Assessment of wrist joint pain by Magnetic Resonance Imaging

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Abstract

Introduction: Wrist pain is a common clinical complaint. The most common causes of wrist pain are traumatic and non traumatic abnormalities involving ganglia, avascular necrosis, and triangular fibrocartilage lesions. MRI serves as a problem-solving technique to assess the cause of wrist pain. It also plays an important prognostic role.

Aim of the Work: The aim of this study is to highlight the value of MRI in assessment of patients suffering from wrist joint pain.

Patients and Methods: A descriptive study, conducted on fifty patients underwent MRI examination (patients with painful wrist joint) during this period. Every patient with normal MRI examination had been excluded from this study. All patients were performed MRI in radiology department, Ain Shams University Hospital. The examination carried out after signing the informed consent by the patient himself or his guardian if the patient is incapacitated by any means.

Results: The study included 50 patients (21 females and 29 males) rangedin age between 19-70 years with mean age 20-40 [30.90±11.38], 56.0% of the patient were between the age of 20-30 years

Conclusion: MRI is modality of choice in evaluating the painful wrist joint diseases due to its high soft tissue contrast resolution, and multi-planar capabilities. It provides a non-invasive tool for the diagnosis of wrist joint disease, which are often difficult to diagnose with alternative modalities. MRI is particularly advantageous for assessing soft tissue structures around the wrist such as tendons, ligaments, nerves, and fascia and for detecting occult bone injuries.

Key words: **wrist joint, pain, magnetic resonance imaging**

Introduction

Wrist joint pain is a common clinical complaint caused by traumatic and non traumatic lesions [1]

The bone and soft tissues of wrist and hand are frequent sites of anatomic variations which may be a source of diagnostic error that simulate disease and potentially result in misdiagnosis. On the other hand, physical injury to wrist and hand may result in wide variety of fractures, dislocations and soft tissue injuries [2]

MRI serves as a problem- solving technique to assess the causes of wrist pain, it also plays an important prognostic role. MRI is particularly suited for evaluation of the complex bone and soft tissue anatomy of wrist because of its superior soft tissue contrast and the ability to image in multiply planes. In addition, new fast scan techniques provided improved efficiency and allow dynamic studies to be performed. MR arthrography technique has improved significantly resulting in more routine use of this technique[3] .

MRI is very helpful in surgical planning, because it is confirms the diagnosis in cases when other radiographs or imaging modalities are normal or equivocal, due to its high

sensitivity and specificity as compared with other modalities[4] .

Aim of the work

The aim of this study is to highlight the value of MRI in assessment of patients suffering from wrist joint pain.

Patients and Methods

Patients:

This is a descriptive study, conducted from January 2017 till October 2018.Fifty patients underwent MRI examination (patients with wrist joint pain) during this period. Every patient with normal MRI examination had been excluded from this study. All patients were performed MRI in radiology department, Ain Shams University Hospital. The examination carried out after signing the informed consent by the patient himself or his guardian if the patient is incapacitated by any means.

The study included patients present with painful wrist joint aged from 19 to 70 years.

Exclusion criteria:

Patients having contraindication to magnetic resonance imaging eg: claustropholoia, patients with non MR compatible cardiac pacemaker or cochlear implants, any patient with painless diseases like swelling joint and pediatric age group were excluded from the study.

***History: All patients were subjected to:**

Personal history: it included age, sex, occupation, history of contraindication to MRI (like: claustrophobia, cochlear implant, non-MR compatible cardiac pacemaker), *Present history:* history of wrist pain; type and duration, *Past history:* pervious diseases or operations, pervious radiological investigations for assessing the wrist pain.

***MRI Examination:**

Equipment: MRI was performed using Philips Achieva device MRI Philips 1.5 tesla.

***Patient position and coils:**

Patients were examined either in the supine or pron position with elevated arm (superman position). *Coils*: wrist at center of scanner, use dedicated wrist coil or small surface coil.

