Surgical correction for ulnocarpal abutment syndrome after malunited distal radius fracture remains controversial. We reviewed sixteen patients (7 men, 9 women) who underwent isolated ulnar-shortening osteotomy for ulnar wrist pain as their main complaint. Mean age was 48 years. The range of flexion-extension increased from $81^\circ$ to $103^\circ$, and range of supination-pronation from $120^\circ$ to $142^\circ$ after osteotomy. Mean grip strength increased from 49% to 69%. Mayo wrist score was excellent in 2 cases, good in 7 cases, fair in 6 cases, and poor in 1 case. Grip strength was found to correlate with radial inclination and flexion-extension range with the amount of ulna shortening.

**Keywords**: ulnar shortening osteotomy; malunited distal radius fracture; ulnar wrist pain.

**INTRODUCTION**

Distal radius fracture (DRF) is one of the most common fractures; 10% of women over 65 years of age are expected to sustain such a fracture (13). Malunion of DRF most often results in radial shortening as the main deformity, and presents clinically as ulnocarpal abutment syndrome (UCA) (10,15,17,20). Corrective osteotomy of the distal part of the radius – the logical treatment of malunion – may be technically difficult (7,13). We use to perform isolated ulnar-shortening osteotomy (USO) if the main deformity of the radius is shortening (8,21). Consensus has yet to be reached regarding what constitutes an 'acceptable' radiological position before or after treatment (7,8,12,21). In an attempt to identify potential predictors of functional outcome after ulnar shortening osteotomy for malunited DRF apart from shortening, we studied the three other key radiological indices (volar tilt [VT], radial inclination [RI], ulnar variance [UV]). All abbreviations used are listed in Table I.
PATIENTS AND METHODS

All study protocols were approved by the institutional review board. Data from patients with ulnocarpal abutment syndrome after malunited DRF were retrospectively reviewed. We selected USO only for cases with a limited volar tilt between -10° and 20° and with good joint congruity. For more severe deformities of malunited DRF, we used corrective osteotomy of the radius with or without USO and these patients were excluded from this study (30). Final diagnosis of abutment was confirmed by arthroscopy showing chondral or osteochondral lesions on the ulnar carpus. Sixteen cases of malunited DRF corresponded with these criteria and were included in the present study. Patient demographics, including age, sex, occupation, and time interval between injury and surgery were reviewed. Mean interval between initial injury and surgery was 39.5 months (range: 5-150 months). Mean duration of follow-up was 72 months (range: 18-180 months). Initial treatment of DRF comprised conservative treatment in 9 cases and operative treatment in 7 cases (percutaneous pinning 6, plating 1). Pre- and postoperative ranges of motion were obtained from clinical charts. Range of motion of the wrist in extension-flexion and pronation-supination was measured using a hand-held goniometer. Grip strength in both hands was measured at the latest follow-up. All patients were assessed using the Mayo wrist score to evaluate preoperative value and final functional outcomes with regard to residual pain, ability to return to work, mobility, and grip strength. The Mayo wrist score uses a 100-point scale comprising separate ratings for pain (25 points), range of motion (25 points), grip strength (25 points), and functional status (25 points), with 100 representing normal wrist function (2).

Radiological assessment (Fig. 1)

Anteroposterior radiographs were taken with the shoulder in 90° of abduction, the elbow in 90° of flexion and the forearm in neutral rotation. Lateral radiographs were taken with the shoulder in adduction, the elbow in 90° of flexion and the forearm in neutral rotation. Pre- and postoperative radiographic measurements of deformities were obtained by the surgeon: VT, RI, UV, sigmoid notch inclination (SNI), and ulnar head inclination (UHI) (26). UV was measured to the nearest 0.5 mm using the method of perpendiculars (4). In addition, plain radiographs were checked for evidence of bony spur formation. Negative values for VT represent dorsal tilt, and negative values for UV represent an ulna that is shorter than the radius. Negative values for SNI and UHI represent a radial inclination. These parameters were compared with the normal side and delta-values (normal side - affected side) were assessed.

Operative technique (8)

Ulnocarpal abutment was confirmed arthroscopically. The distal ulna was approached through a longitudinal
incision between the extensor carpi ulnaris and the flexor carpi ulnaris. We performed a transverse resection of the ulna fixed with a 3.5-mm locking compression plate. The contralateral side served as the reference for the length of shortening. The disappearance of ulnar abutment was then again confirmed arthroscopically. Postoperative immobilization in an above-elbow cast was worn for 3 to 4 weeks.

