USING THE GREATER TUBEROSITY AS A REFERENCE FOR OPEN REDUCTION AND INTERNAL FIXATION OF PROXIMAL HUMERUS FRACTURES LEADS TO A HIGH RATE OF CALCAR SCREW MALPOSITION

Midhat Patel MD[1], Paulo Castañeda MD[1], William K Roache MD[1], Niloofar Dehghan MD[2], Michael D McKee MD[1], Michael Amini MD[2]

[1]Department of Orthopaedic Surgery, University of Arizona College of Medicine, Phoenix, AZ

[2]The CORE Institute, Phoenix, AZ

CONFLICT OF INTEREST

- Disclosures for Drs. Amini, McKee, and Dehghan are available on the AAOS website.
- Drs. Patel, Castañeda, and Roache have no disclosures to report.

BACKGROUND

- 3- and 4-part proximal humerus fractures present a challenging problem, especially in younger, higher demand patients
- Open reduction and internal fixation (ORIF) remains the treatment of choice in this patient population
- Despite advances in locked plating technology, the complication rate after proximal humerus ORIF remains high

CALCAR SCREW

- Placement of one or more screws in the calcar (defined as the inferior 25% of the humeral head) is critical in preventing varus collapse and improving outcomes after proximal humerus ORIF

- Commercially available locking plates generally have one or more dedicated “calcar screw holes” with fixed angle guides and/or variable angle trajectories

PLATE PLACEMENT

- Manufacturers' recommendations and technique guides use the tip of the greater tuberosity (GT) as a reference for ideal placement of proximal humerus locking plates

- The primary goal is to avoid impingement of the plate under the acromion in abduction

”ONE SIZE FITS ALL”

- All humeri are not the same size
- Using the GT as a reference leads to poor placement of the calcar screw in patients that have smaller or larger humeri than average

HOW IMPORTANT IS THE CALCAR SCREW?

ORIGINAL ARTICLE

The Importance of Medial Support in Locked Plating of Proximal Humerus Fractures

Michael J. Gardner, MD, Yoram Weil, MD, Joseph U. Barker, MD, Bryan T. Kelly, MD, David L. Helfet, MD, and Dean G. Lorich, MD

- Retrospective review, 35 patients, 18 with ”medial support”, 17 without
- Medial support: 1.2mm vs 5.8mm ($p < 0.001$), 1 reoperation for screw cut-out vs 5 ($p = 0.02$)

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WHERE DOES THE CALCAR SCREW GO?

Defining optimal calcar screw positioning in proximal humerus fracture fixation

Eric M. Padegimas, MD[a], Benjamin Zmistowski, MD[a], Cassandra Lawrence, MD[b], Aaron Palmquist, BA[c], Thema A. Nicholson, MS[d], Surena Namdari, MD, MSc[d,*]

- Analyzed 26 of 128 proximal humerus fractures with radiographic failure
- ROC curves showed **12mm or inferior 25% of humeral head** as quantifiable threshold for calcar screw to prevent fixation failure

OBJECTIVES

- Investigate the rate at which calcar screws “miss” the calcar when placed according to manufacturer recommendations

HYPOTHESIS

- We hypothesized that in patients with smaller or larger humeri, placement of a plate referencing the GT would result in inappropriate calcar screw placement.

METHODS

- 20 fresh frozen cadaveric specimens were acquired representing a height distribution across the United States population based on data collected by the Center for Disease Control's National Center for Health Statistics for 2015-2016.

- 13 different commercially available plates: Stryker AXSOS©; Synthes PHILOS©, Synthes Periarticular Proximal Humerus Plates©; Smith and Nephew (S&N) PERILOC©, both small and large; S&N EVOS©, both Standard and Lateral plates; Implants for Trauma Surgery (ITS) Phoenix© plate; Exactech Equinoxe Fracture Plate©; Exactech Equinoxe PHx Plate©; Wright ORTHOLOC© plate; Carbofix Piccolo Proximal Humeral Plate©; Advance Orthopedic Solutions (AOS) ALPHA© plate; and AOS Proximal Humeral Plate©

