Scientific Programme

ABSTRACTS

SPECIAL FOCUS COURSE AND SESSIONS

ESSR 2004

June 18 – 19, 2004

Augsburg, Germany

The abstracts are listed along the programme schedule
All abstracts are presented which reached the Congress Office til June 1, 2004

Overview

<u>Postgraduate Special Focus Course</u>
Upper Limb – Hand/Wrist/Elbow
Friday, 08:00 – 17:30
Saturday, 08:30 – 14:30
Mozartsaal

<u>Postgraduate Special Focus Session</u>
Vertebroplasty in the Osteoporotic Patient
(In Cooperation with the Osteoporosis Subcommittee of the ESSR.)
Friday, 09:00 – 11:45
Fuggerzimmer

<u>Postgraduate Special Focus Session</u>
Intervention in Musculoskeletal Radiology
Friday, 13:30 – 15:00
Fuggerzimmer

<u>Postgraduate Special Focus Session</u>
Imaging of Summer Sports Injuries
(In Cooperation with the Sports Imaging Subcommittee of the ESSR.)
Saturday, 08:30 – 12:00
Fuggerzimmer

Postgraduate Course Programme

ESSR 2004

<u>Postgraduate Special Focus Course:</u> Upper Limb – Hand/Wrist/Elbow

Friday, June 18, 2004: Mozartsaal

Chairpersons:	Davies M, Birmingham, United Kingdom; Mester A, Budapest, Hungary
08:00 – 08:35 ---	IMAGING OF THE NORMAL ANATOMY OF THE HAND, WRIST AND ELBOW Pfirrmann Ch, Zürich, Switzerland
08:35 – 09:00 ---	DYNAMIC STUDIES OF THE WRIST: NORMAL ANATOMY, FUNCTION AND PATHOLOGY Maas M, Amsterdam, The Netherlands
09:00 – 09:30 ---	ACUTE INJURIES OF THE HAND AND WRIST – CLINICAL APPROACH Mayr E, Augsburg, Germany
09:30 – 09:50 p8	DIAGNOSTIC PITFALLS AND NORMAL VARIANTS IN THE WRIST Zanetti M, Zürich, Switzerland
09:50 – 10:00	Discussion
10:00 – 10:30	Coffee Break

Chairpersons:	Masciocchi C, L'Aquila, Italy; Watt I, Bristol, United Kingdom
10:30 – 10:50 p11	IMAGING OF ACUTE INJURIES OF THE HAND AND WRIST: PLAIN FILM AND CT Schmitt R, Bad Neustadt, Germany
10:50 – 11:10 p13	ACUTE INJURIES OF THE HAND AND WRIST: MRI Lohman M, Helsinki, Finland
11:10 – 11:30 p16	IMAGING OF OVERUSE SYNDROMES IN THE HAND/WRIST (CT AND MRI) Stäbler A, München, Germany
11:30 – 11:45	Discussion
11:45 – 12:15	**O P E N I N G C E R E M O N Y**
12:15 – 13:30	Lunch

Chairpersons:	Pettersson H, Lund, Sweden; Jevtic V, Ljubljana, Slovenia
13:30 – 13:50 p17	ARTHROGRAPHY (CTA AND MRA) OF THE WRIST Christopoulos G, Bad Neustadt, Germany
 13:50 – 14:10 --- 14:10 – 14:30 p18	SONOGRAPHIC APPLICATIONS IN THE HAND AND WRIST: Part I: TENDONS, CARPAL TUNNEL Silvestri E, Genova, Italy Part II: FRACTURES, GANGLIA, MASSES Ostlere S, Oxford, United Kingdom
14:30 – 14:50 ---	FUNNY FINGERS AND SILLY HANDS: CONGENITAL ABNORMALITIES Johnson K, Birmingham, United Kingdom
14:50 – 15:15	Discussion
15:15 – 15:45	Coffee Break

Chairpersons:	McCall I, Oswestry, United Kingdom; Verstraete K, Gent, Belgium
15:45 – 16:05 ---	OSTEOARTHRITIS IN THE HAND/WRIST AND ELBOW Imhof H, Wien, Austria
16:05 – 16:25 p20	IMAGING OF RHEUMATOLOGICAL DISORDERS IN THE HAND/WRIST AND ELBOW: VALUE OF DIFFERENT IMAGING METHODS Ostergaard M, Hvidovre, Denmark
16:25 – 16:45 ---	CRYSTAL INDUCED ARTHROPATHIES IN THE HAND/WRIST Beggs I, Edinburgh, United Kingdom
16:45 – 17:05 p21	OSTEOMYELITIS AND SEPTIC ARTHRITIS OF THE HAND/WRIST AND ELBOW Jurik A, Aarhus, Denmark
17:05 – 17:20 p24	OSTEONECROSIS IN THE WRIST AND ELBOW Anderson S, Bern, Switzerland
17:20 – 17:30	Discussion

Saturday, June 19, 2004: Mozartsaal

Chairpersons:	Bloem H, Leiden, The Netherlands; Forgács S, Budapest, Hungary
08:30 - 08:50 p27	MALIGNANT MASSES IN THE HAND/WRIST AND ELBOW De Schepper A, Leiden, The Netherlands
08:50 - 09:10 29	BENIGN MASSES IN THE HAND/WRIST AND ELBOW Davies M, Birmingham, United Kingdom
09:10 – 09:30 p30	NERVE ENTRAPMENT AT THE HAND/WRIST AND ELBOW Beltran J, New York, USA
09:30 - 09:50 p36	UNEXPLAINED WRIST PAIN: MY APPROACH TO A CLINICALLY ORIENTATED RADIOLOGICAL DIAGNOSIS Obermann W, Leiden, The Netherlands
09:50 – 10:00	Discussion
10:00 – 10:30	Coffee Break

Chairpersons:	Padron M, Madrid, Spain; Cassar-Pullicino V, Oswestry, United Kingdom
10:30 – 11:00 ---	ACUTE INJURIES OF THE ELBOW – CLINICAL APPROACH Gebhard F, Ulm, Germany
11:00 – 11:30 ---	IMAGING OF ACUTE INJURIES OF THE ELBOW (PLAIN FILM, MRI) Barile A, L'Aquila, Italy
11:30 – 11:50 p39	IMAGING OF ACUTE INJURIES OF THE ELBOW (CT) Jonsson K, Lund, Sweden
11:50 – 12:00	Discussion
12:00 – 13:30	Lunch

Chairpersons:	Cotten A, Lille, France; Reiser M, München, Germany
13:30 – 13:50 ---	IMAGING OF THE ELBOW IN CHILDREN – SPECIAL ASPECTS Bonel H, Bern, Switzerland
13:50 – 14:20 p40	IMAGING AND CLINICAL ASPECTS OF OVERUSE SYNDROMES IN THE ELBOW (SPECIAL REFERENCE TO MRI) Kainberger F, Wien, Austria
14:20 – 14:40 ---	IMAGING OF OVERUSE SYNDROMES IN THE ELBOW – SONOGRAPHY Bianchi S, Genève, Switzerland
14:40 – 14:50	Discussion
14:50 – 15:20	Coffee Break

Don't miss!

Film Reading Session
Saturday, 15:20 – 16:30 Mozartsaal

General Assembly of the ESSR
Saturday, 16:30 – 17:30 Mozartsaal

<u>Postgraduate Special Focus Session:</u> Vertebroplasty in the Osteoporotic Patient
(In Cooperation with the Osteoporosis Subcommittee of the ESSR.)

Friday, June 18, 2004: Fuggerzimmer

Chairpersons:	Guglielmi G, San Giovanni Rotondo, Italy; Genant HK, San Francisco, USA
09:00 - 09:25 p42	DIAGNOSIS AND CLASSIFICATION OF OSTEOPOROTIC FRACTURES Van Kuijk C, Amsterdam, The Netherlands
09:25 - 09:50 p44	VERTEBROPLASTY: TECHNIQUE AND POTENTIAL COMPLICATIONS Cotten A, Lille, France
09:50 – 10:00	Discussion
10:00 – 10:30	Coffee Break

Chairpersons:	Adams J, Manchester, United Kingdom; Heller M, Kiel, Germany
10:30 – 11:00 ---	INITIAL AND LONG TERM RESULTS OF VERTEBROPLASTY Hierholzer J, Potsdam, Germany
11:00 – 11:30 ---	ESSENTIAL MEDICAL MANAGEMENT OF THE PATIENT UNDERGOING VERTEBROPLASTY Adams J, Manchester, United Kingdom
11:30 – 11:45	Discussion
11:45 – 12:15	**O P E N I N G C E R E M O N Y**

<u>Postgraduate Special Focus Session:</u> Intervention in Musculoskeletal Radiology

Friday, June 18, 2004: Fuggerzimmer

Chairpersons:	Hodler J, Zürich, Switzerland; Freyschmidt J, Bremen, Germany
13:30 – 13:45 ---	HOW TO DO A GOOD BONE BIOPSY Wiens J, Bremen, Germany
13:45 – 14:00 ---	RADIOFREQUENCY THERAPY IN BONE TUMORS Wörtler K, München, Germany
14:00 – 14:15 ---	THERAPEUTIC PROCEDURES IN THE CERVICAL SPINE Chevrot A, Paris, France
14:15 – 14:30 ---	DISCOGRAPHY: TECHNIQUE AND RATIONALE Peh W, Singapore
14:30 – 14:45 ---	TREATMENT OF JUXTAARTICULAR CYSTS Aparisi F, Valencia, Spain
14:45 – 15:00	Discussion
15:00 – 15:45	Coffee Break

<u>Postgraduate Special Focus Session:</u> Imaging of Summer Sport Injuries
(In Cooperation with the Sports Imaging Subcommittee of the ESSR.)