MRI Scanning Protocol:

The imaging planes, sequences, and even the selection of which coil to use varied depending on the clinical circumstances.

The FOV (field of view): 8-10 cm included the distal radial and ulnar head, all of the carbal bones, and the bases of the metacarbals.

Slice thickness: ranged from 2-3 mm, only in case of Coronal true fisp 3D slice thickness ranged from 1.5-2mm.

Matrix: 240 x 320

Image Planes:

Our screening examination includes all three image planes (axial, coronal, and sagittal). For certain anatomies, oblique planes are useful. This is particularly true for the carpal bones especially the scaphoid bone.

- Coronal oriented between radial and ulnar styloid process.
- Axial include volume 2-3 cm proximal of radio carpal joint to 1 cm distal to the carpometacarpal joints.
- Sagittals are oriented 90 to coronals.

MRI sequences

T1w imaging sequences are favored by good anatomical detail, and relatively short imaging times, with the ability to visualize tissues with high perfusion and permeability.

To differentiate between haemorrhage, haematoma and oedema. The T1-weighted spin echo sequences were used.

We use conventional spin-echo T1-weighted sequences and turbo spinecho (FSE) T2-weighted sequences with fat suppression in most cases.

FSE inversion recovery sequences are used to differentiate between fluid and pathologic tissues which have high signal intensity in comparison to suppressed marrow and fat signal.

Fat-suppressed T2-weighted or proton density-weighted turbo spin echo (TSE), and short-time inversion recovery (STIR) sequences are suitable for detecting intramuscular or perifascial fluid collections or haematoma.

FS is also frequently applied on T1w images in order to more clearly visualize inflammation in synovium, tendon sheaths, and bursae.

Gradient-echo (GRE) sequences (2D or 3D techniques) used with (0.5 to 1) mm sections to allow well ligament, capsular, and articular anatomy.

We are also routinely performing a coronal dual echo steady state (DESS) sequence to evaluate articular cartilage.

Table 1: MRI Sequences and Parameters

Sequences	Parameters			
	FOV	Slice	TE	Matrix time (mint)
Coronal T1	8-10 cm	2-3 mm	Min	240 x 320
Coronal PD FS	8-10 cm	2-3 mm	10-20	240 x 320
Coronal true fisp 3D	10 cm	1.5 – 2 mm	5	320 x 450
Axial PD FS	10 cm	2-3 mm	10-20	320 x 420
Sagittal T1	10 cm	2-3 mm	Min	240 x 320
Sagittal PD FS	10 cm	2-3 mm	10-20	240 x 320

Data analysis:

All images were interpreted on the computer workstation by two expert radiologists blinded to the patient's history and the diagnosis was established.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

Results

The main age group affected by wrist joint disease are those >20-30 years (Fig 1).

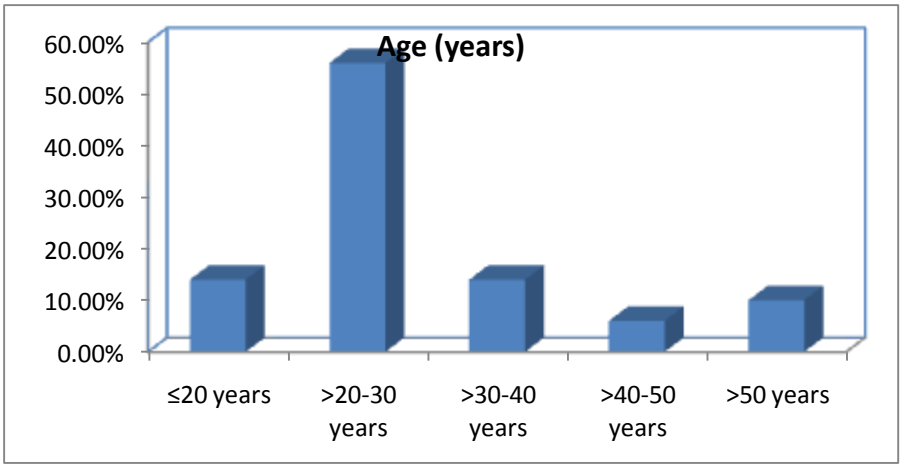


Fig. (1): Bar chart representing age distribution of the study group .

