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Ulnar Shortening Osteotomy for Ulnar Impaction Syndrome

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Abstract:

Background: ulnar impaction syndrome (UIS) is a common cause of ulnar-sided wrist pain. The differential diagnosis of ulnar-sided wrist pain is diverse due to the complex nature of the bony and soft tissue anatomy UIS may lead to degenerative lesions of the triquetrum, lunate, ulnar head cartilage or of the TFCC. Concomitantly the triquetrolunate ligaments may be disrupted. Associated factors of ulno-carpal joint space narrowing may include previous fracture (e.g. of the distal radius), premature physeal arrest of the distal radius or congenital ulna positive variance**.**

Aim of the work: this study aimed to evaluate the outcome of treating ulnar impaction syndrome with ulnar shortening osteotomy upon clinical and radiological.

Materials and Methods: in this study ten adult patients with ulnar impaction syndrome were selected from Orthopedic Outpatient Clinic of Faculty of Medicine (Damietta), Al-Azhar University Hospital from January 2018 to October 2018 and they were operated by ulnar shortening osteotomy and fixed by plating. Description of technique alongitudinal incision over the subcutaneous border of the ulna issued to expose the ulna between the distal and middle third of the ulna from the ulna styloid. Preoperative posteroanterior (PA) X-rays were reviewed to determine the amount of shortening required, with a goal of creating -2 mm variance postoperatively. A 6-hole dynamic compression plate was predrilled distally prior to performing two oblique osteotomies separated by the desired shortening length. The fragments were reduced and plated by using compression. **Results**: the mean disabilities of the arm, shoulder and hand (DASH) score was 9 postoperatively. Flexion, extension and supination were reduced compared to the contralateral unaffected extremity (84.6%, 85.3%, and 86.9% of normal). Patients received worker's compensation 5 of 10 patients required hardware removal for plate irritation and 2 of 10 patients had a nonunion. **Conclusion**: we preferred our surgical technique ulnar shortening osteotomy for all cases of UIS. Pain was significantly improved in our Cases; however smokers had less improvement in pain and higher disability scores.

Keywords: ulnar shortening osteotomy, ulnar impaction syndrome

Introduction

Ulnar impaction syndrome (UIS) is a common cause of ulnar-sided wrist pain. The differential diagnosis of ulnar-sided wrist pain is diverse due to the complex nature of the bony and soft tissue anatomy **.**The clinical scenario of UIS may include pain that localizes to the region of the ulno-carpal articulation and is exacerbated with a pronated grip and/or ulnar deviation. Decreased joint space between the ulnar-carpal bones and the ulnar head is present, either due to positive ulnar variance (UV) or less commonly, in ulnar-neutral or negative UV wrists with a thickened triangular fibrocartilage complex**(1).** UIS is synonymous with ulno-carpal impaction syndrome and ulno-carpal abutment, but is a distinct entity from ulnar styloid impaction and ulnar impingement syndrome. Ulnar styloid impaction is caused by impaction between the ulnar styloid and the proximal triquetrum; ulnar impingement syndrome is defined by a shortened ulna impinging on the distal radius [(1)] **.** UIS may lead to degenerative lesions of the triquetrum, lunate, ulnar head cartilage, or of the TFCC. Concomitantly the triquetrolunate ligaments may be disrupted. Associated factors of ulno-carpal joint space narrowing may include previous fracture (e.g. of the distal radius), premature physeal arrest of the distal radius, or congenital ulna positive variance [(2)]**.** Treatment is initially non-operative. If non-operative management fails, surgery to decompress the ulno-carpal joint is indicated. Joint decompression may be achieved by either ulnar shortening osteotomy (USO) or by wafer procedure. Wafer procedure may be either arthroscopic (AWP) or open (OWP). Various techniques for performing USo have been described **(3)**. The choice of surgical treatment for refractory UIS is largely based on surgeon preference. Each surgery has

