels Belgium.

Advanced MRI of the knee: trauma patterns in relation to mri findings, posterolateral corner

E. Oei[1]

A pattern-based approach of soft-tissue lesions and bone contusion on MRI for traumatic knee injury is presented. This approach is based largely on trauma mechanism and the position of the knee joint at time of injury, giving rise to distinct bone contusion and soft tissue patterns that are visible especially on fat-saturated MRI images. Hence, the several characteristic bone bruises patterns may serve as a footprint of the mechanism of injury.

Knee trauma can be either direct, indirect, or combined. Examples of characteristic direct trauma mechanisms are the dashboard injury and clip injury, as opposed to pivot shift injury and lateral patellar dislocation which are caused by indirect trauma. A dashboard injury is associated with rupture or the posterior cruciate ligament and posterior joint capsule. Bone bruise is visible in the anterior aspect of the proximal tibia and posterior surface of the patella. Pivot shift injury is caused by rapid deceleration with simultaneous direction change and valgus load to the knee combined with external rotation of tibia or internal rotation of femur. Rupture of the anterior cruciate ligament is common along with bone contusion typically located in the lateral femoral condyle, posterolateral tibial plateau, and posteromedial tibial plateau (contre-coup).

The posterolateral corner (PLC) of the knee consists of important static and dynamic knee stabilizers of the knee that provide varus, posterior translation, and external rotation restraint. Injury to the

PLC constitutes a MSK radiology "emergency", because, if missed, this may lead to chronic knee instability, pain, cruciate ligament reconstruction failure, and secondary osteoarthritis. The PLC is composed of the lateral (fibular) collateral ligament, biceps femoris tendon, popliteus myotendinous complex, and mid-third lateral capsular ligament. Variable components are the popliteofibular ligament, fabellofibular ligament, and arcuate ligament. It is important to always scrutinize the PLC, although it may be difficult to identify each of the individual smaller and variable ligaments. Damage to the peroneal nerve may be present with injury of the PLC.

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1. Department of Radiology, Erasmus MC, University Medical Center Rotterdam, Dr. Rotterdam, The Netherlands.

Meniscus: MR Imaging with Emphasis on New Concepts

D. Resnick[1]

Since the introduction and refinement of MR imaging, its application to assessment of disorders of the knee has been its dominant role with regard to the musculoskeletal system. The technique is excellent in the analysis of the menisci, ligaments, bone marrow, and additional supporting and surrounding structures. Classic descriptions exist of the MR imaging features of meniscal tears, but recent information has expanded these features considerably.

Knowledge of meniscal anatomy is fundamental to accurate interpretation of the MR images. The menisci are predominately avascular structures, although the outer 10 to 30 percent of the meniscus contains a red zone, with vascular supply provided by capsular and synovial tissue. With routine imaging technique, there is no reliable way to differentiate the vascular and avascular zones of the menisci. With newer imaging techniques, such as ultrashort TE sequences, this differentiation may be possible in the future.

The menisci exist in a very important environment that consists of numerous supporting structures. Foremost among these are root ligaments, that connect the anterior and posterior horns of both the medial and lateral menisci to the tibia. These meniscal roots can be seen well with MR imaging, especially in the coronal plane. They may be injured in combination with meniscal injuries or alone. Avulsion of the posterior root ligament of the medial meniscus is an important diagnosis leading to meniscal subluxation and marrow edema. Avulsion of any of the root ligaments may be associated with a flipped meniscus.

Gauging the stability or instability of a meniscal tear can be accomplished during MR imaging. Features of unstable meniscal tears include vertical longitudinal tears that measure greater than 9mm in length, multidirectional tears, and large radial tears. The identification of fluid within the site of meniscal disruption is an additional finding of meniscal instability.

Displaced meniscal tears can be classified in a variety of ways. Bucket-handle tears represent displaced vertical longitudinal tears, whereas flap tears and parrot-beak tears refer to displaced horizontal and radial tears. Each of these displaced tears has a characteristic appearance. With regard to bucket-handle tears, without prompt treatment, subsequent and further damage to the involved meniscus may occur. This damage takes the form of disruption of one of the handles of the displaced tear or peripheral meniscal radial tears.

Meniscal cysts are a strong indicator of the presence of a meniscal tear. These are present both on the medial and lateral sides of the knee, being larger on the medial side and, on the medial side, traveling for a greater distance. In rare circumstances, these meniscal cysts may erode bone, simulating a more aggressive lesion.

There are many anatomic variations that provide diagnostic difficulty, simulating the appearance of a meniscal tear. Furthermore, analysis of the postoperative meniscus can be extremely difficult and may require MR arthrography.

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1. Department of Radiology, University of California, San Diego Medical Center, San Diego, CA, USA.

Imaging of knee joint repair

E. Oei[1]

Advances in arthroscopic and open surgical repair procedures of the knee, such as ligamentous repair, meniscal repair and cartilage repair, have resulted in an increased demand for advanced imaging in the context of knee joint repair. This includes pre-operative imaging to guide treatment, decisions and plan surgical procedures, but also post-operative imaging to follow-up surgical repair procedures and assess potential complications. This lecture focuses on the post-operative MRI appearance of the most commonly performed knee repair procedures — anterior cruciate ligament (ACL) reconstruction, meniscal repair and cartilage repair.

The normal MR appearance of an ACL graft depends on the nature of the reconstruction method, but should generally demonstrate uniform thickness with homogenous signal intensity. In hamstring ACL grafts, linear areas of intermediate or fluid signal intensity interposed between the two or four separate strands of the graft are a normal finding. Adequate position of the femoral and tibial tunnels can be evaluated on sagittal MR images and in the coronal plane using a clock-face approach. Complications of ACL reconstruction include recurrent tear of the ACL graft, ACL graft impingement, arthrofibrosis and cyclops lesions, graft degeneration and ganglion cysts and tunnel widening.

Imaging methods after a meniscus-preserving surgery should be sensitive to detect a persistent tear, which is indicative of a failed repair. Similarly, imaging after meniscectomy should be able to detect recurrent tears. Imaging may also reveal new tears in other areas of the meniscus, as well as other causes of post-operative knee symptoms. Several imaging options are currently used to morphologically evaluate the postoperative meniscus, including conventional MRI, MR arthrography (direct and indirect), and CT arthrography. Criteria for persistent or recurrent tears vary according to surgical and imaging techniques and have improved in recent years as a result of enhanced understanding of the normal imaging appearance of the post-operative meniscus. It is crucial to find out as many details as possible on the exact location, type, and extent of the previous surgery performed. Comparison with preoperative imaging may point toward the location of surgery or aid in the detection of new tears.

A variety of interventions have been introduced that are aimed at repairing cartilage damage, each with advantages and limitations. This is a highly dynamic field of research because of its clinical significance and the prevalence of cartilage injury. All surgical cartilage repair techniques have in common that they are aimed at restoring tissue in the focal cartilage defect in order to stabilize the adjacent native cartilage. Normal and abnormal MRI findings after microfracture, osteochondral autograft transplantation or transfer (OAT), autologous chondrocyte implantation (ACI), and matrix-associated ACI (MACI) are discussed.

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1. Department of Radiology, Erasmus MC, University Medical Center Rotterdam, Dr. Rotterdam, The Netherlands.

MR Imaging of the ankle

F.M. Vanhoenacker[1]

Learning Objectives

1. To review how to perform and report and ankle and foot examination.
2. To discuss variants causing symptoms or mimicking disease.
3. To discuss bone marrow disease of the ankle and foot.
4. To discuss common diseases of the forefoot.

Discussion

Imaging technique

Currently, 16 channel ankle coils are currently used. Routine MR of the ankle is performed in supine position with the foot in 20° of planar flexion to decrease the magic angle and for better visualization of the calcaneofibular ligament. Some authors recommend additional prone positioning with plantar flexion of the foot to reduce the magic angle effect.

Normal variants and pitfalls in MR imaging of the ankle and foot

Multiple normal anatomic variants may erroneously be interpreted as pathologic conditions.

