Outcomes of Ulnar Shortening Osteotomy Fixed With a Dynamic Compression System

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Purpose To evaluate the outcomes of patients with ulnar impaction syndrome treated with a jig-facilitated, oblique, diaphyseal ulnar shortening osteotomy and fixed with a TriMed (Santa Clarita, CA) ulnar osteotomy compression plate.

Methods A retrospective chart review of patients with ulnar impaction syndrome identified 38 patients who had had ulnar shortening osteotomy and fixation with the TriMed dynamic compression system. The following clinical data were obtained: patient age, sex, follow-up range of motion, grip strength, and complications. After a minimum of 2 years after surgery, patients reported complications and completed a Disabilities of the Arm, Shoulder, and Hand questionnaire.

Results Eight patients were lost to follow-up. Compared to the opposite limb at an average of 8 months after surgery, the remaining 30 patients attained 92% to 97% of wrist and forearm motion and 71% of grip strength. The average Disabilities of the Arm, Shoulder, and Hand score was 12 after a minimum of 2 years after surgery. Four patients required plate removal due to irritation. Two patients reported persistent ulnar-sided pain, and 2 other patients developed atrophic nonunions and required autologous bone grafting. There were no infections.

Conclusions Ulnar shortening osteotomy using the TriMed system yielded good clinical outcomes that are comparable to those previously documented using other systems. *(J Hand Surg 2013;38A:1520–1523. Copyright © 2013 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Compression plate, positive ulnar variance, triangular fibrocartilage complex, ulnar shortening osteotomy.

In 1991, Friedman and Palmer[1] described ulnar impaction syndrome as a degenerative condition of the ulnar aspect of the wrist in patients with static or dynamic positive ulnar variance. The excessive load bearing of the ulnar head against the triangular fibrocartilage complex (TFCC) or the ulnar carpus often manifests as insidious onset ulnar wrist pain, swelling, and limitation of movement.[2,3] Ulnar impaction syndrome may develop naturally or may result from premature epiphyseal arrest of the distal radius, excision of the radial head, distal radius malunion, or an Essex-Lopresti injury.[1,4,5]

The diagnosis of impaction is determined by the patient history, physical examination, and findings on magnetic resonance imaging. Patients typically report ulnar wrist pain exacerbated by forearm rotation or ulnar deviation of the wrist during daily activities such as opening jars, wringing wet clothes, or typing.[6] Radiographic findings typically include positive ulnar variance and carpal chondromalacia evidenced by cortical sclerosis or subchondral changes consistent with

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cystic changes in the ulnar head, ulnar corner of the lunate, and/or radial corner of the triquetrum.[1,7–9] Progressive irritation at the ulnocarpal junction may result in cartilaginous lesions of the lunate and ulnar head, lunatotriquetral ligament disruption, and degeneration of the TFCC.[2,3,5]

Ulnar shortening osteotomy is often the method of choice to alleviate symptoms of ulnar impaction by restoring neutral or negative ulnar variance.[1,4,5,10] A variety of surgical techniques have been described, with the goal of optimizing the ulnar variance without introducing rotation, angulation, or nonunion.[2,3,6,11–14] This article reports the outcomes of ulnar shortening osteotomy using a dynamic compression system (TriMed Inc., Santa Clarita, CA). This system allows for creation of an oblique ulnar diaphyseal osteotomy with a jig-based system and cutting guides and eliminates the need for a freehand osteotomy.[15] The plate for ulnar fixation is then preferentially placed on the volar aspect of the ulna where soft tissue coverage is robust.