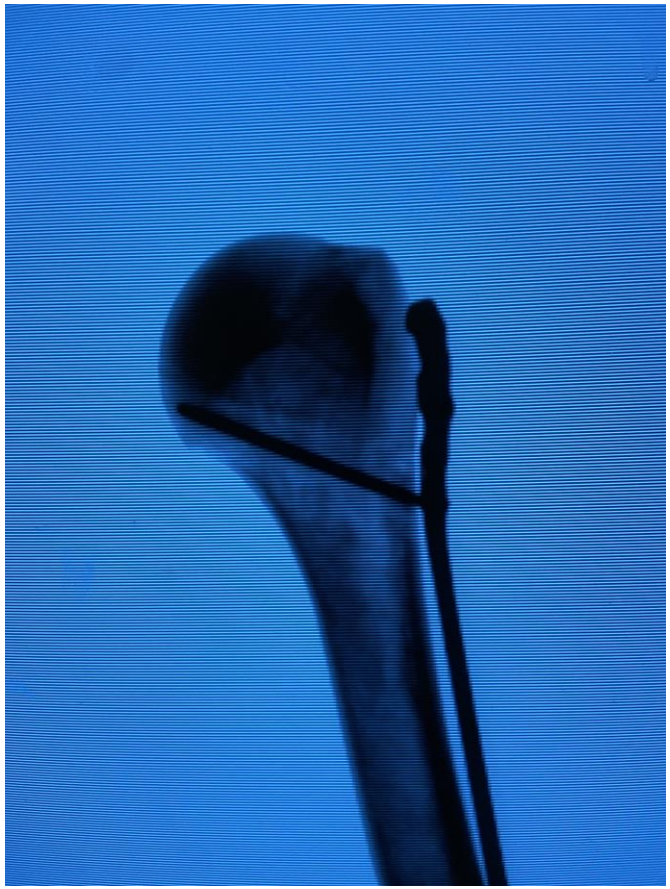
- A screw, drill bit, or K-wire was placed through the designated calcar screw hole per the manufacturer's recommendations.

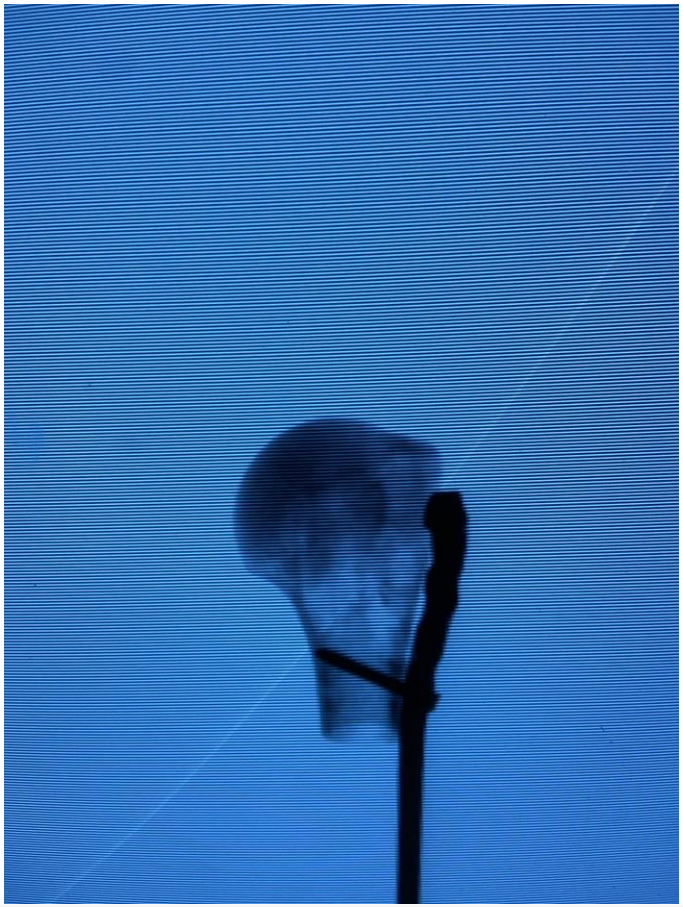
- Calcar screw position was the measured on radiographs as described by Padegimas et al[1], with the inferior 25% of the head representing ideal placement.

OUTCOMES

- Primary outcome: did the calcar screw miss high, low, or was it appropriately placed