Fluid within tendon sheaths

A small amount of tendon sheath fluid is frequently observed in asymptomatic subjects and should not be considered abnormal. Tenosynovial fluid is more common in flexor than extensor tendons. Extensive fluid within tendon sheaths is usually indicative of tenosynovitis; however, communication between the ankle joint and the flexor hallucis longus tendon explains the presence of prominent fluid within this tendon sheath in patients with large joint effusions. Thus, even large amounts of fluid within the tendon sheath of the flexor hallucis longus tendon particularly in the absence of increased fluid in other flexor tendon sheaths, can be of no clinical significance. A small amount of fluid in the tendon sheath of the posterior tibial tendon, however, should be considered as abnormal.

Heterogeneity of the ankle ligaments

Heterogeneity and striation of the ankle ligaments are common findings that are particularly prominent in the posterior talofibular ligament and the posterior talotibial band of the deltoid ligament. These findings are due to fat interposed between the fascicles of the ligaments. The orderly fashion of the striation and the absence of morphological alteration of the ligaments are helpful in the differential diagnosis with a true tear.

Pseudoloose bodies

The posterior and anterior tibiofibular and talofibular ligaments appear as round low signal intensity structures simulating loose bodies on midline sagittal MR images. Cross-sectional imaging of the calcaneofibular ligament on routine coronal images also can manifest as a low signal round structure deep to the peroneal tendons and lateral to the calcaneus.

Accessory muscles of the ankle

Numerous muscle variants are found in the ankle region. Although the presence of these muscles is frequently of no clinical significance, the anomalous muscles can predispose to painful clinical conditions, such as fullness, swelling, and post-exercise pain in the involved region. The four most frequently encountered accessory muscles of the posterior ankle are the accessory soleus, the peroneus quartus, the accessory flexor digitorum longus and the peroneocalcaneus internus muscles.

Accessory bones

Multiple accessory bones have been described in the literature. The most frequent among them are the os peroneum, trigonum, supranaviculare, os naviculare accessorium, vesalianum and intermetatarsale. They should not be misinterpreted as fractures.

Bone marrow disorders

Osteochondrosis dissecans (OCD) and osteochondral fractures

OCD and osteochondral fractures of the ankle are usually located at the talar dome. Osteochondral fracture is secondary to acute trauma, whereas repeated trauma may be the cause of OCD. OCD most commonly involves the medial talar dome, less commonly involves the lateral talar dome, and rarely the central articular surface.

Stress/insufficiency fractures and occult fractures

Stress or insufficiency fracture may involve the different bones of the foot, including the calcaneus, navicular bone, the metatarsal bones and more rarely other tarsal bones.The calcaneus is the most frequent location of a stress fracture, which is usually located at its posterior process, perpendicular to the stress lines of the spongious bone. More rarely it is anteriorly located. Metatarsal stress fractures may be located at the base, the diaphysis, neck and subchondral area of the metatarsal head.MRI is more sensitive in identifying stress fractures not detected on conventional radiographs. Before a stress fracture takes place, a stress response occurs. This corresponds to an ill-defined area of BME, without any visible fracture line. As the stress persists, a fracture develops, which is seen as an irregular line of low signal intensity on both pulse sequences surrounded by an area of BME.In the metatarsal bones, there is often associated focal cortical thickening and periostitis and soft tissue edema, which may mimic a tumoral appearance. A navicular stress fracture has a longitudinal course along the sagittal plane in the middle third or at the junction of the central and lateral thirds of the navicular bone. This site corresponds to the zone of maximum shear stress on the navicular from the surrounding bones during plantar flexion combined with pronation. The lesion begins at the proximal dorsal articular surface and propagates in a distal and plantar direction, resulting in a partial of complete injury. The fracture line in navicular stress fractures is better seen on (CB)CT than on MRI. On the other hand, MRI is more sensitive for evaluation of the extent of bone marrow oedema. Thus the diagnosis may benefit from both imaging modalities. Early detection of navicular stress fractures is mandatory because this lesions are high risk fractures which are prone to delayed union or non-union.

Osteonecrosis

Osteonecrosis of the talus may be idiopathic or secondary to trauma, steroid therapy, or any of the systemic causes of osteonecrosis in other skeletal sites (hypercortisonism, ethylabusus, hyperlipidemia, underlying hemoglobinopathies, other coagulopathies, inflammatory bowel disease, lupus,….). The talus is particularly susceptible to osteonecrosis, because the blood supply to the talar dome is mainly dependent on arteries of the tarsal sinus and the tarsal canal which enter the bone on its plantar surface. This particular intra-osseous blood supply is subject to interruption by fractures of the talar neck. The risk of posttraumatic osteonecrosis of the talus increases with the degree of fracture displacement or subluxation of adjacent joints. Osteonecrosis, due to a nontraumatic etiology is relatively rare in the foot and is usually a secondary process to (repeated micro-) trauma.

Mueller-Weiss syndrome

This entity represents osteonecrosis of the navicular bone, occurring in adults, resulting from chronic compression of the adjacent bones.Radiographs show a mediodorsal protrusion of part of the navicular bone, sclerosis and later on superimposed talonavicular arthrosis.MRI may have an interest in the diagnosis of early stages of the disease.

Freiberg infraction

Freiberg infraction affects the second or third metatarsal head and is characterized by subchondral collapse. The joint may appear normal or widened. It is most commonly seen in females in the second decade. The formerly used term infarction is considered as a misnomer, because the osteonecrosis is secondarily to repetitive microtrauma.In the early stage of the disease, MRI is most sensitive to detect the disease. Later in the course of the disease, subchondral collapse, irregularity of the epiphysis, sclerosis and secondary osteoarthrosis may be seen on standard radiography.

Painful sesamoid syndrome

"Sesamoiditis" does not correspond to a true inflammation. It is a chronic condition, characterized by pain in the sesamoid region of the first metatarsal bone.It pathogenesis is still debated. Previously, it was believed that the condition starts by an interruption of the blood supply to bone, ultimately resulting in microfracture and collapse. According to others, repetitive trauma is the leading cause, secondarily resulting in an ischemic process of the bone. Therefore, this condition is referred in the literature with different terminology, such as osteochondritis or osteochondrosis, stress fracture and osteonecrosis of the sesamoid.In reality, these conditions seem to be all part of the same disease spectrum, with chronic repetitive stress acting as the primum movens. Indeed, the sesamoids are subjects to forces exceeding three times the body weight during each cycle of normal gait. The tibial sesamoid receives most of this force because of its position directly under the first metatarsal head, and therefore it most frequently affected.

This microtraumatic hypothesis, regarding its etiology is further supported by the frequent occurrence of "sesamoiditis" in (young) women wearing high-heeled shoes. Other predisposing factors aggravating stress on the sesamoids are dancing or sports, and a cavus foot. MR imaging findings include decreased signal intensity on T1-weighted images and increased signal intensity on (fat suppressed) T2-weighted images or STIR. Associated soft tissue abnormalities include tendonitis, synovitis and bursitis. Initially, radiographs are negative, but late findings consist of microfracture, cortical irregularity, cyst formation, collapse of bone and increased density. These late changes may be demonstrated on (CB)CT as well. As the process heals, residual sclerosis may persist and may cause a low signal intensity on T2-weighted images.

Other forefoot abnormalities

Morton's neuroma (fibroma)

The term Morton's neuroma is a misnomer, because it is not a true tumor but represents perineural fibrosis around the interdigital nerve associated with pain and paresthesia on standing or compression of the metatarsal heads. Therefore, Morton's fibroma is the preferred terminology.It is typically located in between the metatarsal heads on the plantar side of the transverse intermetatarsal ligament.On MR Imaging, a typical Morton's neuroma is isointense to muscle on T1-weighted images and homogeneously or heterogeneously hypointense to fat on T2-weighted images.Lesions less than 5 mm in diameter are usually asymptomatic.

Bursitis about the forefoot

The differential diagnosis of Morton's neuroma includes a distended intercapitometatarsal and subcapitometatarsal bursitis. Distention results from (micro-) trauma or friction, inflammatory arthritis or infection. Differential diagnosis can easily be obtained by analysis of their specific topography. Intercapitometatarsal bursitis is best visualised on T2-weighted MR images as a fluid filled structure between the metatarsal heads, on the dorsal side of the transverse intermetatarsal ligament. It can compress the interdigital nerve when the bursa exceeds a diameter of 3 mm. Subcapitometatarsal bursitis is an adventitial bursitis located underneath the metatarsal heads. It may be irregularly delineated, which supports its pathogenesis due to chronic friction. Subcapitometatarsal bursitis located underneath the metatarsal heads 1 and 5 are often found in asymptomatic patients, whereas location at the metatarsal heads 2 and 3 are often symptomatic. Other imaging features that may correspond with symptoms are T2-hyperintensity and larger size (more than 14 mm). Both bursae may show (peripheral) enhancement after intravenous contrast administration.