Saturday, June 19, 2004: Fuggerzimmer

Chairpersons:	Kainberger F, Wien, Austria; Rüter A, Augsburg, Germany
08:30 - 08:50 ---	IMAGING OF OVERUSE SYNDROMES IN TRACK ATHLETES Padron M, Madrid, Spain
08:50 - 09:20 p45	IMAGING OF SOCCER INJURIES Vanhoenacker F, Antwerp, Belgium
09:20 - 09:40 p49	IMAGING OF BASKETBALL AND VOLLEYBALL INJURIES Karantanas A, Larissa, Greece
09:40 – 10:00	Discussion
10:00 – 10:30	Coffee Break

Chairpersons:	Beltran J, New York, USA; Rüter A, Augsburg, Germany
10:30 – 10:50 p51	IMAGING OF THROWING SPORT INJURIES McNally E, Oxford, United Kingdom
10:50 – 11:10 ---	IMAGING OF GOLF INJURIES O’Connor P, Leeds, United Kingdom
11:10 – 11:30 ---	IMAGING OF ROWING OVERUSE INJURIES Wilson D, Oxford, United Kingdom
11:30 – 11:50 p52	IMAGING OF CLIMBERS INJURIES Klauser A, Innsbruck, Austria
11:50 – 12:00	Discussion
12:00 – 13:30	Lunch

Wrist abnormalities: pitfalls and normal variants.

Marco Zanetti M.D.

Department of Radiology, Orthopedic University Hospital Balgrist, Zurich, Switzerland

The main pitfalls in the evaluation of wrist abnormalities are related to inappropriately taken radiographs, misinterpretation of carpal bone relationships, and overestimation of abnormalities found on arthrograms and MR images.

Palmar tilt of the distal radius

Distal radius fracture is one of the most commonly encountered fractures. Restoration of the palmar tilt with cast or external fixation is frequently performed when distal articular surface is dorsally tilted. Excessive tilt of the distal articular surface of the radius has been found to have a direct effect on the final functional result in distal fractures. However, the apparent palmar tilt of the distal radius increases with forearm supination and decreases with pronation (1). A wrist rotation of 10° leads to a mean change of apparent tilt of 4 – 5°. A change of 10° rotation between two consecutive control lateral radiographs is not uncommon during clinical follow-up.

Differences of the palmar tilt produced by off lateral projections of the wrist can be estimated by evaluating differences of the so-called “P0” - distance. The “P0” distance is measured between the palmar cortex of the pisiform (p) and the reference point (0). The reference point (0 = 0 mm) is defined as the midpoint within the interval between the palmar cortices of the distal scaphoid pole and the capitate head. One millimeter difference in the “P0” - distance corresponds to a difference in the palmar tilt of approximately one degree (1). The consideration of differences in the “P0” distance should allow to assess if differences of the palmar tilt between two radiographs are true or are only due to various positioning of the wrist.

Ulnar variance

The assessment of ulnar variance is crucial in the treatment approach of Kienbock’s disease, distal radius fratcure, and ulnar impaction syndrome. However, different degrees of forearm rotation, arm position, and wrist deviation are associated with alterations in ulnar variance.

Ulnar variance is more positive in the 0° arm abduction compared to 90° arm abduction. The assessment of the extensor carpi ulnar groove allows to decide if the arm was correctly positioned (2).

DISI or VISI configurations

Wrist instabilities are conditions caused by abnormalities of the carpal bones or ligaments that may result in progressive degenerative arthritis due to abnormal loading or movement of the wrist. Dorsal intercalated segmental instability (DISI) and ventral intercalated segmental instability (VISI) are two common midcarpal instabilities which can be recognized easily on lateral standard radiographs. DISI or VISI configurations are defined by abnormal capitolunate (normal: -30° to +30°), scapholunate (normal: 30° to 60°) and radiolunate (normal: -25° to +10°) angles . However, on standard radiographs it has been recognized that malposition of the wrist can mimic a DISI or VISI configuration in normal wrists. A DISI configuration can be also mimicked on sagittal MR images in the presence of normal standard radiographs.

The angles indicative for instability on standard radiographs are influenced on sagittal MR images by wrist positioning. Subtle errors in the selection of the imaging plane do not significantly influence measurements. The tendency toward dorsal tilting on sagittal MR images is even present in correctly positioned wrists, is exacerbated in ulnar deviation, but is absent in radial deviation. Therefore, statements about carpal alignment on MR images without plains film correlation should be avoided (3).

Abnormalities of the triangular fibrocartilage

Triangular fibrocartilage (TFC) lesions have been recognized as a cause of ulnar wrist pain. However, during wrist arthrography communicating defects (CDs) of the TFC in the asymptomatic contralateral side have been recorded up to 80%. Non-communicating TFC defects which are typically located at the proximal side of the TFC near its ulnar attachment have a more reliable association to symptomatic wrists than communicating radial defects. Separate injections of the distal radioulnar joint are commonly needed to show the proximal ulnar non-communicating defects. (4)

References

1. Zanetti M, Gilula LA, Jacob HA, Hodler J. Palmar tilt of the distal radius: influence of off-lateral projection initial observations. Radiology 2001;220(3):594-600.

2. Levis CM, Yang Z, Gilula LA. Validation of the extensor carpi ulnaris groove as a predictor for the recognition of standard posteroanterior radiographs of the wrist. J Hand Surg [Am] 2002;27(2):252-7.

3. Zanetti M, Hodler J, Gilula LA. Assessment of dorsal or ventral intercalated segmental instability configurations of the wrist: reliability of sagittal MR images. Radiology 1998;206(2):339-45.

4. Zanetti M, Linkous MD, Gilula LA, Hodler J. Characteristics of triangular fibrocartilage defects in symptomatic and contralateral asymptomatic wrists. Radiology 2000;216(3):840-845.

Imaging of acute injuries of the hand and wrist: Plain film and CT.

R. Schmitt, Bad Neustadt/Saale (D)

General considerations: For evaluating forearm and wrist trauma, radiograms are exposed in neutral rotation. Image evaluation includes analysis of ulnar variance, radius tilts, Gilula's carpal arcs, carpal alignment and angles as well as osseous and articular anatomy. Nowadays, complete trauma extent should be determined immediately after the injury by using early CT and MRI. For depiction of complex fractures we prefer multi-slice CT with axial data acquisition (slice thickness 0.5 or 0.75mm), followed by coronal and sagittal MPR, and SSD display, for diagnosis of ligament tears in conjunction with arthrography.

Distal radius fracture: It's essential to differentiate extra- from intraarticular fracture patterns. Extraarticular fractures are sufficiently depicted with standardizied radiograms. Intraarticular radius fracture should be staged with multi-slice CT to assess destruction of the articular surfaces and fragment dislocation. Because the carpus is often involved, it has to be evaluated carefully.

Instability of the distal radioulnar joint: In equivocal cases axial CT scans are very helpful to detect DRUG instability and to assess the extent of subluxation.

Scaphoid fracture: In addition to standard radiographs, Stecher's view (clenched fist with ulnarduction) is particularly helpful for visualizing nondisplaced scaphoid fractures. If these radiograms are negative, we recommend sagittal-oblique CT scans which almost always identifies or rule out a fracture. This algorithm provides an accurate fracture staging. Thus, MRI is required in rare cases.

Other carpal fractures: Dorsal avulsion lesion of the triquetrum is seen on lateral X-ray views. Other carpal fractures may be profiled with special views, but often remain undetected. Subtle fractures (e.g. hook of the hamate) and combined injuries are best assessed with CT scans.

