

# The Influence of Calcar Comminution on Outcomes After Locked Plate Fixation of Proximal Humerus Fractures: An Analysis of Complication Rates, Range of Motion, and PROMIS

Brittany Haws<sup>1</sup>, Steven Samborski, Steven Karnyski<sup>1</sup>, John T Gorczyca<sup>1</sup>, Gregg T Nicandri<sup>2</sup>, Ilya Voloshin<sup>3</sup>, John P Ketz<sup>1</sup>  
<sup>1</sup>University of Rochester, <sup>2</sup>University of Rochester Medical Center, <sup>3</sup>Sawgrass Surgery Center

## INTRODUCTION:

The presence of calcar comminution has been suggested to increase risk for failure after open reduction and internal fixation (ORIF) of proximal humerus fractures. However, the influence on range of motion (ROM) and patient reported outcomes (PROs) remains debated. The purpose of this study is to compare outcomes up to 1 year after proximal humerus ORIF between fractures with or without calcar comminution.

## METHODS:

Patients >55 years old who underwent proximal humerus ORIF from 2015-2018 with at least 1 year of follow up were retrospectively identified. Injury radiographs were reviewed to determine AO/OTA fracture classification and assess for presence of calcar comminution. Visual analog scale (VAS) pain scores and PROMIS physical function (PF), pain interference (PI), and depression scores were obtained up to 1 year postoperatively. ROM values including active forward flexion (AFF), passive forward flexion (PFF), and external rotation (ER) were also recorded. Complications and reoperations during the first postoperative year were identified. Outcomes were compared between those with and without comminution using independent t-tests (continuous) and chi square analysis (categorical). Statistical significance was set at p<0.05.

## RESULTS:

75 patients were included in this analysis, 26 comminuted and 49 non-comminuted. No differences in baseline characteristics were identified. A greater percentage of type C fractures were observed in the comminuted group compared to the non-comminuted group (50% vs 22.4%, p=0.04). Comminuted fractures had a higher complication rate than those without comminution (34.6% vs 14.3%, p=0.04). Comminution was also associated with a significantly higher revision/conversion rate (23.1% vs 2.0%, p<0.01). Comminuted fractures experienced decreased AFF at 3 and 6 months, ER at 6 weeks, 3 months, 6 months, and 1 year, and decreased PFF at all timepoints (**Table 1**). No differences in VAS pain scores or PROMIS PF, PI, or depression scores were identified at any timepoint (p>0.05).

## DISCUSSION AND CONCLUSION:

Calcar comminution is associated with higher complication and reoperation rates and decreased ROM during the first year after proximal humerus ORIF. However, this did not lead to worse PROs at any timepoint. This highlights the importance of medial support for successful proximal humerus ORIF. Greater consideration of alternative surgical options may be warranted for proximal humerus fractures when calcar comminution is present.

	Not Comminuted (N=49)	Comminuted (N=26)	p-value
Any Complication (n (%))	14.3% (7)	34.6% (9)	0.04
Revisions/Conversions (n (%))	2.0% (1)	23.1% (6)	<0.01
Other Reoperations (n (%))	2.0% (1)	3.9% (1)	0.55
Malunion (n (%))	10.2% (5)	50.0% (13)	<0.01
Active Forward Flexion (Mean ± SD, °)			
2-week follow up	2.0 ± 13.4	2.6 ± 9.7	0.85
6-week follow up	38.6 ± 46.8	37.5 ± 32.7	0.92
3-month follow up	107.6 ± 38.9	72.5 ± 40.2	<0.01
6-month follow up	124.8 ± 28.3	102.1 ± 22.3	<0.01
1-year follow up	129.1 ± 32.3	107.5 ± 33.7	0.15
Passive Forward Flexion (Mean ± SD, °)			
2-week follow up	30.8 ± 42.7	9.9 ± 26.0	0.03
6-week follow up	91.2 ± 46.6	59.9 ± 41.9	<0.01
3-month follow up	136.2 ± 31.7	94.6 ± 31.1	<0.01
6-month follow up	145.6 ± 28.9	117.2 ± 38.3	<0.01
1-year follow up	152.8 ± 15.4	106.4 ± 45.9	0.02
External Rotation (Mean ± SD, °)			
2-week follow up	2.8 ± 10.0	1.4 ± 6.0	0.52
6-week follow up	26.2 ± 21.7	10.9 ± 12.1	<0.01
3-month follow up	42.3 ± 18.6	28.5 ± 21.8	0.03
6-month follow up	51.4 ± 28.4	37.7 ± 19.6	0.04
1-year follow up	55.8 ± 21.3	30.8 ± 18.8	0.04
VAS Pain Score (Mean ± SD)			
2-week follow up	2.6 ± 2.5	3.3 ± 3.2	0.33
6-week follow up	2.9 ± 2.1	2.2 ± 2.5	0.65
3-month follow up	1.6 ± 2.0	1.9 ± 2.2	0.58
6-month follow up	1.9 ± 2.1	2.5 ± 2.8	0.17
1-year follow up	1.0 ± 1.5	0.8 ± 1.2	0.68
PROMIS Pain Interference (Mean ± SD)			
2-week follow up	62.5 ± 6.7	64.8 ± 6.1	0.22
6-week follow up	58.3 ± 5.6	59.6 ± 6.0	0.40
3-month follow up	55.1 ± 7.6	55.8 ± 8.0	0.75
6-month follow up	53.3 ± 8.9	53.6 ± 7.7	0.90
1-year follow up	52.1 ± 8.7	51.8 ± 8.2	0.90
PROMIS Physical Function (Mean ± SD)			
2-week follow up	34.1 ± 7.7	30.5 ± 7.1	0.10
6-week follow up	37.9 ± 5.5	36.7 ± 8.2	0.51
3-month follow up	40.2 ± 8.3	39.9 ± 7.2	0.89
6-month follow up	43.1 ± 8.3	43.7 ± 8.2	0.82
1-year follow up	44.7 ± 7.3	44.2 ± 6.3	0.87
PROMIS Depression (Mean ± SD)			
2-week follow up	50.4 ± 10.8	51.7 ± 7.8	0.65
6-week follow up	50.0 ± 9.5	52.0 ± 7.4	0.41
3-month follow up	47.3 ± 10.2	47.4 ± 8.5	0.96
6-month follow up	46.0 ± 10.5	49.2 ± 9.1	0.72
1-year follow up	46.5 ± 11.3	46.4 ± 8.0	0.98

SD = Standard deviation; VAS = Visual analog scale; PROMIS = Patient reported outcomes measurement information system

\*Boldface indicates statistical significance.

†p-values calculated using independent t-tests, chi square analysis and Fisher's exact test

‡ Complications: Not Comminuted - intraarticular screw cutout (1), symptomatic hardware (1), avascular necrosis (2), hardware failure (1), deep infection (1), adhesive capsulitis (1); Comminuted - intraarticular screw cutout (3), avascular necrosis (1), hardware failure (3)

§ All conversions to RSA except 2 revision ORIF (Comminuted)

¶ Other Reoperations: Not Comminuted - biceps tenotomy (1), removal of hardware (1), irrigation & debridement with removal of hardware (1), lysis of adhesions (1); Comminuted - removal of hardware (1)