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1. Department of Radiology, AZ Sint-Maarten, Duffel-Mechelen, University Hospital Antwerp, University of Ghent, Faculty of Medicine and Health Sciences.

Social Media in Radiology – Part I What do they mean for radiology?

E.R. Ranschaert[1]

Social media are defined as a "group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content". The evolution of the rather static structure of the Web 1.0 version of the Internet to the more dynamic architecture of Web 2.0 opened the gates for greater participation of all users by enabling them to generate and share content. The number of users of social media has steadily risen over the past few years: as of January 2014, 74% of all online adults use social networking websites. Facebook is the most popular site, followed by LinkedIn, Pinterest, Twitter and Instagram. By the end of 2013 Facebook had 1,23 billion active users worldwide, of which 757 million login on a daily basis. This tremendous growth in the use of social media has led to radical paradigm shifts in the ways we communicate, collaborate, consume and create information. Technology allows virtual anyone to disseminate information to a global audience, almost instantaneously. New forms of collaboration are being created, making us witness of an emergent "Collective Intelligence". Social media also have a significant impact on medicine, for example the way peers and physicians (including radiologists) communicate with each other. Radiologists are now able to quickly publish and search for information in tweets, blog posts or digital documents through online social networking services. It's important for health care professionals to be well informed about this new technology; they need tips to enhance their use of social media, to avoid pitfalls and to uphold their professional values. For example they should consider separating personal and professional online content and they should respect patient privacy and confidentiality by avoiding posting identifiable patient information online.

Through social media many barriers to enhance (international) collaboration between radiologists have been removed: media in all kinds of formats – even radiological images - can be shared, the latest news, articles and conferences can be discussed online, and professional help or expertise is available from a virtual community of radiological experts. The information obtained during scientific congresses can be discussed in real time, locally or on distance. Educational material can easily be stored and shared and several platforms are available to develop peer interaction and case sharing. Scientific network sites like ResearchGate, BiomedExperts and other allow researchers to discuss ideas and share scientific information with like-minded colleagues and radiologists. Such networks make it possible to create "virtual labs" with common libraries and collaborative groups, which is becoming an indispensable part of the research process.

Patients themselves are also increasingly using social media to find or discuss health-related information, and they want to be better connected to their physician(s). Already about 16% of Facebook users are posting reviews of medications, treatments and doctors. On the other hand, when looking for health related information, social media users seem to prefer posts by doctors to any other groups. Radiologists can also use social media to become more engaged and "visible" in the health care delivery process. It offers them the opportunity to share their expertise not only with peers but also with patients, which might result in better patient care and a change of the old stereotype image of the "disengaged radiologist". Some people are of opinion that image interpretation is an aspect of medicine that could be performed by collective intelligence. "Crowdsourcing" platforms such as CrowdMed are already being used quite extensively. Patients with an uncommon disease can post information and questions about their disease online, including radiological examinations and findings. A registered crowd of both non-physicians and physicians ("medical detectives") is invited to comment on each case, and with support of a computer algorithm a list of the most probable diagnosis is generated. The most successful medical detectives are awarded. This illustrates the fact that today patients aren't only able to do their "own search" on the Internet, but also to make use of the social media crowd to help finding the right diagnosis - a phenomenon that should be taken into account and is probably irreversible. More research should be done however to evaluate the efficiency and accuracy of crowdsourcing health care and radiology, and radiologists should reflect on how to deal with these on-going changes in medicine.

Conclusion

The presence of social media is affecting all patients and medical professionals worldwide, offering both risks and opportunities. Social media give radiologists a chance to enhance collaboration and training, and to relate to the patients better and more closely. Digital medical communication is a potentially powerful tool, but a good balance is needed to achieve a "meaningful use of social media". Radiologists have to be trained to prepare for the future and to become more active in the era of digital health.

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1. Department of Radiology, Jeroen Bosch Ziekenhuis, 's-Hertogenbosch, the Netherlands.

Imaging of the shoulder: US, CT-arthrography and (MR)-arthrography

F.M. Vanhoenacker[1]

Learning Objectives

1. To discuss the imaging features of shoulder diseases.
2. To review the main indication of each imaging modality.
3. To discuss the merit of each imaging modality .

Discussion

Ultrasound

In experienced hands, US has a similar accuracy as conventional MRI for full and partial thickness tears, but has a lower accuracy than MR arthrography for evaluation of undersurface partial thickness tears. Other limitations of ultrasound are evaluation of labroligamentous lesions, osteochondral lesions and lesions of the biceps pulley. Advantages compared to MRI are the low cost, dynamic capabilities and precise guidance of injections.

(MR)-arthrography

Conventional MR has an equal moderate accuracy than US for evaluation of partial thickness tears. Small calcifications are less well evaluated on MRI than on US and plain films. Direct MR arthrography is highly accurate in the diagnosis and staging of full-thickness rotator cuff tears and is accurate in the diagnosis of articular-sided partial-thickness tears. It is the preferred technique to evaluate muscle atrophy and fatty infiltration. The performance of indirect MR arthrography on 3 T has been revisited recently. For evaluation of shoulder instability, direct MR arthrography is regarded as the best technique.

CT-arthrography

It remains the best standard for evaluation of small bony Bankart lesions. In case of claustrophobia or other contraindications for MRI, CT-arthrography may be a useful alternative for MR Arthrography. It is not accurate for evaluation of partial thickness rotator cuff tears at the bursal side. It may also be useful in postoperative shoulder.

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1. Department of Radiology, AZ Sint-Maarten, Duffel-Mechelen, University Hospital Antwerp, University of Ghent, Faculty of Medicine and Health Sciences.

Elbow MRI

I.D. Lyburn[1]

The elbow is a complex joint comprising 3 articulations: radiocapitellar, ulnohumeral, and radioulnar which allow a combination of flexion, extension, pronation and supination of the forearm. High-resolution MRI evaluation of osseous and soft-tissue structures, including ligaments, tendons, nerves, and muscles is achievable – a wide spectrum of pathology may be demonstrated and assessed (1).

Multiple imaging techniques and pulse sequences are described in the literature many suggesting use of surface coils with imaging in 3 planes. Contrast enhancement and arthrography may be utilized (1-2).

MRI is the modality of choice for the detection of radiographically occult fractures. Bone marrow oedema can help to define mechanisms and discrete patterns of injury, encountered in both professional and recreational athletes. Bone marrow oedema may been seen in both lateral epicondylitis (tennis elbow) and medial epicondylitis (golfers elbow) – its presence should lead to close review of adjacent tendons and ligaments (1-2).

Types of bone injury include osteochondritis dissecans and osteochondral defects (OCDs). Osteochondritis dissecans is a form of avascular necrosis usually affecting the capitellum typically seen as diffuse abnormal T2 hyperintensity and T1 hypointensity. OCD is an acquired focal lesion of bone and cartilage, most often affecting the capitellum related to repetitive valgus stress. It typically affects 12-16 year olds and is an intermediate to low T1 signal subchondral lesion with or without demonstrable overlying cartilage injury (Fig. 1). Fluid undercutting the fragment indicates instability. Unstable OCD, osteoarthritis, or fractures can result in intra-articular loose bodies – MRI may be very valuable in the detection of these. In the presence of an effusion arthrography is often not necessary.

4 major muscle groups: medial, lateral, anterior, and posterior can be evaluated. Common flexor and extensor injuries are often associated with trauma to adjacent ligaments and are best visualized on coronal images. Rupture of the distal biceps tendon (anterior group) is recognized by absence of the low signal tendon at the radial tuberosity insertion site (3).

The ulnar (medial) collateral ligament is composed of anterior, posterior, and transverse bands and acts mainly as a restraint to valgus stress at the elbow – it is most commonly injured in overhead throwing, such as pitching in baseball. The radial (lateral) collateral ligament complex including the lateral ulnar collateral ligament acts as the major counterpoint to varus stress. Partial tears are seen as increased T2 signal within the ligament, which may be thickened or thinned.

