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Magnetic Resonance Imaging versus Ultrasonography in Evaluation of Non-Osseous wrist Pain

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ABSTRACT

Background: Ganglion cysts are the most common soft tissue lesions of the wrist and a frequent cause of non-osseous wrist pain. Ultrasonography (US) and magnetic resonance imaging (MRI) are both used in clinical evaluation, yet their relative diagnostic value in routine practice remains debated.

Objective: Evaluation of non-osseous wrist pain caused by ganglion cysts initially by ultrasonography and further comparing it to Magnetic Resonance imaging.

Patients and Methods: A total of 55 individuals with wrist discomfort aged (15 to 62 years old) were participated in this prospective cross-sectional comparative study. On the wrist joint, musculoskeletal ultrasonography was performed using a 4–12–MHz linear array transducer. A 1.5 T wrist joint MRI was performed**.** There was no need for post contrast MRI assessment. **Results:** While both ultrasound and magnetic resonance imaging can be used for this purpose, ultrasound appears to be a favorable option for the assessment of wrist ganglion cysts.

Conclusion: US can be considered as a first line of investigation in assessment of wrist pain caused by ganglion cyst followed by MRI as the second line in evaluation of lesions in debate or with atypical features.

Keywords: (US) Ultrasonography, Non osseous wrist pain, (MRI) Magnetic resonance imaging, Ganglion cysts.

INTRODUCTION

One of the most complex joints in the human body, is the wrist. It is formed from distal radio-carpal, distal radio-ulnar and mid-carpal articulations. The articular surface of is covered with articular (hyaline) cartilage; a connective tissue composed of a dense network of collagen fibers resulting in tissue with tensile strength yet more flexible than bone and is held together by multiple ligaments, tendons, and other soft tissues that provide carpal stability along both the dorsal and volar aspects [1]. Fluid-filled soft tissue masses, known as ganglion cysts, are frequently discovered close to joints or tendon sheaths, especially in the hand and wrist. Although these cysts are more common in women, they are usually not dangerous but can be uncomfortable. The standard course of treatment is monitoring; however, if symptoms become persistent, more invasive procedures like aspiration or surgery can be necessary [2].

Compared to adult populations, juvenile ganglion cysts have not been the subject of as much research, despite their ubiquity. As a result, it's important to learn more about the features of these cysts in kids and pinpoint any potential causes of increased discomfort and impaired upper limb function [2].

Typically, the clinical diagnosis of hand and wrist cysts is evident. When the location or look is unusual or atypical and in a preoperative environment, imaging is considered. Ultrasonography and MRI are the primary modalities for examining hand and wrist cysts, however radiography is still utilized to diagnose concomitant arthropathy [3].

In this study, we address the value of Ultrasonography and Magnetic resonance imaging in the diagnosis of cysts and evaluate which one of these imaging is considered the modality of choice to respond to these inquiries from physicians to radiologists: I feel a lump; is it a cyst? There's no discernible lump; is wrist or hand ache related to a cyst, and if operation is considered, what is its location and which tendon or joint is it related to [3]. Wrist ganglion cysts can often be accurately detected with sonography where wrist ganglia typically measure between 7 and 30 mm and are well-defined, multilobular or multilocular, noncompressible, and hypoechoic. They are frequently found in the volar wrist, which is between the flexor carpi radialis tendon and the radial artery, and the dorsal wrist, which is superficial to the scapholunate ligament. The majority of the literature indicates that ganglion cysts of the wrist are most frequently situated dorsally, accounting for 60% to 70% of cases, although one small study suggesting that a volar position is more common [4]. Magnetic resonance imaging is sometimes being considered to evaluate ganglion cysts when it has a typical features or to determine the precise location of the lesion [5]. So, the aim of this study was to evaluate non-osseous wrist pain caused by ganglion cysts initially by ultrasonography and further comparing it to Magnetic resonance imaging to determine which should be considered as a first line modaity.

PATIENTS AND METHODS

Over the course of a year, from January 2022 to January 2023, patients who were referred from outpatient

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Rheumatology and Orthopedics clinics to our institution participated in this prospective cross-sectional comparative study. Every patient included in the study gave their informed permission and right to privacy was upheld. Twenty-one males and Thirty-four females complaining from wrist pain and palpable mass have participated in this study. All of them underwent Ultrasonography followed by Magnetic resonance imaging.

