Original Article

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Ultrasonography and MRI Evaluation in Wrist Joint Pain

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Abstract

Background: Wrist joint pain is one of the commonest conditions that are encountered in the orthopaedics. Accurate diagnosis is made clinically and confirmed by imaging modalities before any treatment is undertaken. Objectives: To evaluate a patient with wrist joint pain in terms of assessment by ultrasound as the first line of imaging modality, and further correlating with MRI, To use ultrasound along with X-rays and MR imaging to aid in quick and decisive diagnosis & To delineate pitfalls during image interpretation and limitation of USG. **Subjects and Methods**: This is a prospective study conducted for a period of 2 years at the teaching hospital of Bapuji Hospital and Chigateri General Hospital attached to Bapuji Education Association, J.J.M. Medical College, Davangere. Total of fifty patients presenting with wrist joint pain were included in the study after obtaining written informed consent. **Results**: The mean age of the study subjects was 42.32 ± 12.63 with minimum age of 25 years and maximum age of 65 years with female predominance i.e. 32/50 (64%). The sensitivity and specificity analysis of diagnostic tests revealed that 100% sensitivity and specificity in USG was observed for tendinopathy, solid mass and CTS. Whereas MRI showed 100% sensitivity and specificity for tendinopathy, TFCC, simple ganglion cyst and solid mass. **Conclusion**: Ultrasound imaging in correlation with MRI imaging could be considered superior to X-rays in the diagnosis of non-traumatic wrist joint pain. Though operator dependent, a well performed Ultrasonography can effectively serve as a primary diagnostic method and screening of all painful wrist joints because it is non-invasive, cost effective, portable and easily accessible with 100% sensitivity and specificity.

Keywords: Wrist joint pain, X-Ray, Ultrasonography, MRI, de-Quervain's disease, Sensitivity, Specificity

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Introduction

Wrist joint pain is common clinical condition that are seen in the orthopaedics department. Almost one third of the patients visiting hospitals have pain as the primary chief complaint. Majority of them had chronic pains in central India.[1] Wrist pain accounts for an annual consultation prevalence rate of 58 in 10,000 patients in the UK. Generally, the management depends upon diagnosis reached, certain traumatic conditions are managed very differently to inflammatory conditions.[2] Wrist pain is traditionally classified as acute pain caused by a specific injury or as subacute/chronic pain not caused by a traumatic event. In these cases, the differential diagnosis is wide and includes tenosynovitis, tendonitis, tendinopathy ganglions and arthritis.[3]

Overuse of joint may lead to subsequent subacute or chronic pain, have systemic or neurologic causes, or be a sequela from an old injury. Patients with these type of certain injuries may have a history of repetitive wrist movement, either occupationally or recreationally. The features of sensory disturbances, such as tingling or numbness, indicates nerve involvement. Health-care professionals diagnose wrist pain mainly by a patient's history and physical examination. Radiologic investigations such as X-ray, Ultrasound scan (US), Computerised tomography scan (CT) and Magnetic Resonance Imaging (MRI) are often used. Accurate diagnosis should be made clinically and confirmed by imaging modalities before any further treatment is taken.

Non-traumatic aetiologies of wrist pain can vary. A thorough and accurate medical history and a review of the systems are important to uncover potential systemic causes of wrist pain. Most physicians agree that imaging evaluation of a painful wrist should begin with radiography as it is cheap and simple. High frequency Ultrasound is useful in differential diagnosis of various local and systemic causes of the pain.

MRI can be used to further enhance detection and evaluation of several wrist disorders, which allows for discrimination of

soft tissue structures, including muscles tendons, ligaments, cartilage, marrow, nerves, and blood vessels. Also, MRI can be of use in the evaluation of carpal instability of the triangular fibrocartilage disorders, avascular necrosis, fracture synovial abnormalities, nerve entrapment syndromes, tendinopathy, and soft tissue masses.[4] Ultrasonography is the best modality for imaging tendon structures . USG allows dynamic tendon examination which gives it a distinct advantage over MRI and is ideal for assessing peripheral nerves and allows superior imaging definition when compared with MRI or CT.[5,6]

MRI provides clinically quite useful information in examining the wrist joint. Superior clarity in depiction of ligaments, muscles, and tendons as well as the ability to visualize, bone marrow ,nerves, and hyaline cartilage directly are merits of MRI relative to conventional imaging techniques. These features of MR imaging may help to establish the cause of wrist pain by accurately depicting the presence and extent of bone and adjacent soft-tissue pathology. This is very important feature in MRI as the imaging modality that shows a maximum soft tissue resolution compared to other imaging modalities.

