

Distal Humerus Nonunion following Failed Internal Fixation: How do the Outcomes of Internal Fixation and Total Elbow Arthroplasty Compare?

Micah Jon Nieboer¹, Kristin Yu, Anthony Lee Logli, Jonathan D Barlow¹, Shawn W O'Driscoll¹, Mark E Morrey¹, Joaquin Sanchez-Sotelo¹

¹Mayo Clinic

INTRODUCTION: Distal humerus nonunions are associated frequently with bone loss and can be difficult to treat. Many consider internal fixation the procedure of choice for distal humerus nonunions. However, limited bone stock, associated joint fibrosis, and cartilage damage may compromise the outcome of internal fixation, and total elbow arthroplasty (TEA) may be a better alternative for selected patients. At our institution, we have tried to maximize the success of internal fixation with the supracondylar osteotomy and shortening (S.O.S.) technique, which combines humeral shortening, parallel plating, and bone grafting (**Figure 1**). The purpose of this study was to compare the outcomes of revision fixation utilizing the S.O.S. technique vs. salvage TEA for distal humerus nonunions.

METHODS: A retrospective review of electronic medical records including our institutional Total Joint Registry Database identified 25 distal humerus nonunions treated with the SOS internal fixation procedure and 45 TEA performed specifically for distal humerus nonunion, all performed between 1995 and 2019. Elbows without prior internal fixation attempts were excluded from the study. The S.O.S. cohort had a younger mean age, shorter clinical and radiographic follow up, and less common intraarticular nonunion compared to the TEA cohort (**Table 1**). Sex, mean number of prior surgeries, history of open fracture, and history of infection were similar between groups. Outcomes included complications, reoperations, range of motion, and Mayo Elbow Performance Scores (MEPS).

RESULTS: In the S.O.S. cohort, 2 elbows were lost to follow up, 21 elbows achieved union, and 2 elbows developed nonunion and required revision to TEA. Complications occurred in 9 elbows (36%) following S.O.S. compared to 18 elbows (40%) following TEA (OR 0.8, p=0.7). All-cause reoperation occurred in 12 elbows (48%) after S.O.S vs. 12 elbows (27%) after TEA (OR 2.5, p=0.08). Compared to TEA, the S.O.S. cohort had a lower mean flexion-extension arc (100° vs. 115°, p=0.06) and a higher mean pronation-supination arc (155° vs. 145°, p=0.2), although neither met statistical significance. MEPS scores were similar between groups (S.O.S 79 points, TEA 82 points, p=0.6). When stratifying by location of nonunion, elbows with intra-articular nonunion undergoing S.O.S had higher rates of reoperation (75%) compared to extra-articular nonunions (35%, OR 5.5, p=0.08). MEPS were also significantly worse for intra-articular versus extra-articular nonunions treated with the S.O.S. procedure (51 points vs. 88 points, p<0.01; TEA (85 points, p<0.01).

DISCUSSION AND CONCLUSION: Despite achieving a high union rate, the S.O.S. procedure presented similar results compared to TEA in terms of MEPS, motion, complications, and reoperations. Outcomes after internal fixation using the S.O.S. procedure were worse for nonunions with an intraarticular component, which may be better suited for TEA.

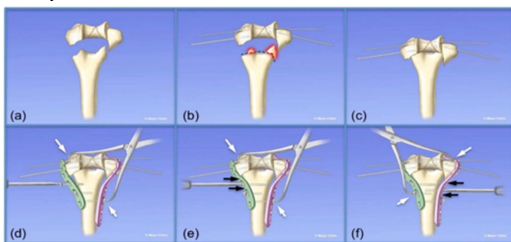


Figure 1: Supracondylar osteotomy and shortening procedure: The distal end of the proximal fragment is contoured to fit the distal fragment (b) such that there is end-to-end bony contact with compression in both columns, and usually side-to-side compression medially and/or laterally (c). Interfragmentary compression is obtained through the use of large bone clamps that provide compression during the insertion of the screws (d). Additional compression at the metaphyseal level results from slight under contouring of the plates and the use of dynamic compression holes in the plates (e-f).

Table 1	S.O.S. (N=25)	TEA (N=45)	P-value
Age	48	63	<0.01
Sex			0.06
Male	12 (48%)	11 (24%)	
Female	13 (52%)	34 (76%)	
Clinical Follow-up (months)	31	78	<0.01
Radiographic Follow-up (months)	31	57	<0.01
Prior surgeries	1.6	1.7	0.7
Open injury	6 (24%)	5 (11%)	0.2
Intra-articular nonunion	8 (32%)	26 (58%)	0.02
Prior Infection	6 (24%)	4 (9%)	0.30
Implant: Coonrad-Morrey		23 (51%)	
Latitude		19 (42%)	
Discovery		3 (7%)	
Complications	9	18	OR 0.8, p=0.7
	Contracture (4), Superficial infection (3), deep infection (1), ulnar neuropathy (1)	Aseptic loosening (8), Deep infection (4), Triceps insufficiency (2), superficial infection (1), CRPS (1), periprosthetic fracture (1), radial head disarticulation (1)	
Reoperations	12	12	OR 2.5, p=0.08
	Contracture release (4), Irrigation & Debridement (4), Hardware removal (3), Ulnar nerve neurolysis (1)	Revision (1 or 2 stage) (9), Radial head revision (2), Debridement and implant retention (1)	