The 3 major nerves: ulnar, radial, and median are best visualized when surrounded by fat. Abnormal nerves can have a variety of appearances, including

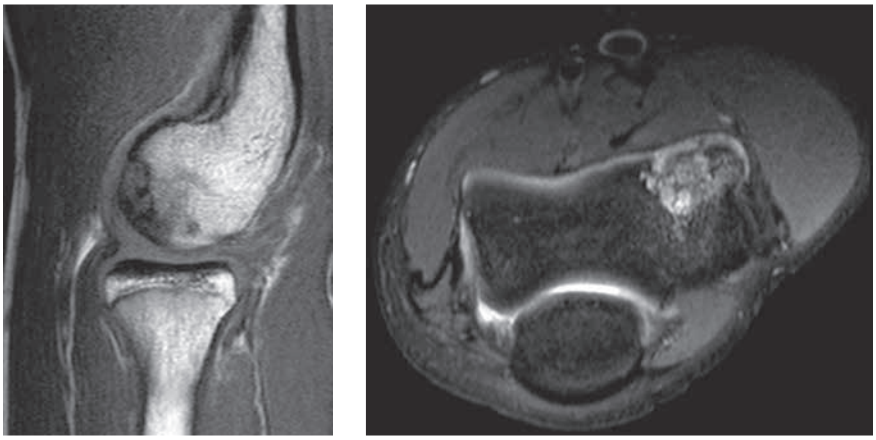

Fig. 1. — Cartilage fissuring in an osteochondral lesion of the capitellum– low signal on T1 sagittal image and high signal on axial PD fat saturation image.

focal or diffuse enlargement, high T2 signal, swelling and indistinct fascicular delineation. The ulnar nerve is the largest, most superficial, and most frequently injured (1-3).

Synovitis of the elbow can occur as a result of infectious, inflammatory, or posttraumatic conditions. In subjects with rheumatoid arthritis, bony erosions and T2-hyperintense pannus may also be present. Abnormal fluid collections may be seen most commonly at bicipitoradial and olecranon bursae (1-2).

Elbow MRI is a valuable, noninvasive method of evaluating a range of conditions including radiographically occult fractures, loose bodies, epicondylitis, osteochondral conditions, neuropathies and synovial disorders (1-3).

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1. Cobalt Imaging Centre, Thirlestaine Road, Cheltenham GL53 7AS, UK.

Imaging of Soft Tissue Pseudotumours (Honorary Lecture dedicated to the memory of professor Arthur M. De Schepper)

F.M. Vanhoenacker[1]

Learning Objectives

1. To become familiar with the normal anatomy.
2. To be able to identify normal variants.
3. To appreciate the range of pitfalls that may simulate Soft Tissue Tumours.

Discussion

Mimickers of the soft tissue tumours belong to a large and heterogeneous group of disorders, varying from normal anatomic variants, and other pitfalls such as inflammatory and infectious lesions, post-traumatic lesions (Fig.1), skin lesions, nonneoplastic vascular lesions, metabolic disorders (crystal deposition disease, amyloidosis) and miscellaneous disorders (Geyser phenomenon in longstanding rotator cuff disease, Baker's cyst, elastofibroma dorsi, pseudohypertrophy of the lower leg due to neurogenic compression…). Classification of these pseudotumours remains still a matter of debate. Many of these lesions are reactive or self-limiting without the need for further investigation or significant intervention. The imaging approach is often very similar to the approach of "true" soft tissue tumoural counterparts.

Knowledge of the normal anatomy and existence and common presentation of these diseases, in combination with the relevant clinical findings (clinical history, location, skin changes), enables the correct diagnosis in most cases, thereby limiting the need for invasive procedures. Biopsy should be performed in doubtful cases.

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1. Department of Radiology, AZ Sint-Maarten, Duffel-Mechelen, University Hospital Antwerp, University of Ghent, Faculty of Medicine and Health Sciences.

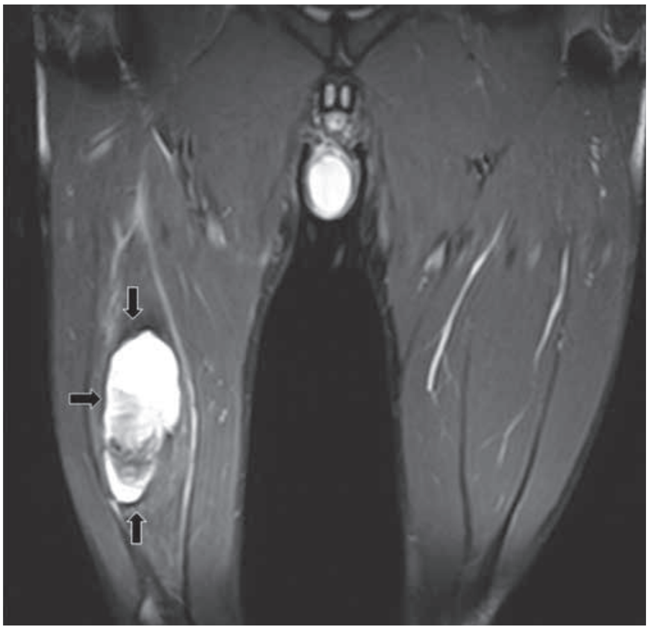

Fig. 1. — Intramuscular hematoma in the right thigh. Coronal Fatsuppressed T2-Weighted image shows heterogeneous signal of the lesion, due to blood degradation product of different age. A faint peripheral hemosiderin rim is seen (black arrows).

Staging of MSK Sarcoma

A. Navas. H. Bloem[1]

Staging of MSK sarcoma encompasses determination of local tumor extent and identification or exclusion of distal spread. This information is a requisite for treatment planning. MRI has gained a prominent position in the diagnosis and in local staging and should be performed before the lesion is sampled. The MR protocol for bone and soft tissue sarcoma can be the same. We use routinely contrast at the baseline and in the workup of musculoskeletal tumors.

Surgery is the cornerstone of the treatment strategy. The biologic aggressiveness of the sarcoma, indicated by histologic grading, is the key factor in the selection of the surgical margins required to achieve local control. Four different surgical procedures, implying four different margins, are recognized: intralesional, marginal, wide and radical. Local staging gives the answer to the question how a required tumor-free margin can be achieved. Both these factors, grade and local extent, are used in the staging system of the Musculoskeletal Tumor Society (1).

The local staging of a primary bone tumor can be divided into determining its intramedullary (extent of bone marrow involvement, epiphyseal involvement and skip metastasis) and extramedullary (joint involvement, muscle compartmental involvement and neurovascular bundle involvement) extent. Local staging of soft tissue sarcomas is divided into lesions that are intracompartimental and extracompartimental. The designation of intracompartimental indicates the lesion remains confined to the compartment of origin and has not crossed a major fascial septae dividing anatomic compartments.

Surgery is often used in combination with other forms of treatment such as chemotherapy and radiotherapy. The role of imaging in monitoring the effect of neoadjuvant (prior to surgery) therapy is also key essential. Information obtained from these imaging studies is also used in local staging before surgery. The dynamic contrast-enhanced magnetic resonance imaging plays therefore an important role in monitoring the response to local or systemic chemotherapy since it can identify and quantify the proportion of therapy-induced necrosis and residual viable tumor. This may have an impact in prognosis, modification of neoadjuvant (presurgical) treatment protocols and planning the surgery. Thus, local staging is typically based on multiple imaging studies taken at different points in time. The surgeon and radiologist should confer, when planning the customized surgical procedure, to make sure that all relevant information is used for the best outcome (2)

Musculoskeletal sarcomas metastasizes first to the lungs and other bones. Multidetector row CT (MDCT) is the most sensitive modality for detecting pulmonary metastasis (3). Tc-99m MDP skeletal scintigraphy is traditionally the modality employed for the detection of distant osseous metastasis and bone marrow in detecting diffuse spread of Ewing's sarcoma. FDG-PET CT and whole body MRI, both show promise for efficient and earlier detection of distal osseous and soft tissue metastasis. Nevertheless, more additional studies evaluating their performance on metastasis, their cost-effectiveness and their effect on patient outcome are needed.

