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ORIGINAL STUDY

Diagnostic accuracy of clinical examination and magnetic resonance imaging for common articular wrist pathology

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The authors retrospectively compared the diagnostic accuracy of clinical examination and magnetic resonance imaging for intra-articular wrist pathology (triangular fibrocartilage complex, lunotriquetral and scapholunate injuries), using wrist arthroscopy as the gold standard. Sixty-six patients had clinical examination and arthroscopy ; 38 of them also had magnetic resonance imaging. The diagnostic accuracy of clinical examination for all three injuries combined was 56.1%, and the accuracy of MRI was 55.3%. Magnetic resonance imaging was more specific, while clinical examination was more sensitive. Clinical examination was more accurate for specific triangular fibrocartilage complex (TFCC) injuries, while magnetic resonance imaging was more accurate for lunotriquetral (LT) and scapholunate (SL) ligament injuries. The study results suggest that magnetic resonance imaging has a use where clinical examination is ambiguous or where scapholunate damage is suspected.

Keywords : wrist arthroscopy ; triangular fibrocartilage complex ; lunotriquetral ligament ; scapholunate ligament ; magnetic resonance imaging.

INTRODUCTION

Wrist pain is a common complaint. A precise diagnosis is not always obvious owing to the complex ligamentous anatomy of the wrist (*3,5,9,13*). The accepted gold standard for diagnosing articular wrist pathology is arthroscopy (*13*), which can allow simultaneous treatment ; however, magnetic resonance imaging (MRI) is increasingly used as a diagnostic aid to assess injury prior to invasive surgery (*2,4,12,13*). MRI is non-invasive, does not expose the patient to harmful radiation, and allows visualization of synovial fluid, soft tissues, bones and any damage to these. However, false positives have been reported for diagnosing articular pathology with MRI (*1,13*). This may place patients at risk with unnecessary surgical procedures. Other authors report low sensitivity (*4,8,11*) ; then there may be no justification for its use, since many patients would be sent for arthroscopy regardless.

The aim of this study was to investigate the usefulness of MRI compared to clinical examination of the wrist. A retrospective analysis was undertaken on patients with injuries of the triangular fibrocartilage complex (TFCC), the lunotriquetral ligament

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(LT) or the scapholunate ligament (SL). The predictive values for diagnosis by clinical examination and MRI were calculated and compared using arthroscopy as the gold standard.

PATIENTS AND METHODS

The clinical, imaging and operative notes of 88 patients were examined ; their ages ranged from 10 to 68 years (mean : 35, SD 12.7). For each patient information was collected regarding age, hand dominance, mechanism of injury, clinical examination, plain radiographs, MRI (where available) and arthroscopic findings. Twenty-two patients were excluded from the study because of incomplete data. Of the 66 remaining patients (32 male, 34 female), 38 had undergone both MRI and arthroscopy, while 28 had arthroscopy alone. The senior author performed all arthroscopic procedures.

Positive diagnoses on clinical examination were attained using various well described clinical tests. The waiter's sign was used for TFCC lesions *(2)*, the Reagan-Shuck and ballottement test *(6)* indicated LT injury, and a positive Watson test *(6,11)* indicated SL pathology. Other indications for arthroscopy were localization of tenderness and pain on certain movements, based on the surgeon's experience and subjective knowledge.

MRI findings were reported by Consultant Radiologists. The pathologies were described in terms of tears and apparent dissociation. Arthroscopic findings of LT and SL instability were graded (Geissler I-IV) *(3)*. If a TFCC 'tear' was reported it was considered a positive finding, however, findings of 'degeneration' or 'thinning' were not. These arthroscopic findings were considered the gold standard against which to compare the physical examination and MRI results.

For both clinical examination findings and MRI findings the sensitivity, specificity, positive and negative predictive values and accuracy were calculated (Table I). The values were calculated for clinical examination and MRI in the 3 wrist injuries combined (Table II, III), and then separate calculations were performed to assess the accuracies for diagnosing specific pathology (TFCC, LT and SL injury) (Table IV, V, VI).

RESULTS

Clinical examination : accuracy vs. arthroscopy, for the 3 wrist injuries combined.

The clinical examination findings for the 3 wrist injuries combined in all 66 patients were compared to the diagnosis on arthroscopy, the gold standard (Table II). In patients with multiple pathologies diagnosed, the analysis was performed according to the suspected pathology for which the arthroscopy was undertaken. The accuracy for clinical examination was 56.1%.

