Tendons of the hand and wrist
J. Jacobson; Ann Arbor, MI/US

After discussion of tendon anatomy, this presentation will focus on tendon pathology as seen on MR imaging and ultrasound. The high resolution of ultrasound and the ability to perform dynamic imaging and imaging-guided intervention makes this an ideal imaging method in the assessment of tendon disorders. Tendon and tendon sheath pathology of the hand and wrist can be divided into various categories, such as trauma, inflammation, and masses. With regard to trauma, topics to be discussed include tendon tear, tendon subluxation/dislocation, intersection syndrome, and de Quervain tenosynovitis, including ultrasound-guided injection of the latter condition. Pulley injuries as well as trigger finger will also be addressed. With regard to inflammation, tenosynovitis will be discussed in the setting of rheumatoid arthritis, systemic lupus erythematosus, and gout. With regard to masses, the topic of giant cell tumor of tendon sheath (or pigmented villonodular tenosynovitis) will be discussed.

Nerves of the forearm and hand
C. Martinoli, L. Oppezzi, B. Bignotti, A. Tagliafico; Genoa/IT

A variety of peripheral neuropathies can be encountered about the forearm and wrist affecting the median, the radial and the ulnar nerve. Most are entrapment syndromes and include: the pronator syndrome, the anterior interosseous neuropathy (Kiloh-Nevin syndrome) and the carpal tunnel syndrome for the median nerve; the posterior interosseous neuropathy and the Wartenberg syndrome for the radial nerve; the Guyon tunnel syndrome for the ulnar nerve. Although clinical examination and nerve conduction studies are the mainstays of the diagnostic work-up of peripheral neuropathies, ultrasound (US) and magnetic resonance (MR) imaging may provide key information about the exact anatomic location of a lesion and the nature of the constricting finding or may help narrow the differential diagnosis. In patients with peripheral neuropathies around the forearm and wrist, US and MR imaging may provide critical information for planning an adequate treatment strategy. A deep knowledge of the normal anatomy and of the possible causes, typical clinical findings, and imaging features of peripheral neuropathies that affect the median, radial, and ulnar nerves allows greater confidence in the diagnosis. Although US and MR imaging have followed parallel paths for nerve imaging with little comparison of the two modalities, US seems to have some advantages over MR imaging, including higher spatial resolution, time effectiveness, the ability to explore long nerve segments in a single study and to examine tissues in both static and dynamic states.

Nerves of the forearm and hand
P. Peetrons; Brussels/BE

Ultrasound of the peripheral nerves is a fast growing indication of diagnosis by sonography. The nerves are easy depicted using the “elevator” technique which consists to find the nerve in an easy anatomic location (elbow or wrist for example) and to move the transducer following it proximally and/or distally, keeping the nerve and its main branches on the screen. The following nerves will be demonstrated: - Radial nerve and its terminal motor branch, the posterior interosseous nerve, responsible of the “finger drop” and its terminal sensitive branch which can be damaged on the dorsolateral wrist (Wartenberg syndrome). - Medial nerve and its motor branch, the anterior interosseous nerve, responsible of the palsy of the flexor pollicis longus and the medial part of the deep flexor digitorum. The terminal sensitive branch will be examined mainly because of compression in the carpal tunnel syndrome - Ulnar nerve, with its terminal sensitive and motor branches and their possible compression at the level of the Guyon canal and the hook of the hamate.

Joint anatomy and arthritis screening protocols
A. Plagou; Athens/GR

The aim of this presentation is to demonstrate the advantages and limitations of ultrasound in the anatomical assessment of the hand and wrist joints and to review the current screening protocols in patients with arthritis. A crucial feature in the anatomy of synovial joints is that the surface of the articulating bones is covered with cartilage except for a small region at the insertion of the joint capsule. In this area the bone is covered by synovium only. In this, so called “bare area”, the bone surface is in direct contact with the synovial tissue and is very susceptible to synovitis-induced bone destruction. The role of ultrasound is to demonstrate the intra-articular component of the disease, namely synovitis and erosions. Several studies have shown that ultrasound can demonstrate synovitis that is silent to clinical examination and depict erosions before they are radiologically evident. Another advantage of ultrasound is the use of colour Doppler, which provides grading of neovascularisation within the synovial lining of joints. The main limitations of ultrasound lie in the assessment of cartilage and deep joint structures. The small joints of the hands and feet as well as the wrist and tarsal joints are very important in the diagnosis and classification...
of arthritis. High frequency ultrasound transponders with a good quality of coupling jelly and very light contact pressure with the transducer can provide detailed anatomic pathology, which is increased by using dynamic imaging. Tendons tend to be identified by the combination of a hypoechoic area surrounded by a normal surrounding hyperechoic tissue. The tendon insertion sites are easily defined. Synovitis: In joint disease, the synovial membrane can become hyperplastic, leading to an increase in synovial fluid. This can be detected by ultrasound as an increased echogenicity of the synovial membrane, which is often accompanied by an increase in Doppler signal intensity. Erosions: Bone erosions are defined as intra-articular discontinuities of the bone surface that can be detected by ultrasound. They are typically associated with synovitis and can be visualized as hypoechogenic areas in the bone. Joint infections: Infection of the joint can be detected by ultrasound as a Hypoechoic area with increased Doppler signal intensity, indicating inflammation. Synovial thickening and hypoechoic areas can be observed. Ultrasound has great potential for non-invasive study of hyaline cartilage, as it can depict microscopic lesions to be demonstrated with a high spatial resolution. Ultrasonography provides rapid and reliable information about the characteristics of articular cartilage, without radiation risk or patient discomfort. The outcome measurement in rheumatoid arthritis and osteoarthritis groups is defined bone erosion as an intra-articular discontinuity of the bone surface that is visible in two perpendicular planes. Acute erosions generally have an irregular margin and a poorly defined base, which allows through transmission of sound and are associated with active synovitis. Bone erosions result from proliferative synovitis. They are less frequently bilateral than synovitis or tenosynovitis. In rheumatoid patients, US can visualize pre-erosive changes, particularly at the level of the ulnar styloid process, the radial aspect of the second MCP joint, the ulnar aspect of the fifth MCP joint, and the lateral aspect of the fifth MTP joint together with loss of the cartilage layer and irregularities of the subchondral bone. A common pitfall is the normal depression that is present on the dorsal aspect of the head of the proximal interphalangeal joint, which can be confused with a bone erosion. The desired treatment of joint disease is to prevent progression of joint damage and to improve the patient's quality of life. Ultrasound is a useful tool for the diagnosis and follow-up of joint disease, as it can provide detailed anatomic pathology, which is increased by using dynamic imaging.
Soft tissue masses in the hand and wrist
G. Allen; Oxford/UK

This presentation will cover the use of ultrasound in identifying and analysing soft tissue masses within the hand and wrist. The deleter will be taught the strengths and weaknesses of ultrasound in the diagnosis of common disorders such as ganglia, rare diseases such as giant cell tumours and the exceptional cases of aggressive malignancies. It will cover the relative value of ultrasound with respect to MRI and will demonstrate the advantage of colour Doppler imaging. The overall aim is to place ultrasound in its proper context as a valuable screening tool. Intervention by ultrasound guidance will be discussed and their role placed in a proper clinical context. Finally there will be emphasis on when and where to refer patients for specialist services.

Gamekeepers/Skiers thumb
J. Jacobson; Ann Arbor, MI/US

Ulnar collateral ligament (UCL) injuries of the thumb, frequently referred to as Gamekeeper’s thumb, are common with up to 200,000 estimated injuries annually. While historically described in Scottish gamekeepers, these injuries occur with other forms of trauma such as skiing accidents. The differentiation of non-displaced ulnar collateral ligament tear from displaced tear (Stener lesion) is critical, as prompt surgery is required in the latter to avoid further instability and joint degeneration. While physical examination is useful in the assessment of these injuries, imaging is usually necessary to more accurately determine the severity of the injury. Routine radiographs serve as initial imaging to determine presence of fracture but are insensitive to soft tissue injury. Currently, magnetic resonance (MRI) imaging and ultrasound are the principal imaging methods that allow direct visualization of the UCL. Magnetic resonance imaging can delineate the ligament injury and identify a Stener lesion, which has a characteristic “yo-yo on a string” appearance on MRI. Ultrasound has also been shown to be effective in the diagnosis of UCL tears, including Stener lesions. This presentation will review anatomy of the first metacarpophalangeal joint and various injuries of the UCL as seen with ultrasound and MRI imaging. Several important aspects of ultrasound examination technique will be emphasized, including bone landmarks to identify the UCL location, and the use of dynamic imaging to visualize UCL tears and the overlying adductor aponeurosis. Variations and misconceptions related to the location of the Stener lesion will be addressed as well.

ECU instability
H. Guerini, J.-L. Drape; Paris/FR

Pain on the ulnar side of the wrist is common among elite tennis players and involving the extensor carpi ulnaris (ECU) tendon. The ECU tendon is stabilised by the actual ECU retinaculum in the osseous groove. Two clinical patterns are described: acute instability of the ECU with tears of the retinaculum and tendinopathy. Each clinical entity requires different therapeutic management. Ultrasound with stress tests and MRI are useful as diagnostic tools and to help monitor the healing process. Anatomical identification of the actual ECU retinaculum and its lesions remain key elements in the stability of the ECU and ulnar sided wrist pain in high level tennis players.

Instability of the distal radioulnar joint
R. Sutter; Zurich/CH

The distal radioulnar joint (DRUJ) is important for the wrist function and is involved in forearm rotation and in load and force transmission. The main stabilizers of the DRUJ are the triangular fibrocartilage and the distal radioulnar ligaments, but also the joint capsule, the ulnocarpal ligaments, the extensor carpi ulnaris, the pronator quadratus, and the bony joint configuration have been reported to contribute to the stability of the joint. DRUJ instability can present with ulnar-sided wrist pain and may necessitate a surgical ligament reconstruction. DRUJ instability is first assessed during the physical examination, where a discrepancy of the dorsopalmar shift of the left versus the right DRUJ may be present. At computed tomography, magnetic resonance imaging, and sonography, several methods are available in order to quantify DRUJ instability, for instance by repeated alignment measurements in pronation, neutral position, and supination, or by repeated measurements at dynamic imaging.

Pulley injuries and trigger finger
G. Rajeswaran; London/UK

Purpose: To describe the role of imaging in diagnosis and management of pathology of the retinacular pulley layer of the digital flexor sheath.


Results: See above.

Conclusion: Pathology of the retinacular pulley layer of the digital flexor sheath is relatively common and imaging is central to diagnosis and management.

