Ulnar shortening for tears of the triangular fibrocartilaginous complex

Ten consecutive patients had their ulnas shortened for treatment of ulnar wrist pain associated with triangular fibrocartilaginous complex tears. Each injury was traced to a previous fall or an overuse syndrome. Conservative treatment failed. In all patients, x-ray films showed ulnar positive or neutral variance. The ulna was shortened an average of 2 mm. Frank ulnolunate abutment and/or cartilage degeneration was found in six cases. Follow-up averaged 23 months, and except for one patient in whom radiocarpal arthritis developed, the remaining patients were satisfied and returned to their work or previous level of activity. Relief of pain, grip strength, and range of motion were excellent, except for an average decrease in flexion of 25.8 degrees (p = 0.01). Hardware irritation was noted in six patients. These findings substantiate the use of ulnar shortening to relieve ulnolunate impingement in patients with ulnar positive or neutral wrists in whom ulnar wrist pain develops and who demonstrate triangular fibrocartilaginous complex tears after acute trauma and/or overuse syndromes. (J HAND SURG 1990;15A:415-20.)

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The treatment of triangular fibrocartilaginous complex (TFCC) tears is at present a controversial topic. Recommended treatment options have included debridement of the tear, excision of the TFCC in whole or in part, repair of the TFCC, ulnar head resections of various types, and ulnar shortening or recession. This study assesses the results of ulnar shortening in 10 consecutive patients with ulnar wrist pain and associated TFCC tears. Factors relating to injury and those affecting the ultimate outcome were assessed. Although previous studies have described the use of ulnar recession for the treatment of a variety of disorders of the distal ulna and its articulations, none have solely addressed its use for the treatment of TFCC tears.

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Anatomy and function

Lewis described in detail the evolutionary changes in the primate wrist and radioulnar joints, which are based in large measure on the gradual proximal migration of the distal ulna from the carpus. As a result, the ulna comes to lose its primitive articulation with the pisiform and triquetrum, and the triangular fibrocartilaginous complex (TFCC) develops in its stead.

The TFCC arises from the ulnar aspect of the lunate fossa of the radius and sigmoid notch and inserts on the caput ulna and base of the ulnar styloid (Fig. 1). Its components may be thought of as anatomic areas of a homogeneous unit, with a clearly defined TFC proper (articular disc), extensor carpi ulnaris (ECU) sheath, and ulnohamate and ulnotriquetral ligaments, in addition to the less well-defined meniscus homologue (ulnocarpal meniscus), ulnar collateral ligament (UCL), and dorsal and palmar radioulnar ligaments. Palmer has described the functions of the TFCC as follows: (1) major stabilizer of the radioulnar joint, (2) major stabilizer of the ulnar carpus and hand on the forearm, and (3) cushion or shock absorber for transfer of axial load.

Mikid has shown that the central, relatively avascular portion of the disk is subject to age-dependent degeneration that begins in the third decade of life and ultimately may result in perforation. However, Palmer has shown that the central, relatively avascular portion of the disk is subject to age-dependent degeneration that begins in the third decade of life and ultimately may result in perforation.
noted that TFCC perforation in the central region of ulnolunate articulation was always associated with evidence of ulnolunate abutment with cartilage erosion and malacia. Furthermore, he found a much higher incidence of TFCC tears associated with ulnar positive or neutral variance (73%), as opposed to ulnar minus (17%).

**History and physical**

Patients with symptomatic TFCC pathology generally complain of pain at the distal radioulnar joint region, which is aggravated by pronation and supination, especially against resistance, as in using a screwdriver. They also complain of decreased grip strength and often describe a click, which is generally painful. Differential diagnosis includes carpal sprains or subluxations, ECU tendonitis, and radioulnar or ulnocarpal arthritis. Arthrography confirms the diagnosis by demonstrating leakage of dye between the radiocarpal and radioular joints.

If one believes that ulnolunate abutment, by virtue of ulnar positive variance leads to attritional perforation of the TFCC, perhaps superimposed on the age-related degeneration of the avascular central disc, then recession of the ulna to eliminate ulnolunate impingement should avert the sequelae of chondromalacia and ultimate arthritis. For this reason, and because of our poor results with other treatment methods, we undertook this study.

**Materials and methods**

Ten consecutive patients had ulnar shortening for treatment of ulnar-sided wrist pain associated with TFCC tears, all of which were documented by arthrography. In each case, a trial of conservative therapy, including immobilization, physical therapy, nonsteroidal antiinflammatory medication, and steroid injection, had failed to relieve symptoms. Previous operations included debridement for ECU tendonitis in one case and TFCC debridements in two cases, without success.