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unique risks, though there exists no high-level evidence to inform X-ray and magnetic resonance imaging (MRI) are the most common imaging modalities used to investigate ulnar impaction syndrome. Computed tomography (CT) is also an available imaging modality. X-ray findings may include a positive ulnar variance, arthritic changes such as subchondral sclerosis or cystic formation of the lunate, triquetrum, or ulna, and on occasion a widened lunotriquetral interval in the case of lunotriquetral ligament instability. A pronated-grip view is helpful to accentuate the ulnar variance and determine whether there is dynamic ulnar impaction. MRI can detect early changes associated with ulnar impaction syndrome, including a TFCC tear or fibrillation, chondromalacia, and bone edema of the affected carpal bones [(4)]. Nonoperative measures such as activity modification, splinting, and nonsteroidal anti-inflammatory drugs (NSAIDs) may provide symptomatic relief; however, they will not alter the underlying pathophysiology. Operative management of ulnar impaction syndrome depends on the underlying etiology; however, the most common procedures used to address ulnar impaction syndrome are an ulnar shortening osteotomy or an open or arthroscopic distal wafer resection with or without TFCC debridement[(5)]. An osteochondral shortening of the ulna that preserves the distal cartilage is another option. Advantages of an ulnar shortening osteotomy (USO) include unloading the ulnar carpus, precise shortening, tightening the ulnocarpal ligament complex and avoiding damage to the distal articular surface of the ulna. Complications include nonunion or delayed union, which can take up to 8 months, or incongruity of the distal radioulnar joint, which may limit the amount of ulnar shortening. In addition, Nakamura ***et al.*** [(6)] described different morphologies of the sigmoid notch. A distally facing notch is a relative contraindication [(6)].

Aim of the work

This study aimed to evaluate the outcome of treating ulnar impaction syndrome with ulnar shortening osteotomy upon clinical and radiological.

Methods

We performed a retrospective analysis of 10 consecutive patients over 11 months who were treated with a USO for ulnar impaction syndrome at AL-Azher University Hospital. There were 4 female patients and 6 male. The average age was 35 (18 to 55) with a mean follow up time of 1o months (8 to12 months). Associated trauma to the affected wrist was reported in 8 of1o patients (80%), with 5 of 1o (50%) received worker's compensation and 3 of 1o patients (30%) being smokers. The mean pre- and post-operative ulnar variance and osteotomy union was evaluated radiographically. The clinical outcomes were measured by using visual analogue scale (VAS) and DASH (Disabilities of the Arm, Shoulder, and Hand) questionnaire. The wrist range of motion (ROM) and grip strength were also recorded and compared with the contralateral extremity. Complete data on preoperative wrist ROM, grip strength, and DASH questionnaire were not available and therefore not included for analysis. Wrist range of motion and grip strength were compared with the contralateral unaffected.

Surgical Technique: operative planning began with evaluation of the X-ray images preoperatively. The amount of ulnar shortening was calculated by evaluating the PA view of the wrist with the shoulder 90° abducted, elbow 90° flexed and wrist in 0° prono supination and flexion-extension. In general, we aimed to achieve a postoperative ulnar variance of -2mm. A longitudinal incision about 1o to 15 cm directly at ulnar side of forearm, started from styloid ulna. Dissection of soft tissue under skin till reaching ulna between flexor carpi ulnaris and extensor carpi ulnaris , elevation of periosteum by periosteal elevator. Marked part of ulna was resected and the osteotomy site underimage intensifier. Resection of this part by electric saw or by osteotomies. Resection done transverse or oblique to enhance healing. Site of osteotomy preferred at diaphyseal part leaving about 5 to 7 cm from distal end of ulna.Compression of two bony edges together under image intensifier and fixation by small DCP and 3.5 mm cortical screws. AP and LAT views was done for assurance about length of ulna and fixation of osteotomy site. DRUJ was examined if disrupted we fix it by k-wire orreconstruction was done if possible.

Fig. 1: preoperative X-ray wrist

Fig. 2: osteotomy site is marked, screws placed

Our technique was performed following administration of an upper-extremity block or general anesthesia and using an upper-arm tourniquet. The site of the osteotomy is then marked and the holes distal to the planned osteotomy site were predrilled. Bicortical screws were placed in these holes. A longitudinal groove was created in the ulna with a sagittal saw to help re-establish the rotational alignment once the osteotomy was done (**Fig. 2).** The plate was then swung away, keeping the distal screw in place and the two osteotomy cuts were planned based on the preoperative measurements. The cuts were planned exactly parallel to one another and at a 45° oblique angle to the plate such that the proximal bone fragment can key into the distal fragment when compressed. Regardless of whether the plate was placed on the dorsal or volar surface of the ulna, the oblique osteotomy is performed such that an acute angle was formed between the plate and cut end of the distal fragment, allowing the proximal fragment to key in. The osteotomies were performed by using a sagittal saw, keeping in mind the cutting kerf of the blade, which can add 1-2 mm of shortening. The surgeon alternated between the distal and proximal cuts, kept a small intervening bone bridge intact for stability. The bone segment was removed. Approximation of the fragments may be difficult with large bone resections due to the tension of the interosseous membrane. Closing the gap could be facilitated using unicortical screws on either side of the osteotomy site. The osteotomy alignment and plate and screw position were checked with intraoperative fluoroscopy. Our postoperative protocol was to immobilize the wrist in a volar splint for 1o-14 days, followed by a short arm cast for 6 weeks. Wrist ROM exercises began at week 6 and strengthening at week 10-12 showed the postoperative X-ray images of ulnar impaction syndrome treated with a USO.