US intervention in the hand and wrist
L. M. Sconfienza; Milan/IT

Given its intrinsic features, ultrasound is ideal to guide interventional procedures in the hand and wrist. This imaging modality may be used to guide injections and drainages throughout the different compartments of this anatomic area. In the hand, ultrasound guidance can be effectively used to guide percutaneous treatment of trigger finger. Also, it can help to perform metacarpophalangeal injections in patients affected by inflammatory or degenerative arthritis.

TFC and wrist ligaments: Is there a role for US?
E. G. G. McNally; Oxford/UK

The dorsal limb of the scapholunate ligament is easily assessed using static and dynamic techniques. Ganglion cysts is the commonest pathology. Diagnostic features and techniques for successful aspiration will be described. Lunotriquetral ligament can also be recognised. The principle extrinsic ligaments can be identified, as can the supporting ligaments of the TFC, but the usefulness of ultrasound in assessment of pathology of these structures has yet to be fully defined.

What does the hand surgeon want to know from MRI?
M. Zenetti; Zurich/CH

Generally, the hand surgeons want to know the surgically treatable pathologic conditions. MRI has to provide the unequivocal diagnoses of fractures clearly differentiated by bone bruise. Hamate fractures and scaphoid fractures should not be missed. The assessing of the viability of the proximal scaphoid pole is necessary to help surgeons plan the treatment of scaphoid nonunion. Deep cartilage defects prompting to bone fusion has to be diagnosed. Triangular fibrocartilage defects and intercarpal ligament tears has to be diagnosed including the exact location: radial or ulnar TFC, palmar or dorsal intercarpal tears. The detection of ganglia and its relationship to pathologic findings is crucial. The detection of impaction syndromes (e.g. at the lunate) plays an important role when ulnar length reduction is considered as treatment. Lunate malacia has to be differentiated. Muscle variants and vessels variants have to be described in carpal tunnel syndromes. Non surgical diagnoses such as rheumatoid arthritis and tenosynovitis should be noted as well.
Cadaveric anatomy of the hand
M. I. Miguel Perez1, C. Martinolli2; 1Barcelona/ES, 2Genoa/IT

Objective: To become familiar with the normal anatomy of the extrinsic capsular wrist ligaments as described in the literature. The wrist ligaments are divided into two major categories: extrinsic capsular and intrinsic interosseous.

Introduction: The wrist ligaments are divided into two major categories: extrinsic capsular and intrinsic interosseous. The extrinsic capsular ligaments are categorized into the palmar and dorsal extrinsic capsular ligaments, which are further divided into intrinsic and extrinsic ligaments.

Palmar extrinsic capsular ligaments:

1. The ulna radioulnar ligament (PULL) and the palmar ulnotriquetral ligament (PUTL) interconnect the ulna and radius and support the palmar radiocarpal ligament. The PULL originates from the volar side of the distal radius and is inserted into the lunate. The PUTL originates from the volar side of the distal radius and is inserted into the triquetrum.

2. The ulnar collateral ligament (UCL) is a palmar extrinsic capsular ligament that prevents ulnar deviation of the wrist. The UCL originates from the volar aspect of the distal ulna and attaches to the triquetrum. It is composed of two fibers: the superficial and deep ligaments.

3. The palmar scaphotriquetral ligament (PSTL) is a palmar extrinsic capsular ligament that connects the scaphoid to the triquetrum. The PSTL is composed of two parts: the superficial and deep ligaments.

Dorsal extrinsic capsular ligaments:

1. The radial collateral ligament (RCL) is a dorsal extrinsic capsular ligament that prevents radial deviation of the wrist. The RCL originates from the dorsal aspect of the distal radius and is inserted into the scaphoid.

2. The radioscapholunate ligament (RSLL) is a dorsal extrinsic capsular ligament that connects the scaphoid to the lunate. The RSLL is composed of two parts: the superficial and deep ligaments.

3. The palmar radiocarpal ligament (PRCL) is a dorsal extrinsic capsular ligament that connects the scaphoid to the lunate. The PRCL is composed of two parts: the superficial and deep ligaments.

Conclusions: The wrist ligaments are important for the stability and function of the wrist joint. Understanding their anatomy is crucial for the diagnosis and treatment of wrist injuries. The wrist ligaments can be divided into extrinsic capsular and intrinsic interosseous ligaments. The extrinsic capsular ligaments are further divided into palmar and dorsal extrinsic capsular ligaments. The most important palmar extrinsic capsular ligaments are the PULL, PUTL, UCL, and PSTL. The most important dorsal extrinsic capsular ligaments are the RCL, RSLL, PRCL, and the radiolunate (RL) ligament.
Malformations of the hand and forearm in children: what radiologists should know
N. Bouthy, J. Aucourt, Lille/FR

Carpal coalition involves the presence of one or more bony bridges between bones of the carpus. This is a very common finding that may be divided into three categories based on the location of the coalition: intra-articular, inter-articular or extra-articular. It has been described in the medical literature. Most are asymptomatic and incidental findings at imaging. In some instances, however, these malformations may become clinically relevant producing paucible swelling, entrapment pain or forearm weakness and weakness. Knowledge of normal anatomic variants and other diagnostic pitfalls is important for accurate analysis of wrist and hand imaging.

References:

Knowledge of normal anatomic variants and other diagnostic pitfalls is important for accurate analysis of wrist and hand imaging. Osseous variants include carpal coalitions, the carpal boss, and the Type 2 lunate. The most common isolated carpal coalition is the luno-triquetral, followed by the capito-hamate. The carpal boss refers to a bony protuberance which is located at the dorsal aspect of the wrist joint. The carpal boss is responsible for a bony protrubance which is located at the dorsum of the wrist at the base of the second or third metacarpal bone. The Type 2 Lunate is a very common variant of the wrist joint. The type II lunate has an additional median facet articulating with the hamate. The TFC is usually hypertensive in all sequences. However, the radial and ulnar attachments of the triangular fibrocartilage often show an intermediate to high signal intensity which may be a potential imaging pitfall. The ulnar attachment is composed of two distinct laminae. The two laminae are separated by the ligamentum subcuneatum which represents fibro-vascular tissue. At the radial attachment, hyaline cartilage curves around the ulnar edge of the radius giving a linear area of high signal on fluid sensitive sequences. The extensor carpi ulnaris tendon often shows centrally increased signal which may represent a normal finding. The abductor pollicis longus tendon has a very oblong course. Often there is high signal signal high signal within this tendon distal to the fingers due to the magic angle phenomenon. Imaging variants and pitfalls are commonly found as coincidental findings and may even be misdiagnosed as relevant abnormality.

Osteoarthritis - General aspects and focus on the wrist
C. Plathow; Ettingen/DE

Osteoarthritis (OA) is the most frequent arthritic disease in the western world. More than 90% of patients with an age >75a show signs of OA. Primary osteoarthritis is a gradual process of degeneration and destruction as result of chronic microtrauma (usually >60a). Secondary osteoarthritis is a non-inflammatory degenerative joint disease resulting from predisposing events such as previous trauma, congenital deformity, infection or metabolic disorder (usually <40a). In general chondromalacia is often accompanied by subchondral sclerosis, subchondral cysts, osteophytes and/or edema. Progression of loss of articular cartilage is associated with new bone formation and capsular fibrosis. Radiography is the primary technique to detect changes. Using MRI a thinning of hyaline cartilage with occasional focal defects with hypointensity in cartilage on FS–PD–TSE is typically seen. An increased hypointensity on T1 with sharp contours may be due to granulation tissue and fibrosis or bone which are borders edema is present. In our present general recommendations of image interpretation of arthritis are presented. Focus of the presentation is osteoarthritis, especially osteoarthritis of the wrist.

Osteoarthritis of the distal radioulnar joint
F. Buck, Zurich/CH

The distal radioulnar joint (DRUJ) is a small but important joint for wrist motion. Wrist pain due to osteoarthritis of the DRUJ is a frequently encountered problem, and changes in the DRUJ are one of the most important causes of pain and disability amongst patients with rheumatoid arthritis. The cartilage at the DRUJ often seems to be thinned and small osteophytes are suspected on MR images even in patients without any symptoms. The significance of these findings is questionable. Therefore, the need for detailed anatomical knowledge and determining the most reliable criteria to diagnose osteoarthritis of the DRUJ arises. On the radial and ulnar side of the DRUJ, specific facets and areas of ligament and joint capsule attachments can be identified. The radial and ulnar osseous contours are physiologically characterized by osseous bumps at typical locations. These bumps should not be confused with osteophytes. However, they do arise at the same location as osteophytes. Characteristic cartilage distribution and thickness patterns can be found at the radial and ulnar articular facets on axial and coronal images. Based on these patterns, specific recommendations can be formulated about where cartilage loss should be sought and in which plane cartilage abnormalities are most reliably evaluated. Cartilage at the radial articular facet is best evaluated on axial images or on coronal images through the centre of the DRUJ. Cartilage at the ulnar articular facet is evaluated on axial images whenever possible. Proximal thinning of cartilage is a normal finding and should not be interpreted as cartilage thinning or cartilage loss. The localization of intra-articular areas devoid of cartilage (bare areas) at the proximal limit of cartilage coverage could potentially explain the typical localization of erosions in patients suffering from rheumatoid arthritis. Positioning of the wrist at the time of image acquisition plays a crucial role in the evaluation of the DRUJ. In maximal pronation, the joint capsule is dragged into the joint space and the ulnar articular facet is rotated dorsally and no longer articulates with the radius. Therefore, imaging in neutral position is considered mandatory.
Crystal disease of the hand
V. M. Pantani, Lille/FR

The main crystal disease of the wrist and of the hand are calcium pyrophosphate dihydrate crystal disease (CPPD), calcium hydroxypatite deposition disease (HD) and gout arthritis. CPPD is the most common crystalline arthritis in the hand and wrist characterized by crystal deposition mainly in hyaline cartilage and fibrocartilage structures. In the wrist, the lunotriquetral ligament and the triangular fibrocartilage are common involved. Narrowing of the metacarpophalangeal joints, intermetacarpal spaces and interpalpelangal joints. Gout arthritis is caused by deposition of monosodium urate crystals within joints, secondary to chronic hyperuricemia. Typical plain radiography features include tophus seen as soft-tissue or periarticular opacities. Bone erosions are typically seen as punched out, along the long axis of the bone, with overhanging edges and sclerotic rims. The joint space is well preserved until late in the disease process. If the role of chondrocrystal deposition is crucial for the diagnosis and for differential diagnosis of advanced stages of these diseases, its usefulness is limited in early-stages. Computed tomography and magnetic resonance imaging are more sensitive than plain radiography in detecting mild modifications, but are less available in daily practice and are costly. Recently, ultrasonography has emerged as a useful tool to detect crystal deposition and many studies have been contributing to delineate specific ultrasound semiology.

