

# Autograft Reconstruction for Volar Ulnar Corner Insufficiency After Distal Radius Fractures

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**INTRODUCTION:** Volar ulnar corner (VUC) insufficiency after distal radius fracture, either due to inadequate fixation of the VUC or irreparable volar marginal fragment, can be reconstructed using articular autograft, in similar nature to hemi-hamate arthroplasty.

## METHODS:

There were two phases of this cadaver study to analyze feasibility and reproducibility of VUC reconstruction. Four anatomical locations were selected as sites of articular autograft: dorsal distal capitate (DC), dorsal third metacarpal base (MCB), lateral olecranon facet, radial styloid, due to their anatomic location and potential similar anatomical shape to the VUC. Analysis of preoperative and postoperative fluoroscopy was performed, measuring volar lip angle (VLA), height of the VUC, and radius of curvature. Qualitative analysis by the authors was also performed. Two autograft options were selected for further evaluation, DC and MCB. A total of four reconstructions of the VUC were performed with each of the preferred autografts. CT analysis was performed measuring VLA, distance to highest buttress of the VUC, and volar cortical angle (VCA) across multiple sagittal cuts. Differences of measurements from preoperative to postoperative were measured for each group, utilizing two tailed comparisons of unequal variance. Differences from preoperative measurements were compared between the two groups.

## RESULTS:

DC and MCB autografts performed better both anatomically, with similar volar lip angles and VUC height postoperatively, and on qualitative measures were more feasible to obtain and better gross fit. CT analysis of third metacarpal base reconstruction showed no significant difference from preoperative to postoperative in distance to height of VUC (7.82mm versus 7.57mm), VLA (16.70 versus 15.49 degrees), and VCA (36.29 versus 31.78 degrees). CT analysis of DC reconstruction showed no significant difference from preoperative to postoperative in VLA (11.69 versus 2.19 degrees), and VCA (34.8 versus 30.26 degrees). There was a significant difference in the distance to height of VUC (8.86mm versus 6.85mm,  $p=0.03$ ). When comparing the two autografts in change from preoperative to postoperative, there was a significant difference in the change from preoperative in distance (-0.26mm for MCB versus -2.01 mm for D,  $p=0.037$ ) and VLA (1.2 degrees for MCB versus -9.5 degrees DC,  $p=0.017$ ).

## DISCUSSION AND CONCLUSION:

VUC reconstruction for VUC insufficiency after distal radius fracture is feasible utilizing autograft reconstruction in similar nature to hemi-hamate arthroplasty. While there are multiple options for VUC reconstruction autograft, the dorsal third metacarpal base may be the most easily reproducible and best anatomic match.

	MCB	DC	LOF	RS
Volar Lip Angle (degrees)	3.1	3.9	-4.4	-5.3
Volar Height (mm)	3.8	6.7	-1.1	4
Ulnar surface appearance (Rated 1-5)	Logan pins excise ulnar facet excise articular surface of DREJ surface (1)	Logan pins excise ulnar facet excise articular surface of (2)	Logan pins excise ulnar facet excise articular surface of (2)	Logan pins excise ulnar facet excise articular surface of (2)
Distal site (Rated 1-5)	Additional incision over sagittal field, pull over to ulnar (1)	Additional incision over sagittal field, pull over to ulnar (1)	Additional incision over sagittal field, pull over to ulnar (1)	None incision over sagittal field, pull over to ulnar (1)
Reconstructive ease (Rated 1-5)	Logan pins available, can be excised to fit (5)	Appropriate size, can be excised to fit (4)	Similar size and shape, challenging fixation (2)	Small size and difficult to work with, challenging fixation (2)

Table 1. Phase 1, radiographic and qualitative findings of the solid autograft reconstructions of volar ulnar corner using distal third metacarpal base (MCB), dorsal distal capitate (DC), lateral olecranon facet (LOF), and radial styloid (RS). Volar lip angle (VLA) and volar height are reported to change from preoperative measurement. Comments made on anatomic appearance, distal site access and ease of harvest, ease of reconstruction. Qualitative assessment rated from 1 to 5.

Distal Third Metacarpal Base	Preoperative				Postoperative				Change after reconstruction			
	Distance (mm)	Height (mm)	Volar Lip Angle (degrees)	Radius of Curvature (mm)	Distance (mm)	Height (mm)	Volar Lip Angle (degrees)	Radius of Curvature (mm)	Distance (mm)	Height (mm)	Volar Lip Angle (degrees)	Radius of Curvature (mm)
1	7.82	3.18	16.70	7.86	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
2	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
3	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
4	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
Mean (SD)	7.82 (0.00)	3.82 (0.00)	16.70 (0.00)	7.82 (0.00)	6.85 (0.00)	15.49 (0.00)	6.91 (0.00)	8.86 (0.00)	-0.97 (0.00)	-1.69 (0.00)	-1.21 (0.00)	1.05 (0.00)
Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2. Radiographic (CT) data before and after distal third metacarpal base reconstruction using distal third metacarpal base. Distance (D), Volar lip angle (VLA), Volar height (VH) measured as described in text for each specimen across multiple distal sagittal CT images.

Distal Third Metacarpal Base	Preoperative				Postoperative				Difference			
	Distance (mm)	Height (mm)	Volar Lip Angle (degrees)	Radius of Curvature (mm)	Distance (mm)	Height (mm)	Volar Lip Angle (degrees)	Radius of Curvature (mm)	Distance (mm)	Height (mm)	Volar Lip Angle (degrees)	Radius of Curvature (mm)
1	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
2	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
3	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
4	8.86	3.82	16.70	7.82	6.85	15.49	6.91	8.86	-0.97	-1.69	-1.21	1.05
Mean (SD)	8.86 (0.00)	3.82 (0.00)	16.70 (0.00)	7.82 (0.00)	6.85 (0.00)	15.49 (0.00)	6.91 (0.00)	8.86 (0.00)	-0.97 (0.00)	-1.69 (0.00)	-1.21 (0.00)	1.05 (0.00)
Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3. Radiographic (CT) data before and after distal third metacarpal base reconstruction using distal third metacarpal base. Distance (D), Volar lip angle (VLA), Volar height (VH) measured as described in text for each specimen across multiple distal sagittal CT images.

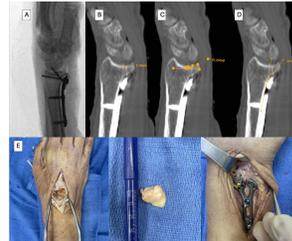


Figure 1. Radiographic (CT) data before and after distal third metacarpal base reconstruction using distal third metacarpal base. Distance (D), Volar lip angle (VLA), Volar height (VH) measured as described in text for each specimen across multiple distal sagittal CT images.