

Pediatric Medial Epicondyle Fractures: A Radiographic and Cadaveric Study

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INTRODUCTION

Medial epicondyle fractures:

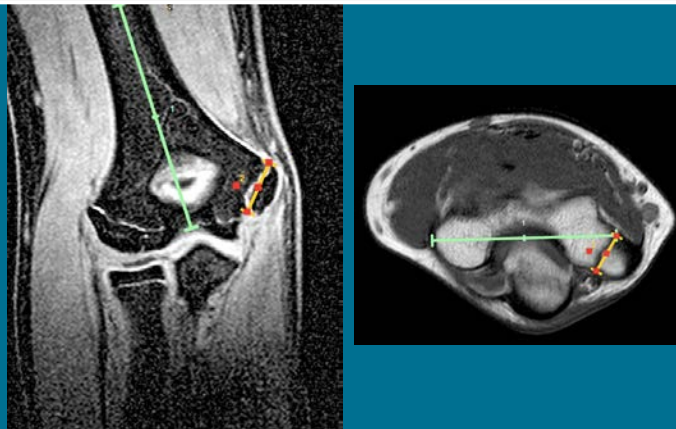
- 3rd most common elbow fractures in the pediatric population
- 50-60% are associated with elbow dislocation
- Significant controversy exists regarding the amount of fracture displacement that can tolerate non-operative management
 - May be due to inconsistencies in fracture displacement measurement techniques

OBJECTIVES

1. To define the orientation of the medial epicondyle physis by analyzing pediatric elbow MRI and CT scans
2. To compare the accuracy of determining fracture displacement between axial x-rays and standard AP x-rays on adult cadaveric medial epicondyle fracture models
3. To determine the relationship between the amount of fracture displacement and loss of terminal elbow extension

METHODS - Objective 1

12 Pediatric elbow CT's and 19 Pediatric elbow MRI's were analyzed for the orientation of the medial physis.



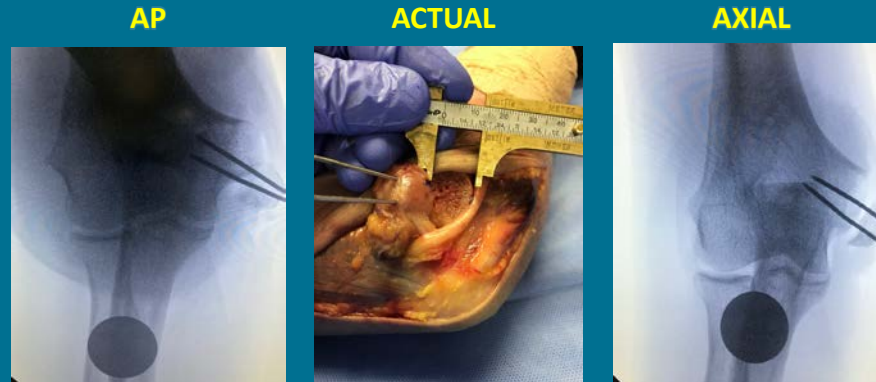
RESULTS – Objective 1

The medial epicondyle physis:

- A **posterior** structure of the distal humerus
- Median coronal alignment of **36 degrees** in the distal direction
- Median axial alignment of **46 degrees** retroverted.

METHODS – Objective 2

15 adult cadaveric medial epicondyle fracture models were created. Fracture displacements of 2mm, 5mm, 10 mm, and maximum displacement, allowed with intact medial collateral ligaments, were created while the elbows were kept at 90 degrees of flexion. A linear mixed model regression analysis was used to compare displacement based on the axial versus the AP radiographic methods.



RESULTS – Objective 2

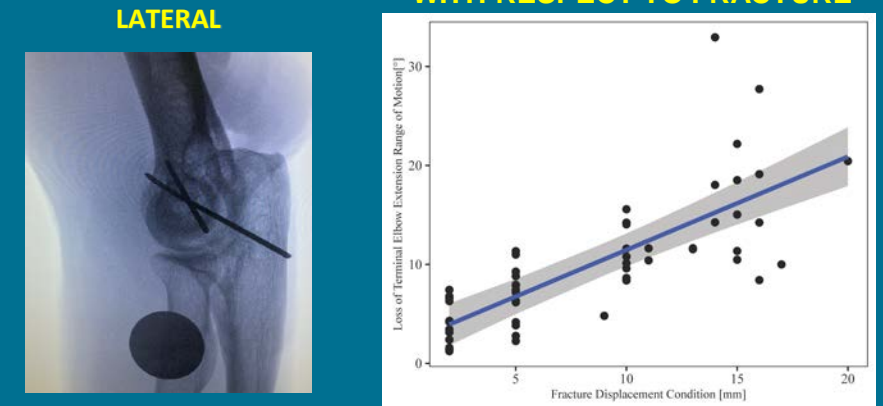
- **2 mm:** **Not** statistically significant. [Mean difference: 0.4 mm, 95% CI: -0.9 to 1.7 mm, $p = 0.56$].
- **5 mm, 10mm, maximum displacement:** The AP radiographic method **underestimated** the actual displacement relative to the axial method.
- **5 mm:** [Mean difference: -1.6, 95% CI: -2.9 to -0.3, $p=0.01$]
- **10 mm:** [Mean difference: -4.5, 95% CI: -5.8 to -3.2 mm, $p<0.01$]
- **Maximal displacement** [Mean difference: -7.1, 95% CI: -8.3 to -5.8, $p<0.01$].

| RADIOGRAPHIC DISPLACEMENT MEASURES BY DISPLACEMENT CONDITION | | |
|--|----------|-------------|
| ACTUAL DISPLACEMENT | AP X-RAY | AXIAL X-RAY |
| 2 MM | 2.8 MM | 2.4 MM |
| 5 MM | 3.8 MM | 5.4 MM |
| 10 MM | 6.4 MM | 10.9 MM |
| MAXIMUM (~15 MM) | 8.9 MM | 16 MM |

METHODS – Objective 3

Lateral x-rays were taken at the maximum elbow extension allowed by each fracture model. A linear mixed model regression analysis was used to test the association between medial epicondyle displacement position and loss of terminal extension range of motion.

LOSS OF TERMINAL EXTENSION WITH RESPECT TO FRACTURE



RESULTS – Objective 3

There was a significant, positive, linear association between medial epicondyle displacement and loss of terminal elbow extension. For every **5 mm** increase in displacement, there was a **4.7 degree** loss [95% CI: 3.6 to 5.8°, $p<0.01$] in terminal elbow extension.

CONCLUSIONS

The medial epicondyle of the distal humerus:

- Is a **posterior structure, oriented distally and posteriorly**
- **Axial X-rays** best predicted the actual displacement
- Every 5mm of anterior malunion is associated with a loss of about 5 degrees of terminal elbow extension
- Understanding the anatomic location and orientation of the medial epicondylar physis will permit an improved anatomic surgical reduction
- Current guidelines for operative treatment of medial epicondylar fractures warrant reevaluation. Standardization of x-ray evaluation to include axial imaging and consideration of the relationship between anterior displacement and loss of terminal extension are indicated