Carpal dislocations and fracture dislocations: Injury vectors follow often the so-called lesser arc (around the lunate) and greater arcs (through distal carpal row), frequently with dorsal dislocation of the carpus. They lead to disruption or overlap of Gilula's carpal arcs on dorsovolar view, and to the "spilled tea cup" sign on lateral view.

Carpal instability: Pathologic alignment of the carpus is visualized on lateral radiograms by means of altered angles, the DISI pattern in scapholunate dissociation and the VISI configuration in lunotriquetral instability. Ulnar translocation of the carpus is proved on dorsovolar view. Unlike these forms dynamic instability is detectable only with stress series and cinematography. Altered carpal ligaments are visualized noninvasively with focal enhancement on MRI after intraveneous gadolinium application. Ligament lesions are depicted more accurately with direct MR arthrography, and with CT arthrography.

ACUTE INJURIES OF THE HAND AND WRIST: MRI

Martina Lohman

It is recommended to include fluid sensitive sequences such as T2FS or STIR in the protocol. Sequences and planes used are dependent both on the MRI, the field strength, the patient, and the clinical question.

OSSEOUS INJURIES

Fractures and bone bruises

When a fracture or dislocation is suspected plain x-rays is the primary examination. As all wrist injuries cannot be detected on plain X-rays in the acute stage (Lohman et al, 1999), either MR or later follow-up X-rays are recommended in possibly hazardous fractures. If further characterization of a fracture line is indicated computed tomography (CT) with reconstructions is recommended.

By MRI cortical avulsions may be missed or interpreted as distensions or contusions (Lohman et al, 1999). However, by MRI, traumatic chondral injuries and injuries to the chondrous growth plate in children can be detected (Carey et al, 1998). In addition to fractures, MRI shows bone bruises, not seen on X-rays or CT . Bone bruises represent trabecular injury with an intact cortex. Pain despite negative X-rays may be explained by a bone bruise (Newberg et al, 1996).

Distal radius and ulna

MRI is seldom needed in acute radius fractures. If additional ligamentous injury is suspected MRI is a better choice.

Carpal bones

Fractures in the carpal bones may be subtle and difficult to pick up on X-rays. Not only scaphoid but also capitate fractures (Breitensehere et al, 1997) may be missed on primary X-rays –both of these may lead to posttraumatic osteonecrosis. Fractures of the hamate hook are also easily missed on regular X-rays but well seen on MRI.

Metacarpal and fingers

As metacarpal and carpal fractures are easily seen on plain X-rays MRI is seldom indicated.

SOFT TISSUE INJURIES

LIGAMENT INJURIES

The amount of joint fluid is generally increased in significant wrist trauma. The joint fluid serves as a natural contrast agent, facilitating the visualization of ligaments and chondrous joint surfaces when fluid-sensitive sequences are used. The wrist ligaments are only a few millimeters in width. To avoid misinterpretation the ligaments should be analyzed in several planes.

TFCC

TFCC injuries may be associated to ulnar styloid fractures. In addition to analyzing the anatomy of the ligaments, the position of the distal radius in relation to the distal ulna and the position of the extensor carpi ulnaris tendon should be evaluated (Pfirrmann et al, 2001).

Scapholunar ligament

Increased scapholunar distance, and discontinuity of the ligament with fluid extending through the ligament are signs of scapholunar ligament tears.

There may also be a DISI-type of malalignment.

Lunotriquetral ligament

The same criteria can be used for lunotriquetral ligament tears. In lunotriquetral ligament tears VISI-malalignment may be present.

UCL of the thumb

A dedicated finger coil enables a smaller field of view. Coronal planes parallel to the ligament facilitates the diagnosis of ligament injuries. By MRI it is usually possible to subgroup tears as Stener- or non-Stener ruptures (Hergan et al, 1995).

TENDON INJURIES

Tendon ruptures

MRI is suitable for the diagnosis of acute tendon ruptures (Drape et al, 1998). Discontinuity of the tendon indicates a total rupture. In partial ruptures the tendon is usually attenuated in the acute phase. Fluid in the tendon sheath or surrounding the tendon is a common finding in acute trauma.

Pulley injuries

The pulley system supports the flexor tendons of the fingers and prevents displacement of the tendons during flexion. Pulley injuries are best seen within the axial or sagittal planes. Flexion of the fingers may facilitate the diagnosis (Parellada et al, 1996).

FOREIGN BODIES

Foreign bodies that are not seen on X-rays can be further examined by MR. Gradient echo sequences are recommended both due to thinner slices and more pronounced ferromagnetic artifacts which may aid in the detection of small foreign bodies. T2FS sequences demonstrate possible edema around a foreign body.

REFERENCES:

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Carey J, Spence L, Blickman H, et al: MRI of pediatric growth plate injury: correlation with plain film radiographs and clinical outcome. Skeletal Radiol. 1998; 27: 250-2555.

Drape JL, Tardif-Chastenet de Gery S, Silbermann-Hoffman O,et al. Closed ruptures of the flexor digitorum tendons: MRI evaluation. Skeletal Radiol. 1998: 27: 617-24.

Hergan K, Mittler C, Oser W. Ulnar collateral ligament: differentiation of displaced and nondisplaced tears with US and MR imaging. Radiology 1995; 194: 65-71.

Lohman M, Kivisaari A, Vehmas T, et al: MR imaging of suspected trauma of the wrist bones. Acta Radiologica 1999: 40: 615-618.

Newberg AH, Wetzner SM. Bone bruises: their patterns and significance. Semin Ultrasound CT MR. 1994; 15: 396-409. Review.

Parellada JA, Balkissoon AR, Hayes CW, et al. Bowstring injury of the flexor tendon pulley system: MR imaging. AJR 1996; 167: 347-9.

Pfirrmann CW, Theumann NH, Chung CB, et al: What happens to the triangular fibrocartilage complex during pronation and supination of the forearm? Analysis of its morphology and diagnostic assessment with MR arthrography. Skeletal Radiol. 2001; 30: 677-85.

Imaging of overuse syndromes in the hand/wrist (CT and MRI).

A. Stäbler

Overuse syndromes in the hand and wrist occur in tendons and tendon sheets, in the triangular fibrocartilage complex including ulnocarpal impaction or abutment syndrome, in the intrinsic and extrinsic carpal ligaments and in the carpal bones e.g. in the presence of bony or fibrous carpal coalitions, especially of the lunate and triquetrum. Overuse can result in stenosing tenosynovitis around the wrist and in synovitis with or without impingement of the flexor or extensor tendons of the digitis or ruptures of the annular and cruciform pulleys. Although diagnosis of these entities is usually made by history and clinical investigation, ultrasound and MRI can be helpful tools in imaging of these diseases. Also carpal ganglion cysts are in some respect related to overuse and tendon degeneration. They can originate from tendon sheets, extrinsic or intrinsic carpal ligaments and can be located in the soft tissue or intraosseously. Intraosseous ganglion cysts are almost always associated with intrinsic and extrinsic palmar or dorsal ligamentous structures, which show degenerative changes. Unlike degenerative cysts, ganglion cysts do not erode the hyaline articular cartilage, and almost always have a continuity with the capsular ligaments. It can be speculated that intraosseous ganglion cysts are the result of mechanical stress and degeneration of adjacent ligaments.

Arthrography, CT and MRI arthrography of the wrist.

G. Christopoulos, Bad Neustadt/Saale (D)

Conventional arthrography is performed with the sequential injection of contrast agent into the wrist joint compartments, usually under fluoroscopic control. Wrist arthrography is used frequently in the evaluation of patients with persistent wrist pain secondary to suspected tears of the TFCC, the intrinsic ligaments, or articular cartilage injuries. The procedure permits indirect visualization and evaluation of the boundaries of the wrist, that are the cartilage, the interosseous ligaments, the capsule with its recesses, and the triangular fibrocartilage complex.

The aim of this work is to demonstrate the technique of **CT- and MRI arthrography**, to distinguish between normal anatomy and variants as well as to assess pathological findings of the most important structures of the wrist, that are the intrinsic ligaments and the triangular fibrocartilage.

This overview should also demonstrate the superiority of CT- and MRI arthrography compared to conventional arthrography regarding its inherent superimposition of anatomic structures of interest. CT- and MRI arthrography have the great advantages of the multiplanar imaging which is free of superimposition. Unlike the conventional technique, arthrography in combination with CT or MRI allows the therapeutically important localization of tears within the scapholunate ligament regarding its three anatomical portions. Special technical feature of CT is the excellent spatial resolution, in MRI the high contrast resolution which allow not only assessment of the wrist anatomy, but also can differentiate tissue lesions by means of the signal intensity, e.g. the depiction of bone marrow edema adjacent to a ligamentous avulsion lesion.