MATERIALS AND METHODS

After institutional review board approval, we performed a retrospective review of patients diagnosed with ulnar impaction syndrome, identifying all patients who had had ulnar shortening osteotomy with the TriMed dynamic compression system at our institution from March 2006 to April 2011. Patient selection was based on ulnar positive variance of at least 1 mm with magnetic resonance imaging evidence of impaction lesions within the lunate and/or triquetrum and failure of conservative measures such as casting, activity modifications, steroid injections, and arthroscopic debridement. The procedure was coded under the Current Procedural Terminology code for ulnar shortening osteotomy (25390). All patients had wrist arthroscopy immediately before the osteotomy to evaluate the condition of the TFCC, the lunatotriquetral interosseous ligament, and the condition of the lunate and triquetrum articular surfaces. Following the shortening osteotomy performed according to the manufacturer's recommended technique, the patients were immobilized after surgery in a short arm splint for 2 weeks followed by a short arm cast for an additional 6 weeks or until radiographic union was achieved. One fellowship-trained hand surgeon performed all procedures.

Data were collected from hand therapy notes and follow-up appointments at our institution. Hand therapy was performed by a team of certified hand therapists. Active range of motion (ROM) assessment consisted of forearm pronation/supination and wrist flexion/extension for the affected and contralateral limbs. Grip strength (Jamar hydraulic dynamometer; North Coast Medical, Gilroy, CA) was evaluated for both limbs, without correction for hand dominance. These metrics were recorded for the 30 patients who maintained follow-up appointments. Information regarding intraoperative or postoperative complications was also retrieved from the patient database. The mean follow-up examination for ROM was 8 months after surgery.

The 30 patients were interviewed by telephone after a minimum of 2 years after surgery to evaluate for complications since their most recent follow-up, any subsequent hospital or clinic visits, and upper extremity function assessment using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. The mean postoperative interval for this longer-term follow-up was 39 months (range, 16–81 mo).

TABLE 1. Outcome Measurements With the TriMed Dynamic Compression System

	Postoperative	Contralateral (%)
Wrist flexion	74°	96
Wrist extension	65°	97
Forearm pronation	77°	96
Forearm supination	73°	92
Grip strength	26 kg	71
DASH scores	12	N/A

N/A, not applicable.

RESULTS

Records of 38 patients (16 men, 22 women) with an average age of 55 years (range, 21–90 y) were retrieved from the database. Of these, 8 patients were lost to follow-up due to relocation out of the area, and the remaining 30 had a mean follow-up of 8 months (range, 2–43 mo). Wrist arthroscopy demonstrated a central TFCC tear in all 30 patients. Of the 30 patients, 14 had Palmer 2C tears (TFCC tear with lunate/ulnar chondromalacia), 11 had Palmer 2D tears (TFCC tear with lunate/ulnar chondromalacia and lunatotriquetral ligament tear), and 5 had Palmer 2E tears (TFCC tear with lunate/ulnar chondromalacia, lunatotriquetral ligament tear, and ulnocarpal arthritis). These concomitant injuries were treated with arthroscopic debridement using a motorized shaver followed by the ulnar shortening osteotomy.

The DASH scores of our patient cohort averaged 12 (SD, 20). As detailed in Table 1, the follow-up ROM ranged from 92% to 97% of the contralateral side at an average follow-up of 8 months after surgery, and mean

grip strength compared to the contralateral side was 71%.

There were 8 complications. Four patients requested plate removal due to irritation from plate prominence. Plate removal was performed only after healing of the osteotomy was confirmed (a minimum of 6 months after the index procedure). There were 2 cases of persistent ulnar-sided pain. One case involved pain at the ulnocarpal joint with twisting activities, but the patient did not seek further treatment. The other patient presented with persistent dorsal ulnar sensory neuropathic pain and had neurolysis of the dorsal sensory branch of the ulnar nerve with limited improvement. Two atrophic nonunions were diagnosed radiographically at a minimum of 6 months after surgery. Both patients were treated with autologous iliac crest bone grafting, leaving the plate *in situ*, and both nonunions subsequently healed within 3 months. The revision surgery was performed by the surgeon who performed the initial ulnar shortening osteotomy. Excluding these nonunions, the mean time to union for the patients treated with the ulnar shortening osteotomy was 10 weeks (range, 8–20 wk). The range of ulnar shortening was between 2 and 5 mm.

