THE ULNOCARPAL STRESS TEST IN THE DIAGNOSIS OF ULNAR-SIDED WRIST PAIN

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Forty-five patients with persistent ulnar-sided wrist pain and a positive ulnocarpal stress test were investigated by X-ray, arthrography, ^{99m}Technetium bone scanning, magnetic resonance imaging and wrist arthroscopy. Ulnar wrist pathology was positively identified in nine of 45 patients by X-ray, 18 of 37 by arthrography, 19 of 27 by bone scan, four of 33 by MRI, and in all 45 patients by arthroscopy. The final diagnosis was ulnocarpal abutment syndrome in 28 patients, traumatic triangular fibrocartilage (TFC) tear in six, lunotriquetral (LT) ligament tear in five, TFC and LT ligament tear in one, wrist arthritis in four and cartilaginous free body in one. The ulnocarpal stress test is a useful provocative test, and a positive test suggests the presence of ulnar-sided wrist pathology. The test is sufficiently sensitive to warrant further investigation by arthroscopy.

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The ulnocarpal stress test is a provocative test for ulnocarpal abutment syndrome (also referred to as ulnocarpal impingement syndrome or ulnar impaction syndrome) and was first described by Friedman and Palmer in 1991. Empirically, it has been shown that the ulnocarpal stress test reliably reproduces ulnar wrist pain and differentiates ulnar wrist pain due to ulnocarpal pathology from wrist pain of other aetiologies. We investigated underlying wrist pathology in patients with positive ulnocarpal stress tests by X-ray, radiocarpal arthrography, bone scanning, magnetic resonance imaging (MRI) and arthroscopy.

PATIENTS AND METHODS

Forty-five consecutive patients evaluated at our hospital between 1991 and 1995 were included in the study. All complained of persistent ulnar wrist pain of more than 3 months' duration and had a positive ulnocarpal stress test before enrolment in the study. There were 27 men and 18 women. Their ages ranged from 15 to 67 years, with a mean of 36 years. All had tenderness just distal to the ulnar head; five patients also had tenderness over the distal radioulnar joint (DRUJ). Twenty-four of 45 patients reported spontaneous onset of the pain. The remaining 21 patients had had wrist injuries. Six had a united fracture of the distal radius (three of these six patients also had an ulnar styloid nonunion without tenderness over the ulnar styloid), one had an isolated non-union of the ulnar styloid, and one had a united ulnar styloid fracture and a united triquetral fracture. Thirteen patients had suffered wrist sprains without fractures or dislocations of the wrist. All patients had been treated with anti-inflammatory drugs, casting, elastic bandage or intra-articular steroid or hyaluronic acid injection for more than 3 months. Range of wrist flexion–extension was restricted to a mean of 87% (range 54–100%) of the unaffected side. The range of ulnar and radial wrist deviation was also restricted to 80% (range 44–100%) of the unaffected side.

Seventeen patients had restriction of forearm rotation of more than 10° compared with the unaffected side. Grip strength averaged 79% (range 29–108%) of the unaffected side, and 15 patients had a grip strength of less than 70%.

The ulnocarpal stress test was performed as shown in Figure 1. Ulnar wrist pain occurring during forearm rotation constituted a positive ulnocarpal stress test. A painless click was evaluated as a negative ulnocarpal stress test, and such patients were excluded from the study. Seven patients felt ulnar wrist pain on ulnar deviation of the wrist alone, and pronation–supination evoked more severe pain. One of the seven patients had associated subluxation of the extensor carpi ulnaris tendon and ulnar deviation of the wrist evoked tendon subluxation with a painful click. This patient complained of ulnocarpal pain not only with supination, but also with pronation. The remaining 38 patients complained of ulnar wrist pain with pronation–supination alone. Wrist pain with a click was elicited in six patients. No patient complained of ulnocarpal pain from forearm rotation with the wrist in radial or neutral deviation.

All patients had X-rays of the wrist including standard PA and lateral views (Epner et al, 1982; Palmer et al, 1982) using a support for projection (Nakamura et al, 1989) and oblique views. Bone and joint abnormalities were studied, and ulnar variance was measured in the PA view. Radiocarpal arthrography (Palmer et al, 1983) was done in 37 patients. Communications with the distal radioulnar joint, and midcarpal joint were identified. Twenty-seven patients had a three-phase ^{99m}Technetium bone scan (Maurer et al, 1983; Pin et al, 1988) to study abnormal accumulation of isotope on the delayed 3-hour uptake images. Thirty-three patients were studied by MRI using a 1.5-T superconducting scanner (Signa, General Electric Medical Systems, Milwaukee, WI, USA). The coronal views of T1-weighted images were examined to search for signal abnormalities in the wrist (Zlatkin et al, 1989).