MRI : accuracy vs. arthroscopy, for the 3 wrist injuries combined

The diagnostic accuracy of MRI was calculated as 55.3% (Table III). Seventeen of the 38 patients, who had both clinical examination and MRI before

Table I. — Method of calculations

	Arthroscopy +	Arthroscopy -	
Clin. examination or MRI +	TP = True Positive	FP = False Positive	PPV = Positive Predictive Value TP/TP + FP
Clin. examination or MRI -	FN = False Negative	TN = True Negative	NPV = Negative Predictive Value TN/FN + TN
	Sensitivity = TP/TP + FN	Specificity = TN/TN + FP	Accuracy = TP + TN/TP + FP + TN + FN

Table II. — Clinical examination vs. Arthroscopy for all 3 wrist injuries combined (n = 66)

PPV	NPV	Sensitivity	Specificity	Accuracy
56.1%	56.0%	67.6%	43.8%	56.1%

PPV = Positive Predictive Value / NPV = Negative Predictive Value.

Table III. — Results for MRI vs. Arthroscopy for all 3 wrist injuries combined (n = 38)

PPV	NPV	Sensitivity	Specificity	Accuracy
62.5%	50.0%	47.6%	64.7%	55.3%

PPV = Positive Predictive Value / NPV = Negative Predictive Value.

Table IV. — Clinical examination vs. Arthroscopy for specific wrist injuries (n = 66)

Structure	PPV	NPV	Sensitivity	Specificity	Accuracy
TFCC	76.9%	71.7%	40%	92.7%	72.7%
LT	50%	82.8%	28.6%	92.3%	78.8%
SL	40%	73.2%	47.6%	66.7%	60.6%

TFCC = Triangular Fibrocartilaginous Complex / LT = Lunotriquetral / SL = Scapholunate.
PPV = Positive Predictive Value / NPV = Negative Predictive Value.

Table V. — MRI vs. Arthroscopy for specific wrist injuries (n = 38)

Structure	PPV	NPV	Sensitivity	Specificity	Accuracy
TFCC	72.7%	70.4%	50.0%	86.4%	71.1%
LT	100%	83.8%	14.3%	100%	84.2%
SL	40%	69.7%	16.7%	88.5%	65.8%

TFCC = Triangular Fibrocartilaginous Complex / LT = Lunotriquetral / SL = Scapholunate.
PPV = Positive Predictive Value / NPV = Negative Predictive Value.

Table VI. — Accuracy of Clinical examination vs. MRI for wrist injuries : all 3 combined and specific

	Accuracy	
Structure	Clinical examination (n = 66)	MRI (n = 38)
All 3 injuries combined	56.1%	55.3%
TFCC	72.7%	71.7%
LT	78.8%	84.2%
SL	60.6%	65.8%

TFCC = Triangular Fibrocartilaginous Complex / LT = Lunotriquetral / SL = Scapholunate.

arthroscopy, had consistent findings across clinical examination and MRI (44.7%).

Clinical examination vs. MRI, for the 3 wrist injuries combined

The accuracy for diagnosis of the 3 injuries combined was low for both clinical examination (56.1%) (Table VI) and MRI (55.3%) (Table VI). Clinical examination was more accurate for certain specific diagnoses (TFCC and LT) (Table VI). MRI was more specific (64.7%) (Table III) than examination (43.8%) (Table II), and clinical examination was more sensitive (67.6%) (Table II) than MRI (47.6%) (Table III).

Clinical examination vs. MRI, for specific wrist injuries

For specific pathology (Table VI), clinical examination detected TFCC injuries more accurately (72.7% > 71.1%), while MRI was more accurate for LT (84.2% > 78.8%) and SL (65.8% > 60.6%) injuries.

Clinical examination vs. MRI as to TFCC pathology

Clinical examination had a low sensitivity for TFCC injuries (40%) (Table IV), and thus a high proportion of patients were given negative results despite having pathology. However, its specificity for TFCC was high (92.7%) (Table IV), indicating that positive results were reasonably reliable. Its accuracy for TFCC was 72.7% (Table IV), which is comparable to MRI (71.1%) (Table V). MRI had a higher sensitivity (50%) (Table V), but was less specific (86.4%) (Table V).