Collagen diseases
J. Freyschmidt, Bremen/DE

Collagen vascular diseases belong to systemic autoimmune disorders. One main point in their pathogenesis is the formation and deposition of antigen-antibody complexes (type III hypersensitivity) which leads to tissue damage. In this context a generalized vasculopathy develops with the consequence of fibroinoid degeneration (fibroinoid necrosis) with bone and soft tissue necrosis. Reactive synovitis with a highly active inflammatory pannus detroys cartilage and osseous tissues. Collagen vascular diseases include: Progressive systemic sclerosis (progressive scleroderma) Systemic lupus erythematosus (SLE) Polyarthritis and dermatomyositis Sjogrens syndrome Jone syndrome Mixed connective tissue disease (Shaps’s syndrome), an overlap syndrome of SLE, mixed connective tissue disease and primary Raynaud’s phenomenon. Radiologists are challenged in the diagnostics of progressive systemic sclerosis and Sharp’s syndrome. Typical radiologic features in the hand-skeleton are: Resorption of distal phalanges and terminal tufts Interstitial calcinosis (Thibierge-Weißenbach syndrome) Osteoporosis. In the case of mixed connective tissue disease signs of an erosive polyarthritis may be seen.

Metabolic disease
R. Arkun, Istanbul/TR

Metabolic bone disease is an umbrella term that covers a number of disorders related to the weakening of the bone or impaired systems function caused by an imbalance in vitamin D3, calcium and phosphorus. Metabolic diseases of the skeleton affect bone as a tissue; all bones are involved, although radiological abnormalities are not always evident. Such disorders can be caused by genetic, endocrine, nutritional or biochemical factors. Knowledge of bone structure, development and physiology is essential to the understanding of the effects that metabolic bone disorders have on the skeleton and in interpreting the abnormalities which may be evident on radiographs and other imaging techniques. The skeletal system is dynamic center for many important physiologic processes, including red blood cell production and calcium and phosphorus metabolism. Maintenance of physiologic homeostasis requires an adequate supply of minerals, hormones, and vitamins. Metabolic bone diseases are characterized by disruption of the normal physiologic activity of bones. Bone turnover and remodeling occurs throughout life and involves the two coupled processes of bone formation by osteoblasts and bone resorption by osteoclasts. The metabolic bone diseases may reflect disturbances in the organic matrix, the mineral phase, the cellular processes of remodeling, and the endocrine, nutritional, and other factors which regulate skeletal and mineral homeostasis. These disorders may be hereditary or acquired and usually affect the entire body skeleton. The acquired metabolic bone diseases can be classified in common and include: osteoporosis, osteomalacia, the skeletal changes of hyperparathyroidism and chronic renal failure (renal osteodystrophy), and osteitis deformans (Paget’s disease of bone). Metabolic bone diseases are also classified based on mechanism of bone turnover and remodeling. These are: Loss of mineralization: osteomalacia/ rickets Low bone mass: osteoporosis, osteogenesis Imperfecta High bone turnover: hyperparathyroidism, thyrotoxicosis, Paget’s disease Low bone turnover: hypophosphatasia Metabolic bone disease is considered when there are multiple sites of bone abnormality throughout the body with or without diffuse osteopenia. However, hand and wrist can have characteristic imaging findings for metabolic disease and some of them may mimic arthritis. Majority of metabolic bone diseases including hyperparathyroidism, renal osteodystrophy, rickets are caused by an excessive extent of bone resorption that exceeds the rate of bone formation, resulting in loss of bone mass. In hyperparathyroidism, bone resorption may occur at many different anatomic sites, osteoporosis at many different anatomic sites, osteomalacia at the base of the 4th and or 5th metacarpal will fracture but not uncommon the hamate and capitates bone will also be

Case presentation and discussion
M. Zenetti; Zürich/CH

A case to the arthritis topic will be presented and discussed.

Fracture patterns and posttraumatic assessment of hand and wrist fractures by MDCT
C. Kreisler; Vienna/AT

This lecture focuses on fracture patterns in the imaging of wrist and hand fractures with multidetector computed tomography (MDCT). The introduction will deal with various acquisition and reconstruction protocols for MDCT of the wrist to determine the optimal protocol for obtaining diagnostic image quality with minimal radiation exposure. The prevalence and the most common sites of fractures and the clinical implications will be discussed. In addition, patterns of carpal instability, including the Mayo classification, will be discussed in detail (CIC, CICI, CIND). MDCT has played an increasingly important role in patients with a high clinical suspicion for a wrist fracture and a negative or indeterminant initial radiograph. MDCT is crucial in anaylsing fractures of complex carpal fractures and dislocations prior to surgical treatment. The advantages of multidetector CT include quick and accurate diagnosis with availability in most emergency centers. Multidetector CT can easily display the extent of carpal fractures and dislocations, often depicting fractures that are occult on radiography. In addition, with multipplanar (two-dimensional) and volumetric (three-dimensional) reformation, pathologic conditions and anatomic relationships are better perceived, which is crucial for referring orthopedic and trauma surgeons. A comparison of Multidetector CT and MRI imaging in carpal fractures will be introduced at the end of this lecture.

Occlut fractures of the wrist and hand
M. C. de Jonge; Amsterdam/NL

Fractures in the wrist and hand are very common in daily clinical practice. Most fractures will reveal themselves and are usually obvious to detect on plain films. If no fracture is seen on a conventional radiograph often a diagnosis of contusion of the wrist is made. In case of missed distal radius or ulna fractures this will often not lead to any serious problems. Non-union or pseudarthrosis of distal radius fractures is very uncommon. Malunion is in fact the most common complication of a distal radius fracture but it is usually a straightforward radiologic diagnosis. It becomes more problematic if the carpal bones are involved in an injury. Due to their complicated shapes and their alignment in the wrist they are much less easily assessed on plain radiographs than the distal radius and ulna. The complications of missing carpal injuries can be potentially severe. The most common fractured carpal is the triquetrum and the scaphoid. The triquetrum fracture is most commonly an avulsion fracture at the dorsal side and usually does not pose many problems either in diagnosis of management. The scaphoid is a very notorious bone for missing fractures. The most common and severe complications of missed scaphoid fractures are avascular necrosis of the proximal pole and pseudarthrosis. They very often will result in chronic complaints and are not seldom found ‘incidentally’ on radiographs months or years after a patient time sustained a fall on an outstretched hand. The patients are often already beyond primary treatment options by that time. Multiple different radiographic views are made to detect scaphoid fractures. There is however hardly any consensus about how many views are necessary and how these views have to be made. In case of negative plain films repeat films after 7-10 days, scintigraphy, MRI and CT are all used to detect a fracture in a patient who is clinically still suspected of having a scaphoid fracture with negative plain films. There is no consensus with regards to the follow up studies in the literature and we will discuss this subject during our presentation. Other frequently missed injuries are fractures at the ulnar side of the hand; they occur with longitudinal traumas to the ulnar side in which not only the base of the 4th and or 5th metacarpal will fracture but not uncommon the hamate and capitates bone will also be
Early undifferentiated hand arthritis
C. Cytelev, MR

Early arthritis may differentiate into established rheumatoid arthritis (RA) but may also go on to remission or stay undifferentiated (UA). MRI is more sensitive for detecting destructive joint changes in early RA than plain film radiography that remains normal in 80% of cases of early RA. US (ultra sonography) is able to show synovitis and erosions (if in an accessible area) There is solid evidence that some MRI findings (synovitis, bone marrow oedema (BME), and MRI bone erosions) predict subsequent radiographic erosive progression. The presence of these findings shows a specificity of 78% and a sensitivity of 100% to confirm the diagnosis of early arthritis. MR signs of inflammation in RA are more frequent in the synovial membrane than at the insertions of ligaments and tendons (enthesitis), while the opposite is true of the seronegative spondyloarthropathies. Even if MRI hands examinations of patients with RA don’t seem to differ from those with systemic lupus erythematosus or Sjögren’s syndrome with respect to most abnormalities (global scores for synovitis, bone erosions, and tenosynovitis), there is a higher frequency of BME in the MCP joints of patients with RA. BME is considered to be a very early manifestation of inflammation closely related to the degree of synovitis and has been associated with subsequent erosive damage, as a result, it is currently considered to be a “forerunner” of erosions. BME may be seen alone or surrounding bone erosions and is considered to be a potentially reversible phenomenon. All these data support the inclusion of BME in MRI diagnostic criteria for early RA.

Psoriatic arthritis
A. Cotten, LL

Psoriatic arthritis (PsA) is an inflammatory arthritis that develops in up to one-third of patients with psoriasis. It can lead to progressive joint damage and disability. The distinctive clinicopathological lesion in psoriatic arthritis is enthesitis, explaining diverse manifestations such as a predilection for distal interphalangeal joints. Other lesions include adjacent soft tissue inflammation, synovitis, oedema, dactylitis, new bone formation and bony destruction. Early administration of disease modifying anti-rheumatic drugs (DMARDs) and especially tumour necrosis factor alpha (TNF-α) inhibitors can stop erosive changes and prevent joint damage. Thus, early diagnosis and exact assessment of this disease are mandatory for a fast initiation of these therapies. The purpose of this paper is to review the radiographic, ultrasound and MR features that should suggest the diagnosis of PsA at the wrist and hand, and to review the main differential diagnoses.

Optical imaging: Early diagnosis of RA and osteoarthritis of hand and wrist - facts and fiction
S. Waldt, Munich/DE

Optical Imaging (OI) is a relatively new, non-invasive and non-ionizing imaging modality with relatively fast image acquisition times. Results of previous studies indicated that optical imaging allows in principle for detection of inflammatory tissues in animal models as well as in humans. The major drawback of OI is the limited tissue penetration of light. However, as inflammatory arthropathies typically affect the small joints of the hands and feet, the hands appear to be a promising anatomic site for implementation of this new imaging modality. The purpose of this refresher course is to present a relatively new commercialized Indocyanine Green (ICG)-enhanced Optical Imaging (OI) system for the detection of arthritis of the hands.

