

Radiocarpal and Midcarpal Joint Malalignment with Distal Radius Malunion and Factors in Correction after Distal Radius Osteotomy in Dorsal Bending Fractures

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Introduction

The purpose of this study is to investigate radiocarpal and midcarpal joints of the hand before and after treatment of distal radius malunion with corrective osteotomy and if initial severity of injury and timing to osteotomy correlate with radiographic outcomes.

Methods

- Patients treated with corrective osteotomy for distal radius bending malunion from 2006- 2015 were retrospectively reviewed.
- Demographic: 27 dorsal bending malunions required osteotomy after a distal radius bending fracture
- Mean follow-up period: 68 weeks
- Data collected included patient demographics, radiographs for osseous healing, and calculation of specific radiocarpal and midcarpal measurements.
- Paired t-test, correlation analysis, and one-way ANOVA were used to determined significance.

Discussion

- Strength of this study includes a follow-up of over a year, longer than current literature
- Timing off osteotomy is important and matters with 40 weeks being the closest conversation point(p = 0.06), after which greater difficulty exists in getting adaptive changes to normal.
- Radiocarpal changes are significantly more difficult achieving correction back towards normal compared to midcarpal changes suggesting added emphasis in early correction for this scenario.
- Limitations of this study is due to a retrospective design, lack of comparison group, and small sample size.
- Future studies should be directed at correlating radiographic changes with clinical results in different ranges of motion and development of post-traumatic arthritis in the long term for the two different adaptation patterns

Results

- Total of 27 radii were available for final analysis at a mean of 68 weeks with a mean age of 54 years.
- Dorsal bending time to corrective osteotomy was 49 weeks, time to union was 15 weeks
- Preoperative vs postoperative radiographic outcomes were statistically significant (p < 0.0001) with a difference in correction of malunion of radial height 4.9 mm, inclination 10.2°, ulnar variance 2.3 mm, volar tilt 23.6°, correction of radiolunate angle 9.3°, radioscapoid angle 7.2°,and effective radiolunate flexion (ERLF) 13.4°.
- Initial severity correlated with ability to correct post-op ERLF(p<0.05).
- Time from injury to osteotomy correlated with ability to correct post-op RLA(p<0.05).
- Radiocarpal malalignment correlated with post-op ERLF(p = 0.001) compared to midcarpal malalignment.
- Timing of osteotomy after 40 week showed greater difficulty in correcting post-op RLA

Table 1. Dorsal Bending Radiographic Outcomes Paired T Test

Parameters	Normal	Preoperative	Postoperative Value	P-Value
	Value (SD)	Value (SD)	(SD)	
Mean Radial Height(mm)	11 (3)	3.9 (3)	8.8 (4)	p < 0.0001*
Radial Inclination	22° (3°)	11.6° (7)	21.8° (6)	p < 0.0001*
Ulnar Variance(mm)	0.9	3.9 (2.5)	1.6 (2.0)	p < 0.0001*
Volar Tilt	11°	23° (11) Dorsal	0.5° (5) Volar	p < 0.0001*
Radiolunate Angle	10° (6°)	17.5 ° (9.8)	8.2 ° (6.8)	p < 0.0001*
Radioscaphoid Angle	60° (4°)	48.1° (8.7)	55.3° (5.9)	p < 0.0001*
Capitolunate Angle	12° (2°)	9 ° (8.4) °	11.4° (7.7) °	p = 0.106
Effective Radiolunate Flexion (ERLF)	0°	20.9° (14.2)	7.5° (5.5)	p < 0.0001*

Values are given as the mean

*Significance

Table 2: Dorsal Malunion Initial Severity Correlated with Carpal Adaptations

Initial Severity	Post-Op RLA (p-value)	Post-op CLA (p-value)	Post-op ERLF (p-value)
Pre-Op Height	0.19 (0.35)	-0.16 (0.44)	-0.41 (0.03*)
Pre-Op Tilt	-0.04 (0.88)	-0.16 (0.42)	0.39 (0.04*)
Pre-op Variance	0.13 (0.5)	0.04 (0.86)	0.40 (0.04*)

Values are given as correlation coefficient

RLA = Radiolunate Angle, CLA = Capitolunate Angle, ERLF = Effective Radiolunate Flexion

*Statistically significant p-value < 0.05

Table 3: Dorsal Malunion Time to Osteotomy Correlated with Carpal Adaptations

	Post-Op RLA (p-value)	Post-op CLA (p-value)	Post-op ERLF (p-value)
Time to Osteotomy	0.47 (0.01*)	-0.31 (0.11)	-0.08 (0.67)

Values are given as correlation coefficient

RLA = Radiolunate Angle, CLA = Capitolunate Angle, ERLF = Effective Radiolunate Flexion

*Statistically significant p-value < 0.05

Table 4. Dorsal Malunions: Malalignment Differences in Carpal Adaptations

	Radiocarpal (n = 11) (SD)	Midcarpal (n = 16) (SD)	p- value
Post-op RLA	5.9° (3.8°)	9.8 (8 °)	0.1
Post-op CLA	10.7° (6.3°)	11.8° (8.7°)	0.73
Post-op RSA	55.6° (3.7°)	55.1° (7.1°)	0.82
Post-op ERLF	11.3° (5.4°)	4.8° (3.7°)	0.001*

Values are given as the mean

RLA = Radiolunate Angle, CLA = Capitolunate Angle, Radioscaphoid Angle, ERLF = Effective Radiolunate Flexion

*Statistically significant p-value < 0.05