Objectives

- To evaluate a patient with wrist joint pain in terms of assessment by ultrasound as the first line of imaging modality, and further correlating with MRI.
- To use ultrasound along with X-rays and MR imaging to aid in quick and decisive diagnosis.
- To differentiate pitfalls during image interpretation and also limitation of USG.

Subjects and Methods

Source of data: This is a prospective study conducted for a period of 2 years. The main source of data for the study are patients from the following teaching hospital attached to Bapuji Education Association J.J.M. Medical College, Davangere.

Data collection: A minimum of 50 patients will undergo MR imaging of wrist joint and hand. A 1.5 Tesla MR scanner (Philips achieva) is utilized for MR imaging.

Results

the distribution of the subjects based on involvement of tendon. Out of 50 (100%) subjects, 5 (10%) subjects had De-Quervain's, 4 (8%) had flexor and 5 (10%) had extensor. However, Tendon tear and tendon rupture was not noticed among all the subjects enrolled in our study [Table 1].

[Table 2] shows the findings of Ultrasonography of the subjects based on the distribution of nerves, TFCC, ligaments and vascular involvement of USG. Median and Ulnar nerve was seen abnormal in 2 (4%) subjects. Whereas TFCC and ligaments, vascular structures were normal among all the subjects enrolled in our study

MRI findings showed Bone marrow edema in 33 (66%) subjects, bone erosions in 1(2%) subject, tendon involvement in 13 (26%) subjects, TFCC and ligaments involvement in 18 (36%) subjects, Intramuscular/ subcutaneous edema in 40 (80%) subjects, Deep soft tissue masses in 2 (4%) subjects and joint effusion in 33 (66%) subjects.

The results of sensitivity and specificity analysis of diagnostic tests revealed that 100% sensitivity and specificity in USG was observed for tendinopathy, solid mass and CTS. Whereas MRI showed 100% sensitivity and specificity for tendinopathy, TFCC, simple ganglion cyst and solid mass.

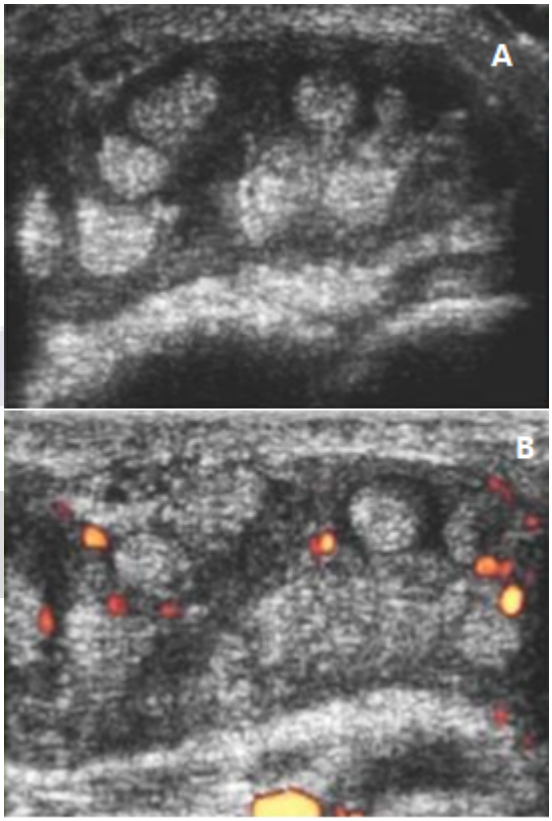

Figure 1: Flexor tenosynovitis a) Axial US image and b) power doppler shows thickening of tendon sheath and hypoechoic collection with increased vascularity.

Discussion

A total of 50 patients having a history of non-traumatic painful wrist were included in our study. The mean age of the subjects was 42.32 ± 12.63 with minimum age of 25 years

Table 1: distribution of the subjects based on tendon pathology

Tendon		Absent		Present	
		Frequency	Percent	Frequency	Percent
Tenosynovitis	De Quervain's	45	90.0	5	10.0
	Flexor	46	92.0	4	8.0
	Extensor	45	90.0	5	10.0
Tendon tear	50	100.0	0	0.0	
Tendon rupture	50	100.0	0	0.0	

Table 2: Distribution of the subjects based on nerves, tfcc, ligaments and vascular structures involvement – on usg

	Abnormal		Normal	
	Frequency	Percent	Frequency	Percent
Median (CTS)	2	4.0	48	96.0
Ulnar	2	4.0	48	96.0
TFCC & ligaments	0	0	50	100
Vascular	0	0	50	100