At the time of follow-up, which averaged 23 months, an independent evaluation was done by one of us (H. J. B.). Patient data are presented in Table I. Objective data consisted of measurements of range of motion using a hand-held goniometer, grip strength as compared with the contralateral uninjured hand by use of a Jamar Adjustable Dynamometer (Asimow Engineering Co., Los Angeles, Calif.), and ulnar variance before and after operation taken from standardized radiographs, by use of the concentric circle method described by Palmer. Because ulnar variance changes with forearm rotation (pronation increases), wrist deviation (radial deviation increases), and x-ray beam incidence angle, Epner describes the standard zero-rotation, ulnar deviation PA with the shoulder at 90 degrees abduction, elbow at 90 degrees flexion, forearm at neutral rotation, wrist in ulnar deviation, as well as the standard zero-rotation, neutral deviation lateral with the shoulder at 0 degrees abduction, elbow at 90 degrees flexion, forearm at neutral rotation, wrist in ulnar deviation.

**Procedure**

The senior author (M. A. M.) did the operation in all cases. Under tourniquet ischemia, a longitudinal skin incision was centered over the ulna with a dorsoradial zig-zag approach about the ulnar head. A longitudinal capsulotomy allowed visualization of the TFCC and both scapholunate and lunotriquetral joints. The TFCC
was inspected for perforation, and the degree of ulnolunate abutment was noted. The scapholunate and lunotriquetral joints were probed for ligamentous tears and were stressed to rule out instability. The cartilaginous surfaces were examined for changes of chondromalacia.

The distal-most aspect of the dorsal ulna was next exposed subperiosteally, and a six-hole 3.5 dynamic compression plate (DCP) was contoured to fit the dorsal surface. The plate was fixed to the ulna using the distal three holes with screws in the neutral mode. An oscillating saw was then used to etch the osteotomy site between the proximal three and distal three holes, as well as to longitudinally etch the ulna alongside the plate to ensure proper rotational alignment after osteotomy.

The proximal two screws were then removed and the distal-most screw was loosened to allow rotation of the plate out of the surgical field. A transverse osteotomy was made with the oscillating saw, removing approximately 2 to 3 mm of bone. The bone ends were then provisionally approximated with clamps. The ulnolunate junction was assessed for any evidence of abutment and the forearm ranged through pronation and supination to check for impingement and congruity of the radioulnar joint. If the recession was inadequate, more bone was removed. The plate was then fixed proximally with one or two screws in the compression mode, with care taken to ensure proper rotational alignment (Fig. 2). After operation, the forearm was placed in a sugar tong splint in neutral rotation, with conversion to a volar splint at 1 week.

Results

The only failure occurred in a patient in whom radiocarpal arthritis developed, which was treated by a limited wrist fusion with good results. The remaining nine patients were all satisfied, with five reporting no pain and four noting mild pain only with strenuous activities. All returned to work, although four patients switched to jobs that were physically less demanding.

The data compiled in Table I were subjected to cross-tabulation statistical analysis, with values obtained for chi square with and without correction, as well as the Fisher exact probability. As regards the latter, the most significant values were for postoperative pain versus both mechanism of injury and previous fracture, click versus previous fracture, and change in variance versus abutment (all $p = 0.08$). Significant values were found
Table I. Patient data

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Hand</th>
<th>Job</th>
<th>Prev. fx</th>
<th>Mech</th>
<th>Sexs</th>
<th>Click</th>
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<td>Fall</td>
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<td>-</td>
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<tr>
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<td>M</td>
<td>ND</td>
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<td>Fall</td>
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<td>+</td>
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<td>F</td>
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<td>-</td>
<td>Overuse</td>
<td>18</td>
<td>-</td>
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<tr>
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<td>D</td>
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<td>Fall</td>
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<td>-</td>
</tr>
<tr>
<td>6</td>
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<td>D</td>
<td>F</td>
<td>Factory</td>
<td>-</td>
<td>Overuse</td>
<td>4</td>
<td>+</td>
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<tr>
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<td>D</td>
<td>Labor</td>
<td>-</td>
<td>Overuse</td>
<td>16</td>
<td>-</td>
</tr>
</tbody>
</table>

Hand, Dominant (D), nondominant (ND); Prev fx, previous fracture; Mech, mechanism; Sexs, symptoms (mo); Prevar, preoperative variance (mm); Postvar, postoperative variance (mm); F/u, follow-up (mo); Pain, postoperative; Rework, return to work (↓, lighter duty); Plate, plate pain; D/C plate, plate removal; Satis, satisfaction; Abut, abutment; Cart, cartilage degeneration.