Vertebroplasty/Kyphoplasty - Different cement types
F. Arapnir Rodriguez; Valencia/ES

Despite the controversy which gave rise to the publication of works that are doubted the efficiency of the vertebroplasty, at the present time Vertebroplasty and Kyphoplasty are tools of safe and universal use. Over the years since these techniques are on the market and the personal experience have shown us that we can trust and use the injection of cement and other materials as the most quick and effective method to treat the pain of vertebral fracture types A1 and A2, classication, AOI and also in the majority of cases increase the stability. Known problems that we have to ask ourselves that ideally should be the vertebroplasty and kyphoplasty. From my point of view the kyphoplasty and vertebroplasty must be easy implementation, with needles of the smaller caliber possible for facilitating percutaneous use safely inject biocompatible materials allowing the recovery of the structure of the spine to be cheap. If we now focus on paragraph entitled to us by types of cement, note that there are two groups that we call within the biocompatibility: biological, theoretically based on calcium salts resorbable and non biological, non-resorbable polymethyl methacrylate (PMMA) and some resin-based. If we observe the biological we can see that they lack one of the ideal qualities. The increase in resistance achieved in the initial phase is low and therefore the initial mobilization should be restricted. All of them operate by accelerating the process of ossification and therefore the patient should keep this possibility as active as possible, circumstances that occur in young patients and is difficult to take in the elderly. Injection derivative of calcium, with certain disputes, this indicated in recent fractures of young patients and purpose is to shorten the immobilization process without leaving buried products of which we do not know that it can occur in the physiological aging process. There are references to use alloplasts in a mesh, OPTIMEESH, bone grafts not authorized by FDA, however with good published results. Now could also be used the demineralized bone matrix (DBM) or calcium phosphate, NORIAN, without recommended its use among the indications of the products. However other presentations of calcium phosphate as CALCIBON, KyPhOs, if that includes the kyphoplasty among possible indications have also been used. Both products are absorbable and totally biocompatible. Calcium sulfate OSTEOSTIL could be included within this group but has no use accepted for use in vertebroplasty. The degree of bone resistance obtained may be appropriate. The most commonly used biological material is the hydroxyapatite. The possibility of the use of this product in a synthetic way, opened a wide field of use. In the beginning employment in maxillofacial surgery and before its speed of action was introduced as a useful product in vertebroplasty of young patients. OSTEIM, SINTUFE, hydroxypatite mixed with magnesium, represents a very useful tool in the filling of hemangiomas and accelerates the ossification in fractures. The success of the hydroxyapatite as osteocement was so ostomized that some authors think a bridge between biological and non biological products. Currently this market is a cement which is associated with PMMA and hydroxypatite, assets, looking for the best integration of the cement to reduce the interface bone and cement. In the contrary to the biological group are the biological not being the product of greater use, with greater experience and great tolerability polymethylmethacrylate (Plexiglas), PMMA, it represent the first adhesive used in a vertebroplasty. His great problem was the viscosity that facilitates the onset of leakage, stage, and produced an important exothermic reaction in its setting. These problems are currently very controlled and almost solved. The problem of the injection system can be minimized with very effective systems of injection. CONSIDERING the above, we can conclude that the most suitable technique for the manufacturer’s instructions. The wide dissemination of the PMMA has allowed to discover that the amount of cement to inject should not be very high, that the aim of calming the pain is achieved with less than 3 cc. and that the gradient of elasticity is non altered in this way. This same group of the non biological products is completed by the two CORTOSS and BonWRx products, both products have two components that are mixed at the time of the injection, have a very good capacity of distribution into the bone and the possibility of embodiment is to low to show great adherence. HISTACRIL, a cannula that hardens quickly in a medium lonic was used for the treatment of arthrosis. Good product to embolize, that does not confer increased resistance As summary to this exhibition, which will be illustrated with images in the presentation I think should be two concepts: must be familiar with the product we are going to inject to minimise the risk of leakage and select a biological or non-biological depending on the age, because of non-resorbable products in youth employment could have complications.

Radiation dose for interventional procedures (vertebroplasty/kyphoplasty/bone biopsy) to compare with other radiological techniques

Radiation dose for interventional procedures (vertebroplasty/kyphoplasty/bone biopsy) to compare with other radiological techniques. The mean effective dose per procedure received by the main operator is about 20 μSv without shielding and about 5 μSv with shielding. The mean hand dose per procedure is about 1.5 μSv with shielding and about 0.5 mGy with shielding. A number of methods are available for the non-invasive assessment of skeletal status. For pencil-beam dual X-ray absorptiometry (DXA) scanners the effective dose is negligible i.e. about 0.001 mSv and about 3.0 mSv respectively. In conclusion, patient radiation exposure from vertebroplasty or kyphoplasty may be considerably. Radiation doses associated with DXA and 2D QCT are much lower compared to most radiological examinations. 3T MRI procedures will be demonstrated through examples of selected bone and soft tissue sports injuries including hook of hamate fractures, scapholunate ligament injuries, ulnar collateral ligament injuries, inferior extensor carpal ligament injuries. In addition, some useful tips to optimize the technique will be provided.

Atypical fractures with bisphosphonates: vigilance and perspective

J. Damlakis, Hentakis/GR

The purpose of this presentation is to a) provide data that document exposure from radiation intervention procedures such as vertebroplasty and kyphoplasty, b) provide data regarding dose from methods used for bone mineral density (BMD) assessment and c) compare this information with radiation exposure from other radiological techniques. The patient effective dose from a vertebroplasty or kyphoplasty procedure ranges from about 4 mSv to about 15 mSv. Treatment of L1 is associated with the most effective dose in comparison with treatment of other vertebrae. This may be attributed to the primary irradiation of radiosensitive abdominal organs such as the stomach and the colon. These values are much higher than doses from common radiographic examinations such as abdominal or chest radiography but they are comparable with the doses from other diagnostic examinations such as ultrasonography and computed tomography. Detailling occupational exposure, the mean effective dose per procedure received by the main operator is about 20 μSv without shielding and about 5 μSv with shielding. The mean hand dose per procedure is about 1.5 μSv without shielding and about 0.5 mGy with shielding. The mean number of methods are available for the non-invasive assessment of skeletal status. For pencil-beam dual X-ray absorptiometry (DXA) scanners the effective dose is negligible i.e. about 0.001 mSv and about 3.0 mSv respectively. In conclusion, patient radiation exposure from vertebroplasty or kyphoplasty may be considerably.

Reference:
Differential diagnosis TFCC lesions

N. H. Rheumann, Lauaringen/CH

Ulnar-sided wrist pain is a common complaint that encompasses a broad range of potential differential diagnoses. One potential cause of unilateral wrist pain is a tear or degeneration of the TFCC. Tears of the TFCC can occur centrally or at the radial or ulnar distal attachments. Other potential causes are: • Extensor carpi ulnaris (ECU) subluxation and posttraumatic injury • Distal radioulnar joint (DRUJ) arthritis (degenerative or inflammatory): Incongruity, intra-articular pathology, instability • Ulnar styloid fracture: Nonunion • Lunotriquetral instability trauma or impaction • Flexor carpi ulnaris (FCU) tendinitis • Ulnar head subluxation-dislocation • Pisiform subluxation-fracture • Pisotriquetral disease, degenerative

In this lecture we will talk about this broad differential diagnosis of ulnar sided wrist pain.

Pathology of extrinsic ligaments

M. Shahabpour-David1, L. van Overstraeten2, P. Ceuterick1, C. Boulet1, J. de Mey1, M. de Maeseneer1, 1Brussels/BE, 2Tournai/BE

The role of the extrinsic ligaments, together with the intrinsic ligaments, seems much more important than previously thought in the setting of carpal stability. The anatomy and pathology of the extrinsic wrist ligaments is complex. MRI imaging with thin slices is essential for direct visualization. The purpose of this paper is to describe the pathological appearance of the extrinsic palmar and dorsal radiocarpal and ulnocarpal ligaments on Magnetic Resonance Imaging (MRI), correlated with arthroscopy (performed by 2 skilled hand surgeons), clinical findings and follow-up. High resolution MRI imaging, especially using isotropic 3D sequences with orthogonal multiplanar reconstructions on 3T MR systems, allows detailed depiction of many of the extrinsic ligaments affected in carpal injuries. Recognition of ligament abnormalities is improved by intraarticular or intravenous injection of contrast prior to the examination. Both techniques may help to determine the precise localisation, size and extent of dorsal and palmar radiocarpal and ulnocarpal ligament lesions. Further experience with these techniques is needed to define the place of MRI imaging in the management of traumatic wrist injuries.

New insights into TFC complex injuries: An update on imaging diagnosis and arthroscopic management

L. Cerezal; Santander/ES

New advances in arthroscopy have changed the anatomical description of the TFCC with a functional division in the proximal and distal TFCC, and have allowed a better characterization of lesions of the Palmer class IIC and IID injuries, and description of new lesions not included in the Palmer classification, such as capsular injuries. MRI imaging is a useful tool for the diagnosis of most TFCC injuries. However, MRI imaging has some limitations in the diagnosis of TFCC lesions such as Palmer class 1B injuries, capsular injuries (TFCC injuries not included in Palmer’s classification), and to distinguish between Palmer class IIC and IID injuries. CT arthrography and MR arthrography may overcome these limitations of conventional MRI imaging, allowing a precise diagnosis of the full spectrum of TFCC lesions.

Wrist arthroplasty: What to pay attention to?

M. Obradov; Nis/SRB

A primary indication for total wrist arthroplasty is rheumatoid arthritis with progressive pain, deformity and function loss. In 1967 Swanson introduced silicone implants. In 1970s Meuli and Volz developed a ball-and-socket system with metal and polyethylene components. The third generation (Biax, the Uni 2, Avant) provides increased stability and function with less bone resection en sparing of the distal ulna. Failure of the prosthesis is clinically defined with malfunction and/or pain. A radiological failure is defined by Cobb and Beakbaugh in 1966 (Fig.1). Radiological evaluation includes initial PA and lateral radiographs for baseline position and serial radiographs for the follow-up. US and MRI are useful for the soft tissue complications, CT for the bone stock inventarisation, fluoroscopic stress views for the impingement and radionucleide scan for the deep infection. Complications include implant dislocation and failure, fractures of the distal radius and metacarpals, soft tissue imbalance, tendon rupture, ulnar nerve compression, hematomas, loosening, infection, (silicone)synovitis.

Fig 1. Cobb and Beakbaugh criteria

Case presentation and discussion

F. M. H. M. Vanhoenacker1, M. Eysebierga2, 1Antwerp, Ghent, Mechelen/BE, 2Mechelen-Duffel/BE

This lecture will focus on selected case studies regarding chronic and acute trauma of the hand and the wrist. The key imaging features, clinical and imaging perspective will be discussed, followed by a final take home message.

Radiological features in remission in RA - good ones and bad ones

F. Kainberger, C. Schuelein-Weidekamm, H. Plätzmüller; Vienne/AUT

Indication: Due to effective medications, the appearance of arthritis is changing and normal radiographs are observed with higher frequency in severe forms of arthritis than in the years before. Near remission Rheumatoid Arthritis (RA) and subclinical synovitis are new terms to describe the course and the potential progression of RA.