Inclusion criteria: Patients from all ages presenting with wrist pain and palpable lesion.

Exclusion criteria: Patients presenting with osseous wrist pain, claustrophobic, with pacemaker, metallic foreign bodies, vascular implants, or patients who are intolerant to contrast administration (impaired renal function), due to the need to use post contrast MRI study in some examination.

Examination of all patients was performed by Superficial linear array transducer of (12mhz) and Siemens MRI (1.5 T).

Ethical Considerations

The study protocol was reviewed and approved by the Research Ethics Committee of Mansoura University, Faculty of Medicine. Written informed consent was obtained from all participants prior to enrollment. The consent process explicitly included agreement to participate in the study and to allow the use of anonymized data for publication, ensuring confidentiality and privacy. The study was conducted in accordance with the ethical standards of the institutional research committee and with the principles outlined in the Declaration of Helsinki for research involving human subjects.

Statistical analysis

Data analysis was performed by SPSS software, version 25 (SPSS Inc., PASW statistics for windows version 25. Chicago: SPSS Inc.). Qualitative data were described using number and percent. Quantitative data were described using mean± Standard deviation for normally distributed data after testing normality using Kolmogorov-Smirnov test. Significance of the obtained results was judged at the (≤0.05) level.

- Fisher exact test was used to compare qualitative data between groups as appropriate.
- The Kappa analysis results were analyzed to assess agreement between Ultrasound and MRI findings
- Validity measures were calculated for sensitivity (TP/ Total disease), PPV (TP/ Total positive), Specificity (TN/ Total non-diseased), NPV (TN/ total negative), accuracy (TP+TN/ total assessed cases).

RESULTS

Fifty-five patients with wrist discomfort who were included in our study had a mean age of 34.18±11.45 years, with a range of 15 to 62 years. 65.5% of the cases under study were females.

This study is a prospective cross-sectional investigation aimed to evaluate the difference between ultrasonography findings and final MRI diagnosis in patients presenting with non-osseous wrist discomfort with ganglion cyst been found as a cause.

Table (1): demonstrates that 60% of lesions are right sided, 40% left sided, 94.5% complaints of pain, 20% swelling, 10.9% numbness and 9.1% limited movement

	N=55	%
Side		
Right	33	60.0
left	22	40.0
Complaint		
Pain	52	94.5
Swelling	11	20.0
Numbness	6	10.9
Limited movement	5	9.1
History		
No	31	56.4
Positive history#	24	43.6

Table (2) demonstrates that mean size of lesion as detected by MRI is 14.82±10.48 mm ranging from 2 to 45 mm versus 11.75±8.42 ranging from 2 to 32.3 mm by ultrasound. Interclass correlation used for assessment of agreement is good =0.613, 95% confidence interval =2.0 to 32.3

Size(cm)	MRI findings N=55	US findings N=55
Mean ±SD	14.82±10.48	11.75±8.42
Median (min-max)	11.95(2-45)	7.4(2.0-32.3)
ICC (95% CI)	0.613(0.023-0.847)	

Table (3) demonstrates that the final diagnosis by MRI was 36.4% ganglion cysts, 25.5% normal, 20% tenosynovitis ,5.5% TFC and 12.7% other diagnosis including sarcoma, Accessory muscle and tear

MRI	N=55	%
Final diagnosis		
normal	14	25.5
Tenosynovitis	11	20.0
Ganglion cyst	20	36.4
TFC	3	5.5
Others	7	12.7

Table (4) shows that ultrasound findings was 32.7% have positive echos 3.6% vascularity and nature of lesion is as following; 41.8% cyst, 27.3% Thickened nodule / calcification / solid lesion, 23.6% Fluid, 3.6% Granulation tissue & 3.6% tears

US	N=55	%
Echoes		
No	37	67.3
Yes	18	32.7
Vascularity		
No	53	96.4
Yes	2	3.6
Nature		
Granulation tissue	2	3.6
Fluid	13	23.6
Cyst	22	41.8
Thickened nodule / calcification / solid lesion	15	27.3
Tear	2	3.6