Evaluation of the wrist arthrograms requires profound knowledge of the normal anatomy and the variants as well as the biomechanics of the different joint compartments. Because asymptomatic degenerative changes of the TFCC and the intrinsic ligaments are frequently seen in the arthrographic techniques presented, it is necessary to consider the clinical symptoms in establishing the final diagnosis

Ultrasound of the Hand: Lumps, Bumps and Trauma.

Simon Ostlere

Nuffield Orthopaedic Centre and Oxford Radcliffe Hospital, Oxford UK

Ultrasound is a rapid, cheap, dynamic, patient friendly method of assessing the musculoskeletal soft tissues, and should be considered as the first line investigation in cases of suspected pathology of structures of a focal and superficial nature. This is particularly so in the hand on account of the exquisite near field spatial resolution of modern scanners. The ultra sensitive colour/power Doppler and new methods of displaying the image such as extended field of view, 3D imaging and digital video clips are other useful features of modern scanners. In addition ultrasound is an ideal method of guiding biopsies and injections.

Lumps and Bumps

In our institution nearly all-soft tissue masses of the hand are initially examined by ultrasound. A minority of these cases will also require MRI for further characterisation or preoperative planning.

Many soft tissue masses of the hand are excised without prior imaging. Imaging should be reserved for those cases when narrowing a differential diagnosis will have reasonable chance of influencing management or to aid preoperative management.

A common request is to confirm the clinical suspicion of a ganglion and to identify its extent. The ganglion may have a narrow stalk that connects the palpable mass to its origin and identification of this stalk will help ensure that the entire lesion is removed. The commonest origin for a ganglion is the dorsal portion of the scapholunate ligament.

Ultrasound will readily differentiate solid masses from ganglia and other cystic lesions. Although solid lesions may be non-specific, their site, vascularity and echo pattern will usually allow differentiation between the commoner lesions such as neuroma, haemangioma, lipoma, giant cell tumour of tendon sheath and glomus tumour. The vast majority of hand lumps are benign but a non-specific mass, which is growing, should suggest a malignant lesion, the commonest of which is synovial sarcoma.

Often exisional biopsy of masses identified on ultrasound is performed without resorting to MR. However, in a number of cases MR will help provide further diagnostic information that may influence the decision to proceed to surgery. In addition, if a malignant lesion is suspected then MR is often warranted prior to excisional or percutaneous biopsy.

Masses around the wrist may impinge on the ulnar or median nerve and present with neurological symptoms. The typical sites of neural compression are the carpal tunnel (median nerve) and Guyon’s canal (ulnar nerve). The well-cited culprits are lipomas, ganglia, aneurysms and anomalous muscles. Ultrasound will identify, and usually accurately characterise, any mass. If no mass is found the entire nerve can easily be scanned to exclude a more proximal lesion.

Trauma

Plain films are the technique of choice for identifying fractures of the hand. Although ultrasound has been used as a second line investigation for scaphoid fractures when plain films are normal, MRI is considered to be a superior technique. Fractures occasionally are found as an unexpected finding in patients with posttraumatic pain and normal plain films.

Ultrasound is however and excellent technique for investigating tendon and ligament rupture. The position of the retracted tendon can be accurately assessed for preoperative management. Ligament ruptures rarely require imaging although ultrasound can be helpful in diagnosing the Stener lesion of ‘game keeper’s thumb’. Pulley and extensor hood injuries are also well visualised.

Ultrasound is the technique of choice in identifying and locating foreign bodies. The offending object is usually clearly visible being echogenic compared to the surrounding inflammatory response. Ultrasound is particularly useful when a foreign body has migrated some distance from the entry point.

IMAGING OF RHEUMATOLOGICAL DISORDERS IN THE HAND/WRIST AND ELBOW: VALUE OF DIFFERENT IMAGING METHODS

Mikkel Østergaard.

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The modern treatment strategy in rheumatoid arthritis (RA) and other inflammatory joint diseases consists in early initiation and optimal adjustments of aggressive therapies. Implementing this strategy requires methods for early diagnosis and sensitive monitoring of the disease process.

In clinical trials and routine management, plain film radiography is the conventional method for diagnosing and monitoring structural joint damage. However, it is insensitive to bone damage at its earliest stages and totally incapable of capturing the primary feature of rheumatoid disease, the synovitis.

In comparison with radiography, magnetic resonance imaging (MRI) offers assessment of bone damage with improved sensitivities to early pathology and to change. In addition, detailed assessment of soft tissue changes, including synovitis, tenosynovitis and enthesitis, is possible and MRI findings are in RA of prognostic value for the long-term radiological and functional outcome.

Ultrasonography (US) is less validated than MRI, but available data suggests that US offers comparable information on both inflammatory and destructive changes in joints that are accessible by US examination, e.g. the finger and toe joints.. Issues of reliability, standardization and documentation probably limit its value in clinical trials

This presentation will briefly review current knowledge on conventional radiography, MRI and US for assessment of hand, wrist and elbow in inflammatory joint diseases, with emphasis on RA. The rationale is provided for MRI being the new gold standard for assessment of arthritic joints and US becoming not only a useful method for radiologists, but also a routine bedside tool for improved joint assessments and injections by rheumatologists.

Pursuing the goal of improving patient care and disease outcome, rheumatologists and radiologists can no longer afford to ignore MRI and US as means to measure disease activity and joint damage in RA and other inflammatory arthritides.

OSTEOMYELITIS AND SEPTIC ARTHRITIS OF THE HAND/WRIST AND ELBOW

Anne Grethe Jurik,

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GOAL

To present the diagnostic aspects of osteomyelitis in the region of the underarm and septic arthritis of the hand/wrist and elbow, including differentials and imaging strategy.

GENERAL CONTENT.

Etiology and pathogenesis: Bone and joint infection usually occur via one of the following ways of contamination: 1) haematogenous spread of organisms (haematogenous osteomyelitis/arthritis), 2) spread from contiguous source of infection or 3) direct implantation of organisms and 4) postoperative infection. 2-4) can be grouped together under the term exogenic infection. The location of exogenic infection depends on the deposition site of the organisms whereas the location of haematogenous infection relates to the age of the patients. In children haematogenous osteomyelitis is usually located to the metaphyseal region and the epiphyseal cartilage plate presents a barrier for spread to the epiphysis and the joint. In newborns and adults there are vessels passing from the metaphysis to the epiphysis and therefore no barrier for spread to the joint. In all age groups haematogenous joint infection can occur directly via seeding through the synovial vessels.

Osteomyelitis/arthritis in the hand region is somewhat different from infection in other regions because exogenic infection caused by penetrating wound, bites, foreign bodies, surgery ect. are more frequent than haematogenous infection and the hand anatomy defines typical routes of disease spread.

The responsible organisms are in 80%-90% of cases Staphylococcus aureus. Other causes are mainly streptococcus species, Haemophilus influenza, pneumococci, pseudomonas, salmonellae, Enterobacteriaceae, Eikenella corrodens (from human bites), Pasteurella multocida (from animal bites), mycobacteria and fungal agents.

Clinical features: Depending on the aggressiveness of the organism and the resistance of the host osteomyelitis or septic arthritis may be acute with accompanying fever and malaise or more insidious as seen in subacute and chronic infection. Serious chronic illness, immunosuppressive therapy and drug/alcohol abuse predispose to both osteomyelitis and joint infection, and pre-existing joint disease to septic arthritis.

Imaging features: The initial signs indicating infection at *radiography* may be soft tissue swelling and blurring of the normal fat planes. The presence of fat pad sign indicates intraarticular collection in the elbow, but is not always present because an oedematous fat pad can attain the same density as muscles. It takes about 7 to 10 days before osseous lesions become visible, a period within which ultrasonography, MRI or scintigraphy may be of great diagnostic help. In acute infection typical osseous changes consist of variable bone destruction with irregular outline and at metaphyseal lesions also periosteal reactions. Subacute infection is characterized by a mixture of osseous destruction and reactive sclerosis, usually with well defined osseous contours. It may present as a round or ovoid intramedullary radiolucency with a sclerotic rim named Brodie's abscess. In chronic infection the dominating feature is osseous sclerosis with loss of the normal trabecular bone structure, sometimes accompanied by hyperostosis due to incorporation of solid periosteal reaction into the involved bone. During active infection the sclerotic area often contains lytic areas representing intraosseous abscesses or nests of granulation tissue, and bone sequestration can be seen.

Ultrasonography is valuable for the early diagnosis of septic arthritis, especially in children, giving the possibility of differentiation between joint effusion and paraarticular soft tissue involvement only, including detection of foreign bodies. Also fluid elevating the periosteum as part of osteomyelitis can be seen and diagnostic aspiration can be guided by ultrasonography.