In this study the male patients (58%) are slightly affected with wrist joint diseases more than female patients (42%) (Fig 2).

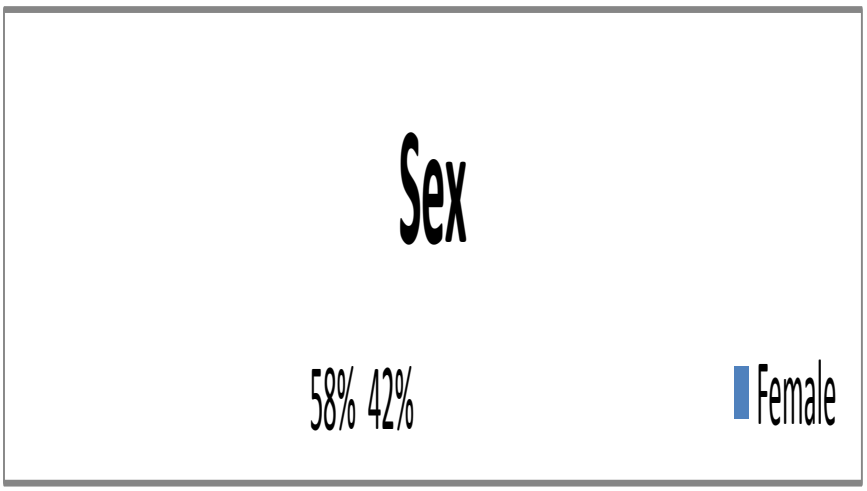


Fig (2): Pie chart representing sex distribution of the study group.

According to the causes of wrist joint lesions, the lesions classifided in two major groups : Traumatic and non traumatic origin.

Traumatic lesions	Non Traumatic lesions
Ganglion cysts	Fractures
Avascular necrosis	Ligament tears
Arthritis	TFCC tears
Carpal tunnel syndrome	SL tears
Tenosynovitis	DRUJ sublaxation
Chronic Tenopathy	

Of all patients, 20 cases (40 %) presented with acute wrist joint pain and 30 cases (60 %) presented with chronic wrist joint pain.
23 cases (46%) had left wrist joint affection, 26 cases (52%) had right wrist joint affection and one case (2%) had bilateral wrist joint affection.
In this study, 5 patients presented with the Rheumatoid arthritis (10.0%), while only two patients had Osteoarthritis (4%). Seven patients of a total 50 patients presented with AVN (14.0%), 4 of them had Lunate AVN while 3 only had AVN of scaphoid. Fourteen patients had Ganglion cysts (28.0%) and 3 patients had Carpal Tunnel syndrome (6.0%). Scaplo lunate ligament tear was found in 10.0% of all 50 patients, four of them were partial tear and only one patient had complete tear. TFCC tear was found in 6 patients (12.0%), all of them were complete tear. The most commonly found fracture was Scaphoid fracture (with DISI) which detected in (14.0%), while Lunate fracture (with displacement), Capitate fracture (will avulsion), Triquetrum,and fracture of Hook of hamate, Distal Radial head fracture, each was detected only in one patient (2.0%). Rolando & Radiostyloid process fracture were found in 2 patients (4.0%). Ulnar styloid process fracture was found in 3 patients (6.0%).
Wrist joint effusion frequently noted among the patients and detected in 13 patients (26.0%). While Bone Marrow edema was found in 7 patients (14.0%) and in both clinically swollen and non-swollen wrist joint. Chronic tenopathy was found in one

patient (2.0%), and Tenosynovitis was found in 2 patients (4.0%). All these MRI finding and their percentage are summarized in Table 2.