Investigation: Projection radiographs of the hands, feet, cervical spine and in case of pain other joints are part of the standardized investigation techniques. Images of hands and feet with oblique beam direction are necessary rather for baseline studies than for follow-ups.

Interpretation: The normal radiograph is one of the aims in treatment of arthritis and has been found in an increasing number of patients during the last decade. Joint space narrowing and erosions are still distinctive signs of progression, stable disease or remission and are features of today used scoring systems. Soft-tissue swelling and malalignment, however, should be included in the radiologic assessment. Control images are an important tool for not overlooking disease progression in joints without pain or swelling during treatment. Correlations to ultrasound and MRI offer new insights into the regional distribution and the assessment of rheumatic pseudolesions.

Conclusion: Projection radiographs are among the basic diagnostic tools for assessing diseases progression and remission in arthritis.
Whole body MRI in the differential diagnosis of rheumatoid disorders

S. Wiekbad, Munich/DE

The high soft tissue contrast and anatomical resolution in combination with an excellent specificity and sensitivity of MRI for the recognition of structural abnormalities and for distinguishing the different stages of disease activity lead to whole body MRI examinations in the diagnostic procedures for rheumatoid disorders, including pathologies and pattern typical for Ankylosing Spondylitis (AS), Psoriatic Arthritis, Chronic Multifocal Osteomyelitis (CMRO), Systemic Lupus Erythematosus (SLE), Systemic vasculitis and Polymyositis. In summary, WB-MRI does not only give an excellent overview of the anatomy and pathology of the spine, the sacroiliac and peripheral joints as well as of most entheses, it also allows a sensitive detection of bone marrow changes and muscle pathologies. Due to the exact localization of inflammatory processes present at multiple sites and visualization of this disease pattern, we are able to distinguish between a variety of rheumatological disorders.

References:

Anterior chest wall: Pitfalls and variants

A-G. Jukić, Aarhus/DK

Background: The anterior chest wall (ACW) has been generally neglected in patients with inflammatory disorders due to patients primarily presenting with structural changes such as sternoclavicular hyperostosis and pustulotic arthrop- ositis (1). Whole body MRI (WB-MRI) is increasingly used to diagnose inflammatory musculoskeletal disorders, especially seronegative spondyloarthritides (SpA). The ACW joints and surrounding entheses and bones are often involved in SpA (1- 3). This necessitates awareness of normal ACW findings including variants and pitfalls. The finding of ACW abnormalities simulating SpA changes by WB MRI in 20% of healthy individuals supports this (4)(ESSR 2012, Abstract 220).

Purpose: To present the normal ACW anatomy and the most frequent variants in addition to pitfalls in diagnosing rheumatic inflammation of the ACW.

Content: The presentation is based on the current knowledge about ACW variants and pitfalls to be taken into consideration when diagnosing arthropathies in the ACW region. 1. Normal anatomy and imaging findings The anatomy of ACW joints is shown and compared to corresponding general joint morphology (4). 2. Development of ACW variants Variants of normal joint structure and bone margin presented in two perpendicular plane. Erosion is an interruption of bone margin presented in two perpendicular plane. The sternoclavicular joints are rhomboid fossa at the medial part of the clavicle, accessory ossicles and asymmetrical closure of growth plates. Variants corresponding to the MSJ include non-inflammatory, occurring in 6-12% of adults (10). Synovial proliferation may be accompanied by the formation of the sternoclavicular joint capsule on the side of the synovial cavity in 12% of individuals, and have together with reactive sclerosis and/or ankylosis been observed in 28% of non-rheumatic individuals. (12). However, such changes may partly be related to stress or joint degeneration. 3. Stress related/degenerative changes There are other points of stress related changes of the ACW joints. Sternoclavicular joints can be mechanically tested by palpation of the upper extremity and the trunk. They are therefore exposed to strain during shoulder movements and also move during respiration. Degenerative changes are therefore frequently displaying features as in other synovial joints. The manubrio-clavicular joint is also moving during respiration implying strain affecting the stability of the joint capsule. Erosive changes may occur at a young age and in elderly persons. The observed “erosions” at the MSJ may be related to osteoarthritis (13). A post-mortem micro-radiographic and histological study of 31 sternal bones showed indentations of the MSJ surface in 14 of 20 eldery persons not affected by rheumatic conditions as well as herniation of articular cartilagedisc into bone (13). 4. Traumatic/ posttraumatic changes Traumatic lesions of the sternoclavicular joints, capsule and especially the intra-articular disc can cause joint swelling simulating arthritis (1). 5. Infections Osteoarticular infection in the ACW region is rare and can simulate rheumatic inflammation, especially in early stages without abscess formation. 6. Malignancies Malignancies normally do not cross joints and sternocostal joints are also moving during respiration implying strain affecting the stability of the joint capsule. Erosive changes may occur at a young age and in elderly persons. The observed “erosions” at the MSJ may be related to osteoarthritis (13). A post-mortem micro-radiographic and histological study of 31 sternal bones showed indentations of the MSJ surface in 14 of 20 eldery persons not affected by rheumatic conditions as well as herniation of articular cartilagedisc into bone (13). 4. Traumatic/ posttraumatic changes Traumatic lesions of the sternoclavicular joints, capsule and especially the intra-articular disc can cause joint swelling simulating arthritis (1). 5. Infections Osteoarticular infection in the ACW region is rare and can simulate rheumatic inflammation, especially in early stages without abscess formation. 6. Malignancies Malignancies normally do not cross joints and sternocostal joints are also moving during respiration implying strain affecting the stability of the joint capsule. Erosive changes may occur at a young age and in elderly persons. The observed “erosions” at the MSJ may be related to osteoarthritis (13). A post-mortem micro-radiographic and histological study of 31 sternal bones showed indentations of the MSJ surface in 14 of 20 eldery persons not affected by rheumatic conditions as well as herniation of articular cartilagedisc into bone (13). 4. Traumatic/ posttraumatic changes Traumatic lesions of the sternoclavicular joints, capsule and especially the intra-articular disc can cause joint swelling simulating arthritis (1). 5. Infections Osteoarticular infection in the ACW region is rare and can simulate rheumatic inflammation, especially in early stages without abscess formation. 6. Malignancies Malignancies normally do not cross joints and sternocostal joints are also moving during respiration implying strain affecting the stability of the joint capsule. Erosive changes may occur at a young age and in elderly persons. The observed “erosions” at the MSJ may be related to osteoarthritis (13). A post-mortem micro-radiographic and histological study of 31 sternal bones showed indentations of the MSJ surface in 14 of 20 eldery persons not affected by rheumatic conditions as well as herniation of articular cartilagedisc into bone (13).

Conclusion: To avoid misinterpretation of ACW changes by WB MRI, it is important to know the normal ACW anatomy, the frequently seen ACW-related and age-related changes and the ACW variants and pitfalls found in non-rheumatic conditions.


Sacrolitis - pseudopositive or true?
M. C. Wink, Innsbruck/AUT

Establishing an early and reliable diagnosis of sacroiliitis is of major importance but can be a great clinical challenge, leading to direct therapeutic consequences. Moreover, the rapid identification of sacroiliitis in rheumatic patients at early clinical disease stages provides a window of treatment opportunity before irreversible joint damage occurs. Imaging assessments in patients with a suspicion of rheumatic sacroilitis yield important information for definitive diagnosis at baseline and anti-rheumatic therapy decisions during the follow-up of the disease course. However, several other conditions of the musculoskeletal system can also present with clinical signs and symptoms similar to sacroiliac pain in rheumatic sacroilitis. This presentation summarizes the most important radiological features of rheumatic sacroilitis and the radiological findings of its closest differential diagnoses.

Anatomical and functional basics of the stable and instable wrist
R. Schmitt, Bad Neustadt An Der Saale/DE

The wrist – built of several carpal joints allowing three-dimensional motion – is susceptible to axial forces and deforming vectors. Carpal stability is described as the ability of the wrist to maintain a normal balance between the articulating partners under physiologic loads and movements. In the “equilibrium”; any external force is answered by a counterforce to restore the original joint status without losing joint congruency. If the counterforces are insufficient to keep the normal arrangement, the balance of the articulating partners is disturbed: In “dysequilibrium”, the carpus cannot sustain physiologic loads, whereas in “dysequilibration” abnormal motion of the carpal bones is present. Instability follows an injury or specific diseases like CPPD arthropathy. Dissociative subcategories located within the proximal carpal row, scapholunate dissociation being most relevant are differentiated from non-dissociative subcategories (located between the carpal rows) and combined patterns.

In the natural history of carpal instability, four stages are passed through: Remarkably, the stages I (“pre-dynamic”) and II (“dynamic”) are occult in standard radiograms. They are detectable only with use of cinematography, contrast-enhanced MRI and MRCT arthrography. Stages III (“static malalignment”) and IV (“ostearthritis”) will develop later at the wrist. If carpal dysfunction is suspected, particular care must be provided for the Gilula’s lines and the carpal angles on conventional radiograms. In presence of normal X-ray findings, the next step should be a kinematographic study. MRI is ideal for assessing the ligamentous lesions of the wrist: a) Contrast-enhanced, high-resolution MRI directly visualizes the intrinsic and extrinsic carpal ligaments. b) MRCT arthrography is most reliable to detect lesions of the intrinsic ligaments. In instability stages III and IV, conventional radiograms are mostly sufficient for final diagnosis. An anatomical overview of the osseous and ligamentous structures as well as the biomechanical foundations of the wrist is given. The most relevant instability patterns (SL and LT dissociation, mediocarpal and radiocarpal instability) are illustrated using dedicated and rational imaging approaches.

MR arthrography of the wrist
L. Steinbach, San Francisco, CA/US

This lecture will focus upon wrist MR arthrography. Technique, anatomy, indications and pathology will be emphasized. In particular, use of this method for evaluation of the triangular fibrocartilage and proximal carpal row ligaments will be stressed. Some review of the literature will also be included.

CT arthrography hand and wrist
E. Ljipas, Alzira/ES

Recent advances on imaging techniques have improved visualization of wrist structures. However, the use of intraarticular contrast for adequate distension of wrist compartments and therefore identification of TFCC and wrist ligaments is indicated in some specific lesions, especially uinaural attachment of TFCC, capsular insertions, small intrinsics ligaments lesions, and small cartilage defects. Bi or tricompartmental arthrography is recommended under fluoroscopic approach using iodine solution, Gd-DTPA dilution or a combination of iodine contrast and gadolinium and has been regarded safe and allows CTs and MRAs following a unique joint injection. CTs has been demonstrated as a safe and valuable tool for intraarticular evaluation due to the excellent spatial resolution and the contrast resolution, especially for small fractures and cartilage lesions. New dynamic study in multidetector CT will provide a useful tool for early diagnosis and understanding of wrist instability.