MRI with its multiplanare capability, greater anatomic detail and excellent bone marrow and soft tissue contrast resolution has obtained a significant role in the evaluation of osteoarticular infections. The most suitable sequence for screening is STIR because of its excellent visualization of inflammatory oedema, supplemented by T1-weighted SE images which provide excellent anatomic detail. Unless contraindicated, intravenous gadolinium-based contrast medium should always be administered to differentiate abscesses or necrotic areas (sequester) from inflammatory oedema.

Osteomyelitis presents as high signal intensity on STIR images with corresponding low-signal intensity on T1-weighted images. Periosseous oedema is consistently present in acute osteomyelitis seen as a high-signal rim around the bone on STIR images and may also occur in subacute and chronic infection. Areas of vascularized inflammatory tissue display contrast enhancement, whereas low signal intensity persist corresponding to abscess cavities and sequestra. The inflammatory areas are usually large and irregularly outlined in acute osteomyelitis, more moderate in subacute osteomyelitis and sometimes minimal in chronic infection. The most specific features of septic arthritis are synovial enhancement and perisynovial oedema. Joint effusion is detectable in about two third of patients, but may be absent, especially in small joints.

CT is a valid method for diagnosing sequestra. Such avascular osseous fragments will present as high density areas usually surrounded by an area with relative low attenuation corresponding to fluid or soft tissue inflammation. Visualisation of sinuses with contrast can also be provided by CT (CT-sinography).

Differential diagnoses of septic arthritis of the hand/wrist and elbow includes rheumatoid arthritis, other synovial-based arthropaties, osteoarthritis, gout/pseudogout, neuropathic arthropathy, haemophilic arthropathy, traumatic lesions (traumatic arthritis/fracture), avascular necrosis/osteochondritis dissecans, osteochondromatosis, villonodular synovitis, chondroblastoma, intraosseous ganglion and subchondral cyst. In the hand region tendonitis and reflex sympathetic dystrophy may simulate infection and at the elbow septic olecranon bursitis. Osteomyelitis has to be differentiated from primary and secondary malignant bone tumours such as Ewing sarcoma, osteosarcoma, chondrosarcoma, lymphoma, leukaemia and metastasis. In addition from benign tumours, e.g. osteoid osteoma and osteoblastoma, eosinophilic granuloma, enchondroma, bone cysts, fibrous dysplasia and traumatic lesions (stress fractures, traumatic periostitis).

Imaging strategy*:* Imaging is essential in the diagnosis and follow-up of osteomyelitis and septic arthritis. The challenge is to detect infections as early as possible to prompt commencement of treatment which improves the prognosis. In addition to assure whether abscesses or sequestra are present since they may require surgical intervention.

In patients suspicious for having osteomyelitis or septic arthritis with unknown location and in patients with multifocal disease bone scintigraphy will be the best initial diagnostic method to localize the areas of disease followed by radiography. In cases with known localisation of the infection radiography should be the initial imaging although it usually will appear normal during the first 1-2 weeks of acute infection. Its value is to exclude other disorders and to be a background for the evaluation of therapy. In subacute or chronic infection radiography may give sufficient information with respect to therapy. Ultrasonography and especially MRI gives valuable supplementary diagnostic information. Intraarticular fluid collection or soft tissue abscesses can be detected by ultrasonography, which also gives the possibility of guided aspiration. MRI provides excellent visualisation of both soft tissue and osseous structures with regard to therapy and differentiation against other disorders. CT may be of value in detecting sequestration and visualization of fistula tracts.

Osteonecrosis in the Wrist and Elbow.

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The educational objectives of this presentation are to review the common and less common forms of avascular necrosis of the wrist and elbow regions and to review some pitfalls and differential diagnoses. Case examples with radiographs and MRI will be used to illustrate the main radiological diagnostic features and clinically relevant details.

Etiologies of osteonecrosis include idiopathic, related to anatomical variation, associated with exogenous or endogenous hypercortisolism, chemotherapy, systemic disorders such as sickle cell disease, collagen vascular disorders, Gauchers disease, alcoholism, dysbaric disorders, pregnancy, radiation induced necrosis, renal transplantation and renal dialysis, chronic pancreatitis, gout, metabolic conditions and trauma. Trauma may be either acute or repetitive and recurrent. Certain sites of osteonecrosis are associated with specific occupations and sporting activities, such as butchers and gymnasts. Osteonecrosis occurs due to a significant reduction or obliteration of the blood supply to the bone. Phases of ostenecrosis include cell death and acute host reaction, cellular moderation in the ischemic zone with hyperemia, development of reactive interfaces, remodelling at this interface and articular collapse (crescent sign). The ostenecrotic bone may then undergo fragmentation and secondary degenerative osteoarthritis may ensue, with possible intra-articular osseous and cartilaginous body formation, and rarely cystic formation. End stages include carpal collapse (SLAC wrist) and osteoarthritis. Conventional radiographs and MRI are central for the diagnosis of ostenecrosis (1), to review for extent and severity of the ostenecrosis and adjacent articular cartilage and for the presence of intra-articular bodies (2, 3). Computered tomography is useful in defining the extent of collapse, morphology and remains the gold standard for diagnosis of union after fracture or surgery.

Osteonecrosis of the carpal bones primarily affects three sites, most commonly the lunate bone (Kienböck`s disease), rarely the scaphoid bone (Preiser`s disease, idiopathic spontaneous ostenecrosis), and less commonly the capitate bone (1, 4). Other carpal bones are rarely associated with ischemic necrosis, such as the hamate bone. Osteonecrosis of the hook of hamate is not uncommon. The commonest cause of avascular necrosis of the scaphoid bone is within the proximal pole after fracture which occurs in approximately 10 to 15% of cases. If radiographs are negative, MRI screening for fracture and the presence of avascular necrosis is a useful tool. Pitfalls and differential diagnoses include bone contusions, bone islands, osteoid osteoma, large intraosseous ganglions, ulnolunate/carpal abutment syndromes, marked degenerative osteoarthritis and focal inflammatory and rheumatological disorders.

Unusual sites of ostenoecrosis within the hand include within the distal or proximal metacarpal bones (Diedertrich`s Disease) (5, 6), and within the phalanges (Thiemann`s disease). These are quite rare.

Panner`s disease, or osteochondrosis of the capitellum of the humerus or less commonly involving the radial head usually occurs in boys between the ages of 5 and 10 years and is well defined with MRI (7). It may be associated with specific sports such as base ball ( Little-leaguer`s elbow) and in gymnasts (8). After fracture or fracture dislocation any bone portion may potentially develop avascular necrosis. Osteonecrosis of the adult elbow has been described in the radial head, capitellum, trochlea, lateral and medial condyles in association with corticosteroid therapy (9). Post traumatic avascular necrosis of the radial head has been described in children (10). Pitfalls (11) and differential diagnoses of the elbow include bone contusions, pseudodefect of the capitellum, pseudodefect of the trochlear groove, bone islands and focal and marked degenerative and inflammatory joint disease.

After fracture or fracture dislocation any bone portion may potentially develop avascular necrosis. Osteonecrosis of the adult elbow has been described in the radial head, capitellum, trochlea, lateral and medial condyles in association with corticosteroid therapy.

Early diagnosis with MRI in combination with conventional radiographs may allow for earlier intervention both clinically and surgically, decreasing severity of disease and complications. Awareness of pitfalls and differential diagnoses is important.

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MALIGNANT BONE and SOFT TISSUE TUMORS of the HAND.

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PURPOSE

To report the prevalence of bone and soft tissue tumors of the hand and to assess the value of imaging in distinguishing malignant from benign lesions.

METHOD and MATERIALS

Two hundred consecutive cases of bone tumors of the hand, registered at the « Dutch Bone Tumor Committee » and one hundred consecutive cases of soft tissue tumors of the hand, registered at the « Belgian Soft Tissue Neoplasm Registry ». All cases were peer reviewed and histologically proven.Plain radiographs of all cases of bone tumor were available, 50 patients had an additional MR examination. MR examinations of all cases of soft tissue tumor were available.

RESULTS

One hundred seventy five bone lesions were benign, 25 were malignant.The majority (58%) consisted of tumors of cartilaginous origin (47% benign, 11% malignant).A correct grading (benign versus malignant) was made in 85% of the lesions.

Ninety two soft tissue lesions were benign, 8 were malignant.The majority consisted of giant cell tumors of the tendon sheath (18%), hemangiomas (14%), pseudotumors (10%), and ganglion cysts (9%).

CONCLUSIONS

1.Plain radiography remains the first choice modality in diagnosis of bone tumors of the hand.The same diagnostic algorithm can be applied as for other osseous structures.

