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Positive magnetic resonance imaging findings in the asymptomatic wrist

Greg Couzens,*† Nick Daunt,‡ Ross Crawford§ and Mark Ross*†¶

*Brisbane Hand and Upper Limb Research Institute, Brisbane Private Hospital, Brisbane, Queensland, Australia
†Department of Orthopaedics, Princess Alexandra Hospital, Brisbane, Queensland, Australia
‡Queensland X-Ray, Greenslopes Private Hospital, Brisbane, Queensland, Australia
§Institute of Health and Biomedical Innovation, Orthopaedic Research Unit, The Prince Charles Hospital, Queensland University of Technology, Brisbane, Queensland, Australia and
¶Orthopaedic Surgery, The University of Queensland, Brisbane, Queensland, Australia

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Correspondence
Dr Greg Couzens, Brisbane Hand and Upper Limb Clinic, Brisbane Hand and Upper Limb Research Institute, 9/259 Wickham Tce, Brisbane, Qld 4007, Australia. Email: research@upperlimb.com, greg.couzens@upperlimb.com

G. Couzens MBBS, FRACS; **N. Daunt** MBBS, FRACR; **R. Crawford** MBBS, PhD; **M. Ross** MBBS, FRACS.

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Abstract

Background: Magnetic resonance imaging (MRI) is being increasingly utilized to define pathology and guide treatment in patients presenting with wrist pain. The clinical relevance of MRI identified or confirmed pathology has not been established, and the prevalence of asymptomatic MRI pathology is not known.
Methods: Twenty volunteers with no previous wrist injury or symptoms underwent bilateral MRI wrist studies in this exploratory diagnostic study. The scans were reported by an experienced musculoskeletal radiologist and an experienced wrist surgeon, with a consensus reached on each report.
Results: There were 3.15 positive MRI findings per wrist. There were 126 positive findings (range 1–6 per wrist). Sixty-eight ganglia were identified. Eleven ligament tears or perforations were also identified. Increased joint fluid was seen at many sites, most frequently adjacent to the piso-triquetral joint.
Conclusion: The accuracy of MRI in identifying triangular fibrocartilage complex tears, intercarpal ligament tears and carpal bone osteonecrosis is rapidly being refined. Positive MRI findings are common and may be coincidental in patients with wrist pain. MRI findings need to be correlated closely with clinical examination and history.

Introduction

Wrist injury leading to persistent symptoms is relatively common in athletes and manual workers.[1] Wrist pain is often attributed to changes in anatomy noted on imaging studies.[2] In particular, the relationship between wrist pain and the presence of degenerative change or interrupted ligaments is not well understood.[2–4] Magnetic resonance imaging (MRI) has the capability to detect lesions not visualized by other imaging modalities. The term positive finding has been suggested rather than abnormality since the significance and the specificity is not known.[5]

High-resolution MRI of the wrist has allowed the identification of an increasing number of abnormalities in the wrist. Refinement in imaging protocols and improvement in MRI scanners has led to more frequent identification of lesions of bone, cartilage, ligament and soft tissues. This is a relatively new technique and there are few studies available identifying the prevalence of positive findings in the wrists of asymptomatic individuals.

Methods

Twenty subjects were recruited from the staff of our hospital. There were 10 males and 10 females. The average age was 42.6 years (range 23–58 years). Eighteen were right-hand dominant. The subjects were members of medical, nursing or clerical staff. There were no subjects engaged in manual labour.

All subjects were screened and completed a self-administered questionnaire to exclude previous symptoms or injury. The questionnaire contained the following questions:

(1) Have you ever had an injury to your wrist that required medical attention?
(2) Do you ever have problems using your wrist in certain positions?
(3) Does your wrist ever give way?
(4) Can you place your weight on your wrist when getting up of the floor?
(5) Have you ever had a lump or swelling on your wrist?

(6) Do you ever take painkillers for your wrist?

Appropriate institutional review board approval was obtained. Subjects were provided with written information and were required to sign a consent form before being enrolled in the study.