Conclusion

The selection of appropriate imaging techniques for the evaluation of a patient with a suspected MSK tumor is crucial for accurate local staging. MR imaging is the imaging technique of choice for local staging for its exquisite anatomic detail. MR imaging plays also an important role in monitoring the response to local or systemic therapy. This may have an impact in prognosis and in planning the surgery.

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1. Leiden University Medical Center, Leiden. The Netherlands.

Imaging bone tumors

K. Verstraete[1]

The majority of bone tumors can be detected on plain radiography. The age of the patient, location of the tumor in a bone and history of a pre-existing bone abnormality should be included in determining the likely diagnosis. Careful analysis of the pattern of bone destruction, periosteal reaction and matrix mineralisation allow for characterization of most bone tumors and differentiation from pseudotumors. CT may be useful for osteoid osteoma and fibrous dysplasia, and MRI is the best imaging technique for further diagnosis and staging by displaying tumor composition and extent of bone marrow involvement, including skip lesions, presence and extent of extraosseous soft tissue mass, and involvement of neurovascular bundle, muscle compartments and adjacent joint. This allows to find the best biopsy and surgical approach.

To evaluate local control of disease and for detection of local recurrence, MRI is usually the best imaging technique.

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Fig. 1. — Sagittal T1 image of the knee after intravenous gadolinium contrast agent administration. Remark the septal enhancement and the non-enhancing hyaline components of this chondrosarcoma. The dynamic contrast-enhanced MR study showed more than 3 times faster and higher enhancement than muscle tissue.

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1. Department of Radiology and Medical Imaging, Ghent University Hospital, Ghent, Belgium.

Imaging of musculoskeletal metastases

A. Navas, H. Bloem[1]

Musculoskeletal metastases are unfortunately common. The frequency with which they are detected varies considerably with the type of tumor as well as with the (imaging) methodology used for their detection. In general, the prognosis for patients presenting with bone metastasis is poor. However patients with fewer metastases or solitary lesions appear to have a better outlook than those with multiple metastatic deposits. Bone scintigraphy is the most common imaging techniques used for imaging the musculoskeletal metastases, but it has limitations. PET-CT and whole body MRI, both show promise for efficient and earlier detection of distal osseous and soft tissue metastasis. Since PET-CT and whole body MRI have different strengths and weakness, their roles in tumor staging may be complementary. Nevertheless, more additional studies evaluating their performance on metastasis, their cost-effectiveness and their effect on patient outcome are needed. CT is used in bone metastasis to determine chance of fracture.

Conclusion

Imaging of musculoskeletal metastasis reflects specific tumor-host interaction. Since the different imaging techniques have strengths and weakness, their roles in tumor staging may be complementary. More additional studies evaluating their performance on metastasis, their cost-effectiveness and their effect on patient outcome are needed.

1. Leiden University Medical Center, Leiden. The Netherlands.

Table I. — Differences between STIR, fat-sat intermediate-weighted and Dixon sequences.

	STIR	Fat sat SE sequence	Dixon Method
Fat-saturation	Inversion time in pulse sequence	Selective saturation of fat signal	Opposition of fat and water protons
Signal-to-noise ratio	limited	High	high
Field inhomogeneities	Low sensitivity	High sensitivity	Low sensitivity
T1 contrast	Very limited	Compatible	compatible
T2 contrast	dominant	Compatible	compatible

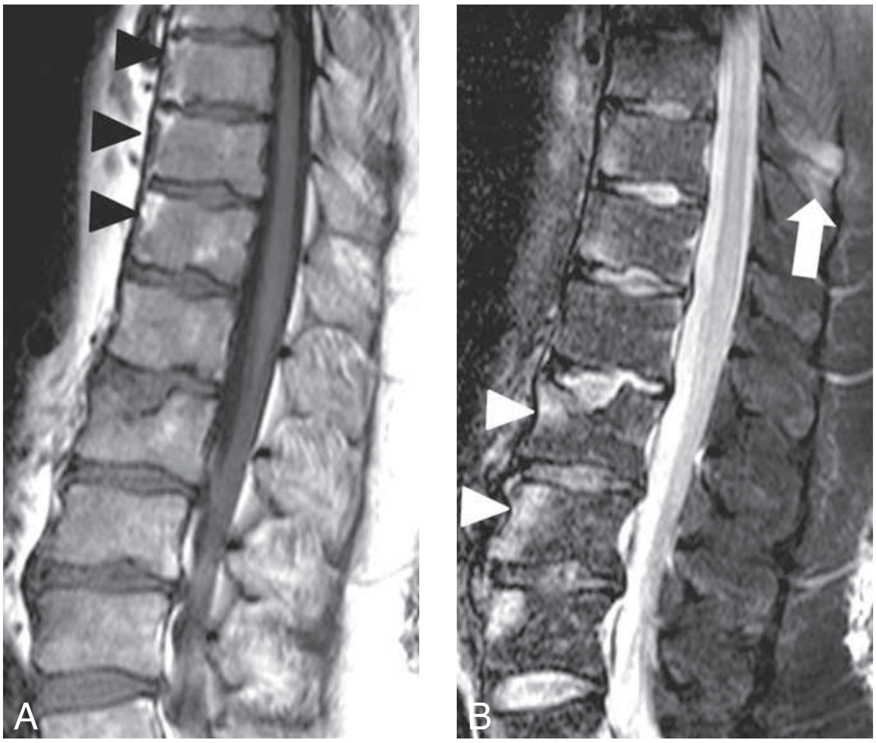

Fig. 1. — Increased sensitivity for lesion detection with fat saturation. (A) On SE T1-weighted image, areas of increased signal intensity are seen in the anterior aspect of several vertebral bodies (arrows in A). No other changes are detected. (B) On the corresponding fat-saturated water-sensitive MR images, multiple areas of increased signal intensity are detected and demonstrate active inflammatory enthesopathies.

MRI of the musculoskeletal system with fat-saturation: How to make the best of it?

B. Vande Berg

Fat-saturated sequences are obtained in almost all standard MR imaging protocols of the musculoskeletal system (MSK). Numerous fat-saturated sequences are available and differ in many aspects including technique to saturate fat signal, signal to noise ratio, sensitivity to field inhomogeneities and sensitivity to gadolinium-induced changes in relaxation time (Table I) (1, 2).

As a main advantage, fat-saturation is associated with increased sensitivity for lesion detection on water-sensitive sequences in all components of the MSK system including cartilage, muscles, tendons and marrow. Lesion conspicuity is generally increased due to the decreased signal intensity of the normal adjacent tissues. When an adequate fat-saturated sequence is obtained after gadolinium intra-venous injection, it usually provides (intra-articular or intravenous) better detection of signal intensity enhancement than the conventional SE T1-weighted sequence.

Consequent to this increase in sensitivity for lesion detection, fat-saturated sequence usually show decreased specificity for lesion characterization which is related to a narrowed range of signal intensity of abnormal tissue in comparison to SE T2-weighted sequences. As an example, SE T2-weighted sequence is superior to fat-saturated water-sensitive sequences for the differentiation of pure water from hydrated tissue or of marrow edema from red marrow. Fat saturated SE T1 sequences may contribute to lesion characterization in differentiating fat from hemorrhage. The use of fat saturation is

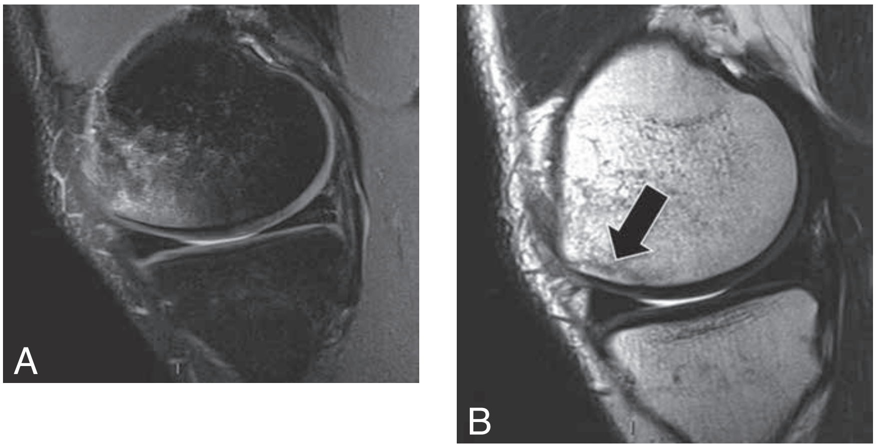

Fig. 2. — Decreased specificity for lesion characterization with fat-saturation. (A) Fat saturated fluid-sentive sagittal image of the knee after knee trauma demonstrates a subchondral area of increased signal intensity. The lesion is non specific but compatible with a marrow contusion. (B) The corresponding T2-weighted SE image demonstrates a line of low signal intensity (arrow) indicative of an impaction fracture.

associated with loss of anatomic landmarks, better seen on SE T1-weighted sequences.