The choice of which patients underwent wrist arthrography, bone scan or MRI was not selective or intentional.

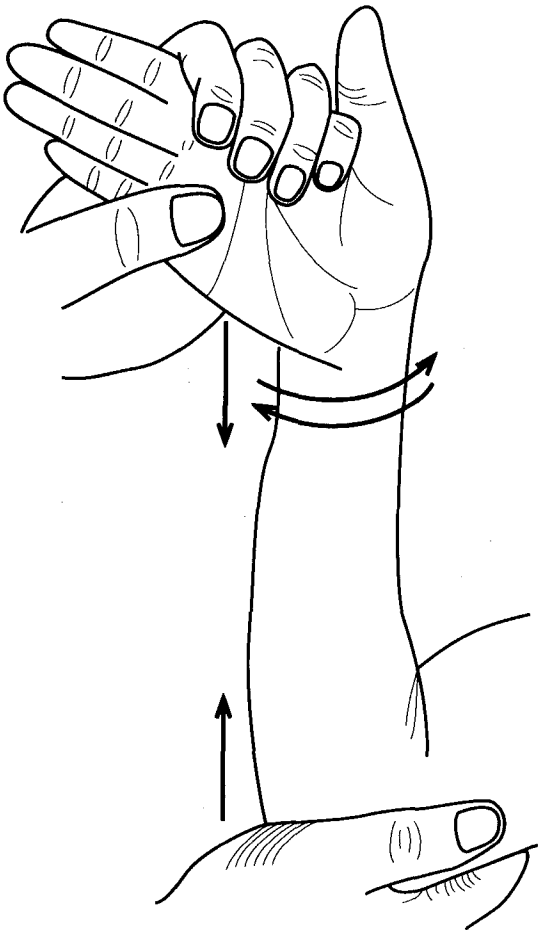

Fig 1 Diagram demonstrating the performance of the ulnocarpal stress test. The test is positive when axial stress produces ulnar wrist pain during passive supination–pronation with the wrist in maximum ulnar deviation.

Economic considerations and schedule conflicts precluded conducting all studies in all patients. All patients had arthroscopy of both the radiocarpal and midcarpal joints using a 2.4 mm arthroscope (Whipple et al, 1995). Intra-articular lesions identified by arthroscopy were recorded.

RESULTS

X-ray

Ulnar variance ranged from –1 to 7 mm, with a mean (SD) of 1.7 (2.0) mm on the affected side compared with 1.2 (1.4) mm on the unaffected side. Thirty-three patients had positive ulnar variance of 1 mm or more on the affected side. X-rays showed ulceration or a cystic lesion of the ulna or proximal ulnar aspect of the lunate in nine patients.

One of five patients with tenderness over the DRUJ had osteoarthritis of this joint. Dynamic computed tomography of the DRUJ (Wechsler et al, 1987) was done in the remaining four patients with tenderness of the distal radioulnar joint and revealed dorsal subluxation of the DRUJ in one patient and palmar subluxation in one patient. No patient had carpal malalignment on X-ray

Arthrography

Radiocarpal arthrography showed communication with the DRUJ in 18 of 37 patients and communication to the midcarpal joint in 18. Twenty-nine patients had either communication with the DRUJ or the midcarpal joint.

Bone scan

Radioisotope accumulation around the ulnocarpal region was confirmed in 19 of 27 patients (Fig 2). One patient had accumulation on both the radial and ulnar sides of the wrist.