Clinical examination vs. MRI as to LT (lunotriquetral) pathology

Clinical examination was found to have a low sensitivity of 28.6% (Table IV) for LT pathology, indicating many missed diagnoses. However, with a specificity of 92.3% (Table IV), those it does detect are reliable. The accuracy was 78.8% (Table IV), whereas MRI had an accuracy of 84.2% (Table V). The MRI sensitivity was even lower at 14.3% (Table V), the specificity was 100% (Table V) however.

Clinical examination vs. MRI as to SL (scapholunate) pathology

Clinical examination of the wrist had a sensitivity of 47.6% (Table IV) and a specificity of 66.7% (Table IV) for SL pathology. The accuracy was 60.6% (Table IV), the lowest of the articular injuries. The accuracy of MRI was 65.8% (Table V), also relatively low, and the sensitivity and specificity of MRI were 16.7% (Table V) and 88.5% (Table V) respectively.

DISCUSSION

The scaphoid, lunate and triquetrum, bonded by strong interosseous ligaments, form a congruent surface for articulation with the distal radius. The intact ligaments limit motion at the scapholunate and lunotriquetral joints, whilst the multi-component TFCC stabilizes the distal radioulnar joint.

The majority of carpal injuries are a consequence of falls on an outstretched hand. The resultant carpal extension, ulnar deviation and intercarpal supination lead to ligamentous disruption and carpal dislocations, with varying degrees of instability (*6*). TFCC perforations following trauma can occur, but they are also an age related finding in the majority of individuals over 50 (*2*).

A thorough history to determine any traumatic injury and the mechanism of such provides the initial foundation for an accurate diagnosis. The most common symptoms of articular pathology are pain, weakness, limited motion and 'clunking' (instability). Clinical examination includes dynamic manipulative tests to provoke signs indicative of specific pathology. However, the accuracy of diagnosis depends on the level of skill and experience of the clinician, and many presentations of wrist pain can be ambiguous. Watson's scaphoid shift test (for SL instability), for example, can be positive in normal wrists, especially in young women (*6*).

Complete tears of the SL and LT ligaments can be seen on plain radiographs, but partial ruptures and stretching are less easily visualized. MRI can help ascertain damage to these structures by showing variations in signal intensity, or abnormal synovial fluid movement out of the midcarpal joint. The TFCC is usually of low intensity, but with degeneration the intensity increases. The LT and SL ligaments also have varying intensities and shapes even in normal wrists ; therefore MRI findings need to be interpreted in conjunction with the patient's symptoms (*2*).

In light of the reported ambiguity of clinical examination and MRI the study aimed to compare the two and to determine the usefulness of clinical and imaging findings.

Clinical examination vs. MRI as to TFCC pathology

The study showed that clinical examination has a low sensitivity (40%) but a high specificity (92.7%) for detecting TFCC injury, therefore clinical suspicion should not require confirmation with MRI. However, any uncertainty as to diagnosis should be followed by an MRI.

Clinical examination vs. MRI as to LT pathology

The results for LT pathology similarly suggest that should clinical examination detect LT injury, an MRI is not indicated as the diagnosis is likely to be correct (specificity of 92.3%). Both examination and MRI have low sensitivity, respectively 28.6% and 14.3% ; therefore if LT injury is suspected from a history yet not confirmed on examination, further investigation with MRI may aid diagnosis.

Clinical examination vs. MRI as to SL pathology

Analysis of SL injury suggests that diagnoses are missed on examination (sensitivity only 47.6%), yet even positive findings cannot be considered diagnostic with a high level of certainty (specificity only 66.7%). In other words : despite clinical examination having a better sensitivity than for other injuries, the specificity was low implying false positives. Completion of the investigation with MRI, which has a lower sensitivity (16.7%) but higher specificity (88.5%), may increase diagnostic accuracy and therefore reduce rates of unnecessary surgery. Since neither diagnostic test showed high accuracy for diagnosing scapholunate pathology (clinical examination 60.6%, MRI 65.8%), both tests could be combined for patients with suspected SL injury.

Clinical examination vs. MRI as to the 3 wrist injuries combined

Since neither clinical examination nor MRI was highly sensitive for any of the three types of injury, both tests should be combined where no clear diagnosis is found on examination. In light of the potential for false positives with MRI (specificity only 64.7%) (Table III), due to the variable signal intensities even in normal wrists, MRI findings should be compared always with those of the history and examination, to see if they correlate or are incidental. Comparing the accuracy percentages for MRI and clinical examination, one can see that whilst TFCC injuries were more accurately detected by clinical examination, MRI more accurately picked up LT and SL injuries.