Sports injuries at the hand and wrist
N. Subhaia, Cleveland, OH/US

3T MRI is a valuable tool in the imaging of sports injuries in the hand and wrist. With its increased SNR, high resolution images can be obtained to visualize small anatomic structures. The benefits of 3T MRI will be demonstrated through examples of selected bone and soft tissue sports injuries including hook of hamate fractures, scapholunate ligament injuries, ulnar collateral ligament injuries of the thumb, flexor tendon pulley injuries, and extensor carpi unarum tendon injuries. In addition, some useful tips to optimize the technique will be provided.

Case presentation and discussion
J. L. Bloem; Leiden/NL

Patient with traumatized wrist. What is the differential based on radiographs? Has MR added value?

Rf-ablation of osteoblastoma and osteoid osteoma in tricky localisations
C. Rehnitz, M.-A. Weber; Heidelberg/DE

Introduction: Osteoblastoma (OB) is a benign tumour that, because of the striking histological similarity, has been termed “giant osteoid osteoma”. CT-guided radiofrequency ablation (RFA) is the most widely used minimal invasive technique to treat the “small brother” osteoid osteoma (OO) and has replaced surgery as method of choice. Today most OB are treated with surgery, despite several advantages and the principal feasibility of the minimal invasive CT-guided RFA. Despite RFA has been proved to be safe and effective in “standard” localisations, many institutions refrain form treating OO/DOB in intracartical or spinal locations, especially when they are close to neural structures.

Content: In this Refresher Course lecture, the feasibility, technical aspects, imaging features and success rates of CT guided RFA of osteoblastomas in different localisations will be discussed. Moreover several tips and tricks how to safely perform RFA- ablation of osteoblastoma and osteoid osteoma in challenging localisations, such as joint-associated or spinal will be presented. Technical considerations will be presented in view of the literature and on the bases of the experience of the successful treatment of 12 patients with OB and 75 with OO, including 9 spinal and 17 intra-/periarticular located tumours in our institute. Examples for those technical considerations are: - Three-dimensional access planning - Multiple needle positions to cover the whole tumor volume - Thermal protection techniques.

The current status of cement augmentation of the spine
D. J. Wilson; Oxford/UK

Cement augmentation has developed technically. The introduction of new cements including those with bioabsorable material, low temperature setting and a variety of viscosities has improved safety whilst increasing the range of patients who might be treated. Needles and devices now allow easier introduction of cement, cavity formation, tumour ablation and stent support of fractures. It is becoming possible to treat cases where posterior wall defects would have been a contraindication to percutaneous therapy. However the most important changes are with regard to efficacy and outcome of treatment. Debate continues regarding the publications in the New England Journal where control procedures proved as effective as vertebroplasty. Newer publications suggest that the key is patient selection and there is evidence that problems of sagittal imbalance and overload of other parts of the spine are very significant. Progress in being made in methods that might reduce the risk of spinal cord compression in patients with metastatic disease and there may be means by which fracture risk may be predicted for each affected vertebra.
US guided interventions in the shoulder

I. Beggs; Edinburgh/UK

This brief presentation deals with the technique and efficacy of US-guided injections at the shoulder including joint aspiration and therapeutic injections into the subacromial bursa, therapeutic injections into the rotator cuff, suprascapular nerve block, barbotage and treatment of frozen shoulder.

Best indications of plated plate-rich plasma in tendon disorders

P Peetrons; Brussels/BE

Platelet rich plasma is a new injected technique, allowing the delivery of concentrated platelets plaited within tendons, muscles or ligaments. It is more and more used in sports medicine, being recently accepted (2010 for tendons and ligaments, 2011 for muscles) by the World Anti-Doping Agency (WADA), on condition of a Therapeutic Use Acceptance (TUA). The platelets contain many growth factors among them the most important is the angiogenesis factor allowing to bring more vessels in the lesion site and the one helping the differentiation of mesenchymal cells to fibrogenic and tendinous cells. Unlike other treatments (steroids, vessels sclerosis), it uses the normal potential of healing the tendons and reformulating tendinous cells within the lesion itself. The best indication is then focal tendinopathy and partial tendon ruptures, which don’t response to the usual conservative treatment (exercise, physiotherapy and kinesitherapy). The advantage of using ultrasounds is to be able to bring the concentrated platelets (obtained by centrifugation of autologous blood) exactly on the site of the microruptures and to close the existing microruptures seen by means of Color or Power Doppler. We will present our experience on about 50 cases (study not closed at the time of submitting the abstract) followed on a period going from 3 months to 1 year follow up. The clinical results, followed by VAS, are really very encouraging, reaching percentages never obtained by other non surgical techniques on a so long follow up period. Usually, ultrasound follow up will also be discussed showing in some patients at long term a real reorganization of the rupture site by tendinous parallel fibers. But neither ultrasound, nor Doppler can be discerning to assess the clinical relevance of these symptoms. We use very thin needles (32 G), without anesthetics and without NSAID, and this is made possible by the topology of the tubes used for the centrifugation, avoiding any clothing of the plasma during the whole procedure. The injected amount varies between 1,5 and 2 cc, depending on the tendon. The majority of the procedures were done on common extensor and flexor tendons on the elbow (lateral and medial epicondylalgia), patellar tendons (Jumper’s knee) and Achilles tendons. Other indications are the common hamstrings tendon and the plantar fascia. The rotator cuff is not a very good indication because the extension of the lesion is often underestimated and what is looking like a partial intra-articular rupture is often in communication with either the subdeltoid bursa or the joint space or both, leading to a extensive dilution of the injected platelets.

Hyaluronic acid injections: Joint and non joint applications

S. Torriente, Rome/IT

Hyaluronic acid (HA) is a high molecular weight polysaccharide distributed throughout the body, in particular as a major component of synovial tissue. It is synthesized by chondrocytes and synoviocytes. Hyaluronic acid has different biochemical properties. In particular it has a high molecular weight, forms highly viscous and elastic solutions, acts as a filling material in the connective tissue and displays molecular filtering behavior. Its high osmotic pressure determines tissue hydration and, due to its lubricating properties, plays a crucial role in the joint cavity. HA is also the back bone of the extracellular matrix of the cartilage [1]. The clinical applications of HA are: chondroprotection, viscosupplementation and tissue repair. HA displays also an anti-inflammatory effect, suppressing the production and the activity of pro-inflammatory substances as well as modifying the behavior of immune cells. In osteoarthrosis synovial fluid (SF) is diluted due to infiltration of plasma fluid and proteins and contains HA with lower molecular size. This causes a reduction of the rheological properties of SF. In 1993 Balasz and Deninger [2] introduced the concept of viscosupplementation. Rationale for the use of intra-articular HA in osteoarthritis is that abnormal SF is a high viscosity, high molecular size SF- viscosoelasticity, improve joint function and decrease symptoms. Up to now the Cochrane review and recent meta-analysis [3, 4] confirm viscosupplementation efficacy for knee osteoarthritis. Additionally, there are many studies which show the efficacy of HA also in other joints, such as hip, shoulder, small joints of hand and foot, trapeziometa-carpal joint and ankle [6-10]. HA is classified as a SYODADD (Symptomatic Slow-Acting Drugs in OsteoArthritis) because intra-articular injection of HA is characterized by a delayed but prolonged symptomatic effect when compared with intra-articular steroids. This prolonged efficacy, that may last longer than 6 months, has several clinical implications: first, high viscosity exogenous HA in order to maintain the injected HA to stimulate endogenous cellular production of HA of physiological molecular weight. This production continues even when injected HA is no longer present in joint cavity (half-life of injected HA varies approximately from hours to few days) [11]. Intra-articular injections of HA may generate a reduction of symptoms of at least 40-60% in treated patients suffering from mild to moderate osteoarthritis, it is possible to maintain obtained efficacy by cyclic repetition of injections, usually every six months.

Steroid injection of synovial cysts of the wrist under US guidance

R. Campagnari, G. Guerini, E. Pezzati, A. Feydy, J-L. Draper; Parma/FR, ‘San-Denis/Fr

To describe tips and tricks of the percutaneous treatment of synovial cysts of the wrist under US guidance. All patients were addressed for a visible prominence of the dorsal side of the wrist (cyst more than 1 cm). The treatment consisted on an aspiration, a washing of the residual cyst with lidocaine, and steroid injection. We describe the technique to place the wrist in the best position to practice aspiration under US guidance, the way to avoid tendons, and the needle we use. We also describe a technique to perform a continuous aspiration, allowing turning the level, and moving the needle with a direct visualisation by ultrasound with Doppler. We describe the treatment of the cyst of the radial aspect of the distal radioulnar joint. The pathogenesis of this cyst is due to peritendinous adherence with a cystic fluid formation around tendons. Currently there is no evidence to support the benefit of aspiration with corticosteroids. In our experience, good results were obtained using ultrasound-guided aspiration and steroid injection.

References:

Radiographical features of bone tumors

V Vasilevskova, Skopje/ MK

Bone tumors are categorized according to their tissue of origin, whether benign or malignant presentations. Primary bone tumors of the hand and wrist are unusual but if present are frequently chondroblastic in origin. Despite newer imaging techniques, the radiography is the preliminary and single most important imaging investigation in patients with suspected bone tumors. This presentation will review with examples of its radiographical presentation will be given systematically the tissue of origin. Enchondroma is the most common primary bone tumor of the hand. Approximately 40 to 65% of solitary enchondromas occur in the hand. Typical presentations of enchondroma, enchondromatosis (Ollier’s disease), Maffucci’s syndrome, periosteal (ectoarticular) chondroma, chondroblastoma will be presented. Malignant tumors of the hand are rare, however malignant transformation of the solitary enchondroma can occur. In the hands, osteoid osteomas usually were
found in a proximal phalanx or a metacarpal bone; of the carpal bones, the scaphoid was affected most frequently. Although
a tumour-like lesion that may simulate an osteosarcoma because of its rapid growth and irregular histology. Radiographically, a
biphasic appearance with a solid bone component and a cartilage cap is usually not necessary to confirm the diagnosis of an enchondroma. The typical image is a lesion with an intermediate signal
to a low-grade chondrosarcoma should be considered and additional imaging by MR imaging and/or CT is pivotal. MR imaging
soft tissue abnormalities are not allowed in benign enchondromas. In these particular cases, development of an enchondroma
eccentric enchondroma from a periosteal chondroma with secondary erosion of the cortical bone. Endosteal thinning of the
cavity of the bone and capped by cartilaginous tissue. They arise near the end of phalanges or metacarpals and can cause
distal phalanx, which are considered part of the nidus. MRI may show edema in the bone marrow and soft tissue surrounding the lesion. Malign primary bone tumors:
the metacarpal bones are not infrequently low-grade chondrosarcomas, even without cortical breakthrough or other signs of much higher signal intensity on T1 and (very) high SI on T2-weighted images, with more or less lobulated contours and peripheral or septal-nodular
eccentric aneurysmal bone cyst. Infection of the fingertip is common and MRI may be useful to confirm an osteomyelitis
the relationship of the osseous mass to the underlying cortex. Periosteal ossifications is rare in the hand, and may mimic florid reactive periostitis and BPOP or sometimes resemble juxtaarticular or surface osteosarcomas. Periarticular ossification is the
diagnostic feature of this entity. Turret exostosis is a rare posttraumatic lesion to the fingers and represent ossification of a 
subperiosteal haematoma. Subungual exostosis is an uncommon benign bone tumour which arises in the distal phalanx of the fingers. Tumors consist of a mixture of fibrovascular tissue with no continuity to the underlying cortex and medullary canal. Synovial proliferative disorders: Giant cell tumors of the tendon sheath (GCTS) localized to the digits may produce pressure erosion of the adjacent bone or joint, or in a small group a cortical perforation and intratendinous tumor extension can be seen. Gout may produce intratendinous or paratendinous tumours caused by tophiaceous deposits. Miscellaneous surface lesions: Macrodystrophia lipomatosa, parosteal lipidoma, melorheostosis, stress fracture or soft tissue sarcomas may presents as surface lesion.

