

70% Radiographic Failure Rate in Conservative Treatment of Complete Proximal Third Radial Shaft Fractures in Children

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Introduction

- Diaphyseal fractures of the forearm are the third most common pediatric fracture.¹
- Approximately 75% of forearm shaft fractures occur in the distal third, 18% in the middle third, and 7% in the proximal third.²
- Historically, pediatric forearm shaft fractures are treated with closed reduction and casting.^{1,3}
- Fracture malunion and residual angulation is associated with significant functional impairment.⁴
- Forearm fractures with complete cortical disruption of the radius are more likely to redisplace.^{5,6}
- Proximal-third radial shaft fractures have been identified as a high risk group for failure of conservative treatment.^{7,8,9}
- The failure rate of non-operative management of proximal-third radial shaft fractures remains unclear.

Purpose and Hypothesis

- The purpose of this study was to evaluate the radiographic failure rate of pediatric complete proximal radial shaft fractures treated with closed reduction and casting.
- Secondly, we evaluated the efficacy of an alternative fracture level categorization based on equal halves.
- We hypothesize the failure rate of conservative treatment of proximal third radial shaft fractures will exceed the failure rate of this treatment in more distal radial shaft fractures.

Methods

- A retrospective review assessing radiographic angulation of complete radial shaft fractures.
- Patients were treated between 2007 and 2015.

Inclusion Criteria

- Males < 18 years old and females < 17 years old.
- Radial shaft fracture demonstrating complete cortical disruption on AP and lateral view.
- Treated with closed reduction and casting.

Determining Fracture Level

- Distal border of the radial shaft defined by the width of the physis plotted proximally from the physis.
- Proximal border of the radial shaft defined as the proximal edge of the bicipital tuberosity.
- Length of the shaft measured from proximal to distal border and divided into equal thirds and halves.
- Fracture level classified as either proximal, middle, or distal third, and as either proximal or distal half.

Assessing Angulation

- Fracture angulation was measured using PACS digital software.
- Evaluated at injury, post-reduction films, and each subsequent radiograph up to 4 weeks post injury.
- Acceptable angulation defined according to age and sex specific criteria.

	Proximal third	Middle third	Distal third		Proximal half	Distal half
Females < 8 y.o. Males < 10 y.o.	< 10°	< 15°	< 20°	Females < 8 y.o. Males < 10 y.o.	< 15°	< 20°
Females ≥ 10 y.o. Male ≥ 8 y.o.	< 10°	< 10°	< 10°	Females ≥ 10 y.o. Male ≥ 8 y.o.	< 10°	< 10°

Table 1 and 2. Accepted fracture angulation.

