Hemiepiphysiodesis Using Tension-band Plates: Does Initial Screw Angle Influence Speed of Correction?

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Introduction

- When using tension-band plates for angular deformity correction, the literature is unclear regarding the most effective screw insertion angle to use.
- A biomechanical study by Schoenleber et al.[1] showed more statistically significant angular correction in the models with parallel screws compared with the models with divergent screws; however, this was never clinically tested.
- This study evaluates the correlation between initial screw angle and the average rate of correction during hemiepiphysiodesis with tension-band plates.

Methods

- This retrospective study includes 35 patients (47 physes) with genu valgum deformity (17 idiopathic and 18 fibular hemimelia) who underwent insertion of eight-Plates between 2010 and 2015.
- Initial screw angle was determined from the intraoperative fluoroscopic images.
- Radiographs were obtained within 3 months of surgery, and follow-up films were obtained every 3 to 6 months.
- Change in mechanical lateral distal femoral angle, medial proximal tibial angle, and screw angle was obtained from each follow-up radiograph.
- Initial screw angle was correlated with the average rate of correction during the entire treatment period.
- The average rate of angular correction during first and last follow-up periods was also compared.

Results

- Mean total follow-up period was 12.2 months (7 to 25 months). Mean age at the time of surgery was 11 years (3 to 15 years), and the initial screw angle ranged from 0° to 30°. In all, 25 physes were in female patients and 22 were in male patients. A total of 39 physes had medial distal femoral hemiepiphysiodesis and 8 were treated with medial proximal tibial hemiepiphysiodesis. In the idiopathic group, medial distal femoral hemiepiphysiodesis was done for 21 physes, while medial proximal tibial was done for 7 physes. In the fibular hemimelia group, medial distal femoral hemiepiphysiodesis was done in 18 physes and medial proximal tibial was done for a single case.
- A negative correlation was observed between the initial screw angle and the rate of correction ($p = 0.2$) (Fig. 1). While the negative correlation suggests that a greater initial screw angle gives a slower correction, the results were neither clinically nor statistically significant. The mean rate of angular correction (change in correction/month) was 0.74° per month (0.3° to 1.4°; SD 0.31°).
- The mean rate of correction for the first follow-up period was 0.86° per month (0° to 2.3°; SD 0.45) with a mean follow-up of 4.7 months (2.8 to 5.9 months). The mean rate of correction during the last follow-up period was 0.71° per month (0.3° to 1.7°; SD 0.33) with a mean follow-up of 5.1 months (3.1 to 6.7 months). There was no statistical significance between these results ($p = 0.18$).

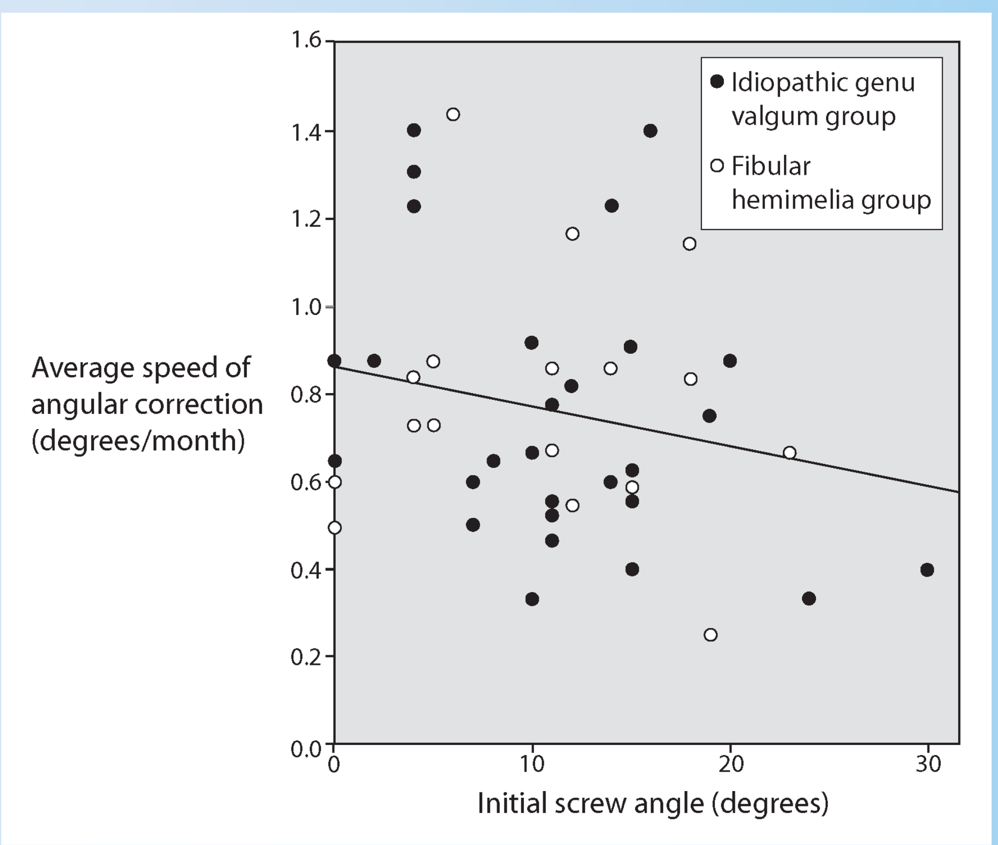

Figure 1. The results showed a trend towards a negative correlation between the initial screw angle and the rate of correction (p=0.2).