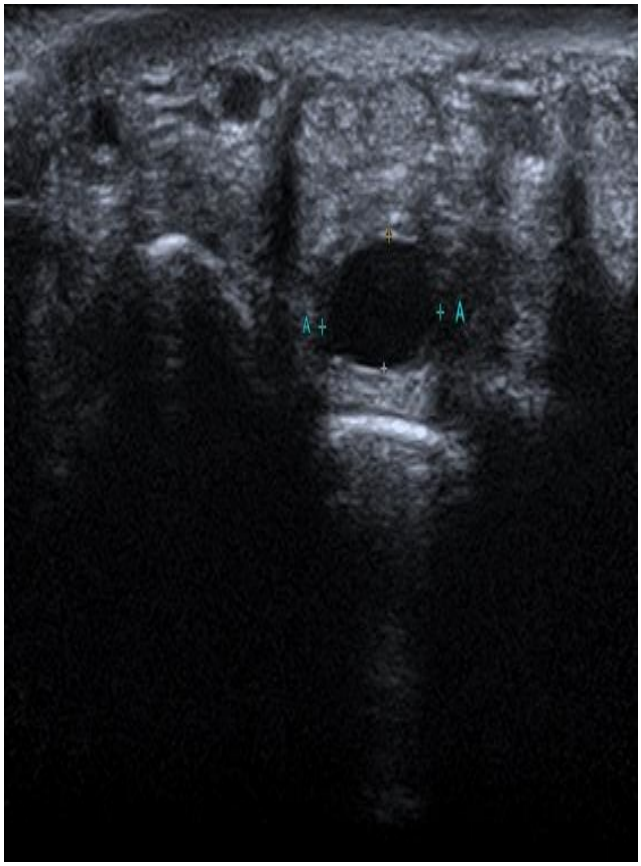


Fig (1 and 2): A 25 years old male patient complaining from dorsal wrist pain **Figure 1** shows Ultrasound images that revealed ganglion cyst related to the dorsum of the wrist between capitate and lunate. **Figure 2** MRI shows Same findings noted by Ultrasound.

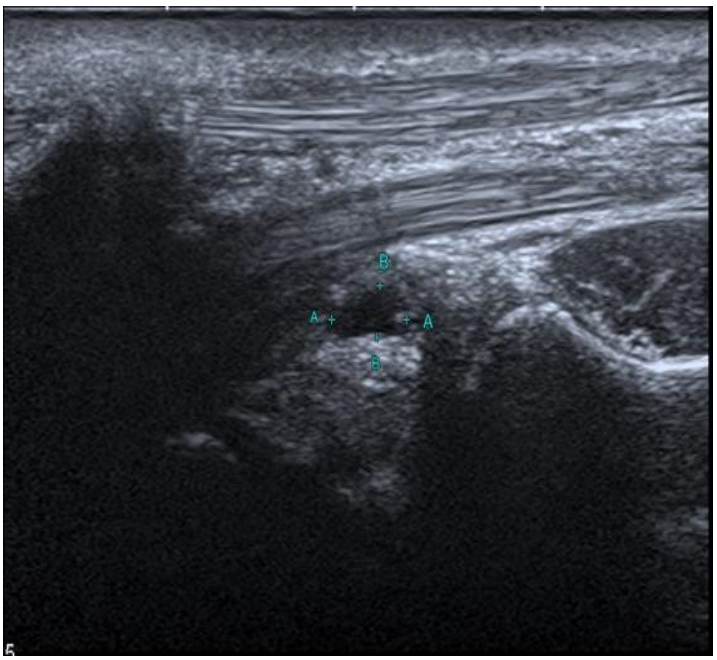
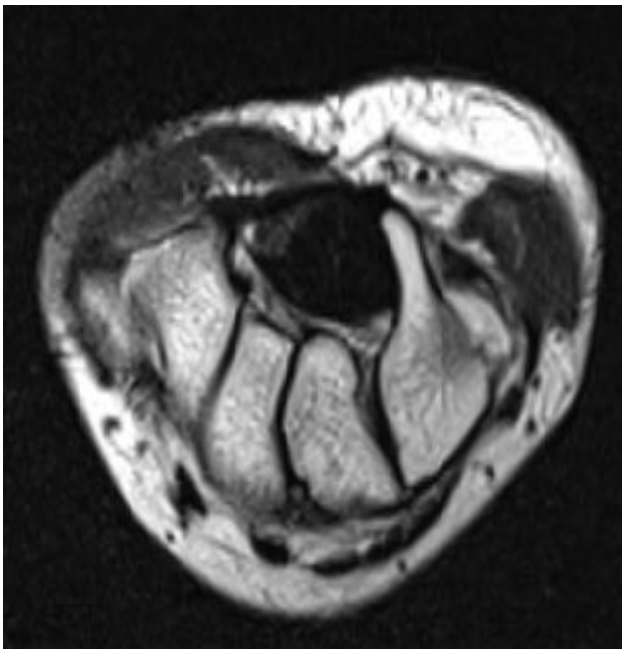