In conclusion, fat-saturated sequences must be widely used for optimized lesion detection. Standard T2-weighted SE sequence should be obtained when lesion characterization is temptated.

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1. Department of Radiology IREC Cliniques universitaires Saint-Luc 10 avenue Hippocrate, 1200 Brussels Belgium.

FDG PET/CT in musculoskeletal malignancy

I.D. Lyburn[1]

Positron emission tomography/computed tomography (PET/CT) has a number of roles in the management of patients with musculoskeletal malignancy. Information of particular benefit to patient management is yielded when findings are correlated with comprehensive clinical information and features on other imaging modalities. PET/CT may be used to determine whether a lesion is benign or malignant and in known malignant lesions grade the primary and identify metastases. Treatment response and potential recurrence can also be evaluated (1).

The main isotope utilized in current clinical oncologic practice is 2-deoxy-2-(^{18}F) fluoro-D-glucose (FDG), a glucose analog, with the positron-emitting radioactive isotope fluorine-18 substituted for the normal hydroxyl group at the 2′ position in the glucose molecule (2).

Most malignancies in the musculoskeletal system overexpress glucose transporters and show increased hexokinase activity. After being phosphorylated by the hexokinase, FDG does not continue along the glycolysis pathway and is intracellularly trapped. Uptake of tracer at a specific point can be semi-quantified; the standardised uptake value (SUV) may be calculated from normalising the injected tracer dose to the patient's weight (2).

A low level of FDG uptake suggests that a bone lesion is likely benign; high uptake is more likely to represent malignancy (primary or metastatic). This feature is not specific – low levels of uptake may occur in malignancies such as chondrosarcoma and myeloma (1,3); a high level of uptake may be seen in a wide range of non malignant lesions including fractures, enchondroma and Paget disease (1).

In soft tissue tumours, low uptake is of limited value (low grade sarcomas may not be FDG avid). High uptake is more useful, usually indicating intermediate or high grade malignancy. Delayed imaging may differentiate benign from malignant lesions, with malignant lesions demonstrating increase in avidity on later acquisitions.

There are a number of uses of FDG PET/CT in the evaluation of known musculoskeletal tumours: staging, guiding biopsy and tumour grading (Fig. 1). Post treatment, response to therapy can be assessed and, when MRI appearances in treatment beds are equivocal, recurrence may be identified.

In multiple myeloma FDG PET/CT is useful in evaluating initial extent of disease and treatment response, especially in non-secretory disease. FDG PET/CT is particularly useful in post treatment monitoring – the functional aspect often providing more definitive information than

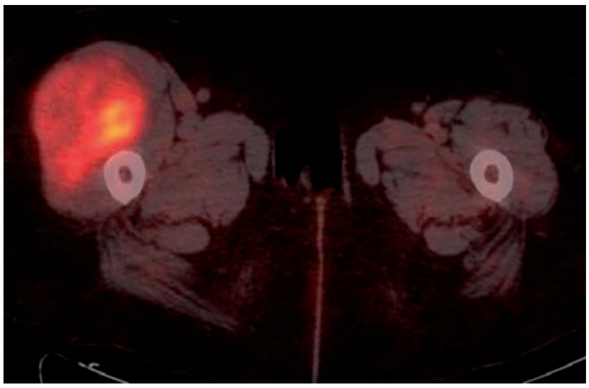

Fig. 1. — 59-year-old woman with a sarcoma of the anterior compartment of the right thigh. Axial fused PET/CT. Whole body MIP PET. The uptake is heterogeneous with more avidity medially – biopsy targeted to this site may yield the most aggressive region of the tumour.

MRI which may display a range of features with difficulty differentiating response from progression (3).

There are a number of indications for FDG PET/CT in evaluating bone and soft tissue lesions and known malignant lesions. The diagnostic yield is greatly enhanced when correlating with other imaging modalities.

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1. Department of Molecular Imaging, Cobalt Imaging Centre, Thirlestaine Road, Cheltenham GL53 7AS, UK.

Imaging of osteoarthritis update

E. Oei[1]

Osteoarthritis (OA) is the most prevalent and costly joint disease and attributes most to impaired physical well-being and quality-of-life on a population level. Because of population ageing and rising obesity rates, OA prevalence is expected to increase with 50% in coming decades. OA is, therefore, considered a population disease with tremendous consequences for patients and society. OA cannot be stopped, slowed, or cured, and treatment currently is symptomatic or entails joint replacement for end-stage disease. Research efforts to develop disease-modifying OA drugs have been unsuccessful. An important reason for this is that current OA imaging techniques focus on morphological joint tissue damage, cannot detect early OA, are insensitive to OA progression, and correlate poorly with symptoms. Early OA diagnosis is, however, essential because novel OA interventions have highest impact in early disease.

Classic radiographic OA features consist of osteophytes, cartilage defects/joint space narrowing, subchondral sclerosis and cysts. A novel pathological concept is introduced in which OA is considered a “whole joint disease”, implying that all joint tissues are affected instead of articular cartilage and bone alone. Many of these affected tissues, e.g. synovium, meniscus, and ligaments, can be assessed with clinical MRI.

“Traditional” radiographic OA assessment provides indirect visualization of articular cartilage loss, i.e. joint space narrowing, associated with advanced OA. “Traditional” MRI methods for OA also rely on morphological cartilage loss – thinning and defects – that represent advanced stage OA. A number of semiquantitative morphological MRI scoring methods for OA exist, of which the most recent MRI Osteoarthritis Knee Score (MOAKS) is discussed. All current MRI scoring systems share important limitations: they are laborious and lack a cut-off point and severity grading for OA. Thus, traditional radiographical and MRI methods for OA are unsuitable for advanced OA research because they are too insensitive to OA change, too subjective, and all focus on advanced stages of the disease.

Advanced quantitative MRI techniques to assess OA are discussed in the remainder of the lecture. Two different concepts of quantitative MRI of cartilage can be distinguished: quantitative morphometry and quantitative compositional (or biochemical) MRI. Quantitative cartilage morphometry provides a numerical outcome of articular cartilage morphology (e.g. thickness or volume) after manual or automated segmentation. Although this increases sensitivity compared to visual radiographical and MRI methods, these techniques are also very laborious and are incapable of evaluating early stage OA.

Quantitative compositional MRI of cartilage enables visualization of articular cartilage structure and biochemical composition, which can be mapped in various joint regionst and quantified to provide an objective numerical outcome measure of cartilage quality. By assessing cartilage composition changes rather than morphology alterations, such techniques are sensitive to detect the earliest stages of OA, as it is known that change in cartilage composition occur long before the onset of morphological cartilage loss. The main composites of articular cartilage are type 2 collagen (15%), proteoglycans (glycosaminoglycans) (15%) and water (70%), collectively referred to as the extracellular matrix of cartilage. These components of cartilage can be evaluated with a variety of novel quantitative MRI techniques, such as delayed gadolinium enhanced MRI of cartilage (dGEMRIC), T2 mapping, T1rho mapping, sodium MRI, and GagCest. Some of these techniques can also be applied to meniscus. CT arthrography with a negatively charged contrast agent administered intra-articularly can also be used to measure proteoglycan content in a similar way as dGEMRIC, providing additional high resolution information on subchondral bone. Advanced MRI techniques are also increasingly applied to other joint tissues. For example, it is possible to image synovitis without contrast agents with the use of novel diffusion weighted imaging pulse sequences.

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1. Department of Radiology, Erasmus MC, University Medical Center Rotterdam, Dr. Rotterdam, The Netherlands.