All scans were performed by the department of radiology of the hospital. The images were acquired on a 1.5T Twinspeed (GE Medical Systems, Milwaukee, WI, USA) using whole body mode (23 mT/m) with a quadrature wrist coil (GE Medical Systems) and a modified wrist holder. Subjects were positioned semi supine with the wrist in the true lateral position, shoulder and wrist in plane and securely immobilized. Axial, sagittal and coronal fat suppressed proton density images were acquired using an 8–10 cm field of view and slice thickness of 2.2 mm.[4] The average examination time for each wrist was 30 min.

In this study, ganglia were defined as high signal collections, which were related to, but clearly separate to the joint. Collections that could not be identified as external to the joint were reported as intra-articular fluid. Degenerate change within the intra-carpal ligaments and triangular fibrocartilage complex (TFCC) was defined as altered signal intensity with continuity of the structure. In the case of the intrinsic interosseous ligaments, the term 'degenerate' may indicate post-traumatic change short of an overt tear. Perforation in a ligament or the articular disc of the TFCC was identified by a well-localized full-thickness focus of increased signal. Tears were defined as more extensive than perforations.

Results

Twenty subjects with no wrist symptoms underwent bilateral wrist MR scans. 126 positive findings (range 1–6 per wrist) were found. Incidence of positive findings is listed in Table 1.

There were 68 ganglia identified in 37 wrists (range 1–4 per wrist). Thirty-eight arose from the volar aspect of the joint and 30 arose over the dorsal aspect of the joint (Fig. 1). The size ranged from flattened 2 mm ganglia to 22 mm. Thirteen of the dorsal ganglia (43%) were related to the dorsal band of the scapholunate ligament; in three subjects, this was a bilateral finding. Only one dorsal ganglion and four volar ganglions were contiguous with a degenerate scapholunate ligament (SLL). The remainder of the ganglia appeared to arise in otherwise normal structures. The distributions of the ganglia are listed in Table 1.

Degenerate change (abnormal signal or configuration) was noted in 10 SLLs (Fig. 2a,b). In five ligaments (four patients), this involved the volar portion, in one the dorsal band, and in two, there was diffuse abnormality. One subject had bilateral degeneration involving the proximal band of the SLL. Three of the TFCCs had evidence of degenerate change; in two subjects, it was associated with a central tear.

Five SLL perforations were identified in four wrists. All were seen in the proximal zone of the SLL (Fig. 2c). One perforation extended from the proximal zone into the volar portion of the SLL. Four of the five perforations occurred in a degenerate area of the ligament. In three wrists, there was a focal area of degenerate change associated with the perforation. There was diffuse degenerate change in the remaining perforated SLL. The average age of the patients with perforations of the SLL was 37.7 years (range 35–48).

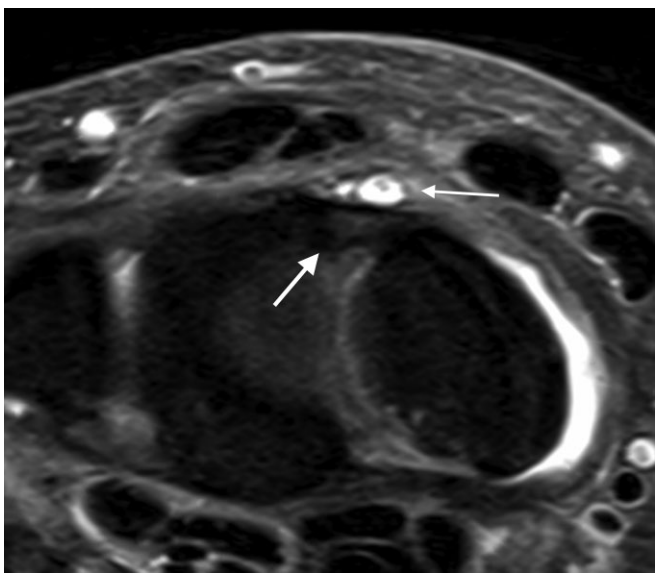

Fig. 1. Small ganglion (small arrow) adjacent to the dorsal band of the scapholunate ligament (large arrow).