Fig (3 and 4): A 22 years old male patient complaining from ulnar sided wrist pain and tenderness. History of trauma 14 years ago with no osseous related cause. **Figure 3** shows ultrasound images that shows Ganglion cyst deeper to flexor digitorum tendons, it measured 4x2mm **Figure 4** Normal MRI.

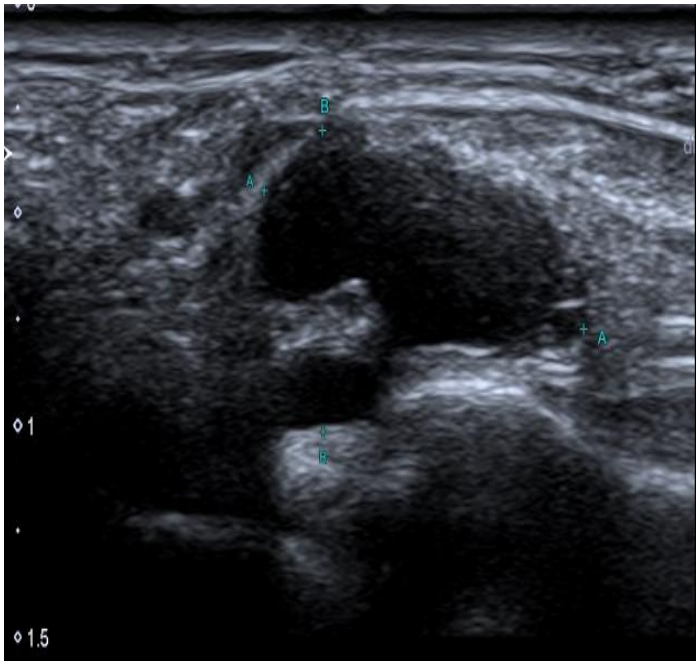
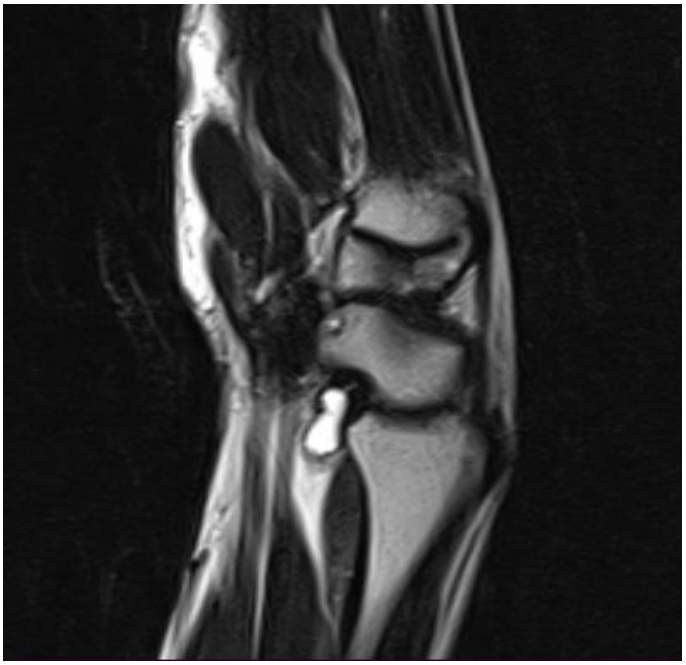



Fig (5 and 6): A 27 years old female patient complaining from volar wrist pain and swelling. **Figure 5** shows Ultrasound images show radio-scaphoid ganglion cyst with internal echoes. **Figure 6** shows MRI images that show the same findings.