2.MRI has an additional value in staging bone tumors, in assessing soft tissue involvement of a bone tumor (lymphoma, metastasis…), in recognizing a primary soft tissue tumor as a cause of secondary bone alteration and in confirming (or rarely changing) the diagnosis made on radiography.

3.Soft tissue tumors of the hand are more frequent than bone tumors, benign tumors largely outnumber their malignant counterparts (92 vs 8%).

4.There are some soft tissue tumors having the hand as a preferential location.They all are benign tumors (ganglion cyst, GCTTS, fibrolipohamartoma…).

5.Benign soft tissue tumors mostly have distinctive features on MRI, MR parameters predicting malignancy are less sensitive and specific.

6.The goal of MRI is to characterize as much as benign soft tissue tumors and to advocate a biopsy in a small number of MRI-non specific lesions.

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BENIGN MASSES OF THE HAND AND WRIST

Davies AM

This presentation will briefly review the causes and imaging features of benign masses of the hand and wrist. The emphasis will be on the radiographic and MRI appearances. In routine practise, 70% are of soft tissue origin and 30% bone. The commonest of all bone tumours in the hand is the enchondroma which can have a variety of appearances. Giant cell tumours (GCT) have a predilection for the distal radius but may also occur in the distal ulna, metacarpals and rarely the phalanges. Dynamic contrast-enhanced MRI is useful in the detection of local recurrence of GCT. A spectrum of exophytic lesions may arise from the long bones of the hand. These include osteochondroma, subungual exostosis, BPOP and turret exostosis. The differential diagnosis of these conditions and their malignant counterparts are discussed. As at other sites, infection may also present in the hand and wrist as a mass lesion. TB being a prime example

Compressive and Entrapment Neuropathies of the Elbow and Wrist

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CEN: Role of MRI

- Detection of external cause compressing nerve
- Identify muscle denervation patterns
- Exclude other pathologies mimicking CEN

Pathophysiology of Nerve Injuries

- Mechanical compression
- Functional compression
- Repetitive friction
- Taction
- Traumatic disruption

Grades of Nerve Injury

Seddon, 1943

•Neuropraxia: reversible, compression, loss of conduction. Damage myelin sheath. No axonal disruption

•Axonotmesis: Axonal disruption without damage of Scwan cells or endoneurium with wallerian degeneration. Axonal regeneration. No surgery.

•Neurotmesis: Axonal disruption, discontinuity of tissues. Fibrosis. No regeneration. Resection, anastomosis or graft.

Grades of Nerve Injury

Suderland, 1968

- Grade 1: Neuropraxia
- Grade 2: Axonotmesis
- Grade 3: Advance axonotmetic, early neurotmesis
- Grades 4, 5: Progressive degrees of neurotmesis

- Several grades may coexist

MRI Signs of CEN

•Hyperintense on T2, STIR (Increased endoneurial free water)

•Motled appearance.

•Thickening (proximal or at the compression)

•Compression, displacement

•Muscle edema (early phases) (axonotmetic and neurotmetic lesions)

•Muscle atrophy (late phases)

Median Nerve

•Lateral and medial cords of brachial plexus (C7-T1)

•Flexor pronator group

–Pronator teres

–Flexor carpi radialis

–Palmaris longus

–Flexor digitorum superficialis

•Branches to elbow and proximal RU joints

•Skin palm

•Thenar eminence

Median Nerve CEN

- Pronator syndrome
- Anterior interosseous nerve syndrome

Median Nerve CEN

- Non-specific forearm pain
- Paresthesias
- Similar or co-exist with Carpal Tunnel Syndrome
- Pronator Syndrome

–Symptoms during the day

–Increase with activity (forceful pronation)

Additional Causes of Median Nerve CEN

- Accesory lacertus fibrosus
- Bicipitoradialis bursitis
- Soft tissue masses
- Elbow dislocation
- Accessory muscles

–Gantzer's muscle: accessory head of the flexor pollicis longus muscle

–Palmaris profundus

Anterior Interosseous Nerve Syndrome

- Ulnar head of pronator teres
- Flexor digitorum superficialis
- Accessory muscles
- Anomalous arteries
- Fibrous bands

Anterior Interosseous Nerve Syndrome

- Pain or paralysis flexor pollicis longus, flexor profundus of the 2^{nd} digit and pronator quadratus: loss of pinch mechanism
- No sensory deficit (DD with pronator syndrome and CTS)

Ulnar Nerve

- Medial cord brachial plexus (C8, T1)
- Arcade of Struthers: 8 cm proximal to medial epicondyle (fibrous tunnel between medal intermuscular septum and medial head of triceps
- Cubital tunnel: arcuate ligament, mediala epicondyle, medial trochlea, olecranon and MCL

Cubital Tunnel Syndrome

•Physiologic compression (decreased size during flexion)

•Acute and subacute external compression (trauma)

•Chronic compression (mass)

•Anconeus epitrochlearis

•Fractures, dislocations, callus

•Cubitus valgus (MCL laxity, athletes, tardy ulnar palsy 15 years after trauma during childhood)

•Ulnar nerve sublxation, dislocation (snapping triceps syndrome)

•Conservative treatment

•Surgery (transposition)

Radial Nerve

- Posterior cord brachial plexus (C5-C8, T1)
- Between brachialis and brachioradialis muscles
- Superficial branch (sensory)
- Deep branch (motor): posterior interosseous nerve: Arcade of Frohse

Radial Nerve

–Medial and long heads of triceps

–Anconeus

–Brachialis

–Brachioradialis

–EC Radialis longus and brevis

–Supinator

–Extensor muscles wrist and hand

Posterior Interosseous Nerve Compression Syndrome

•Trauma (displaced humeral fractures)

•Space occupying lesion

•Inflammatory process (RA)

Posterior Interosseous Nerve Compression Syndrome

- Pain without sensory deficit
- Loss of extension of digits

- Decreased wrist dorsiflexion

Radial Tunnel Syndrome

•Pain without motor deficit worsened with pronation

•Dynamic compression (violinists, conductors, tennis players)

•DD: Lateral epycondilitis (may coexist in 5% of cases)

Hand and Wristn Compressive Neuropathies

•Carpal Tunnel Syndrome

•Guyon Canal Syndrome

Role of MRI

•Inconclusive clinical diagnosis

–Tinel’s sign: paresthesias on percussion

–Phalen’s sign: dysesthesia after 1 min. wrist flexion

–Electrodiagnosis

•Severe symtoms

•Suspect tumor, aberrant muscle or infiltrative process

•Failed surgery

Anatomic Variants

Carpal Tunnel

•41% patient undergoing carpal tunnel release

–Anomalus persistent median artery

–Bifid median nerve

–Reversed palmaris longus

–Palmaris profundus

–Accessory flexor digitorum superficialis

–Aberrant origin of thenar and lumbrical muscles

Anatomic Variants

Guyon's Canal

- 25% muscle variants

–Accessory Palmaris longus

–Accessory Abductor digiti minimi

–Accessory Flexor carpi ulnaris

Carpal Tunnel Syndrome

•Tenosynovitis

•Ganglion Cyst

•Lipoma

•Calcium Deposits

•Hematoma

•Fluid Retention

•Amyloid

•Aberrant Artery, muscle

•Low Insertion of Lumbricalis

•Hormonal Changes

CTS: MRI Manifestations

•Enlargement of Median Nerve proximal to the tunnel

•High SI on T2WI

•Obliteration of deep fat plane

•Bowing of the retinaculum

Guyon's Canal Syndrome

- Trauma (fx hook of the hamate)
- Ganglia
- Other causes, same as carpal tunnel syndrome

UNEXPLAINED WRIST PAIN: MY APPROACH TO A CLINICALLY ORIENTATED RADIOLOGICAL DIAGNOSIS

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Learning objective: how to asses the status of the wrist clinically and to adapt to that status the radiologic work up. The kind of investigations will be demonstrated and also the way to correlate the radiological finding with the clinical symptoms.

Patients with unexplained wrist pain or with pain and unclear röntgenologic changes on plain films will be send to a radiological department with the following questions; is there a carpal instability or is there ligament or disc damage or are there any (post)traumatic changes or any stress related changes which could explain the symptoms?

After inspection of the previous wrist examinations we will first have a an interview with the patient in the fluoroscopy room. The clinical history is important e.g. the kind of trauma or repetitive trauma, the followed treatments or operations. After the clinical history a short clinical examination is followed. The function and strength of the wrist will be examined. When there is a history of instability, this should be tested and the patient is asked to show any abnormal motion, snaps or locking features. The site of the pain is also noticed and marked with a lead bal on the skin.