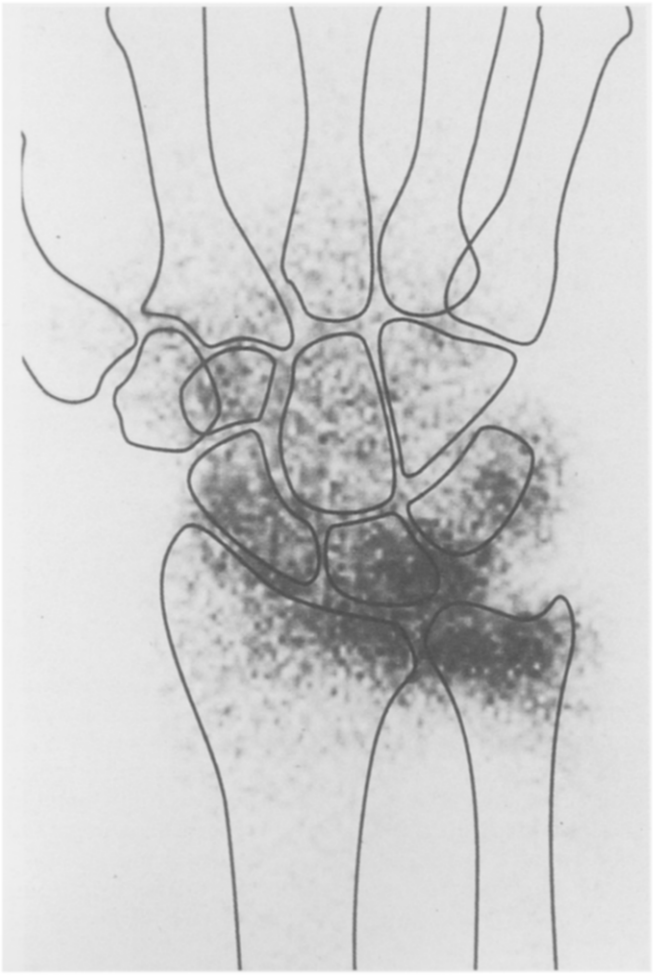

Fig 2 ^{99m}Technetium bone scan showing isotope accumulation in the lunate and the ulnar head in a patient with a positive ulnocarpal stress test.

MR imaging

MRI revealed low signal intensity in the proximal ulnar aspect of the lunate on T1-weighted images in four of 33 patients. This is diagnostic of ulnocarpal abutment syndrome (Escobedo et al, 1995).

Arthroscopy

Arthroscopy demonstrated ulnar-sided wrist pathology in all 45 patients. Triangular fibrocartilage wear or a degenerative tear (classified as a class II TFC complex lesion as a result of repetitive loading from ulnocarpal abutment by Palmer in 1989) was confirmed in 19 patients (Fig 3). Cartilage wear, erosion or defect of the ulnar aspect of the lunate was seen in 20 patients. Wear of the base of the triquetrum was evident in five patients, and ulnar head wear was confirmed in three patients. Traumatic TFC tear (classified as a class 1A TFC complex lesion by Palmer in 1989) was seen in six patients. Lunotriquetral (LT) ligament tear or wear was seen in 11 patients (Fig 4), and LT instability was confirmed by pushing the triquetrum with a probe during midcarpal arthroscopy in four patients (Table 1). Marked synovial proliferation was confirmed in four patients, and a cartilaginous free body was found in the ulnocarpal space in one patient.

Final diagnosis

The final diagnosis was based principally on arthroscopy, but in four patients MRI and X-ray findings contributed to the final diagnosis. Diagnostic criteria for ulnocarpal abutment syndrome are shown in Table 2. Of the 24 patients with spontaneous onset of pain, 19 patients were diagnosed as having ulnocarpal abutment syndrome, four patients had wrist arthritis and one patient had a joint mouse. In the 21 patients with post-traumatic pain, nine had ulnocarpal abutment syndrome, six had a traumatic TFC tear (one of the six patients had an associated dislocation of the extensor carpi ulnaris tendon and two patients had associated DRUJ subluxation), five had traumatic LT ligament tear, and one had both TFC and LT ligament tear.

Using Palmer's classification (1989), three of 28 patients had a class IIA lesion (TFC complex wear), 13 had a class IIB lesion (TFC complex wear with lunate and/or ulnar chondromalacia), seven patients had a IIC lesion (TFC complex perforation with lunate and/or ulnar chondromalacia), and five patients had a IID lesion (TFC complex perforation with lunate and/or ulnar chondromalacia, and LT ligament perforation).