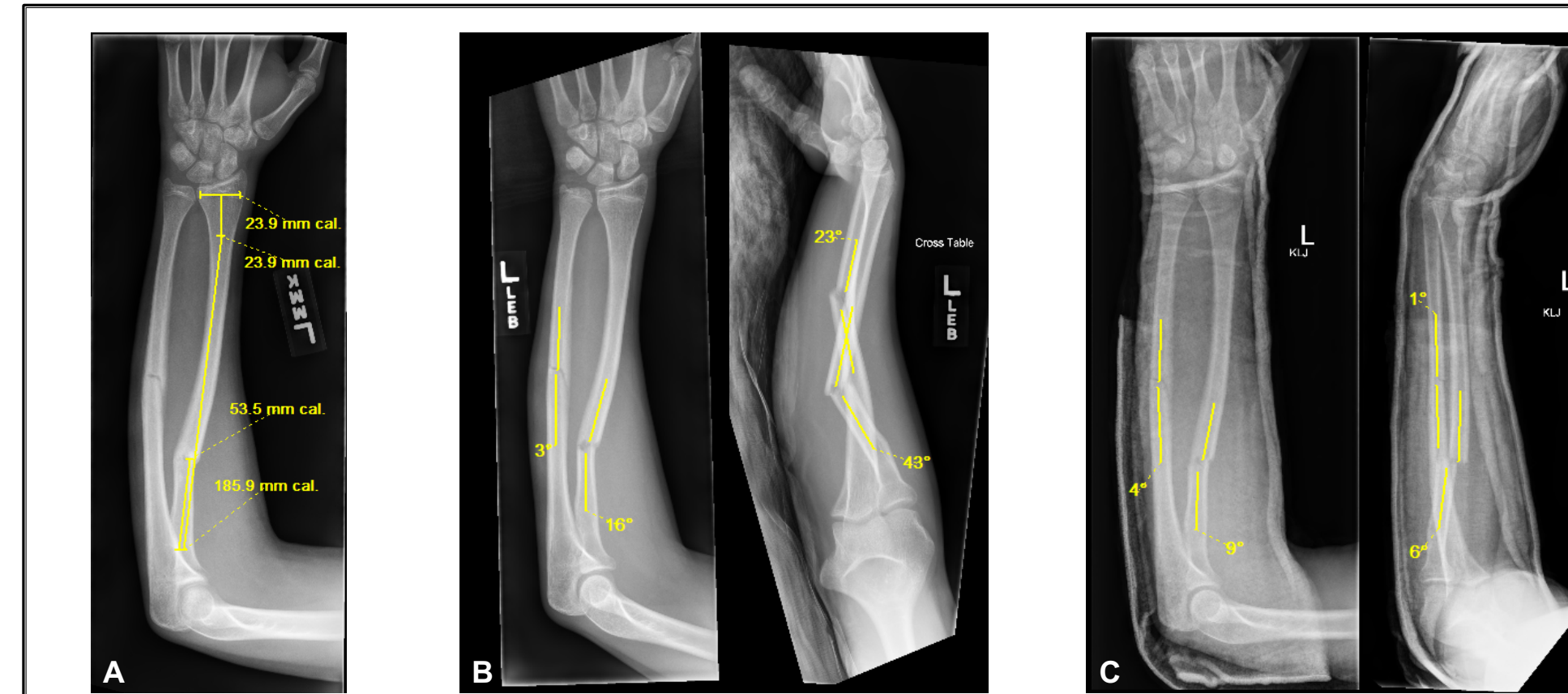


Figure 1. Measurement technique (A) Determining fracture level (B) Injury angulation (C) 1-week follow up angulation.

Results

- 309 patients underwent non-operative treatment of complete radial shaft fractures.
- Average age of patients was 8.7 years old.
- The majority of the cohort (64%) was male.
- 86% of the cohort had a fractured ulna in addition to a completely fractured radius.
- 69.5% of proximal third fractures and 49.5% of proximal half fractures failed non-operative management.
- Proximal third fractures were significantly more likely to fail conservative treatment compared to middle third ($p=0.000046$), distal third ($p=0.000066$), and middle and distal third fractures combined ($p=0.000027$).
- Proximal half fractures were significantly more likely to fail non-operative management compared to distal half fractures ($p=0.00027$).

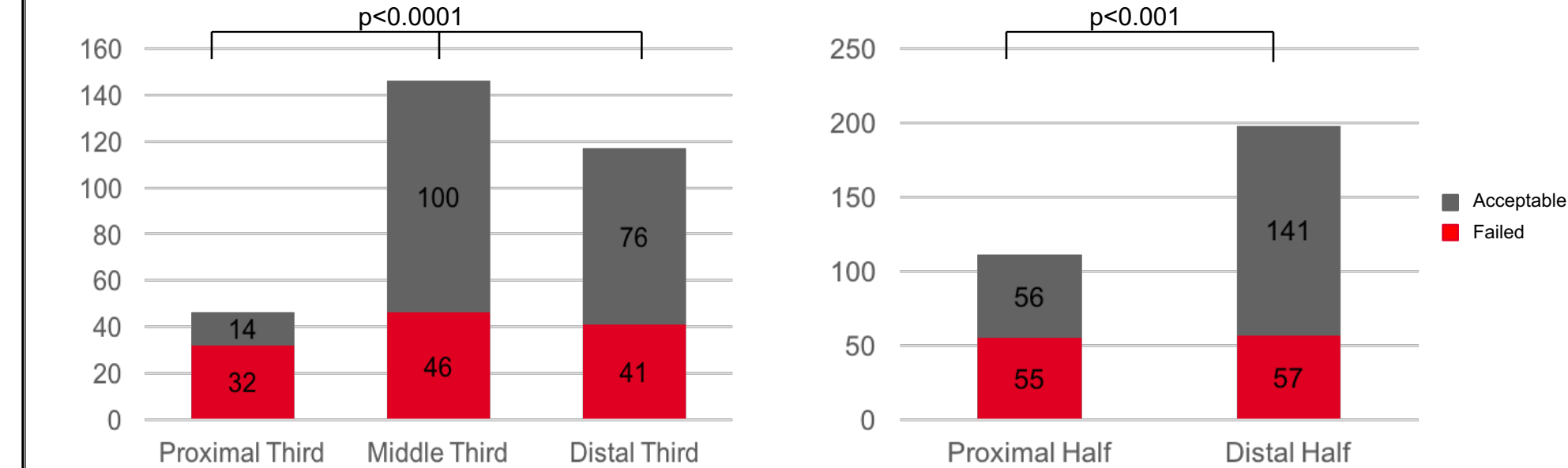


Figure 2. Cohort description by fracture level and angulation outcome.