Weaknesses and strengths

The results were calculated according to methodology used by previous authors (*1,7,11*). However, there are certain limitations to the data. Firstly, this is a retrospective analysis, with loss of patient numbers due to incomplete or ambiguous recording at the time of the procedures : ideally there would have been a larger patient group for statistical analysis. Although this study maintains consistency by using data from only one surgeon, it would be useful to perform comparable analyses of records from other surgeons, to compare and also combine figures. Of use would be a prospective longitudinal study to follow up patients, recording the appropriate details in specifically designed proforma.

CONCLUSION

The study results suggest that MRI has a use where clinical examination is ambiguous or where SL damage is suspected. Since it has a lower specificity than clinical examination for TFCC injury, the use of MRI to confirm clinical findings, positive for TFCC injury, is superfluous and incurs unnecessary expenditure and time.

REFERENCES

1. **Ben-Galim P, Steinberg EL, Amir H *et al.*** Accuracy of magnetic resonance imaging of the knee and unjustified surgery. *Clin Orthop Relat Res* 2006 ; 447 : 100-104.
2. **Berquist TH.** Hand and wrist. In : Berquist TH (ed.) *MRI of the Musculoskeletal System*. 3rd edition. Lippincott-Raven, Philadelphia, 1997 : pp 673-735.
3. **Garcia-Elias M, Geissler WB.** Carpal instability. In : Green D, Hotchkiss R, Pederson W, Wolfe S (eds). *Green's Operative Hand Surgery*. 5th edition, Vol 1. Churchill Livingstone, New York, 2005 : pp 535-604.
4. **Haims AH, Moore AE, Schweitzer ME *et al.*** MRI in the diagnosis of cartilage injury in the wrist. *AJR Am J Roentgenol* 2004 ; 182 : 1267-1270.
5. **Johnstone DJ, Thorogood S, Smith WH, Scott TD.** A comparison of magnetic resonance imaging and arthroscopy in the investigation of chronic wrist pain. *J Hand Surg* 1997 ; 22-B : 714-718.
6. **Lister G.** In : *The Hand – Diagnosis and Indications*. 3rd edition. Churchill Livingstone, Edinburgh, 1993, pp 75-85, 203-221.
7. **Loo WL, Liu YEB, Lee YHD, Soon YHM.** A comparison of accuracy between clinical history, physical examination

and magnetic resonance imaging and arthroscopy in the diagnosis of meniscal and anterior cruciate ligament tears. *J Orthopedics* 2008 ; 5 (3) e8.

8. **Morley J, Bidwell J, Bransby-Zachary M.** A comparison of the findings of wrist arthroscopy and magnetic resonance imaging in the investigation of wrist pain. *J Hand Surg* 2001 ; 26-B : 544-546.
9. **North ER, Meyer S.** Wrist injuries : correlation of clinical and arthroscopic findings. *J Hand Surg* 1990 ; 15-A : 915-920.
10. **Pederzini L, Luchetti R, Soragni O *et al.*** Evaluation of the triangular fibrocartilage complex tears by arthroscopy, arthrography, and magnetic resonance imaging. *Arthroscopy* 1992 ; 8 : 191-197.
11. **Schädel-Höpfner M, Iwinska-Zelder J, Braus T *et al.*** MRI versus arthroscopy in the diagnosis of scapholunate ligament injury. *J Hand Surg* 2001 ; 26-B : 17- 21.
12. **Scheck RJ, Kubitzek C, Hierner R *et al.*** The scapholunate interosseous ligament in MR arthrography of the wrist : correlation with non-enhanced MRI and wrist arthroscopy. *Skeletal Radiol* 1997 ; 26 : 263-271.
13. **Scheck RJ, Romagnolo A, Hierner R *et al.*** The carpal ligaments in MR arthrography of the wrist : correlation with standard MRI and wrist arthroscopy. *J Magn Reson Imaging* 1999 ; 9 : 468-474.
14. **Tanaka T, Yoshioka H, Ueno T, Shindo M, Ochiai N.** Comparison between high-resolution MRI with a microscopy coil and arthroscopy in triangular fibrocartilage complex injury. *J Hand Surg* 2006 ; 31-A : 1308-1314.