Table 3: distribution of the subjects based on mri findings

MRI findings	Absent		Present	
	Frequency	Percent	equency	Percent
Bone marrow edema	17	34.0	33	66.0
Bone Erosions	49	98.0	1	2.0
Tendons	37	74.0	13	26.0
TFCC & Ligaments	32	64.0	18	36.0
Intramuscular/ subcutaneous edema	10	20.0	40	80.0
Deep soft tissue masses	48	96.0	2	4.0
Joint effusion	17	34.0	33	66.0

Table 4: Sensitivity and specificity of diagnostic tools

	No	Methods	No	Sensitivity %	Specificity %	PPV %	NPV %	Accuracy
	13	USG	13	100	100	100	100	100
		MRI	13	100	100	100	100	100
TFCC	19	USG	0	0	100	0	62	62
		MRI	19	100	100	100	100	100
Simple	12	USG	9	75	100	100	92.68	94
		MRI	12	100	100	100	100	100
Solid mass	3	USG	3	100	100	100	100	100
		MRI	3	100	100	100	100	100
CTS	2	USG	2	100	100	100	100	100
		MRI	1	50	-	100	-	50

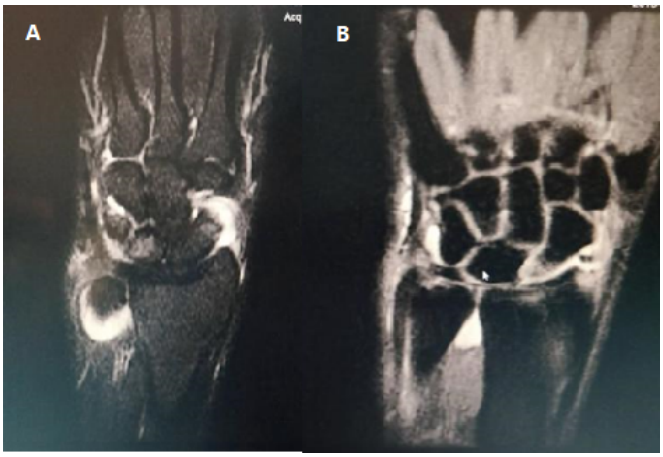

Figure 2: Tenosynovitis of the flexordigitorum superficialis and profundus and flexor pollicis longus tendons.

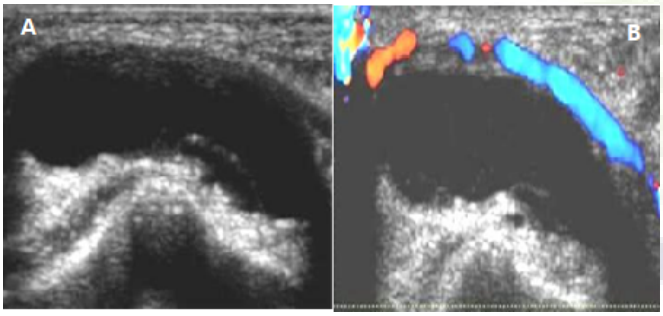

Figure 3: Volar ganglion cyst a) Longitudinal US image and b) with colour doppler showing a well-defined cystic lesion in relation to the distal end of radius adjacent to and deviating the radial artery

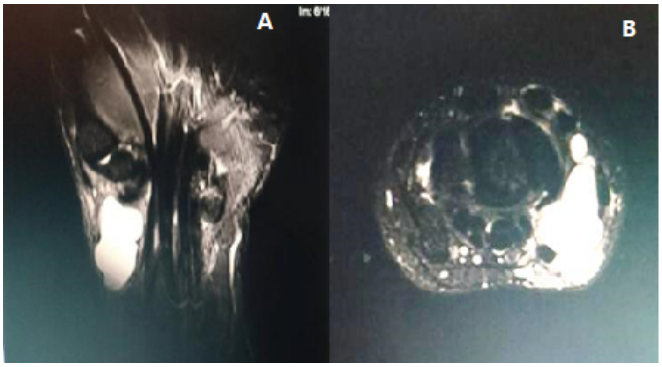

Figure 4: a) Coronal STIR and b) AXIAL STIR images .Ganglion cyst with focal rupture noted in the volar aspect of left wrist on radial aspect.