MRI finding	No.	%
Rheumatoid arthritis	5	10.0%
AVN	7	14.0%
Scaphoid	*3*	6.0%
Lunal	*4*	8.0%
Ganglion cyst	14	28.0%
Scaplo lunat tear	5	10.0%
Partial	*4*	8.0%
Complete	*1*	2.0%
Carpal Tunnel syndrome	3	6.0%
TFCC tear	6	12.0%
Complete	*0*	0.0%
Partial	*6*	12.0%
Scaphoid fracture with DISI	7	14.0%
Lunate fracture (with displacement)	1	2.0%
Tenosynovitis	2	4.0%
Capitate fracture (will avulsion)	1	2.0%
Triquetrum fracture	1	2.0%
Osteo arthritis	2	4.0%
Hook of hamate fracture	1	2.0%
Rolando & Radio styloid process fracture	2	4.0%
Distal Radial head fracture	1	2.0%
Ulnar styloid process fracture	3	6.0%
Wrist joint effusion	13	26.0%
Bone Marrow edema	7	14.0%
Chronic tenopathy	1	2.0%

Table 2. MRI finding distribution of the stud group.

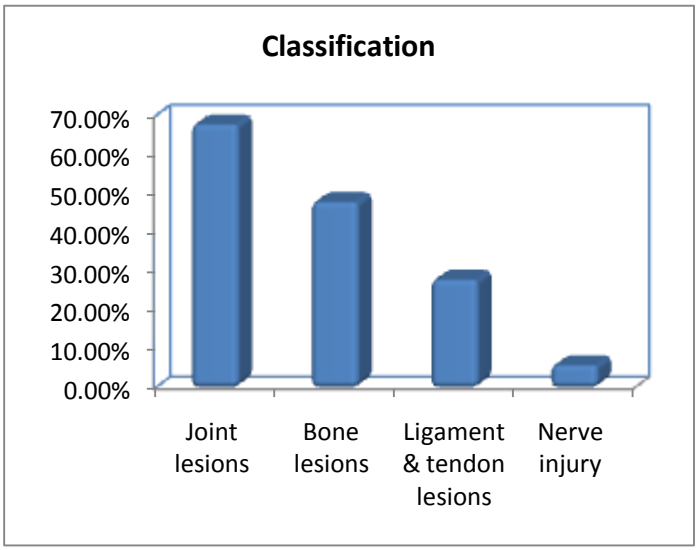
According to the data collected from our study (Table 6.2), we had 75 pathologies diagnosed by MRI, 34 of them (68%) were joint lesions, while 24 of them (48%) were bone lesions, 14 of them (28%) were ligament & tendon lesions and 3 of them (6%) of them were nerve lesions in a form Carpal tunnel syndrome (Fig. 3).

Cl assification	No.	%
Joint lesions	34	68.0%
Bone lesions	24	48.0%
Ligament & tendon lesions	14	28.0%
Nerve pathology	3	6.0%

Table 3. Classification of different pathology distribution of the study group (n=50)

Fig. 3 Bar chart classification of different pathology distribution of the study group (n=50)

The different joint pathologies detected were joint effusion (38.2%), benign tumors (ganglion cysts) (41.2%), Rheumatoid arthritis (14.7%) and Osteo arthritis (5.9%) of joint lesions (Table 4).



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	No.	%
Joint effusion	13	38.2%
Benign tumor	14	41.2%
Rheumatoid arthritis	5	14.7%
Osteo arthritis	2	5.9%

Table 4. Joint lesions distribution of the study group (n=34).

From 24 Bone lesions, the fractures represented (70.8%) and bone edema represented (29.2%).

	No.	%
Fracture	17	70.8%
Bone edema	7	29.2%

Table 5. Bone lesions distribution of the study group (n=24)

From all cases of Ligament and tendon lesions, the scapholunat tear represent (35.7%), TFCC tear (42.9%), tenosynovitis (14.3%) and chronic tenopathy (7.1%) (Table 6).

