Structural versus Non-Structural Graft Use in Corrective Osteotomy for Distal Radius Malunion

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INTRODUCTION:

Malunion is the most common complication of distal radius fractures and can cause disability with significant deformity. Operative treatment for distal radius malunion typically includes a corrective osteotomy which, due to the bony void created, usually requires a bone graft to maintain the correction. Options for type of bone grafts in distal radius corrective osteotomies vary widely and consist of structural, non-structural, or osteoconductive substitutes. The advantages of structural grafts are load-bearing capacity and contributing stability to the construct. However, there is often significant donor site morbidity, and shaping the graft to the defect may not feasible. With the advent of fixed-angle devices, construct stability may be adequate without the contribution from structural grafts, thus limiting their need. The purpose of this study was to compare structural versus non-structural grafts when used with corrective osteotomy for treatment of distal radius malunion.

METHODS:

A retrospective review of wrist x-rays and intraoperative fluoroscopic images was performed for patients undergoing corrective osteotomy for distal radius malunion by multiple surgeons at a single institution with either structural or non-structural grafts. Volar tilt, radial inclination, and ulnar variance were measured by a single rater on preoperative, immediate postoperative, and final follow-up radiographs.

RESULTS:

A total of 52 patients were included in the analysis (35% in the structural graft group and 65% in the non-structural graft group). The overall mean age of the included patients was 52.2 +/- 18.6 years. There were no differences in baseline demographic factors between groups, other than duration from initial injury to osteotomy (6.2 +/- 4.0 months vs. 2.8 +/- 4.0 months, $p = 0.008$, Table 1). There were no differences between groups in terms of preoperative radiographic alignment or immediate postoperative radiographic alignment (Table 2). There was a significant difference in radial inclination between structural and non-structural groups at the time of final follow-up (21.7 +/- 5.2 months vs. 18.1 +/- 5.1 months). However, comparison of within-group differences by timepoint demonstrate that the position of the osteotomized distal radius was well maintained in both groups. Radial inclination changed a mean of 5 +/- 5.4 degrees from preoperative to postoperative in the structural group versus 4.4 +/- 5.6 degrees in the non-structural group ($p = 0.697$). From initial postoperative to final follow up, radial inclination changed -0.1 +/- 2.9 degrees in the structural group versus -0.8 +/- 4.7 degrees in the non-structural group ($p = 0.556$).

Similarly, volar tilt increased a mean of 10.8 +/- 17.6 degrees from preoperative to postoperative in the structural group versus 15.7 +/- 19.6 degrees in the non-structural group ($p = 0.383$). From initial postoperative to final follow up, volar tilt changed 0.3 +/- 3.4 degrees in the structural group versus -0.5 +/- 4.7 degrees in the non-structural group ($p = 0.498$, Figure 1).

DISCUSSION AND CONCLUSION:

Treatment of distal radius malunion with corrective osteotomy most commonly involves the use of a structural graft obtained from the iliac crest or other donor sites, such as the olecranon or locally from the radius. However, there is often significant donor site morbidity. In this study, there were no significant differences between the structural and non-structural graft groups when comparing preoperative and postoperative radiographic alignment. As such, simple and less morbid graft selection, such as cancellous bone chips, may be sufficient when performing corrective osteotomies for distal radius malunion.

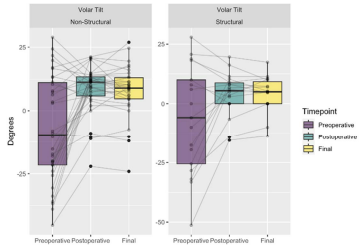

Figure 1. Change in volar tilt between groups.

Characteristic	Overall, N = 52[1]	Type of Bone Graft		p-value[2]
		Structural, N = 18[1]	Non-Structural, N = 34[1]	
Age (Years)	52.2 +/- 18.6	52.1 +/- 19.7	52.2 +/- 18.2	0.989
Sex				0.120
Female	36 (69.2%)	10 (55.6%)	26 (76.5%)	
Male	16 (30.8%)	8 (44.4%)	8 (23.5%)	
BMI	25.9 +/- 5.5	26.1 +/- 5.1	25.7 +/- 5.7	0.781
Smoking Status				0.460
Never	28 (53.8%)	8 (44.4%)	20 (58.8%)	
Former	14 (26.9%)	5 (27.8%)	9 (26.5%)	
Current	10 (19.2%)	5 (27.8%)	5 (14.7%)	
Time From Injury to Surgery (Months)	4.0 +/- 4.3	6.2 +/- 4.0	2.8 +/- 4.0	**0.008**
Preoperative Volar Tilt (Degrees)	-7.1 +/- 21.4	-6.7 +/- 22.9	-7.3 +/- 21.0	0.930
Preoperative Ulnar Variance (mm)	0.8 +/- 1.1	0.9 +/- 1.0	0.8 +/- 1.2	0.713
Preoperative Radial Inclination (Degrees)	15.6 +/- 6.2	17.5 +/- 7.8	14.7 +/- 5.1	0.189

[1] Mean +/- SD; n (%)
[2] Welch Two Sample t-test; Pearson's Chi-squared test; Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates)

Table 1. Patient demographics and radiologic measurements.

Characteristic	Volar Tilt			Ulnar Variance			Radial Inclination		
	Structural, N = 18[1]	Non-Structural, N = 34[1]	p-value[2]	Structural, N = 18[1]	Non-Structural, N = 34[1]	p-value[2]	Structural, N = 18[1]	Non-Structural, N = 34[1]	p-value[2]
Preoperative	-6.7 +/- 22.9	-7.3 +/- 21.0	0.930	0.9 +/- 1.0	0.8 +/- 1.2	0.713	17.5 +/- 7.8	14.7 +/- 5.1	0.189
Postoperative	3.9 +/- 9.2	8.3 +/- 9.6	0.110	-0.1 +/- 0.8	-0.3 +/- 0.6	0.437	21.9 +/- 6.0	19.1 +/- 5.3	0.104
Final Follow-Up	4.2 +/- 7.5	7.7 +/- 10.2	0.163	-0.1 +/- 0.8	-0.1 +/- 0.7	0.949	21.7 +/- 5.2	18.1 +/- 5.1	**0.022**

[1] Mean +/- SD
[2] Welch Two Sample t-test

Table 2. Radiographic Parameters