Discussion

- Application of a tension-band plate with a divergent angle ranging from 0° to 30° results in similar rates of angular correction. Although we hypothesized that using a wider initial screw angle would result in faster angular correction, this was generally not seen. It has previously been suggested that divergent screws engage the plate more rigidly, thus tethering the physis more efficiently. However, the results of this study showed a negative correlation between initial screw angle and rate of correction. In other words, tension-band plates with a narrow initial screw angle corrected faster.
- A possible explanation for this finding could be Steven's theory that the tension-band plate creates an extra-physeal fulcrum.[2] Figure 2 illustrates the extra-articular fulcrum (marked in the figures with a small white circle) created by a narrow screw angle (Fig. 2A) *versus* a wide screw angle (Fig. 2B). The fulcrum that is closer to the growth plate would seem to correct faster, but our data did not bear this out.
- A proposed theory for the faster correction in the first follow-up compared to the last follow-up period was that as angular correction proceeds, the tension-band plate screws continue to diverge, moving the imaginary extraphyseal fulcrum closer to the bone, thus slowing the rate of correction. This difference in rate, however, was not significant ($p = 0.18$), thus the proposed theory might not necessarily be valid. The change in the rate of correction was probably not related to any decrease in the patient's growth rate since the mean follow-up was only 12.2 months and the study included patients as young as age 3 years.

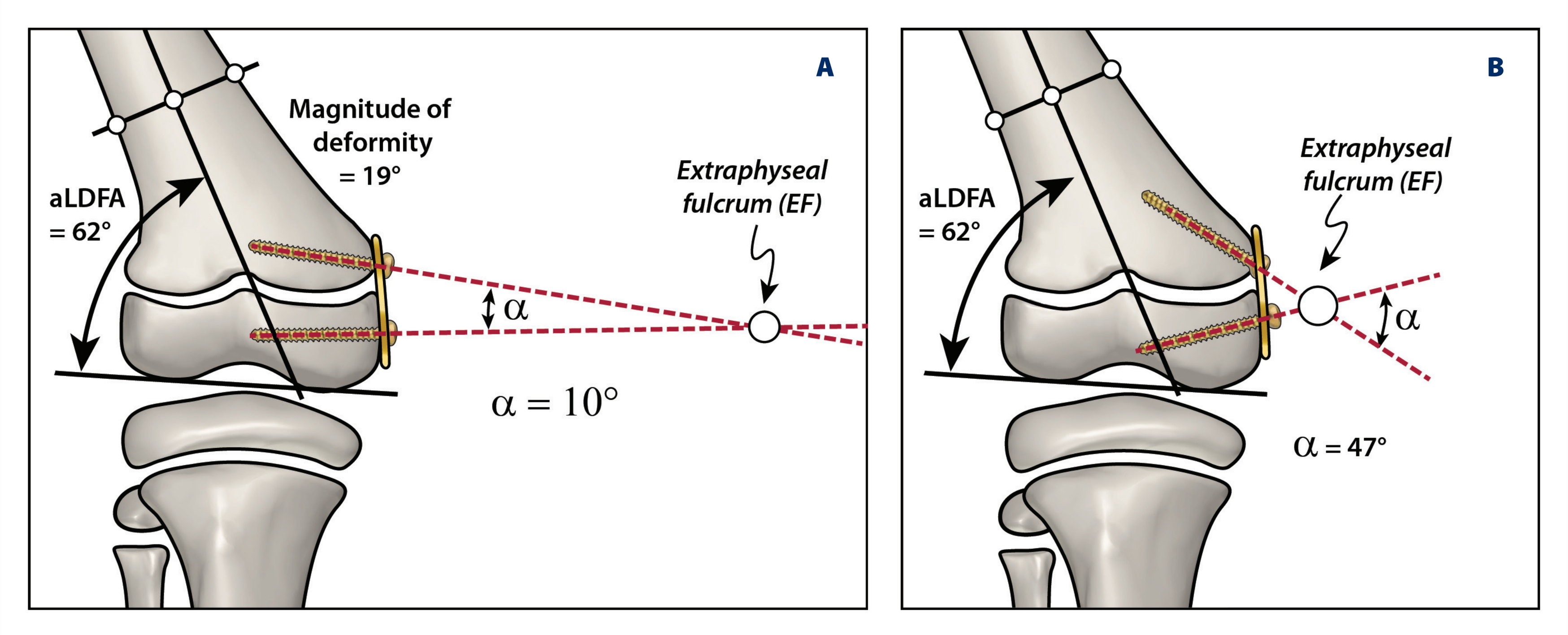

Figure 2. The extra-physeal fulcrum (marked with a small white circle) created by a narrow screw angle (A) *versus* a wide screw angle (B).

References

1. Schoenleber SJ, Iobst CA, Baitner A, Standard SC. The biomechanics of guided growth. J Pediatr Orthop B. 2014;23(2):122–5.
2. Stevens PM. Guided growth for angular correction. J Pediatr Orthop. 2007;27(3):253–9.