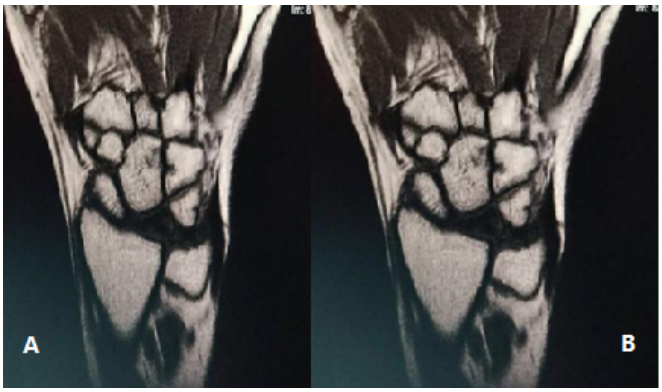

Figure 5: Kienbock's disease (Lunatomalacia) , a) Coronal T1 & b) Coronal T2 images show lunate bone is flattened and sclerosed (bone is T1 and T2 hypointense).Negative ulnar variance noted.

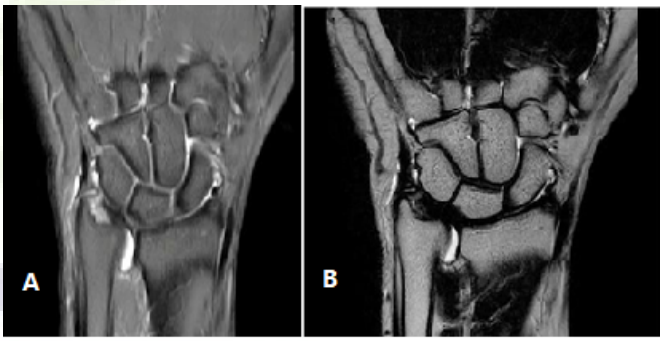

Figure 6: TFCC tear: Tear of the TFCC predominantly involving the volar radio-ulnar ligament

and maximum age of 65 years with female predominance i.e. 32 (64%) and 18 (36%) were males.

In our distribution of symptoms, subjects had pain, 20 (40%) subjects had swelling, 3 (6%) had numbness and all had restricted movements as their chief complaint.

X-ray findings of the study subjects in the present study revealed that 46 (92%) of subjects had normal findings and rest 4 (8%) had abnormal findings. Therese findings were comparable to the research findings of Kumar S et al wherein authors reported that the number of positive cases on ultrasound was 1 (6.66%) and the number of positive cases on MRI was also same i.e. 1 (6.66%).[7]

Tenosynovitis is the inflammation of the fluid-filled sheath (called the synovium) that surrounds a tendon, which leads to joint pain, stiffness, and swelling. Tenosynovitis may be either infectious or non-infectious. Common clinical scenerios of non-infectious tenosynovitis include de-Quervain's

tendinopathy and stenosing tenosynovitis (also known as trigger finger). In our study distribution of the subjects based on involvement of tendon, although tendon tear and tendon rupture were absent in all the subjects. Whereas, 5 (10%) subjects had de-Quervain's, 4 (8%) had flexor and 5 (10%) had extensor. Mild internal vascularity was also noted within the thickened tendon sheath.[7]

The anatomy of the wrist joint is quite complex and its structures are small, with ligaments and cartilage measuring in few millimeters. Evaluation of wrist pain begins with a review of findings from medical history, a detailed physical examination, and plain radiograph. If a diagnosis is not forthcoming, additional diagnostic studies such as ultrasound, computed tomography, and MRI may be obtained. On USG, ligaments and tendons appear as echogenic structures of multiple parallel lines in a longitudinal view or multiple dots in a axial view. In the present study the ultrasonography of the subjects based on the distribution of nerves, TFCC, ligaments and vascular involvement of USG, the median and Ulnar nerve was seen abnormal in 2 (4%) subjects whereas TFCC and ligaments, vascular structures were normal in all the subjects. In all 5 patients with clinical suspicion of carpal tunnel syndrome and abnormal nerve conduction velocity test, swelling of the median nerve at carpal 2 tunnel with a cross sectional area of >10 mm was seen. All the patients also showed increased wrist forearm ratio of cross-sectional area of median nerve.

Ganglion occurring as the most common cause of mass in the wrist joint area. Ganglion may form due to chronic irritation and degeneration of tendon sheath or may arise from a joint. Cystic-simple ganglion was present in 9 (18%) subjects and absent in 41 (82%) subjects in the present study.