Table II. Statistical analysis of range of motion

<table>
<thead>
<tr>
<th>ROM</th>
<th>Analysis of variance*</th>
<th>% Decrease</th>
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<tbody>
<tr>
<td>Flexion</td>
<td>0.01</td>
<td>24.8</td>
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<tr>
<td>Extension</td>
<td>0.61</td>
<td>3.7</td>
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<tr>
<td>Radial deviation</td>
<td>0.21</td>
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<tr>
<td>Ulnar deviation</td>
<td>0.09</td>
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<tr>
<td>Pronation</td>
<td>0.09</td>
<td>6.7</td>
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<tr>
<td>Supination</td>
<td>n/a</td>
<td>0</td>
</tr>
</tbody>
</table>

*One-way ANOVA.

in the chi square tests for age versus both plate pain and click and return to work versus both mechanism and cartilage changes (p ≤ 0.05).

The range of motion and grip strength data were subjected to one-way ANOVA analysis of variance, as shown for range of motion in Table II. Grip strength diminished an average of 17.5 kilograms-force (p = 0.17). Significant values were obtained for flexion (p = 0.01) only, with an average decrease of 24.8 degrees. These parameters tended to improve up to a year after operation.

Complications. Healing of the osteotomies was uneventful (<3 months) in all but one patient, whose delayed union eventually healed at 1 year. One patient sustained a fracture through the osteotomy site after early plate removal at 9 months, with subsequent re-plating and uneventful union. Six patients voiced complaints referable to prominent hardware, with removal requested in three, followed by resolution of symptoms.

Discussion

Ulnolunate impingement was alluded to as early as 1942 when Milch described the “so-called dislocation” of the distal ulna after Colles’ fracture as a result of radial settling. He recommended subperiosteal cuff resection as a means by which the ulnolunate junction could be decompressed, with good results which were corroborated by Weigl and Spira. On the other hand, Cooley, Imbriglia, Van der Linden, and Menon all reported relief of symptoms merely by excision of the TFCC.

More recently, Faupel, followed by Darrow and colleagues, reported on the use of ulnar shortening as a treatment for TFCC tears associated with ulnar positive variance and ulnolunate impingement by unloading the ulnocarpal joint. While there may be concern regarding increased stress borne by the lunate with subsequent development of Kienböck’s disease, such a scenario has not been reported.

With the exception of one patient whose result was compromised by the development of radiocarpal arthritis, the remaining nine patients were satisfied with their treatment, both in terms of pain relief and ability to return to gainful employment or previous level of activity. While four patients switched to jobs with lighter duty, and four complained of mild pain only with strenuous activity, all nine patients felt significantly improved after operation and voiced no regrets about having had the procedure.

Objectively, range of motion was significantly reduced only in flexion (average 24.8 degrees decreased), with no significant diminution in grip strength. Both of these factors improved with time.

Osteotomies generally healed uneventfully, although one patient had a delayed union and another refractured after having the plate removed too early. There were complaints referable to the plate in six patients, with removal requested in three, followed by resolution of
symptoms. This likely represented irritation from a relatively bulky plate lying in a subcutaneous position. Removal of the plate to relieve symptoms is recommended after approximately 1½ to 2 years after operation.

The finding of ulnar positive or neutral variance in every patient lends credence to the hypothesis that ulnolunate impingement may be associated with TFCC tears and ulnar wrist pain. Although frank abutment and/or cartilage changes were not noted in every case, these were common findings and their absence may, in part, be attributable to insufficient documentation in the operative report. We believe it is particularly important to visualize this area after recession of the ulna to ensure that abutment does not persist. Finally, because significant degenerative changes at the radiolunate joint may preclude a good result from ulnar shortening, as demonstrated by our one failure, perhaps initial arthroscopic evaluation may aid in assessing the severity of osteochondral damage.

Examining the many variables in Table I, few significant correlations could be made. Patients with frank abutment tended to undergo greater ulnar recession. Those with a history of previous fracture tended to be seen initially with clicks and experienced mild postoperative discomfort, perhaps indicating altered geometry at the radioulnar joint, with click and pain as a result. Also, patients who fell were more likely to have persistent mild postoperative pain compared with those with overuse syndrome, perhaps relating to the severity of the original injury. Finally, patients with an overuse syndrome were more likely to seek lighter duty work, which may be the result of employer concern for further injury or employee desire for less work and/or monetary settlement.

The shortcomings of this study relate primarily to its retrospective nature. As such, range of motion and grip strength were compared with the uninjured hand, without accounting for dominance or previous injury. Furthermore, documentation of complaints or clinical findings may have been incomplete. Also, there was no good means for specifically assessing the radioulnar joint clinically. Perhaps preoperative and postoperative BTE (Baltimore Therapeutic Equipment, Baltimore, Md.) testing would have been beneficial. Finally, despite looking at a number of variables, few clinical correlations could be found, perhaps resulting from the small number of cases examined.

REFERENCES