MR imaging of osteomyelitis of the peripheral skeleton (including diabetic foot)

A. Navas, H. Bloem[1]

The clinical diagnostic of osteomyelitis can be challenge especially in acute phases mimicking malignancies in some cases. Due to this, imaging techniques play an important role for an accurate diagnosis. However, despite the tremendous advancement in the imaging of bone infection, it remains a challenge to detect and diagnose osteomyelitis at an early stage. The implication of early diagnosis is that early treatment increases the cure rate and reduces complications.

Conventional radiography should always be the first imaging modality to start with, as it provides an overview of the anatomy and the pathologic conditions of the bone and soft tissues of the region of interest. Nevertheless, radiographs are often negative. After initial radiography, magnetic resonance (MR) imaging is the modality of choice for the evaluation of osteomyelitis and soft-tissue infection, with sensitivity of 90% and specificity of 83% (1). It also provides good anatomic detail and accurate information of the extent of the infectious process and involved soft tissues. The MR imaging examination should be tailored to the patient and the specific clinical concern.

MR is also effective in monitoring treatment in osteomyelitis, but clinical improvement precedes changes on MR images. One sign detected on MR, return of yellow bone marrow, is a late but very specific sign of healing (2). MR imaging allows also, if necessary, preoperative mapping, in complicated cases. MR also plays a key role for an accurate diagnosis in the diabetic foot. Diabetes-related foot problems like osteomyelitis and Charcot neuro-osteoarthropathy are associated with a high morbidity and high healthcare costs. Osteomyelitis develops, almost exclusively, by the contiguous spread of infection from skin ulceration at predictable sites, whereas neuroarthropathy is primarily articular. These features may help distinguish neuroarthropathy from osteomyelitis at MR imaging. Nevertheless, the presence of neuroarthropathy may limit the specificity of MR imaging for the detection of a superimposed infection. However, patients with neuroarthropathy and an ulcer that extends to the bone are more likely to also have osteomyelitis than the patients with no pre-existing neuroarthropathy. In these patients, MR imaging is performed to evaluate the extent of disease rather than make a diagnosis. Also several MR imaging features may be useful for distinguishing neuroarthropathy with superimposed osteomyelitis (3).

Conclusion

The diagnostic imaging of osteomyelitis can require the combination of diverse imaging techniques for an accurate diagnosis, but MR imaging plays a key role in the workup of osteomyelitis from the diagnose to the preoperative mapping as well as for an accurate diagnosis in the diabetic foot.

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1. Leiden University Medical Center, Leiden, The Netherlands.

Whole body, Dynamic contrast-enhanced and Diffusion MR Imaging in MGUS and Multiple Myeloma

K. Verstraete, J. Dutoit[1]

Bone marrow can be investigated with whole body MRI (WB-MRI), dynamic contrast-enhanced MRI (DCE-MRI) and diffusion MRI. Optimal imaging in patients with plasma cell dyscrasias (monoclonal gammopathy of unknown significance (MGUS), solitary plasmocytoma, smouldering myeloma, and multiple myeloma (MM)) consists of T1- and fat-saturated T2-weighted imaging of the whole body in coronal plane and of the spine in sagittal plane, in combination with DCE-MR and diffusion MRI of the spine in sagittal plane. WB-MRI allows to detect focal, mixed and diffuse bone marrow infiltration, whereas DCE-MRI depicts tumoral neovascularization and diffusion MRI reflects tumoral cell density. The combination of these 3 techniques is required for optimal diagnosis and monitoring of therapy (drugs, radiation therapy and stem-cell transplantation) (Fig. 1).

Whereas WB-MRI alone might be sufficient for diagnosis of advanced stages of MM, additional imaging with DCE-MRI and diffusion MRI are required to detect the angiogenetic switch and advanced cell proliferation in patients with progression from MGUS and smouldering myeloma to MM, for assessment of response to therapy, and for early detection of relapse after therapy.

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1. Department of Radiology and Medical Imaging, Ghent University Hospital, Ghent, Belgium.

FDG PET/CT: Arthritides, other non-malignant bone disorders and physiological patterns

I.D. Lyburn[1]

2-deoxy-2- (^{18}F) fluoro-D-glucose (FDG) will accumulate in tissue in proportion to the rate of glucose utilization. FDG uptake in cells is related to glucose transport protein 1 (GLUT1). In addition to many malignant cells, stimulated macrophages, neutrophils and lymphocytes overexpress GLUT 1 – thus areas of inflamma-

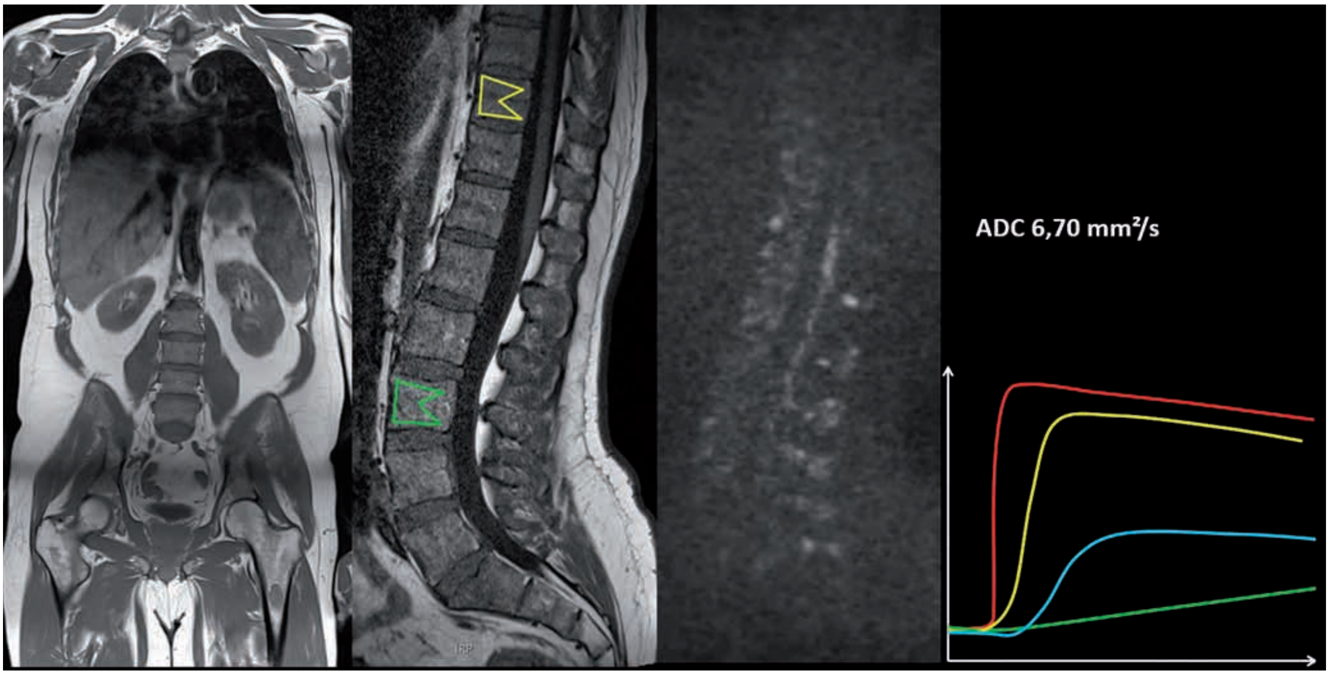

Fig. 1. — Coronal T1 of the body, sagittal T1 of the spine, sagittal diffusion MR of the spine (B1000) and dynamic contrast enhanced MR (Time-intensity curve) show full invasion of the pelvis and spine, with diffusion restriction and increased vascualization and perfusion (high first-pass followed by wash out).