Statistical analysis

Differences in clinical details such as bony spur at the distal radioulnar joint (DRUJ) and in radiological assessments (UV, length of shortening, RI, VT, SNI, UHI) were analyzed using the Mann-Whitney U test. Spearman’s rank correlation coefficient was estimated between clinical results and radiological measurements. All variables are reported as the mean value ± standard deviation. Values of $p < 0.05$ were considered statistically significant and post hoc power analysis was calculated (19). All data analyses were performed using SPSS version 18 software and G*power software.

**RESULTS**

The data of sixteen cases were available for analysis. Overall, range of wrist motion was significantly better postoperatively (Table II). Complications were rare, with no patients showing ulnar non-union or Complex Regional Pain Syndrome. Mayo wrist score showed that outcomes were excellent in 2 cases, good in 7, fair in 6, and poor in only 1 case. Radiographic measurements of DRUJ alignment (UV, length of shortening, RI, VT, SNI, UHI) are shown in Table III. Post-operative flexion-extension correlated with both pre-operative UV ($r = -0.645$, $\beta = 0.184$) and length of shortening ($r = -0.537$, $\beta = 0.393$) (Fig. 2), and delta-RI ($r = 0.680$, $\beta = 0.128$) (Fig. 3). Post-operative grip strength correlated with RI on the affected side ($r = 0.528$, $\beta = 0.411$) and delta-RI (0.570, $\beta = 0.326$) (Fig. 3). No significant correlation was identified between methods of pre-operative treatment (conservative/operative) and parameters as VT. SNI and UHI also showed no correlation with flexion-extension and grip strength. After USO, 10 of 16 wrists showed a bony spur at the DRUJ. No significant associations with bony spur formation were identified for any parameters.
DISCUSSION

The aim of surgery for malunited DRF should be to restore normal anatomy, and surgical correction remains controversial (5). Malunion of DRF often causes discrepancy in the wrist with a long ulna relative to the radius. Restoration of distal radioulnar joint congruity using USO is commonly performed to treat UCA (24). The ulnocarpal joint is unloaded and wrist pain relieved. USO satisfactorily restores ulnar variance.

Acceptable limits of the three key radiographic parameters (VT, RI, and UV) after corrective osteotomy have not been clarified (7,12). Orthopaedic surgeons still face a dilemma when deciding between surgical and nonsurgical treatment for DRF (9). Controversy remains regarding acceptable values for malunited fractures (25,29). Moreover, surgical correction of a malunited DRF may be technically difficult (7,13,23). Even if accurate preoperative planning is performed, we should adapt operative methods to correct shortening and realign angular deformities simultaneously. Among the components of the deformity (VT, RI, and UV), RI accounts less for carpal alignment, and VT clearly shows a greater impact (14,28). Our findings show that clinical results correlate with RI and length of shortening. VT within our criteria showed no correlation with clinical results. Corrective osteotomy of the radius can improve RI and restore length. Combined corrective osteotomy of the radius and USO could avoid excessive shortening of the ulna, although the surgical method is invasive.

USO has been the standard treatment for UCA for many years (1,18); it can be performed for most cases of positive ulnar wrist (5). We have previously reported clinical results for USO and TFCC evaluation (27). Malalignment with respect to ulnar inclination and the sigmoid notch has been considered a relative contraindication for USO (11), which might cause degenerative changes in the DRUJ (6,16,22). Although spur formation occurred in two-thirds of patients in this study, clinical results did not correlate with bony spur formation at the DRUJ. Moreover, this study found no correlation between bony spur formation and radiological alignment. We think USO can be performed irrespective of DRUJ morphology. The advantage of USO is the simplicity of the procedure, which does not require bone grafting (8). The disadvantage of USO is the risk of nonunion/delayed union and irritation by the implant (21). However, the rate of complications could be low if properly performed (1,8). We thus assume USO is only suitable in the malunited DRF with mild axial shortening and minimal tilt in the coronal and sagittal plane.

This study has some limitations. This study was retrospective in design, and included only patients who underwent USO, and none who were treated conservatively or underwent other procedures. Second, the number of cases was small. Differences in each parameter were also relatively small and this small sample size may have limited the statistical power of the analyses. Further prospective research is thus warranted to clarify whether all patients of UCA with malunited DRF need corrective osteotomy.

In conclusion, about half of the patients had a good or excellent result. Radial inclination and the length of ulnar shortening were found to affect the clinical results of USO for malunited DRF. We
recommend USO for the surgical treatment of UCA after malunited DRF, for which the main deformity is moderate radial shortening with a normal radial inclination. In the presence of severe radial shortening and decreased radial inclination, combined osteotomy should be considered.

REFERENCES