We start with fluoroscopy of the wrist with the patient prone on a fluoroscopy table and with the hand along the head. The examiner sits at the end of the table and can manipulate the patients wrist during fluoroscopy. Both hands will be examined for comparison. First the joint spaces are projected free to see if there is any abnormal widening as for example in scapholunate dissociation. Also obscure fractures or pseudoarthroses can be looked for. The site of the pain will be noticed by the lead bal mark. The patient is asked to provoke any abnormal motion in the wrist joint when appropiate (e.g. midcarpal instability, dynamic scapholunate dissociation, ulnar head subluxations). Sometimes the examiner should assist somewhat to provoke these abnormal motions. Then standard radial and ulnar deviation motions and dorsal and volar flexion motions are done to see if there is any abnormal or restricted motion.

Of the end-positions images are made (function views) and also images of positions before and after an abnormal motion (mostly with a snap). Abnormal motions can also be videotaped for documentation.

If the fluoroscopy does not give all the answers or there is still doubt or there is doubt if the found abnormalities do explain the symptoms arthrography can be followed in the same session. Regarding the site of the pain the wrist compartment closest to this site can be start with. A mixture of an iodine containing contrast medium (preferable a dimer) and a local anaesthetic (preferable 2%) should injected in the closest or most important compartment (mostly the radiocarpal joint). The radiocarpal joint arthrogram can show; interosseous ligament and articular disc ruptures or damages, adhaesive capsulitis, free bodies and cartilage damage. If the pain disappears there must be a relation with the joint. This is mostly a synovitis provoked by ligament and/or capsule damage or by osteoarthritis. If the site of the pain shows pathology and the pain disappears it is likely that there is a correlation. If not the pathology can be a not-related coincidental finding. A lot of wrist will have dorsal pain where no abnormality is found but which disappears after the arthrogram and represent probably surmenage (overuse) of the dorsal capsule which is in close vicinity to the synovial membrane.

Sometimes a specific joint should be injected, e.g. the pisotriquetral joint in case of pain in that joint or free bodies in that joint, or the distal radio-ulnar joint when the pain is there or any abnormality on the plain films. When the pain is more distal also the midcarpal joint should be injected or one can start with that joint. In general when the pain sensation does no change at all, I do not consider the joints or the very close vicinity as the cause of the pain.

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IMAGING OF ACUTE INJURIES OF THE ELBOW (CT)

K. Jonsson

CT is an excellent method for evlauating fractures of the elbow. The beauty with CT is that the skeleton is easily evaluated also with plaster fixation. In comminuted fractures there may be problems to evaluate the full extension of the fracture system with plain radiographjy. CT is well suited for such an evaluation. The same may be true in fractures with only one fragment seen with plain radiography, The extent of the fragment may be important for treatment planning and also in such a situation CT is of great help.

Another application is the ability to evaluate rotational dislocation in supracondylar fractures of the elbow. If the rotational dislocation exceeds 15 degrees there is great risk for varus deformity of the elbow. CT is thus of great help to detect such rotational dislocation and imply correct teatement.

OVERUSE SYNDROMES IN THE ELBOW: IMAGING AND CLINICAL ASPECTS

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Learning objectives: to understand the patterns of overuse with respect to “movement chains” in sports and to classify imaging signs following the concept of the “tendon overuse syndrome (TOS)”.

Athletes of all ages and skill levels are increasingly participating in sports involving overhead arm motions, making elbow injuries more common. Lateral epicondylitis occurs in over 50% of athletes using overhead arm motions.

Indications for imaging include conventional radiography and CT are of little value for diagnosing soft-tissue derangement, which is a common source of dysfunction. Ultrasound and MRI are indicated in all types of overuse with MRI being most useful for the detection of internal derangements and for non-responders to conservative therapy.

Investigation with MRI has to be performed in a high-resolution mode (FOV not more than 120 cm, slice thickness of 3 and 5 mm in coronal and axial direction, respectively) and with frequency-selective fat-suppression technique.

Image interpretation should follow the concept of “movement chains” in sports with four major types of injury patterns medially, laterally, anteriorly and posteriorly: Elbow problems are frequently related to the medial tension-lateral compression phenomenon, so-called valgus-stress overload syndrome, producing medially located abnormalities in the form of flexor-pronator strain (with or without medial epicondylitis, thrower’s or golfer’s elbow), ulnar collateral ligament sprain, ulnar traction spurring, and ulnar neuropathy. Elbow instability is a late result from degenerative rupture of the medial collateral ligaments.

Lateral compression causes osteochondral lesions of the capitellum and radial head, degenerative arthritis, and loose bodies. Lateral elbow tendinosis (lateral epicondylitis, tennis elbow) is a degenerative process due to tensile overuse fatigue with the extensor carpi radialis brevis being primarily involved. Anular ligament instability may be an associated finding.

Posterior olecranon impingement (posterior tennis elbow, hyperextension elbow injury) is associated with aggressive hyperextension and eventual triceps tendinosis and osteophyte formation. Olecranon bursitis (student’s elbow) may develop due to bleeding.

Anterior injuries include rupture of the distal biceps tendon and entrapments of the radial or median nerves (pronator teres syndrome).

Tendon overuse syndrome (TOS) is a useful concept for image interpretation with respect to functional impairment without morphologic changes (stage 1), peritendinous changes with fluid filled bursae or soft-tissue edema (stage 2), tendinosis (stage 3), and degenerative rupture (stage 4).

The differential diagnosis includes post-traumatic sequels and, especially in case of biceps tendon ruptures, neoplasms.

In conclusion, with MR imaging detailed insights about the various injury patterns can be gained and conventional radiograms are being progressively replaced by cross-sectional imaging modalities.

Vertebral fracture and osteoporosis

Dr C. van Kuijk

Radiographic diagnosis is considered to be the best way to identify and confirm the presence of osteoporotic vertebral fractures in clinical practice. The severity of vertebral fractures may be visually determined from radiographs using the semi-quantitative (SQ) assessment criteria developed by Genant et al. In visual SQ assessment each vertebra receives a severity grade of either 0, 1, 2, or 3, corresponding to no fracture, or a mild, moderate, or severe fracture, respectively, based upon the visually apparent degree of vertebral height loss. Alternatively, the severity of vertebral deformities can be measured. The dimensions of the vertebral body and the corresponding calculated ratio's such as the ratio of anterior to posterior height are assessed. Using a predefined threshold vertebral bodies are designated to be fractured or not.
Both the semi-quantitative visual approach and the morphometric approach have advantages and disadvantages. In clinical trials to assess the efficacy of anti-osteoporotic drugs both methods are used.
Radiologists should be aware of the importance of diagnosis of vertebral fractures as their presence predicts strongly the occurrence of new osteoporotic fractures, even better than bone densitometry. Prompt and correct diagnosis is therefore warranted, as there are drugs available that can prevent new fractures. In addition to recognition of vertebral fractures and their importance a correct differential diagnosis is needed. Not all deformities are osteoporotic of origin. The differential will be given.

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Vertebroplasty: technique and potential complications

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Managing patients with painful osteoporotic vertebral compression fracture is challenging. Stabilization of the vertebral bodies has been attempted with injection of polymethylmethacrylate into the fractured vertebrae through a needle. This procedure, known as percutaneous vertebroplasty, has been reported to result in substantial and immediate pain relief, and is increasingly being accepted as a major treatment option in management of these patients.

The aim of this lecture is to describe the technique of the vertebroplasty and the potential complications mainly related to leakages of cement. This lecture will also discuss the indication and technique of kyphoplasty, a percutaneous procedure which refers to the insertion of a balloon tamp into the vertebral body prior to cement injection.

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IMAGING IN SOCCER INJURIES

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Learning objectives:

1. To give an overview of the most frequent injuries encountered in soccer players.
2. To define the role of imaging in the diagnosis (and follow-up) of those injuries.

Discussion:

Soccer is a very popular sport, enjoyed by millions of athletes each year. Therefore, soccer-related injuries are increasingly common. Fortunately, most soccer injuries are minor and are easily treated. Less than 20 % of soccer injuries are severe, necessitating further diagnostic imaging. Most injuries are due to acute trauma (80%), occurring more frequently during games than during training. Most often, injuries result from player-to-player contact during tackling. Chronic stress or repetitive microtraumata are less frequent causes of soccer injuries (20%).

Although any part of the body can be involved, the lower extremities -particularly the knee and the ankle joints- are affected.

This lecture will review the most frequent soccer-related injuries based on an anatomic approach.