OUTCOMES - EXAMPLE



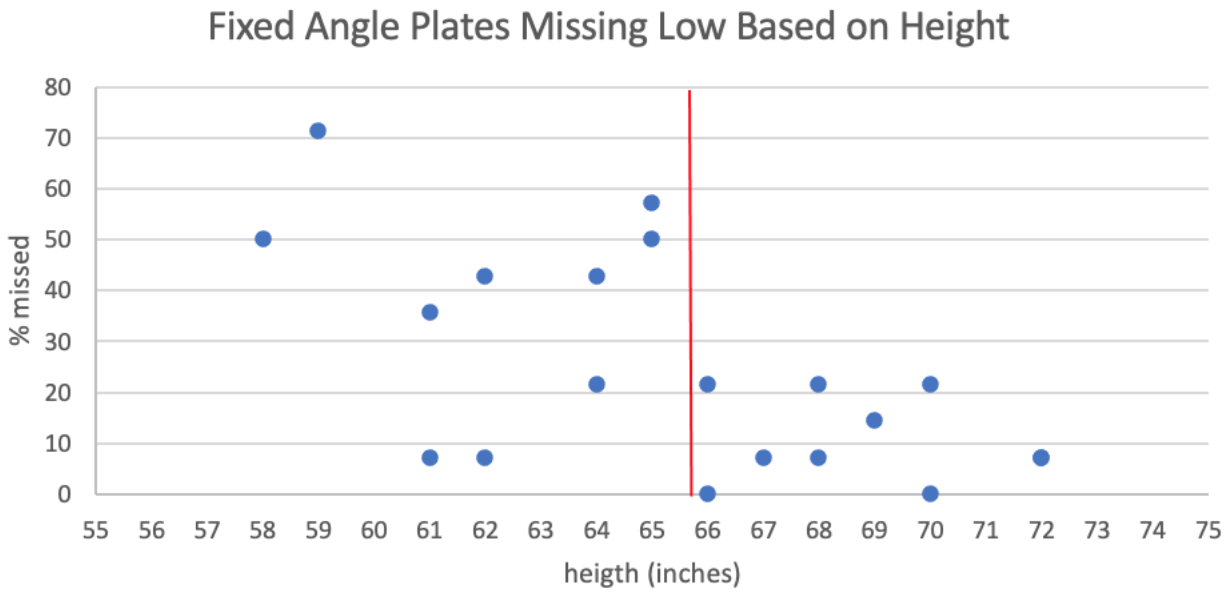


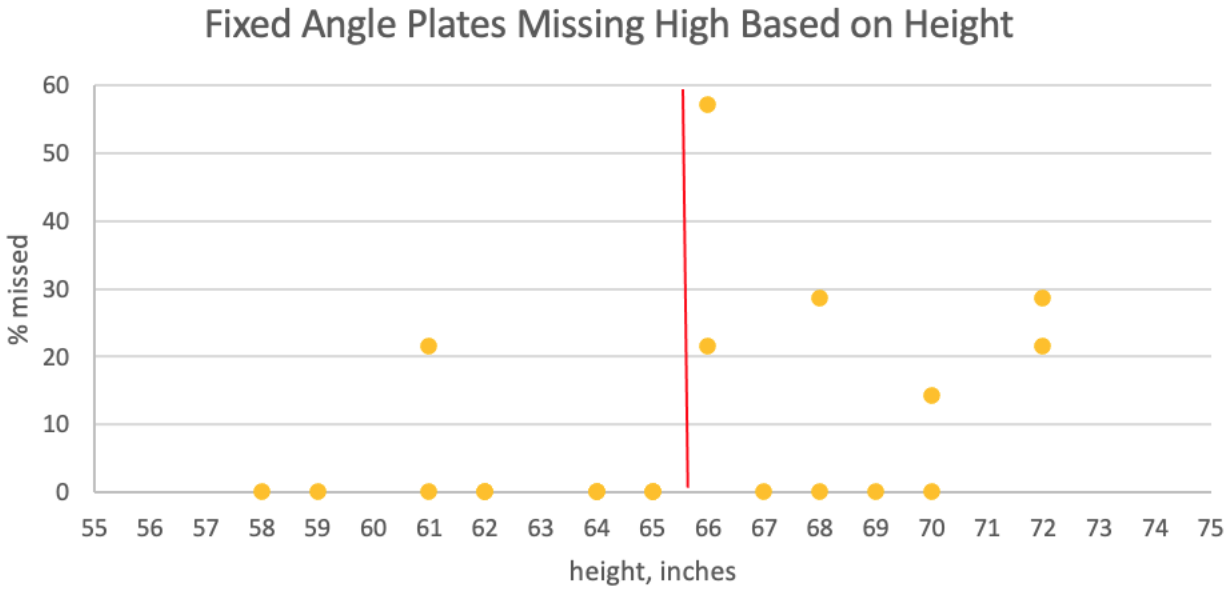
RESULTS

- 350 total constructs
- 28% missed the calcar!
  - 20% missed low
  - 8% missed high

RESULTS – HEIGHT MATTERS

- Median height was 5 feet, 5.5 inches
- 30% missed low in shorter patients
  - OR 4.8 (95% CI 2.6-8.8)
  - RR 3.6 (95% CI 2.1-6.1)
- 13% missed high in taller patients
  - OR 9.1 (95% CI 2.7-30.9)
  - RR 8 (95% CI 2.5-16.0)


Fixed Angle Plates Missing Low Based on Height
% missed
80
70
60
50
40
30
20
10
0
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
heigth (inches)


Fixed Angle Plates Missing High Based on Height
% missed
60
50
40
30
20
10
0
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
height, inches

RESULTS – PLATE MATTERS

- Rate of a misplaced calcar screw varied 0-80% depending on the plate
- Variable angle technology allowed calcar fixation in ALL constructs
- Fixed angle constructs missed 36% of the time

CONCLUSIONS

- Using the GT as a reference leads to an unacceptable rate of calcar screw malposition, especially in fixed angle constructs

- Caution patients that are shorter than 5’5.5” that they are more likely to require hardware removal in the future

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THANK YOU! QUESTIONS?