Surface lesions
A. Oktya; Izmir/TR
Surface lesion of bone refers to the lesions which arise from the cortex, the periosteum or the fibrous tissues adjacent
to the periostea. The words ‘juxta’ and ‘para’ both refer to the same location; next to or in relation to the surface of a bone. These lesions are in the long bones of the hand, and include benign and malignant primary bone tumors, proliferative periosteal disorders, synovial proliferative disorders and miscellaneous surface disorders. Benign primary bone tumors: Periosteal chondroid tumors are of chondroid origin, arising in the periosteal layer of tubular bones, and they are recognized as distinct disease entities. These lesions are relatively rare, accounting for 1% of all bone neoplasms, between 25 and 29% involve the hands and feet. Chondromas occurng 3-5% of all aneurismal bone tumors. They mostly occur in the metacarpal bones, followed by the phalangeal bones and rarely in the carpal bones. Bone malignancies involve both primary tumors, of which chondrosarcomas are the most common, and metastatic lesions. More frequently are in older patients; 61% of tumors were found in the metacarpal and proximal phalanges. Metastases to the hands are very rare, about 0.1% incidence. Usually are developed from common, and metastatic lesions. More frequently are in older patients; 61% of tumors were found in the metacarpal and proximal phalanges. Bone malignancies involve both primary tumors, of which chondrosarcomas are the most

Differential diagnosis of distal phalangetic lesions
J-L. Drape, H. Guerini, R. Campagna, A. Feydy, Paris/FR
Plain films remain the main imaging modality for pathologies of the distal phalanges. Clinical symptoms may be pain, a pseudoclaudication, a nail dystrophy, a paresthesia or a fingertip shortening. An acroosteolysis, a bone sclerosis, a periostitis or ossifications of the soft tissues may be depicted on radiographs. Etiologies of acroosteolysis may be diagnosed with plain films and the clinical history acquired pathologies as toxoc, trauma, systemic scleroderma or idiopathic pathologies as Haü-cheny or pachyonychia. Some bone tumors of the distal phalanx may be seen on plain films (enchondroma, osteoid osteoma, giant cell tumor...) and confirmed with CT and MRI. Erosions of the distal phalax may be due to tumors or pseudotumors of the nail bed. Ultrasoundography and/or MRI or MR angiography are helpful to characterize the lesion (glomus tumor, nail melanocytoma, foreign body granuloma, pyogenic granuloma, mucoid pseudocyst...). Infection of the fingers is common and MRI may be useful to confirm an osteomyelitis and/or arthritis. Inflammatory rheumatism as psoriasis may produce bone formation and periostitis of the distal phalanx. Deposition of the connexion of an exostosis with the distal phalanx may be subtle on plain films and MRI better depicted the connexion and the conjoinnt part.

Cartilage lesions and syndromes
H-J. van der Woude, Amsterdam/NL
Primary bone tumors of the hand are unusual. If present, these lesions are frequently of chondroid origin. Enchondroma is the most common primary bone tumor of the hand, predominantly found in one of the phalanges, less common in a metacarpal bone. Enchondromas of the hand can be encountered as a coincidental finding on plain radiographs or present with a fracture secondary to a minor trauma. Enchondromas can become manifest in the central part of the small bones or present eccentrically as a lucent lesion, but without punctate calcifications. Incidently it can be difficult to differentiate an eccentrical enchondroma from a periosteal chondroma with secondary erosion of the cortical bone. Endosteal thinning of the cortical bone is a common feature and expansion of the bone may occur. Permeation of the cortical bone, periosteal reaction and soft tissue abnormalities are not allowed in benign enchondromas. In these particular cases, development of an enchondroma to a low-grade chondrosarcoma should be considered and additional imaging by MRI imaging and/or CT is pivotal. MRI imaging is usually not necessary to confirm the diagnosis of an enchondroma. The typical image is a lesion with an intermediate signal intensity on T1 and (very) high SI on T2-weighted images, with more or less lobulated contours and peripheral or septal-nodular enhancement after contrast administration. In case of a suspected chondrosarcoma, MRI imaging assists in demonstrating the soft tissue extension. MRI may also have the helpful in distinguishing primary osteous lesions, from periosteal or soft tissue (synovial, capsule, tendon) origin. From a statistical point of view, it should be noticed that chondroid lesions arising in one of the metacarpal bones are not infrequently low-grade chondrosarcomas, even without cortical breakthrough or other signs of malignancy. On this location, the chondroid tumors tend to behave more like lesions in the long tubular bones in adult patients. For pathologists, it is of great importance to be adequately informed about the radiological features and origin of chondroid lesions of the hand after treatment (curettage or excision) to call a lesion benign or malignant. For instance the amount of subperiosteal haematoma. Subungual exostosis is an uncommon benign bone tumour which arises in the distal phalanx of the fingers. Tumors consist of a mixture of fibrovascular tissue with no continuity to the underlying cortex and medullary canal. Synovial proliferative disorders: Giant cell tumors of the tendon sheath (GCTS) localized to the digits may produce pressure erosion of the adjacent bone or joint, or in a small group a cortical perforation and intratendinous tumor extension can be seen. Gout may produce intratendinous or paratendinous tumours caused by tophiaceous deposits. Miscellaneous surface lesions: Macrodystrophia lipomatosa, parosteal lipidoma, melorheostosis, stress fracture or soft tissue sarcomas may presents as surface lesion.
Soft tissue lumps in the hand and wrist: MRI indications

W. C. Peh, Singapore/SG

Soft tissue lumps in the hand and wrist are not infrequently encountered. Initial imaging investigation should start with a radiograph, followed by magnetic resonance imaging (MRI). MRI is helpful in firstly confirming the presence of a mass. If a soft tissue mass is present, the compartment in which the mass is located and its exact extent can be accurately determined by MRI. For many soft tissue masses in the hand and wrist, recognition of certain characteristic MRI features can lead to a specific diagnosis. Otherwise, the differential diagnosis can be narrowed using an "anatomical" approach. Soft tissue masses in the hand and feet that may have characteristic MRI features include ganglia, hemangioma including arteriovenous malformation, giant cell tumor of the tendon sheath, simple lipoma and lipoma arborescens. The diagnosis may be suggested by a characteristic imaging pattern in some cases of neurogenic tumors, synovitis and tenosynovitis, and normal variants. For indeterminate lesions where the MRI features are insufficiently characteristic for diagnosis, the role of MRI will be local staging of the lesion, to guide biopsy and help plan management. MRI is also useful for the follow-up of treated soft tissue lesions.

References:


Soft tissue lumps hand and wrist: US indications

P. Robinson, Leeds/UK

The hand and wrist are ideally suited for interrogation by high frequency ultrasound. This talk will present how the most commonly encountered soft tissue masses in this region.

• Pseudotumour and inflammatory lesions
• Ganglia
• Synovitis that frequently occurs in this region or are largely specific to this region
• Illustrate the ultrasound appearances in the hand and wrist that define benign, indeterminate and malignant masses.
• Present how ultrasound can also be used for biopsy and how this technique interacts with MRI.

References:

have also reported that SEL is accurate in detecting rotator cuff disease (tears, bursitis), in evaluating the regenerated tendon/scar tissue, and in diagnosing patella tendinopathy. The results indicate that SEL is an accurate and reproducible technique for the evaluation of tendon pathology (at least for Achilles and lateral epicondyritis), but further follow up studies are needed to establish its clinical role for diagnosing, monitoring, and predicting the healing of tendinous injuries.

The goal of this project was to assess the performance of the technique and probably account for discrepancies found between various studies. Such parameters need to be established with long follow up studies and correlation with histology. Emphasis should be placed on standardisation of the technique to provide reproducible and comparable results between studies. In its current form, SEL is still a highly subjective technique that requires training and experience in the interpretation of the images. Although SEL presents a promising supplementary tool in the diagnostic workup of muscle and tendon disease, its clinical value needs to be established with long follow up studies and correlation with histology.