Table 6. Ligament and tendon lesions distribution of the study group (n=14)

	No.	%
Scapholunat tear	5	35.7%
TFCC tear	6	42.9%
Tenosynovitis	2	14.3%
Chronic tenopathy	1	7.1%


(A)


(B)


(C)

Avascular necrosis of the Lunate bone

Discussion

Wrist painful conditions are common causes of functional loss in the general population especially affecting the younger population. The wrist is a complex joint comprised of the distal radio-ulnar joint (DRUJ), the radio-carpal joint (RCJ), the intercarpal joints and the carpo-metacarpal joint (CMCJ) [5]

Usually, the evaluation of painful wrist condition begins with clinicians when start dealing with findings from medical history, a detailed physical examination, and plain radiograph. The plain film radiography is the primary radiological investigation of the wrist because is easy, cheap and has a great ability in demonstrating fractures, intra- articular loose bodies, arthritis, osteophytes, calcifications as well as sclerotic and lytic bone lesions. However, if a diagnosis is not well established, additional diagnostic studies such as ultrasound, computed tomography, and MRI may be obtained[6].

MRI of the wrist is often challenging because the components of the wrist have complex anatomy of bone and soft tissues,

with ligaments and cartilage which are small sized structures measuring millimeters[7].

MRI is a one of advanced imaging techniques that play an important role in evaluating the wrist and is a useful examination modality because of its multiplanar, multisequence capability and its excellent resolution of soft tissue structures. MRI is the most sensitive imaging modality for the assessment of structures critical in the evolution of inflammatory disease,

with studies confirming the superiority of MRI when compared with plain film radiography[8]

The purpose of study carred out by **Burke**[9] was to summarize and review the role of MRI in the assessment of synovitis and joint effusion which are common manifestations of rheumatic disease and play an important role in the disease pathophysiology. MRI enables not only detection of synovitis and effusion, but also allows quantification, detailed characterization, and noninvasive monitoring of synovial processes. Also they discussed the utility of MRI as an outcome measure to assess treatment response, particularly with respect to osteoarthritis and rheumatoid arthritis. Magnetic resonance imaging (MRI) allows assessment of all joint structures and associated pathology. This is corresponds with our aim to highlight the role of MRI in assessment of painful wrist joint diseases including rheumatoid arthritis and osteoarthritis (Arthropathies).

Our study included 50 patients; this is close to those in the study by **El-Kholy et al**[1] which was carried out on 50 patients, included 32 males and 18 females; their ages ranged between 17 and 60 years (mean age 38 years). The most affected age group was between 20 and 40 years (60%). Avascular necrosis was the commonest non traumatic lesion found in 10 patients (26%) and two cases(4%) of tumors recorded yet, not mensioned their type. Our study included 29 male patients and 21 female patients,their ages ranged between 19 and 70 years;the mean age was 30 years [30.90±11.38]. AVN was the second commonest non traumatic lesion found in 7 patients (14%) after Ganglion cysts (28%) of all cases. Our study did not include any case of tumor apart of ganglion cysts.

In the study by **El-Kholy et al.** [1], the causes of wrist joint pain subdivided into traumatic and non traumatic categories. This is in agreement with our study which subdivided the painful wrist joint diseases into traumatic and non traumatic origin that included ganglia, AVN, arthritis, ligament lesions, TFC lesions, fractures,, tendinopathy, and neuropathy.

The fractures are the most common abnormality but the hook of hamate fractures account for less than 4% of carpal fractures. This was mentioned in a study conducted by **Davis**[10]. There is total agreement with our study which proved that the fractures are the most common lesions of wrist joint and present in 17 patients (34%); the hook of hamate fractures was one case only among 50 patients (2%).

In our study, the earliest stage of AVN of the lunate (Kienbock's disease) in MRI examination is manifested by marrow edema; and in advanced stage, the lunate bone had low signal in all pulse sequences. AVN of the scaphoid also showed same features. This finding also stated by **El- Koly et al.** [1] .

