

Ulnar Shortening Osteotomy versus Corrective Radius Osteotomy after Distal Radius Malunion

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Abstract

Background: Mismanagement of distal radius fractures can lead to malunion and eventual pain, loss of motion, decrease grip and pinch strength, and variable degrees of disability. Numerous studies have described results with corrective osteotomy of the distal radius to address this issue. However, few studies report on the functional outcomes after ulnar shortening procedures.

Objective: We sought to compare the ulnar shortening osteotomy to the corrective distal radius osteotomy for addressing distal radius malunions.

Methods: We identified 11 patients with an extra-articular distal radius malunion treated with ulnar shortening osteotomy (USO). The mean follow-up was 12.7 months. A 1:1 sex- and age-matched cohort of patients treated with corrective distal radius osteotomy (DRO) was randomly selected. Visual analogue scores (VAS), wrist range of motion, grip and pinch strength, postoperative complications, and radiographic parameters were analyzed.

Results: The average age of patients undergoing USO and DRO was 52 and 54 years, respectively. In the USO group, the average amount of shortening was 4.9 mm, with an average of 4.3 mm ulnar positive variance preoperatively. Wrist flexion and extension improved in both groups, with statistical significance in the DRO group only ($p < 0.05$). There was no statistically significant change in forearm rotation or ulnar and radial deviation. Grip strength increased from 14.4 kg to 23.3 kg in the USO group, while this increased from 14.1 kg to 22.3 kg in the DRO group ($p > 0.05$). Similarly, average VAS improved from 5.1 to 2.0 and from 5.4 to 1.95 in the USO and DRO groups, respectively ($p > 0.05$). After USO, the average ulnar variance was 1.9 mm negative while this was 0.8 mm positive in the DRO group. Two patients underwent USO after DRO for persistent impaction symptoms. The total tourniquet time was 97.3 minutes in the USO group compared to 116 minutes in the DRO group ($p < 0.05$).

Conclusions: This case-control retrospective review demonstrates an improvement in range of motion, grip strength, and VAS for patients undergoing both USO and DRO. Patients had similar clinical outcomes, with only a difference in wrist flexion and extension. Nevertheless, USO being a simpler procedure, with a shorter operative time, and the ability to better correct the radioulnar length relationship makes it an attractive option with acceptable outcomes to address distal radius malunions.

Background & Objective

Distal radius fractures are exceedingly common in the pediatric and elderly populations. In the adult population, malunion is the most common complication and can lead to pain, limitations in range of motion and grip strength, and functional disability. Surgical management is often required. Corrective distal radius osteotomy (DRO) as a closing or opening wedge, is traditionally employed to address the volar tilt, radial inclination, and ulnar variance. (Figure 1) Recently, some have advocated an ulnar-based procedure. An ulnar shortening osteotomy (USO) aims to restore the radioulnar length relationship. (Figure 2)

There are few reports on the outcomes of ulnar shortening osteotomies. Srinivasan et al reported on 18 patients with ulnar impaction syndrome who underwent an isolated USO. There was improvement in wrist range of motion (ROM), visual analogue score (VAS), and Quick Disabilities of the Arm, Shoulder, and Hand (Quick DASH) scores. Tabebe et al reported on 16 patients who underwent isolated USO, with improved ROM and grip strength.

Methods

A retrospective review of all distal radius malunions at our institution identified 11 treated with USO. These were compared to a 1:1 age- and sex-matched cohort of patients treated with a corrective DRO. Clinical, functional, and radiographic parameters were analyzed. Clinically, we assessed wrist ROM, grip and pinch strength, as well as post-operative complications. We also recorded tourniquet time, anesthesia strategy, and shortening amount. Functionally we reviewed pre- and post-operative VAS. Radiographic parameters recorded included ulnar variance, volar tilt, radial inclination, and radial height. Patients were followed for a minimum of 1 year clinical or radiographic follow-up, or until reoperation.

Results

- Mean follow-up: 12.7 months
- Wrist flexion and extension improved in both groups, with statistical significance being reached in the DRO group ($p < 0.05$).
- Pronation and supination improved in the DRO group, but there was no statistical significance in either group.
- Grip strength and VAS improved uniformly in both groups with no significant difference.

Results (cont'd)

- Ulnar variance improved in both groups, with the USO group providing greater correction with an average negative variance at final follow-up of -1.8 mm.
- Radial height, radial inclination, and volar tilt was corrected in the DRO group, with no significant change in the USO group. Based on patient selection, the USO group consisted largely of only an affected radioulnar length relationship.
- Tourniquet time was 97.3 minutes in the USO group compared to 116 minutes in the DRO group ($p < 0.05$).
- There were 2 reoperations in the USO group. One for nonunion, requiring revision plating with iliac crest bone grafting. The other was for persistent wrist pain treated with a wrist arthrodesis.
- There were 6 reoperations in the DRO group. Three patients underwent bone grafting procedure for nonunion of the osteotomy. One patient had hardware removal. Another underwent a distal ulnar head replacement for radioulnar arthritis. The sixth had decompression of the superficial dorsal sensory branch for neuropathic pain.

Figure 1



Top: Preoperative AP & lateral radiographs of a 60-year-old right hand dominant female who sustained a distal radius fracture treated non-operatively which went on to a malunion with significant pain and functional limitations.

Bottom: Postoperative AP & Lateral radiograph of the same patient at 1 year follow-up following a corrective distal radius osteotomy.

Outcome Measures

	Ulnar Shortening Osteotomy		Distal Radius Osteotomy	
	Pre-Op	Post-Op	Pre-Op	Post-Op
Flexion-Extension Arc	91.2°	103.6°	89.8°	107.8°
Pronation-Supination Arc	120.7°	109.0°	128.9°	148.3°
Grip Strength (% contralateral)	48.0%	66.5%	50.6%	88.1%
VAS	5.1	2.0	5.4	1.95
Ulnar Variance (mm)	+ 4.4	-1.8	+ 4.7	+ 0.8
Volar Tilt	11.5°	10.8°	-9.6°	8.2°
Radial Height (mm)	10.5	11.6	9.6	15.0

Figure 2



Top: Preoperative AP & lateral radiographs of a 56-year-old right hand dominant female who sustained a distal radius fracture, which went on to a malunion with significant pain and functional limitations 2 years after initial treatment with ORIF.

Bottom: Postoperative AP & Lateral radiograph of the same patient at 18 month follow-up following a 9 mm ulnar shortening osteotomy.

Discussion

- This retrospective case-control series demonstrates positive outcomes in patients undergoing corrective osteotomies for a distal radius malunion.
- Decision for an isolated ulna or radius based osteotomy was determined by the staff surgeon. In most instances of an USO, an ulnar positive variance was the sole radiographic abnormality.
- Srinivasan et al recommended isolated USO for patients with dorsal tilt up to 20° .

Conclusions

- Wrist range of motion, grip strength, and VAS improvement for patients with a distal radius malunion can be achieved with either a USO or DRO.
- Isolated ulnar shortening osteotomy has the advantage of being a technically simpler procedure with a shorter operative time, greater restoration of the radioulnar length, and fewer complications
- Isolated ulnar shortening osteotomy is a safe and efficacious option for carefully selected patients.

References

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