References:

Early findings-overuse, Initial alteratons/minimal injuries: Shoulder
I. Bovic, Zabol/HR

The shoulder is the most movable and the most unstable joint in a human body. The glenohumeral joint is particularly vulnerable because overhead activities put tremendous stress on its static stabilizers (ligamentous labral complex) and the dynamic stabilizers (rotator cuff muscles). Minor aberrations in mechanisms controlling stability have a significant and cumulative effect on the shoulder biomechanics, and increase the risk of injury. Overuse and impingement syndromes in the shoulders of athletes are predominantly caused by instability of the glenohumeral joint. Glenohumeral joint instability is usually acquired from repetitive overuse of the rotator cuff and shoulder girdle muscles, or injury of the static and dynamic stabilizers of the glenohumeral joint. Congenital hypermobility of the joint may also contribute to these syndromes in some individuals. With its noninvasive approach, multiplanar capabilities, and exceptional soft-tissue contrast resolution, magnetic resonance imaging (MRI) has established itself as the optimal noninvasive means for assessing musculoskeletal dysfunction. The role of MRI in overuse and impingement syndromes of the shoulder is to accurately diagnose the underlying structural changes and serves to assist the clinician in instituting the appropriate conservative or surgical treatment for individual athletes. Most common overuse injuries with initial alteration that are visible on MRI involve structural changes and rupture of the tendons, glenoidal labrum lesions, overuse injury of the long head of the biceps tendon, and stress fracture of the clavicle. Tendinosis of the rotator cuff tendons is initial alteration of the tendons exposed to overuse. The repetitive loading of tendon collagen beyond its yield strength causes microfailure of the fibres. This initiates a repair process in which tendon cells produce extra collagen. Tendinosis can progress to a partial tear or complete disruption. Internal impingement syndrome is defined as injury to the supraspinatus and infraspinatus tendons characterized by articular-sided fraying and partial tearing, internal impingement involves slipping of the affected tendons between the posterosuperior glenolabrum and humeral head, when the arm is in maximal external rotation. MRI demonstrates abnormal signal within the posterosuperior labrum with associated labral irregularity. Abnormal increased signal involving the articular portion of the supraspinatus tendon and infraspinatus tendon is also noted. Other associated findings may include tearing of the anteroinferior labrum and injury to the posterosuperior humeral head as evidenced by edema. A SLAP lesion is defined as a tear of the labrocapsular complex that originates at the superior labrum and extends anteriorly and posteriorly to varying degrees, accounting for the numerous subtypes described in the literature. The lesion is a result of a combination of extreme compressive, distraction, and translational forces subjected on the shoulder during the cocking and deceleration phases of pitching. Oblique coronal MRI sequences generally depict irregularity of the superior labrum with areas of abnormally high signal extending to the articular surface. Frank detachment of the superior labrum can also occur. Overuse injury of the long head of the biceps tendon is generally located at the infraspinatus insertion, related to compression between the humeral head, acromion, and coracoacromial ligament during abduction and internal rotation. The injury is best demonstrated on fluid-sensitive sequence, evidence as increased tendon signal and thickening, and fluid that completely encircles the tendon, particularly when noted in the absence of an associated glenohumeral joint effusion, increases the specificity for the diagnosis. Weightlifter’s shoulder is a subacromial stress fracture at the distal clavicle that results from chronic stress caused by repetitive compressive forces encountered during the weightlifting motion. The role of MRI in overuse and impingement syndromes of the shoulder, especially in initial alterations is to accurately diagnose the underlying structural changes and serves to assist the clinician in instituting the appropriate conservative or surgical treatment for individual patient.

Elbow
M. Padron, Madrid/ES

Overuse injuries are a very common cause of pain in athletes. The elbow and forearm are common sites of injury among competitive tennis players and throwing athletes. The majority of these chronic injuries involve the soft tissues, particularly the periarticular soft tissues of the elbow joint. Subtle changes in tendon morphology in lateral and medial epicondyritis can be depicted with either US or MRI. OCD of the capitellum and avulsion injury of the medial epicondylar apophysis are most commonly encountered in the immature skeleton and MRI is a very useful tool in early diagnosis. Ultrasound and magnetic resonance imaging can be used to assess tendon pathology, including rotator cuff disease, partial tears, and complete tears of the biceps brachii tendon. MRI is a useful tool in assessing the extent of soft tissue injury, including tears of the ulnar collateral ligament, degeneration/tear and pronator syndrome caused by median nerve entrapment are also discussed. Spontaneous deep vein thrombosis in early diagnosis and initial changes with different imaging modalities is the main focus of this presentation.
Diffusion tensor imaging and fiber tractography of nerves at the wrist

G. Andresek, Zurich/CH

Diffusion Tensor Imaging (DTI) is a special application of diffusion weighted imaging (DWI) based on measurements of molecular diffusion along multiple directions in space, which allows characterization of the microarchitecture of biologic tissues. In so called isotropic tissues with lamellar texture (e.g. peripheral nerves), the water diffusion is hindered perpendicular to the long axis of the nerves and less hindered along their long axis due to the fibrillar alignment of axons with myelin sheaths and compartmentalization of the fiber bundles. DTI allows quantification of diffusion by measuring fractional anisotropy (FA) and apparent diffusion coefficient (ADC) as well as visualization of diffusion using fiber tractography. The latter provides the capability to track individual nerves or nerve bundles and to display them on color-coded three-dimensional images. My lecture will provide a review of the basics of DTI and fiber tractography, an overview of current status of research, as well as potential applications.

Nerves of the hand beyond the carpal tunnel

A. Tagliafico1, A. Cadoni1, E. Facci1, S. Gennaro1, L. Moffetta1, M. Miguel Perez2, A. Klauser3, C. Martinoli1; 1Genoa/IT, 2Barcelona/ES, 3Innsbruck/AT

Imaging studies including ultrasound (US) and magnetic resonance imaging (MRI) may be required to evaluate the median nerve in patients with suspect carpal tunnel syndrome. However, the radial and ulnar nerves contribute to sensory and motor innervations to the hand as well. Compressive, traumatic and iatrogenic events may damage the small terminal branches of these nerves. In the hand, US is able to identify injuries of the median, ulnar, radial nerve and terminal branches. In this article, the role of imaging to evaluate the nerves of the hand will be presented with an emphasis on US. Due to its high-resolution capabilities, US is useful to determine the location, extent and type of nerve lesion. Moreover, US is useful for a post-surgical assessment. Anterior interosseous nerve, Guyon tunnel syndrome and Wartenberg's syndrome will also be described.

Interventional techniques and image-guided pain management

H. Gruber; Innsbruck/AT

Ultrasound (US) is an imaging technique which is known for high availability and low costs. Crucial for its success in the interventional field is the bed-side situation patients may undergo intervention and the real-time approach and thus live control of the procedures. Pain management includes the local approaches to rather specific regions of the peripheral nervous system and even approaches to the vertebral column as well: at peripheral nerves instillations with local anaesthetics w/o corticoids may be administered in a very acurate and thus univalued manner. Also the field of neuroma pain may be addressed in this context. In the vertebral column pain due to the facet joint disorders and due to the spinal roots may be treated locally and at least as sufficiently as known from other modalities as e.g. C-Guided techniques: the immanent advantage of US guidance also in this field is the high availability of US and the bed side situation such installations are performed. In summary US guided intervention and pain management is no longer only an emerging field but represents rather the first line algorithm in this topic: other more time, money and ionisation consuming modalities should have their field for special cases that cannot be approached by US sufficiently.

Tractography of peripheral nerves

V. Babli1, J.-F. Budzik1, V. Le ThuC1, A. Cotten1; 1Lille/FR, 2La Madeleine/FR

Diffusion tensor imaging (DTI) with fiber tracking (i.e. tractography) has been an important area of research in the past decade and found clinical applications in the evaluation of the central nervous system. However the interest in DTI with tractography in the field of musculoskeletal imaging is rapidly growing, especially in the evaluation of peripheral nerves. These techniques have been successfully applied in both volunteers and patients, providing non-invasively, quantitative microstructural parameters (mainly mean fractional anisotropy and apparent diffusion coefficient) of the nerves. Tractography offers a three-dimensional depiction of nerves and may reveal abnormalities that are beyond the resolution of conventional MRI techniques. We will summarize the current state of DTI and tractography in the evaluation of peripheral nerves as well as their potential future clinical applications in chronic nerve root compression, acute nerve injury or nerve tumor. We will also address important technical considerations, which understanding is necessary to appropriately apply DTI and tractography, and in order to understand the current limitations of these innovative and promising techniques.
Imaging of the carpal tunnel
D. J. Wilson, G. Allen; Oxford/UK

The majority of patients with symptoms related to the carpal tunnel are suffering from idiopathic median nerve compression. Imaging has little role in the care of most cases as steroid injection, therapeutic ultrasound and surgery have established roles. However, cases with atypical presentation, mass lesions, synovitis or failed carpal tunnel surgery will benefit from imaging. In this paper we review the anatomy of the carpal tunnel, the diseases affecting this region and then discuss the use of conventional radiographs, CT, ultrasound and MRI outlining the strengths and weaknesses of each method whilst listing the signs of disease. We conclude that both ultrasound examination and MRI are powerful and often complimentary techniques.

Anatomical evaluation of the upper thoracic aperture in computed tomography and magnetic resonance imaging with regard to the thoracic outlet syndrome
D. Berzaczy, M. Benedikt, T. Moritz, G. Kasprian, G. Bodner; Vienna/AT

Introduction: The true neurogenic and symptomatic Thoracic-outlet-Syndrome (TOS) is believed to be a result of compression of the brachial plexus. The thoracic outlet includes three confined compartments, in all of which compression of the structures of the plexus is possible. The purpose of present study is to identify and evaluate the incidence and distribution of musculoskeletal variants and abnormal muscles that might be the underlying cause for compression neuropathy.

Materials and methods: For 150 patients we performed measurements in the thoracic outlet of distances [mm] between bony structures, between bones and muscles and between specific muscles in different planes. Furthermore diameters of the serratus anterior and subclavius muscle were assessed in two planes. Variants in muscle attachment, accessory muscles and musculotendinous or bony structures were noted. All measurements were performed in both CT and MRI.

Results: Results of measurements, correlation to clinical presence of TOS and incidence of findings regarding muscular variants will be presented.

Conclusion: The evaluation of anatomical variants which are able to trigger TOS contributes to a better understanding of the mechanism of compression neuropathy.

New Ultrasound-based therapeutic strategy in Chronic Regional Pain Syndrome (CRPS) – Preliminary Findings
T. Moritz, W. Gruther, D. Berzaczy, A. Sachs, W. Happak, G. Bodner; Vienna/AT

Purpose: CRPS is a painful neuropathic disorder occurring after traumatic events or surgical procedures. Symptoms include pain, loss of function, and autonomic dysfunction. The pain mechanism is not fully understood, however a contribution of the sympathetic nervous system can be assumed. We report upon the preliminary results of a therapeutic approach using Ultrasound (US) - guided peripheral sympathetic blocks.

Methods & Materials: A series of 14 cases referred to US-guided interventions was collected. US was performed on a GE Logiq e9 device using a 18Mhz linear probe. Infiltrations around subcutaneous nerves were performed with 0.3ml local anaesthetic (Lidocain 2%) and a 25G-needle. Visual Analog Scale (VAS) was noted before and after the intervention, and the duration of therapeutic effect was noted. Thermography was performed in 8 patients before and after the intervention.

Results: All but one patient showed a significant decrease in the VAS score (Mean 68%). One patient did not respond to the blockade. The mean response time after the first injection was 10 hours, increasing with repeated injections. 7 patients were pain-free after the intervention.

Conclusion: US-guided peripheral sympathetic blocks show promising potential for utilisation as a novel therapeutic concept in CRPS.