A study performed by **Tibrewal et al.** [11] **,**which included 137 patients referred to the orthopaedic department with clinically suspected scaphoid fracture but normal series of plain radiographs were prospectively followed up over a two-year period. They implemented the use of early MRI for these patients and determined its incidence of detected scaphoid injury in addition to other occult injuries. Soft-tissue pathology was diagnosed in 59 patients (43.4%). Of those, 46 were triangular fibrocartilage complex (TFCC) tears (33.8%) and 18 were intercarpal

ligament injuries (13.2 %). According to the data collected from our study, Soft-tissue pathology was diagnosed in 17 patients (34%), 6 of them were triangular fibrocartilage complex (TFCC) tears (12%), Scapholunate ligament injuries were 5 (10%), Nerve injuries were 6%,Tenosynovitis 4% and only 2% was chronic Tenopathy.

In **Tibrewal et al.** [11] study, bone marrow oedema with no distinct fracture was discovered in 55 cases (40.4%).The scaphoid was involved only in 17 (12.5%) cases. In the remainder, the other carpal bones or distal radius were also involved. Fractures were diagnosed on 30 cases (22.0%). In our study the bone marrow oedema without fracture was discovered in 7 cases (14%). The scaphoid was involved only in 7 patients (14%). The other Fractures of carpal bones and distal radius fractures collectively account together 10 cases (20%).

Krabben[12] study Concluded that the Inflammation in wrist joint on MRI is not only present in clinically swollen but also in non-swollen joints. In particular BME occurred in clinically non-inflamed joints. This coincided with our study that observed bone marrow edema occurred frequently in both swollen and non swollen wrist joint.

Murthy[13] study stated that Fractures of the scaphoid are the most common surgically treated carpal fracture, and early diagnosis is critical to minimize complications including osteonecrosis. If the initial radiographs after the injury are inconclusive, early magnetic resonance imaging provides an immediate diagnosis to allow for proper management. This shown to be cost effective both in direct and indirect measureable costs. Our study also found that early MRI can detected occult fractures in carpal bones especially scaphoid and lunate bone although X ray was inconclusive, this allow early management and prevention of AVN.

MRI is the best imaging modality for assessing osteonecrosis of the proximal pole in a scaphoid nonunion. This what mentioned by **Murthy**[13] study that relied on the non contrast T1-weighted images for the primary diagnosis of osteonecrosis with dynamic contrast enhancement used in a supplemental fashion. Our study highlighted the ability of non contrast T1-weighted images and post contrast images of MRI in diagnosis of Scaphoid Osteonecrosis, and the lunate AVN as well.

Finlay et al. [14] reported in their study that TFC tears had a linear focus of high signal intensity crossing the low-signal TFC in T2-weighted image, whereas in our study TFC tears had intermediate signal intensity in T2-weighted image crossing low-signal TFC in three cases of degeneration and high signal intensity in T2 in two cases with actual tear. **Finlay et al.**[14] added that with TFC tear showed either negative ulnar deviation, fracture ulnar styloid, distorted scaphoid, abnormal position of distal radius overlapping DRUJ, or space widening between scaphoid and lunate bones in different cases. This coincides with our study, which detected same association with TFC tear and other wrist joint abnormalities like negative ulnar deviation, fracture or pathologies in carpal bones, ulnar and radial styloid fractures, displacement of distal radius overlapping DRUJ, or space widening between scaphoid and lunate bones.

Conclusion

MRI is a non-invasive tool and the modality of choice in assessment of painful wrist joint diseases which are often difficult to diagnose with

alternative or conventional modalities due to its high soft tissue contrast resolution, and multiplanar capabilities. MRI is particularly advantageous for assessing occult bone lesions and soft tissue structures around the wrist such as cartilages, tendons, ligaments and nerves. MRI because its high sensitivity and specificity is very useful in follow up the patients after treatment, as well as for surgical planning and the patients response for surgical management in post operative stage.

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