DISCUSSION

Ulnar shortening osteotomy treats ulnar impaction syndrome by leveling the distal radioulnar joint extra-articularly while maintaining the integrity of the soft tissue stabilizing structures of the distal radioulnar joint.[4,10] The TriMed dynamic compression system has been reported to reduce surgical time due to its efficient design.[13] This study supports the effectiveness of the osteotomy system, as wrist pain generally resolved in the majority of our patient cohort, with postoperative DASH scores averaging 12 (similar to 11 as reported in the literature).[13] Postoperative ROM was more than 90% and grip strength was 71% of the contralateral side at an average of 8 months follow-up. The limited follow-up time may account for the incomplete restoration of grip strength, as recovery of strength typically takes longer than recovery of range of motion.

Complications of ulnar shortening osteotomy include plate irritation leading to secondary surgical procedures, neurovascular injury, nonunion, and increased risk of distal radioulnar joint osteoarthritis.[16–18] Plate irritation requiring removal is the most common complication of ulnar shortening osteotomy and has been reported in up to 55% of cases.[19] Loh et al[5] presented a review of 22 patients in which 7 patients (32%) had plate removal. Chen et al[12] reported that 8/18 (44%) patients requested removal of their plate. Pomerance[17] removed 14 of 40 plates (35%), and Lauder[15] and Luria et al[13] each reported 4 cases (24%) of plate removal in cohorts of 17 patients.

The incidence of nonunion after ulnar shortening osteotomy has been reported as up to 13% in a study by Koppel et al.[20] In another study, Rayhack et al[21] reported 1 nonunion in a cohort of 17 patients (6%).

In our cohort, 7 of the 30 patients (23%) had a secondary surgery. Four patients (13%) experienced plate irritation and had subsequent removal for symptomatic relief. Two patients exhibited evidence of nonunion 6 months after surgery. One of these patients was a chronic smoker and had chronic rheumatoid arthritis. The second nonunion patient was a former kidney-pancreas transplant recipient taking chronic immunosuppressive medication. Both nonunions healed following treatment with autologous bone grafting. Finally, 1 patient had neurolysis of the dorsal sensory branch of the ulnar nerve for persistent ulnar neuropathic pain.

The limitations of this study are inherent to the retrospective nature of this analysis. Postoperative outcomes are reported in terms of DASH scores and ROM and grip strength compared to the contralateral side, but preoperative data were not available. Consequently, the degree of functional improvement was not quantifiable. Nevertheless, 28/30 patients were functioning at a high level with low DASH scores at a minimum of 2 years after surgery. In addition, the postoperative follow-up physical examinations were limited (mean, 8 months) because patients typically do not require or seek further follow-up after reaching a state of stable functional recovery. Finally, there was no control group. The patients in this study had indications for surgery due to disabling ulnar-sided wrist pain with radiographic evidence of positive ulnar variance and ulnar impaction lesions within the lunate and/or triquetrum. These patients' symptoms were refractory to conservative therapy that included immobilization and anti-inflammatory medications. The vast majority of these patients had a noteworthy improvement in symptoms following the procedure. However, as discussed by McBeath et al,[18] symptomatic improvement following ulnar shortening osteotomy cannot be definitively attributed to the surgical intervention, as it may be the natural course of the illness, regression to the mean, or the placebo effect. As a result, a randomized, controlled trial with a larger patient population is needed to distinguish between surgical and nonsurgical techniques.

Ulnar shortening osteotomy with the TriMed dynamic compression system yields good postoperative outcomes, as evidenced by near-equivalent ROM to the contralateral limb and low DASH scores indicative of

excellent subjective restoration of function. Symptomatic plate prominence and nonunion are the 2 main concerns with this technique. Surgical removal was performed for plate irritation in 4 (13%) of our patients. This outcome remains a concern for this technique when compared to methods of leveling the distal ulna without the use of hardware (such as the wafer procedure). Our nonunion rate was 7%, which appears to be an inherent risk of this type of surgery on the ulna, regardless of technique, due to limited muscle coverage and the diaphyseal nature of this bone. These caveats should be considered when discussing this technique with patients, although overall success is expected.

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