DISCUSSION

In the ulnocarpal stress test, the examiner produces ulnar deviation of the wrist and rotates the forearm. Ulnar deviation of the wrist is believed to increase the proportion of the axial load on the ulna by decreasing the load on the radius. Several different experimental studies have supported this hypothesis. Palmer and Werner (1984) have examined axial loading using load cells, Sato et al (1991) have used pressure sensitive film, and Watanabe

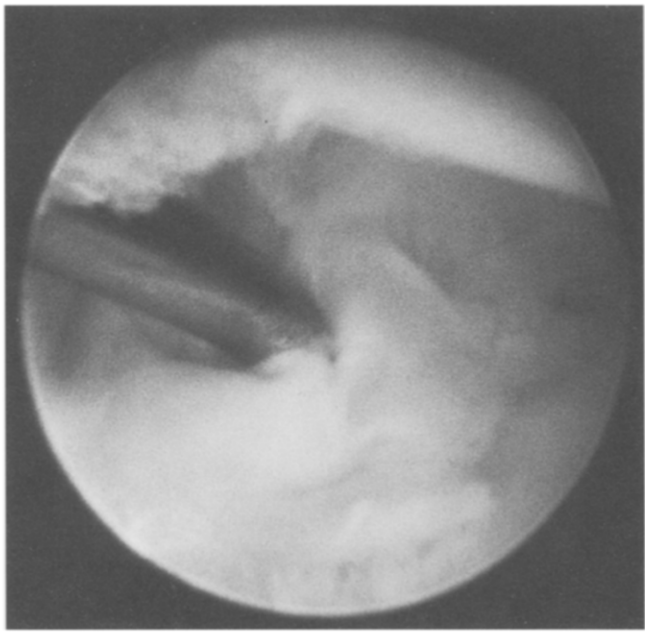

Fig 3 Radiocarpal arthroscopy showing a degenerative perforation of the triangular fibrocartilage and lunate chondromalacia (TFC complex class IIC lesion) in a patient with a positive ulnocarpal stress test. A probe is inserted into the site of perforation.

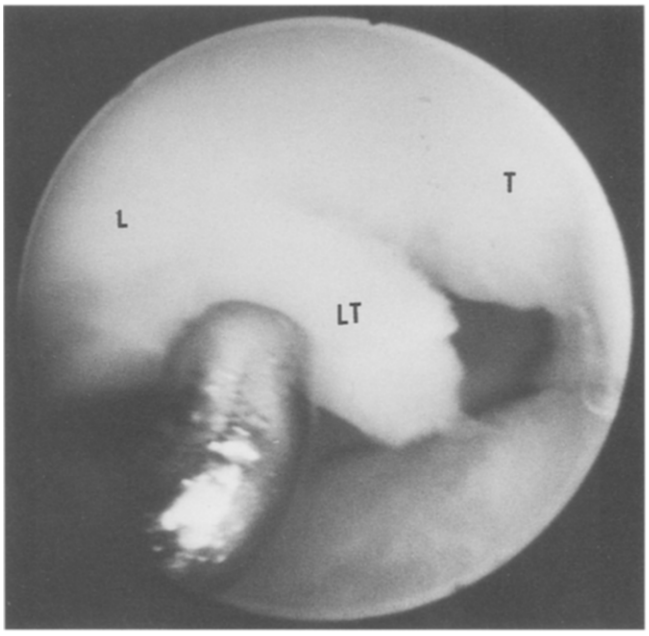

Fig 4 Radiocarpal arthroscopy showing a traumatic lunotriquetral ligament flap tear in a patient with a positive ulnocarpal stress test. (L: lunate, LT: lunotriquetral ligament, T: triquetrum.)

Table 1—Results of investigations in patients with a positive ulnocarpal stress test

Examination	*Findings*	*No. of patients with positive results* / *No. of patients who underwent examination*
X-ray	Ulceration or cystic lesion of the ulna or proximal ulnar aspect of the lunate	9 / 45
Radiocarpal arthrography	Communication with the distal radioulnar joint	18 / 37
	Communication with the midcarpal joint	18 / 37
^{99m}Technetium bone scan	Radioisotope accumulation around the ulnocarpal region	19 / 27
Magnetic resonance imaging	Low signal intensity in the proximal ulnar aspect of the lunate on T1-weighted image	4 / 33
Arthroscopy	Triangular fibrocartilage tear or wear	25 / 45
	Lunate cartilage chondromalacia	20 / 45
	Triquetrum cartilage chondromalacia	5 / 45
	Ulnar head cartilage chondromalacia	3 / 45
	Lunotriquetral ligament tear or wear	11 / 45
	Synovial proliferation	4 / 45
	Free body	1 / 45

Table 2—Criteria for diagnosing ulnocarpal abutment syndrome (patients must fulfil criteria 1 and 2)

1. Ulnar wrist pain with tenderness just distal to the ulnar head (dorsal and/or palmar).
2. Ulceration or cystic lesion of the lunate ulnar base and/or ulnar head on X-ray, *or*