Table 1 Positive MRI findings

Positive findings seen on MRI	Number	Distribution of dorsal ganglia	Number	Distribution of volar ganglia	Number
Ganglia	68	Scapho-lunate	13	Radioscapholunate	8
Scapholunate ligament tear/perforation	8	Scaphoid	6	Flexor carpi radialis	7
Triangular fibrocartilage tear	4	Capito-trapezoid	3	Scapho-lunate	6
Increased joint fluid	20	Capitate	3	Scaphoid	6
Degenerate change	13	Scapho-capitate	2	Radius	4
Bilateral thumb metacarpal osteoarthritis	2	Lunate	1	Piso-triquetral	4
Distal radioulnar joint arthritis	1	Scapho-trapezoid	1	Thumb carpometacarpal joint	1
Partial fibrous lunotriquetral coalition	2	Distral radioulnar joint	1	Hamate	1
Synovitis – thickened synovium or a particulate appearance to fluid	3	—	—	Flexor tendons	1
Synovial cyst	1	—	—	—	—
Hamate chondromalacia	3	—	—	—	—
Altered marrow signal distal ulna	1	—	—	—	—
Total	126	—	30	—	38

MRI, magnetic resonance imaging.

Fig. 2. (a) Normal hypointense dorsal band of the scapholunate ligament (arrow). (b) Absent hypointense dorsal band in a degenerate scapholunate ligament (SLL; arrow). (c) Perforation of proximal zone of SLL (arrow).

Fig. 3. Small central to radial perforation of the articular disc of the triangular fibrocartilage complex (TFCC; arrow). The hypointensity between the perforation and the hyaline cartilage of the radius indicates that this is within the fibrocartilage rather than a radial sided avulsion of the disc.

The oldest subject in the study (age 58 years) had bilateral disruption of the SLL, and a further subject had a tear with widened SL interval in a diffusely abnormal SLL. There were four TFCC tears identified (Fig. 3). Two were small radial sided tears in otherwise normal appearing triangular cartilages. One subject with ulnar positive variance had a degenerate TFCC with a central and an ulnar tear with associated altered signal in the distal ulna.

Lunotriquetral ligament (LTL) pathology is difficult to visualize on MR of the wrist. In our study, we were not able to identify any tears or perforations of the LTL.

Twenty wrists in 12 subjects had evidence of localized fluid collections within the wrist joint. Fluid collections, especially in the piso-triquetral joint are not easily appreciated by any other imaging studies. In half the scans, increased fluid was related to the pisotriquetral joint (Fig. 4).

Prominent fluid dorsal to the scaphoid was a bilateral finding in one wrist. Fluid was noted in the midcarpal joint in three scans. Increased fluid was noted in the distal radioulnar joint (DRUJ) in five wrists in four subjects. The TFCC was torn in one wrist with fluid in the DRUJ.

Discussion

Degeneration in the ligament and fibrocartilage structures of the wrist is part of the normal aging process and frequently occurs early in life.[5–7] The signal changes, noted on MRI, reflect the underlying tissue changes characterized histologically by reduced cellularity, loss of elastic fibers, mucoid degeneration, erosion, thinning and perforation.[4,5,8] MRI can identify these lesions before they become apparent on other imaging studies.[3,5]

Fortems *et al.*[9] performed anatomical and radiological studies relating to cartilaginous and ligamentous lesions in 51 wrists of 30 embalmed cadavers. They noted that two thirds of all wrists showed cartilaginous lesions and almost half the patients had a perforation of the triangular fibrocartilage complex. Viegas *et al.*[10] identified tears of the ligaments or TFCC in 56% of 393 cadaver wrists. Chondromalacia (24%) and arthrosis (58%) were commonly present but in an older population to our study group.

Arthrographic studies provide some insight into the frequency of identifying lesions or positive findings in the wrist. Herbert *et al.*[3] utilized bilateral arthrograms in 60 patients with unilateral wrist pain. He identified positive findings in 74% of the asymptomatic wrists that had a positive finding on the symptomatic side. In a similar study, Cantor *et al.*[2] assessed the clinical significance of arthrographic abnormalities in the ligaments of a painful wrist. They performed comparison arthrography on the asymptomatic wrist. In

Fig. 4. Small pisiform-triquetral joint effusion (arrow).