1/ Lower extremity lesions

Acute lesions

Pelvis/Groin	**Thigh**	**Knee**	**Calf/Lower leg**	**Ankle**
Hernia	Muscle strain • Adductor • Hamstrings • Quadriceps	Ligament sprain • MCL • ACL • Meniscus Popliteus muscle rupture	Muscle strain • Gastrocnemius • Soleus	Sprain • LCL (ATFL) • (Deltoid)
Avulsion fractures (immature skeleton)		(associated) bone bruise or avulsion fracture	Compartment syndrome	Achilles tendon rupture
		(associated) (osteo-)chondral lesion	Fractures (open)	Fractures

Lesions due to chronic overload

Pelvis/Groin	**Thigh**	**Knee**	**Calf/Lower leg**	**Ankle/Foot**
Hernia	Tendinosis • Adductor • Hamstrings	Tendinosis • Patellar tendon • (Quadriceps)	Shin splints	Tendinosis • Achilles • Peroneus
Gracilis syndrome	Thigh splints	Friction syndromes • IT band • Hoffa's	Stress fracture	Football ankle Stress fracture navicular bone

Sequellae or complications

Pelvis/Groin	**Thigh**	**Knee**	**Calf/Lower leg**	**Ankle**
Strangulation of hernia	Inadequate muscle healing • Fibrosis • Myositis ossificans	Instability Accelerated osteoarthritis	Inadequate muscle healing • Fibrosis • Myositis ossificans	Instability Accelerated osteoarthritis Anterolateral impingement
Avulsion fractures : delayed union		Delayed (non) union	Non union of fractures	Non union of fractures
		Loose bodies	Osteomyelitis (open fracture*)*	

2/ Other less frequent locations

Shoulder injuries

The acromio-clavicular joint can be injured by falling onto the shoulder, the elbow or outstretched arm.
Shoulder dislocations and instability may occur in goalkeepers.

Spine

Repetitive hyperextension of the lumbar spine places stress onto the posterior elements, which may result in bone marrow edema and subsequent fatigue fracture of the pars interarticularis (spondylolysis).

Head and facial bones

Concussions or neck pain, resulting from heading a ball are relatively rare.

Soccer is the second leading cause of dental and facial injuries in sports, only preceded by basketball.

Conclusions:

1. The lower extremities are most frequently involved in soccer injuries.
2. Conventional radiography is still the mainstay in the detection of fractures and small avulsions.
3. Ultrasound can be regarded as the initial imaging technique of choice for evaluation of muscle and tendon injuries, and groin pain.
4. In most cases-however-MRI is the imaging technique of choice to demonstrate both bone and soft tissue lesions occurring in soccer trauma.

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Summer sports injuries: beach volley and outdoor basketball

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Musculoskeletal injuries are common in both elite athletes and the general population. MR imaging (MRI) is used extensively to assess abnormalities of the osseous and soft tissues. Ultrasound is also being employed at an increasing rate. The information gained from imaging can be helpful in both making a diagnosis and determining the severity of an injury, thus guiding treatment.

Summer sports in Greece are quite popular. Beach volleyball is performed during July and August whereas outdoor basketball from late March to late October. Data, collected over two summer seasons, are presented on the epidemiology and severity of injuries with emphasis on MRI.

Beach volleyball

Literature data suggests that the ankle is the most commonly injured region in elite indoor volleyball (1). The shoulder is most commonly injured with overuse injuries and rotator cuff tendonitis. The fingers and knees are also injured. Injuries in elite indoor volleyball happen at about a rate of less than 4 per player per 1000 hours played. In beach volleyball injuries happen at about a rate of 5 per player per 1000 hours played with acute injuries most commonly involving the ankle and fingers while overuse injuries involve the knee and shoulder (2). The pattern of injury varies, though, field defense and spiking being common in beach volleyball as opposed to blocking and spiking in indoor volleyball.

Not many publications exist on recreational beach volleyball injuries (3). Our own data, collected over two summer seasons from a single university sports injuries clinic covering an area of about 1 million inhabitants, comprise of 124 cases. Fifty six of them required imaging (plain x-rays and/or MRI). All injuries were evaluated clinically as being acute with no overuse component. With the exception of a hip dislocation with acetabular fracture in an obese weekend athlete, no serious injury was recorded after the imaging and clinical correlation. It should be noted that no stretching before the game was reported by almost all injured athletes. Interestingly, most of the injuries (75%) happened during field defense (back-row position) whereas the rest occurred during landing after blocking or attacking (front-row position). The ankle (sprains, bone bruise, osteochondral injuries), shoulder (bone bruise, muscle contusion), knee (meniscal tears, ligamentous injuries), hip (dislocation, muscle contusion) and fingers (chip fractures) were the most commonly injured sites.

Outdoor basketball

Injuries in elite basketball involve the ankle, low back and knee with strains and sprains being the commonest findings. An overall injury rate occurs at about 25 per 1000 hours played (4). More serious injuries occur in the lower limb as opposed to other body regions. In recreational basketball, on the other hand, players most commonly suffer from recurrent ankle injuries (5).

Our own data from a single university sports injuries clinic over two summer seasons comprises of 98 cases. Thirty two of them required imaging (plain x-rays and/or MRI). All injuries were evaluated clinically as being acute with no overuse component. Most players used to be competitive in the past, at various levels of skill. Most of the injuries happened during contact (89%) and the rest at landing. The ankle (32%) and knee (21%) were the most commonly injured regions, with the lower back to follow. Although sprains and strains (52%) and bone bruises (22%) were the most common MRI findings, the incidence of serious injury was also high. ACL tears accounted for 70% of severe knee injuries Bony fractures, meniscal tears and osteochondral defects were among the most commonly diagnosed severe injuries.

Conclusion

In beach volleyball and outdoor basketball acute rather than overuse injuries result. The ankle and knee are the most commonly injured sites. Most of the injured athletes did not stretch before the game. Severe injuries tend to occur with basketball. Half of the injuries in beach volleyball and one third in outdoor basketball required imaging. The profound diagnostic capabilities of MRI in evaluating sports-related injuries, contribute to select the appropriate treatment.

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INJURIES IN THROWING ATHLETES

E McNally

The kinematics of the throw vary with the particular sport, but often involve a rapid transition from external to internal rotation with the shoulder anywhere between full and 90 degrees of elevation. Injuries primarily affect the shoulder and elbow, but injuries to the lower back also occur in sports that combine running and throwing like javelin and cricket. Shoulder injuries include: Impingement, Rotator cuff tear Instability, Labral injuries, Posterosuperior Glenoid impingement, HAGL, Bennett lesion, Suprascapular Neuropathy,Quadrilateral space syndrome and the Snapping scapula syndrome. This can be due to Osteochondroma, Bursitis or Rib fracture. Less common manifestation include: Thoracic inlet syndrome, Teres major avulsion, Pec Major injury. Injuries also occur to the humerus itself, including: Little Leaguer's Shoulder, Stress and overt fracture of the Humerus. Elbow injuries can involve the bony or soft tissue structures including : Stress Lesion of the Proximal Medial Ulna, Avulsion Fracture of the Coronoid Tubercle and Epicondylitis and collateral ligament tears. The typical spinal injury is the pars defect. The imaging features of many of these lesions will be dicussed.

IMAGING OF CLIMBERS INJURIES

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Rock climbing is a rapidly expanding sport, attracting an increasing number of recreational climbers. High-performance training with modern training concepts can be employed for all ages, including young children during school sport activities.
Typical climbing associated injuries are due to overuse and involve predominantly the upper limb. The most commonly involved structures are the fingers and the wrist, where 60% of the injuries occur. The other 40% are equally divided between the elbow and the shoulder, known as ”climber’s finger” and ”climber’s elbow”.

Magnetic Resonance Imaging, Computed Tomography and Ultrasound (US) have been used to assess finger injuries. US is known to have the advantage to be readily available and a less expensive alternative.
The evaluation of the flexor annular pulley system (A1-A5) with dynamic high frequency US enables a differentiation of incomplete, complete and combined finger pulley injury. Dynamic measurement are performed on extended fingers at rest followed by active forced flexion against the fingertips. An increase of the tendon phalanx (TP-) distance during forced flexion with values higher than 3.0 mm can be considered as complete rupture of the A2 pulley, values greater than 5.0 mm as a sign for complete combined rupture of the A2 and A3 pulley. An increase of TP distance greater than 2.5 mm is a sign for complete rupture of the A4 pulley.
Differential diagnosis in finger swelling includes overuse in terms of focal tenovaginitis, pulley hypertrophy, ganglion-cysts, and increased joint fluid. Furthermore injuries of extensor hood, flexor unit strains, tendinosis at the insertion of flexor digitorum profundus and superficialis can be well demonstrated due to US.
Furthermore US is well accepted by the climbers in terms of changing of climbing schedules and exercise habits to protect and rehabilitate the climbers. Therefore dynamic high frequency US can be used as the primary imaging modality for overuse injuries in rock climbers.