Results

There was a statistically significant improvement in pain, based on the VAS and DASH score , before and after operation with a preoperative mean of 7.4 (Range 6-10) as compared to a postoperative mean of 5.2 (Range 1-7). The average postoperative DASH score in our cohort was 8.2 (5 to 10.5).

Table 1: results according to DASH score

	Preoperative	2-months post	4-months post	6-months post	8-months post
18-30 y	20.5	32.5	18	10.5	8.5
30-35 y	28	40	27	22	10.5
35-45 y	30	47	31	19	7
45-55 y	22	44	33	17	14

ROM and grip strength were compared with the contralateral unaffected wrist postoperatively. A statistically significant reduction was recorded in wrist flexion (53° versus 63° , extension (47°versus57°) and supination (67°versus7).

The average ulnar variance after opertion was -0.8 mm (range -2.8-1.2), compared to +2.3 mm preoperatively (range 0.44-4.16). a-2 mm ulnar variance post-operatively

Table 2: outcome measurement of range of wrist motion and grip strength after ulnar shortening osteotomy

ROM and Grip strength	Post-operative wrist	Contralateral wrist
Wrist flexion	53	63
Wrist extension	46	57
Forearm pronation	85	96
Forearm supination	70	79
Grip strength	80%	100%

Discussion

USO for the management of ulnar impaction syndrome was originally described by **Milch** [(2)]. Since this report, multiple variations of osteotomy techniques, fixation devices and arthroscopic procedures have been detailed. The common aim of these procedures was to unload the ulno carpal joint. **Nichols *et al.*** [(7)] demonstrated in a cadaver model that in an ulnar neutral wrist, the DRUJ bore 18% of the total load. An increase in the length of the ulna by 2.5 mm increased the load on the ulnar wrist to 42%, where as a decrease in length of the ulna by 2.5 mm decreases the load to 4.3%. Limitations of our previous study included selection bias, as only 5 of 1o eligible patient's consented to inclusion in this study. This may influence the incidence of nonunion and hardware removal, as a portion of the 1o patients who consented were likely still being followed due to these conditions, whereas the other patients who did not consent were likely no longer routinely followed and did not wish to come into clinic for reassessment. We had not significantly changed our technique based on this point. In addition, because of the retrospective nature of that study, preoperative measures were not consistently available, and patient- reported pain based on the VAS was subject to recall bias. **Niemantsverdriet *et al.*** [(8)] found that 4 of 1o wrists following a USO had X-ray signs of DRUJ osteoarthritis at the 5-year followup visit. Five of the 6 wrists with DRUJ osteoarthritis had a type II IDRUJ configuration. In addition, DRUJ osteoarthritis occurred particularly in those that were significantly ulnar positive preoperatively (6.7 mm versus 4.3 mm) and those with more bone resection (7.0 mm versus 4.8 mm). Despite the development of DRUJ osteoarthritis, there was no difference in clinical outcomes (Gartland and Werley Wrist Score) between those with osteoarthritis and those without [(9)].At a mean follow-up of 18 months, these changes did not affect clinical outcome. Although ulnar impaction syndrome has been primarily described for wrists with ulnar positive variance, it has also been observed in ulnar neutral and negative variance wrists. The decision to offload the ulnar carpus with an ulnar shortening procedure should be based on the clinical and radiographic findings of the patient. We presented our technique to accomplish this using a USO. The USO technique allowed precise amounts and larger segments of bone to be removed without affecting the TFCC, effectively relieves pain and tightens the extrinsic ulnar ligaments of the wrist. Hardware irritation and nonunion risks must be acknowledged with this technique and mitigated by covering the plate as much as possible with overlying flexor or extensor muscle and encouraging smoking cessation. Risks of complications should be thoroughly reviewed with patients receiving worker's compensation, as there was a higher risk of poor outcomes in this population.

Conclusion

The degree of radiological changes in the lunate cystic lesions and improvements in the clinical results postoperatively (following shortening of the ulna) did not differ significantly between the patients with unintended positive and negative residual variance. It was suggested that further research should ideally take into account etiologic factors, and should include accurate reporting of pre- and post- operative UV using the method of perpendiculars, as well as objective outcome measurements like grip strength and range of motion.

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