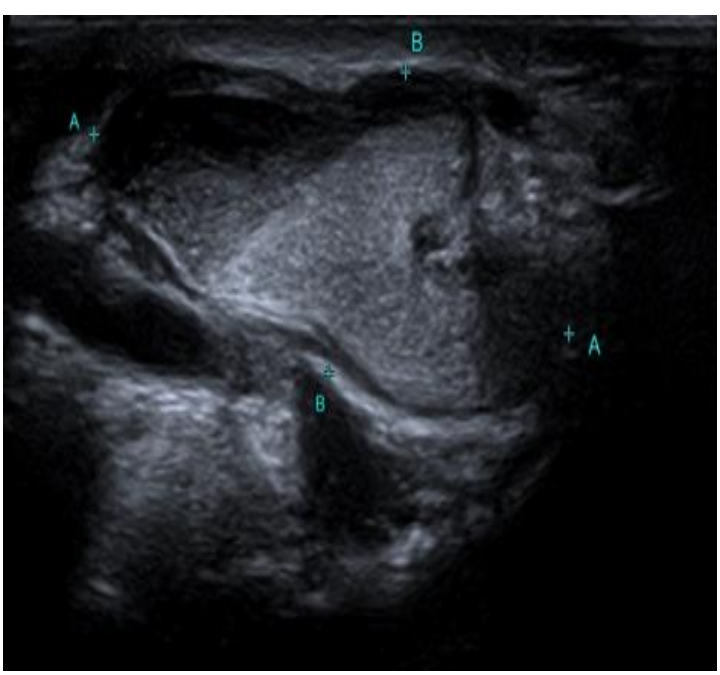
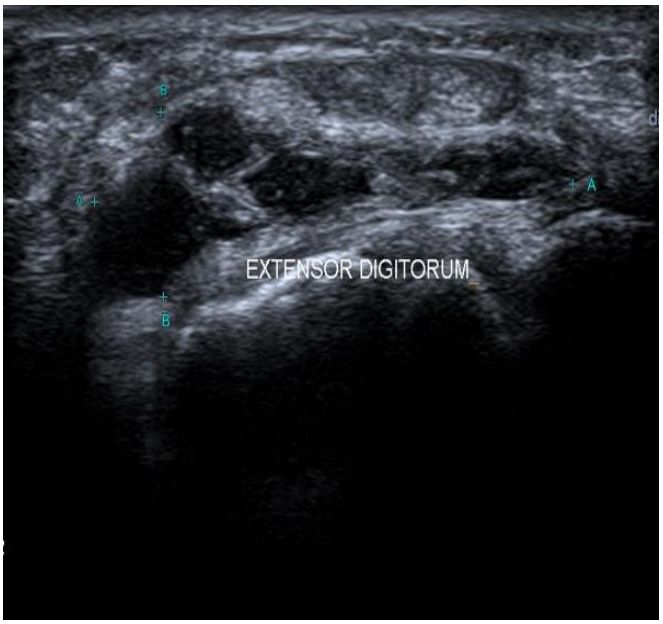


Fig (7 and 8): A 35 years old male patient complaining from radial sided wrist pain **figure 7** shows Ultrasound images show ganglion cyst with internal echoes and leveling that was related to ABL and radial artery. **Figure 8** shows MRI images show same ultra-sonographic findings.