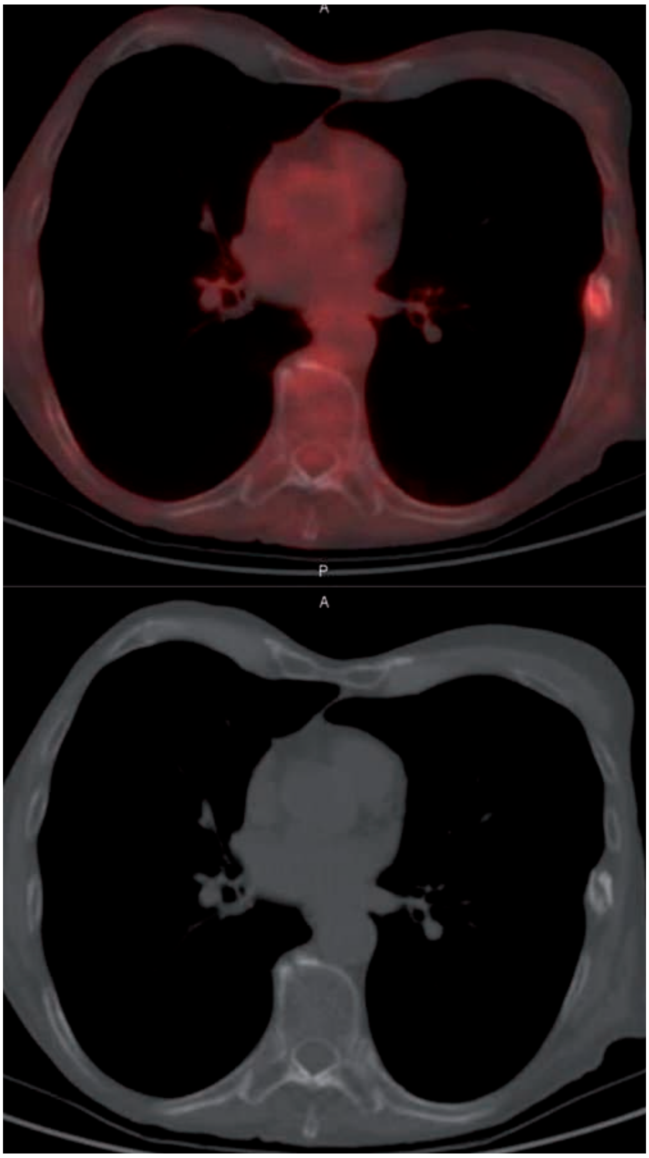

Fig. 1. — Focal uptake in the lateral aspect of the left 7th rib at the site of a traumatic fracture. Axial fused PET/CT and CT images.

tion and infection may acccumuated FDG. Physiologically active cells utilising glucose also accumulate FDG (1).

When a scan is being undertaken for an oncologic indication these variants should be considered. Correlation with clinical data and other imaging studies should alert the interpreter in many cases to potentail non malignant causes of FDG accummulation.

Physiological muscular uptake is common. Widespread uptake may occur after insulin injection and recent exercise. In respiratory disease, increased respiratory effort can result in prominent uptake in the diaphragmatic crura and accessory muscles. In the neck sternocleidomastoid and longus colli are frequently affected. The pattern is usually linear following the contour of the muscle which is of normal morphological appearance. Occasionally focal asymmetrical uptake may be difficult to differentiate from a focal lesion such as an intramuscular metastasis (1-2).

Diffuse physiological uptake occurs in red marrow conversion associated with anaemia, many chemotherapy regimens and during granulocyte colony-stimulating factor administration. Traumatic and insufficiency fractures can cause focal uptake, sometimes years after being sustained (Fig. 1). Periarticular uptake is seen in inflammatory arthropathies and degenerative osteoarthritis (1-3).

White fat stores energy; brown fat generates heat. Focal uptake may occur in brown fat and be particularly avid. Neck/supraclavicular uptake is most common and is usually symmetrical. Other areas include the axillae, interatrial septum, paraspinal region and perinephric space (1-2).

As uptake may occur in infection and inflammation this phenomena may be exploited to evalute such conditions. Indications for scans, with relatively small series to date include: chronic osteomyelitis; differentiation of infection from acute neuropathic osteoarthropathy in complicated diabetic feet; assessing protheses for infection and response to treatment in inflammatory arthropathies (3).

With FDG uptake being non specific and occurring in areas of high physiological activity and inflammation in addition to malignancy, knowledge of these patterns aids diagnostic accuracy in interpretating PET/CT scans.

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1. Cobalt Imaging Centre, Thirlestaine Road, Cheltenham GL53 7AS, UK.

Ultrasound of Large Joints

M. van Holsbeeck, G. Vanderschueren[1]

In recent years, ultrasound of small joints has received a lot of attention as research tool for identification of early rheumatoid and psoriatic arthritis. Small joint arthrosonography has also been used for research follow-up of disease of synovia and entheses.

In the imaging diagnosis of musculoskeletal disease, ultrasound has the potential of playing a much bigger role however in the evaluation of large joints. The greatest strengths of ultrasound for the investigation of these joints relates to its unique capability in assessing capsular structures, its capability of recording dynamics of articular pathology and its resolution of crystalline material.

In respect to other imaging techniques, these features of the ultrasound examination compliment the radiographic, CT and MRI work-up of articular disease. The ultrasound-guided sampling of fluid or synovium can in some cases radically change the differential diagnosis.

The revolution that ultrasound has brought about in imaging of large joints in our practice will be explained through examples of the pathologic diagnosis of gout, rheumatoid arthritis, and a variety of more rare inflammations and tumors of large joints.

For large hospital practices, ultrasound as diagnostic sampling tool has the potential to fulfill the role for articular pathology that CT and fluoroscopy have acquired for bone tumor pathology.

1. From the Henry Ford Hospital, USA, and from the KU Leuven, Belgium.

Social Media in Radiology – Part II
A practical approach

E.R. Ranschaert[1]

Radiologists can use social media for many purposes, such as gathering news and information about radiology, connecting to professional and/or scientific networks, blogging, training and teaching, bookmarking and sharing of information, discussing and solving interesting cases, virtually attending congresses etc. Several radiological societies such as the ESR and RSNA are aware of the enormous potential of social media and now leverage this technology to improve communication with their members. Social media are increasingly being used at major radiological meetings in order to increase the engagement of attendees, to improve the scientific sessions and to promote collaboration between participants. The ESR has developed several channels on social media such as Facebook, Youtube, Twitter and Blog (WordPress). In the first half of 2014 the myESR Facebook page counted more than 164.000 fans and the myESR Twitter site had 3667 followers. The RSNA also increased its presence on social media and arrived at 40.000 members on Facebook and 15.000 on Twitter. Many other radiology-related pages can be found on Facebook, such as educational resources, scientific journals, news about radiological congresses and announcement of radiological events (e.g. the International Day of Radiology). Twitter is a micro blogging medium and is ideal to quickly find or post news and information about a variety of topics connected to radiology. Using Twitter is also called “micro-blogging” since the messages (“Tweets”) can only contain a limited amount of words, which often refer or are linked to other articles, papers, images or events. Topics of interest for radiologists can be found on Twitter by searching a key word preceded by a hash tag (#). By using Twitter radiologists aren’t only able to engage with other colleagues, but also with patients from around the globe. Many radiologists follow the so-called “radiology influencers”, radiologists that frequently post relevant information on Twitter. Blogs on the other hand are more extensive messages or articles posted by social media users on specific blogging platforms. Several radiologists and organisations have created such blogs, such as the myESR Dr. Pepe’s Casebook and the ESR News blog. Youtube is a video sharing website that has numerous “social” features for sharing and viewing of media. Radiological organisations and radiologists are using this medium to post educational information. The myESR Youtube page includes trailers, teasers, video reports and interviews and currently has 104.000 followers. ECR lectures are made available on this site and can be accessed after the yearly meeting in Vienna. LinkedIn is another very popular social network that is mainly used for professional purposes. Hospitals and health care professionals represent approximately 8% of the current users. Radiological Wiki’s are open-edit radiology resources that are created by users motivated to add or modify radiological content, which can be accessed by anyone. Radiopaedia.org is an excellent example. SlideShare is a slide hosting service that allows its users to upload presentations privately or publicly. Users can rate, comment on or share uploaded comment. This platform already has 16 million users and also contains interesting information about radiological topics. Scientific networks such as ResearchGate and BiomedExperts are sites where medical professionals, scientists and researchers can create a network with collaborators, co-authors and other users with the same fields of interest. Currently it counts 180.000 members in multiple disciplines ranging from biological sciences to radiology. Easy access to numerous scientific publications, abstracts and topics or discussions is offered to all its members. More practical information regarding the usage of these social media will be presented during the lecture.

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1. Department of Radiology, Jeroen Bosch Ziekenhuis, ’s-Hertogenbosch, the Netherlands.

Obituary

Dr G. Penneman de Bosscheyde, member of the Society passed away on 15.09.2014.

The BSR assures his family of its support and sympathy in the ordeal.