   Low signal intensity of the lunate ulnar base on T1-weighted images of magnetic resonance imaging, *or*

   Degenerative lesions of the triangular fibrocartilage complex on arthroscopy (Palmer's class II lesion).

et al (1992) have developed a rigid body-spring model to analyse forces on the wrist. All these investigators have shown that ulnar deviation of the wrist shifts a portion of the axial load from the radius to the ulna. Increased ulnocarpal loading presumably induces impingement or abnormal motion in the ulnar carpus or TFC complex. Rotation of the forearm alters the TFC configuration and produces a non-uniform distribution of strain (Adams and Holley, 1993). The non-uniform strain in the injured TFC is believed to deform it. Although the precise mechanism of the ulnocarpal stress test has not yet to be explained, increased axial loading through the ulnar wrist and strain on the TFC is believed to play a major role in producing ulnar wrist pain.

Our results show that wrist pain in patients with a positive ulnocarpal stress test is due to a variety of types of intra-articular ulnar wrist pathology, including TFC injury, LT ligament injury, ulnocarpal abutment syndrome, arthritis and a joint mouse. Therefore, a positive test does not necessarily indicate a diagnosis of ulnocarpal abutment syndrome; any number of other types of ulnar-sided wrist pathology may be present. DRUJ subluxation, ulnar styloid fracture and extensor carpi ulnaris dislocation may also produce a positive test. Therefore, we should consider which of these lesions is responsible for the positive stress test.

DRUJ subluxation and dislocation must accompany TFC injury (Morrissy and Nalebuff, 1979; Palmer, 1989; Taylor and Parson, 1938). Recurrent subluxation usually can be reduced by supination with pain. This may present as a positive ulnocarpal stress test, although patients with DRUJ subluxation and dislocation usually experience pain and tenderness of the DRUJ.

Ulnar styloid fractures, including non-unions, may also produce a positive ulnocarpal stress test. To differentiate between a positive test due to ulnar styloid fracture and intra-articular ulnar wrist pathology, it is essential to determine whether the pain and tenderness are localized to the ulnar styloid.

Extensor carpi ulnaris dislocation also may produce a positive ulnocarpal stress test because dislocation commonly is produced by ulnar deviation and supination, which is a manoeuvre similar to the ulnocarpal stress test. Tendon dislocation can be confirmed easily by inspection during the provocative test. Coexistence of tendon dislocation and intra-articular ulnar wrist pathology should be suspected when a patient with a tendon dislocation has a positive ulnocarpal stress test in pronation.

Arthrography, bone scan, and arthroscopy were the investigations that were most frequently diagnostic in our study. A positive ulnocarpal stress test suggests the existence of pathology on the ulnar side of the wrist even when X-rays and MRI are nondiagnostic.

The significance of arthrographic communication between the compartments in the wrist is controversial. In addition to communication due to symptomatic lesions of the TFC complex or intercarpal ligament

(Belsole et al, 1990; Frahm et al, 1990; Resnick et al, 1984), aging (Mikic, 1978), non-pathological pin holes and asymptomatic perforations can also yield positive findings on arthrography (Kirschenbaum et al, 1995). Therefore, we did not consider the arthrographic results when making the final diagnosis, even though the communication rate was not low.

A bone scan is a sensitive screening test for bone and joint abnormalities and often identifies the site of the pathology (Maurer et al, 1983; Pin et al, 1988). Seventy per cent of patients with a positive ulnocarpal stress test who underwent a bone scan had some bone and joint abnormality.

Wrist arthroscopy permits the direct visualization of intra-aricular lesions of the wrist and is believed to be the most reliable examination for diagnosing of intra-articular pathology of the wrist (Cooney 1993; Hanker, 1991; North and Meyer, 1990). We would emphasize that arthroscopy confirmed the existence of wrist pathology in all patients with a positive ulnocarpal stress test.

In conclusion, the ulnocarpal stress test is a useful provocative test for determining the aetiology of ulnar-sided wrist pain. A positive test suggests the presence of ulnocarpal abutment syndrome, TFC injury, lunotriquetral ligament tear, ulnocarpal arthritis or free body. Distal radioulnar joint dislocation and subluxation, extensor carpi ulnaris dislocation, or ulnar styloid fracture may also yield a positive test. The test is sufficiently sensitive to warrant further investigation by arthroscopy to establish the diagnosis.

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