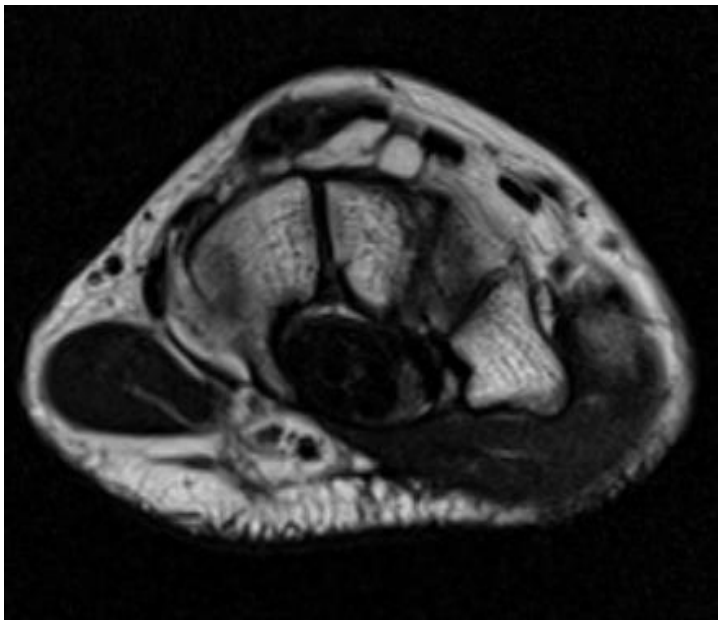


Fig (9 and 10): A 29 years old female patient complaining from dorsal wrist pain and swelling. **Figure 9** shows Ultrasound images show (A) lobulated ganglion cyst related to extensor digitorum compartment with stations and echoes. **Figure 10** shows MRI images show same ultrasonographic findings.

DISCUSSION

One of the most common complaints that is encountered in clinics, is wrist pain. Ganglion cysts are one of the most common causes of non-osseous wrist pain. Good clinical examination followed by proper imaging modality can lead to proper diagnosis and better management [6].

The application of ultrasonography in the evaluation of wrist pain has various benefits. It makes it possible to precisely localize pain and correlate it with sonographic results. It also makes it easier to compare the wrist with the asymptomatic contralateral wrist and allows for a dynamic assessment. Furthermore, ultrasonography helps differentiate between solid and cystic lesions [7].

With its excellent spatial and contrast resolution, MRI is a useful diagnostic tool for wrist discomfort. Among its many applications are the characterization of soft tissue and bone marrow diseases, assessment of TFCC and intrinsic wrist ligament pathologies, detection of soft tissue masses, and diagnosis of peripheral neuropathies [8].

The present study was conducted out on 55 patients, 36 females and 19 males ranging from 18 to 62 years old, all of them complained from wrist pain. Every patient had an MRI and US examination.

In line with our findings and as stated by **Faruch Bilfeld *et al.* [9],** US is regarded as the main technique for evaluating wrist masses. US aids in identifying the anatomical structure that gives rise to the lesion. It is essential for identifying the type of lesion, either solid or cystic. Moreover, color Doppler ultrasonography is required to assess a tissue mass. Furthermore, US supports the management strategy using US-guided biopsies. MRI, however, is crucial for characterizing the lesion. The ability of magnetic resonance imaging to discriminate between benign and malignant soft tissue masses is 93% sensitive and 82% specific.

Additionally, **Kunwarpal *et al.* [10]** presented a paper detailing how ultrasonography allows for dynamic wrist evaluation, is less expensive, and offers extensive assessment of superficial tissues. It implies that ultrasonography can be utilized as an initial examination for most of cystic, tendinous, vascular and fibrotic disorders.

In a similar vein, a research done by **Mousa *et al.* [11]** found that US had 100% specificity and 96% sensitivity for the detection of ganglion cysts in tendon sheaths. This supported the initial line of diagnosis in such cases using ultrasonography. Because of its tiny size and deep position, MRI was able to diagnose 16 out of 17 cases of ganglion cysts, with only one false negative.

So, MRI can be a second imaging modality if choice if there is any doubt about the diagnosis and for accurately differentiating ganglion cysts from other soft tissue masses.

CONCLUSION

There was no statistically significant difference between MRI and US and the findings were nearly equal. However, US was better than MRI in diagnosis of ganglion cysts owing to its cost effectiveness and dynamic evaluation. So, ultrasound can be the modality of choice when coming to evaluation of non-osseous wrist pain caused by ganglion cysts, followed by MRI as a second line if there are atypical features.

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