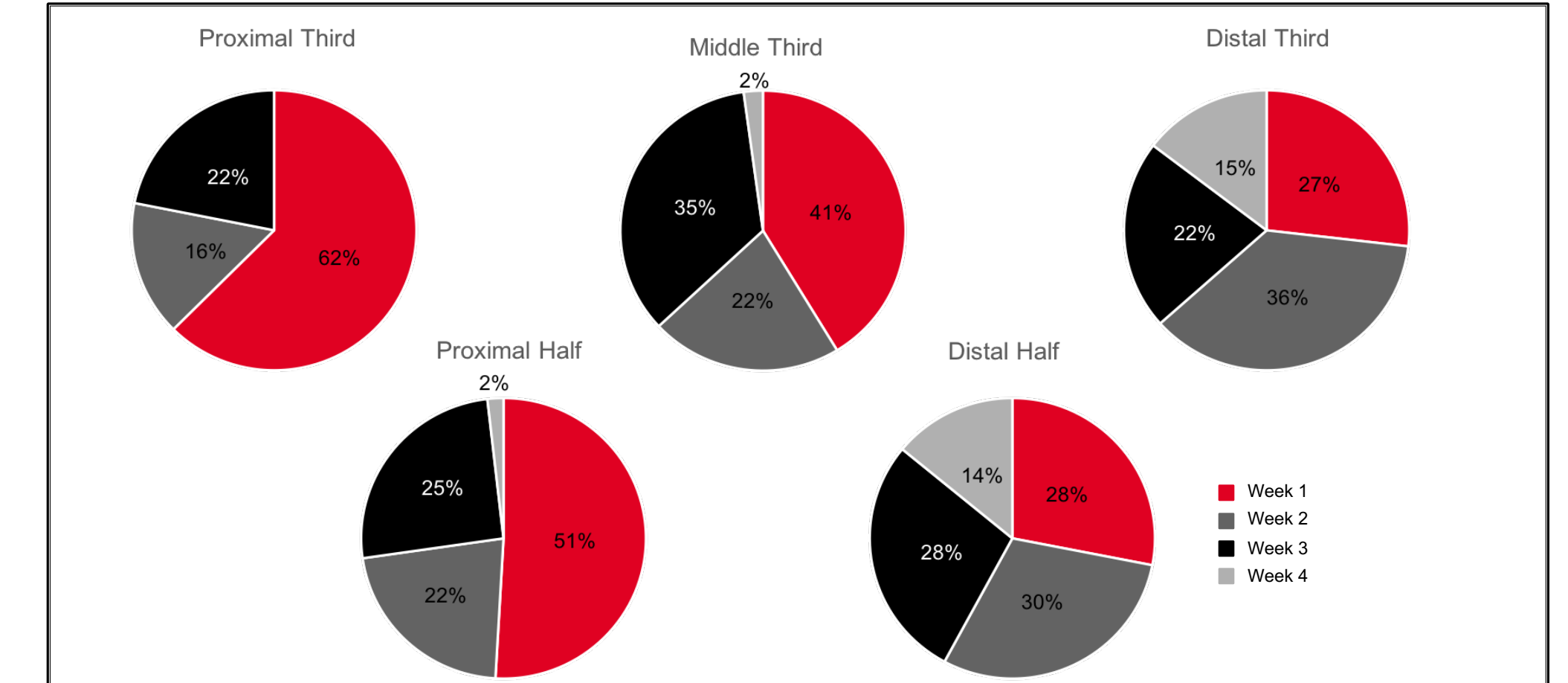


Figure 3-7. Time to failure by fracture level.

Conclusions

- Proximal radial shaft fractures, whether defined in thirds or halves, were significantly more likely to fail non-operative treatment.
- Proximal third fractures had a 4.6 times greater odds of failing conservative treatment than middle and distal third fractures combined ($CI_{95}: 2.35-9.11$).
- Proximal half fractures had a 2.4 times increased odds of failing non-operative treatment than distal half fractures ($CI_{95}: 1.49-3.94$).
- Our study shows that providers can reasonably predict fracture outcome based on fracture level alone.
- Though classification of fracture level by halves provides differentiation of fracture outcome, traditional classification of the radial shaft in thirds provides greater differentiation of patient outcome.
- Further investigation may show that defining the radial shaft in terms of halves is useful for guiding treatment decisions for patients with middle third fractures.
- Many forearm shaft fractures exceeded angulation criteria within the first 4 weeks of treatment.
- Special attention should be given to proximal forearm shaft fractures by the treating orthopedic surgeon.
- Given the odds of failure, early surgical intervention should be considered for patients with complete proximal radial shaft fractures.

References

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Figure 8. Clinical example of failure (A) Injury (B) Post Reduction (C) Week 1 (D) Week 2 (E) Week 4.