In our ultrasound findings of focal masses of wrist joint of study subjects, the cystic-infection was present in 4 (8%) subjects, while it was absent in 46 (92%) subjects. These findings were in contrast to Kumar S et al, where in all the patients with focal soft tissue mass such as ganglion cyst and haemangioma who underwent both ultrasound and MRI, the findings were diagnosed on both scans. All the 3 cases of ganglion cysts were diagnosed on both ultrasound and MR scans.[7]

The distribution of the subjects based on cystic affected aspect in our study showed that the solid mass was found in the affected wrist were present in 3 (6%) subjects and absent in 47 (94%) subjects. In Kumar S et al study, the authors observed the most common pathology on ultrasound was the presence of cystic / solid soft tissue masses, which is noted in 17 (38.59%) of patients.[7] In a review article published by Bianchi S. et al in 2008 to present the sonographic appearance of the most common masses of the wrist and hand and to discuss the role of sonography in their diagnosis stated ganglia are the most common masse of the wrist and hand.[8]

Descriptive statistical analysis of ultrasound findings of affected wrist joint of study subjects in the present study revealed that, the joint involvement showed normal among 49 (98%) subjects and abnormal in 1 (2%) subject. Appropriate clinical history such as duration of pain, swelling, number of joints involved and restricted movement of wrist joint were seen in all patients as noted in Kumar S et al study.[7]

Avascular necrosis of lunate (Keinbock's disease) was present in 1 (2%) of the subject in our study. It was observed in Kumar S et al study that MRI scan showed 2 (13.33%) cases of Keinbock's disease (Avascular necrosis), MRI showed altered signal intensity and collapse in lunate bone.[7] And ultrasound did not show the positive cases for Keinbock's disease. Magnetic resonance imaging is the modality of choice for early diagnosis of Keinbock's disease.

MRI findings of the present study showed Bone marrow edema in 33 (66%) subjects, bone erosions in 1 (2%) subject, tendon involvement in 13 (26%) subjects, TFCC and ligaments involvement in 18 (36%) subjects, Intramuscular/ subcutaneous edema in 40(80%) subjects, Deep soft tissue masses in 2 (4%) subjects and joint effusion in 33 (66%) subjects. Overall, our study results based on diagnostic tests performed for the affected joint showed 100% sensitivity and specificity in USG for tendinopathy, solid mass and CTS whereas MRI showed 100% sensitivity and specificity for tendinopathy, TFCC, simple ganglion cyst and solid mass. These findings were in corroboration with the findings of Kumar S et al wherein the number of positive cases of MRI was 100%, compared to ultrasound i.e. 80% for ganglion cysts, haemangioma, tendosynovitis, fibrolipomatoushamartoma, rheumatoid arthritis, Keinbock's disease and synovial osteochondro-matosis.[7]

The advantages of ultrasound are that it is non-invasive, real time, multi planar and non-ionizing. It can be done rapidly without any patient preparation. It is widely available and at a low cost. It has high spatial resolution.

If we look at the pitfalls of ultrasound – Anisotropy, the tendons appear echogenic when the ultrasound beam insonates at 90° to the long axis of the tendon fibres because the beam is then reflected maximally. The more the angle deviates from this angle, the fewer reflected sound waves will be detected by the transducer. The tendon becomes isoechoic to muscle at angles 2°– 7° and hypoechoic at greater angles. Tendons are more vulnerable to the anisotropic artifact due to their course. If unaware of this artifact, less experienced scanners could erroneously take this for tendinosis or tear. The extensor retinaculum may also simulate a complex fluid collection or tenosynovitis because of anisotropy. At wrists, it is possible to confuse the median nerve with one of the long flexor tendons and vice versa. The long flexor tendons may also be distinguished from median nerve because they merge with their respective muscles more proximally and displays anisotropy.

In summary based on the findings of our study it was demonstrated that ultrasound along with MRI correlation is a valuable imaging modality for diagnosis of wrist pain and is able to detect abnormality in high percentage of cases. While USG could be considered as diagnostic tool in most of the soft tissue pathologies associated with wrist pain. It also helps in early detection of pathology, before radiographic abnormalities become apparent especially the soft tissue lesions. It can also help in detecting cortical erosions but has a limited role in assessing other osseous abnormalities in patients with wrist pain where MRI was more useful.

Conclusion

Based on the findings of our study following conclusions could be drawn out

- Clinical examination of the wrist joint does not provide adequate insight on the cause of wrist pain.
- USG and MRI imaging can be considered superior to X-rays in the diagnosis of non-traumatic wrist joint pain.
- Though operator dependent, a well performed USG with MRI can effectively serve as a primary diagnostic method and screening of all painful wrist joints because it is non-invasive, cost effective, portable and easily accessible.
- Hence, USG along with MRI could be recommended for quick and decisive diagnosis for the wrist joint pain with 100% sensitivity and specificity.

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