56 patients, they identified bilateral symmetric lesions in up to 90%. They further concluded that physical examination was not predictive of specific ligament defects.

In asymptomatic young subjects, Kirschenbaum *et al*.[1] identified an abnormal communication between joint compartments in the wrist due to ligamentous or TFCC defects in 27% of wrists ($n = 52$). Arthrographic studies not only support the view that perforations occur in asymptomatic subjects,[1–3,11] but also suggest that in symptomatic individuals the perforations may correlate poorly with the site of pain.[12] The findings of ligament perforations and tears are summarized in Table 2.

Our study may have underestimated the number of perforations in interosseous ligaments that may be detectable by MRI, particularly LTL perforations, as the thin slice gradient echo sequence that is usually part of our examination of symptomatic individuals was not included in this study. LTL structure, especially integrity of volar and dorsal bands, may be better observed on this sequence.[8] However, this sequence is not widely used and the incremental gain may be minor.

Table 2 Ligament tears and perforations

	Average Age (years)	Total Wrists	SLL	LTL	TFCC
Fortems *et al.*	76	51	14	18	23
	—	—	(27%)	(35%)	(45%)
Viegas *et al.*	67	393	110	141	142
	—	—	(28%)	(36%)	(36%)
Kirschenbaum *et al.*	28	52	3	5	10
	—	—	(6%)	(10%)	(19%)
Couzens *et al.*	43	40	8	0	4
	—	—	(20%)	—	(10%)

LTL, lunotriquetral ligament; SLL, scapholunate ligament; TFCC, triangular fibrocartilage complex.

Positive findings have also been reported in MRI scans of asymptomatic individuals in other anatomical sites. For instance, in the lumbar spine[13,14] as well as in the cervical spine,[15] abnormal findings have been identified in between 20% and 50% of asymptomatic individuals.

Fredericson *et al*.[16] described MRI findings within the shoulder and wrist of asymptomatic elite athletes. They studied 33 individuals who competed in high-level volleyball, swimming or gymnastics and found abnormalities related to ligament, cartilage, tendon, carpal tunnel or abnormal fluid collections in all studies.

Iordache *et al*.[17] studied the TFCC in asymptomatic wrists and found abnormalities in 39 of 103 subjects. There were two readers who found 15 disc abnormalities, 2 radial attachment, 4 disc and radial attachment, and in 18, they could not agree on where the tear was situated.

It is not yet apparent what features of MRI positive findings in the wrist make it more likely to be of clinical significance.

Precise definitions of MRI lesions in the wrist have not been clearly stated. Connell *et al*.[18] described discontinuity of normal striated bands, incomplete disruption, irregularities and alteration in normal signal. Fluid pooling around ligaments and concomitant bone injury may also indicate wrist injury.

Daunt[8] has suggested five cardinal characteristics for SLL or LTL tears: (i) tear, perforation or communication; (ii) a widened joint space – more than two layers of articular cartilage, which would approximate to more than 2 mm. In addition, an incongruous joint space, that is, wider on the palmar or dorsal aspect; (iii) abnormal intra-articular signal between the appropriate bones; (iv) altered signal of the normal portion of the SLL or LTL; (v) abnormal thickening of normal interosseous ligamentous structures. A description of the definition of our findings has been described above.

A common indication for wrist MRI examination is to confirm clinically suspected TFCC or SLL injury. We have difficulty in patients who have symptoms on one side of the wrist and positive MRI findings on the other side of the wrist. It is tempting to attribute symptoms to the presence of anatomic lesions identified on MRI scan; however, similar lesions may be present in asymptomatic subjects.

The expectation that degenerative change is age related might not be so true for the wrist, which complicates attributing symptoms to certain MRI findings in the wrist. In this study, we demonstrated a high incidence of positive MRI findings in asymptomatic wrists. The

significance of positive MRI findings in the wrist is not known, and needs to be interpreted with caution. Positive findings need to be correlated closely with the history and clinical findings.

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