

Growth Modulation for Fixed Flexion Contracture of the Knee: A Comparison of Two Techniques

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Introduction

- Growth modulation has become a mainstream method for treatment of coronal plane angular deformities in the lower extremities of children.¹
- Growth modulation with tension band plates for treatment of fixed knee flexion contracture is supported in the literature, with the expectation of improvement but not necessarily the resolution of contractures.^{2,3}
- Multiple devices and techniques are available to harness growth, including staples, screws, and combined screw and plate techniques.
- No studies are available that compare the various techniques of anterior growth modulation in the distal femur for fixed flexion contracture.
- Our aim is to compare two anterior distal femoral growth modulation techniques for fixed flexion contracture.

Methods

- Records were retrospectively reviewed for patients who underwent insertion of either 4.5-mm transphyseal screws (A) or anterior tension-band plates (B) into the anterior distal femoral hemiphysis for fixed flexion contracture (Figure 1).
- Radiographic parameters were evaluated preoperatively and at least 10 months after implantation:
 - Posterior distal femoral angle (PDFA)
 - Posterior proximal tibial angle (PPTA)
 - Anterior cortical line (ACL) measurement
- Hardware failures and migration were also evaluated.

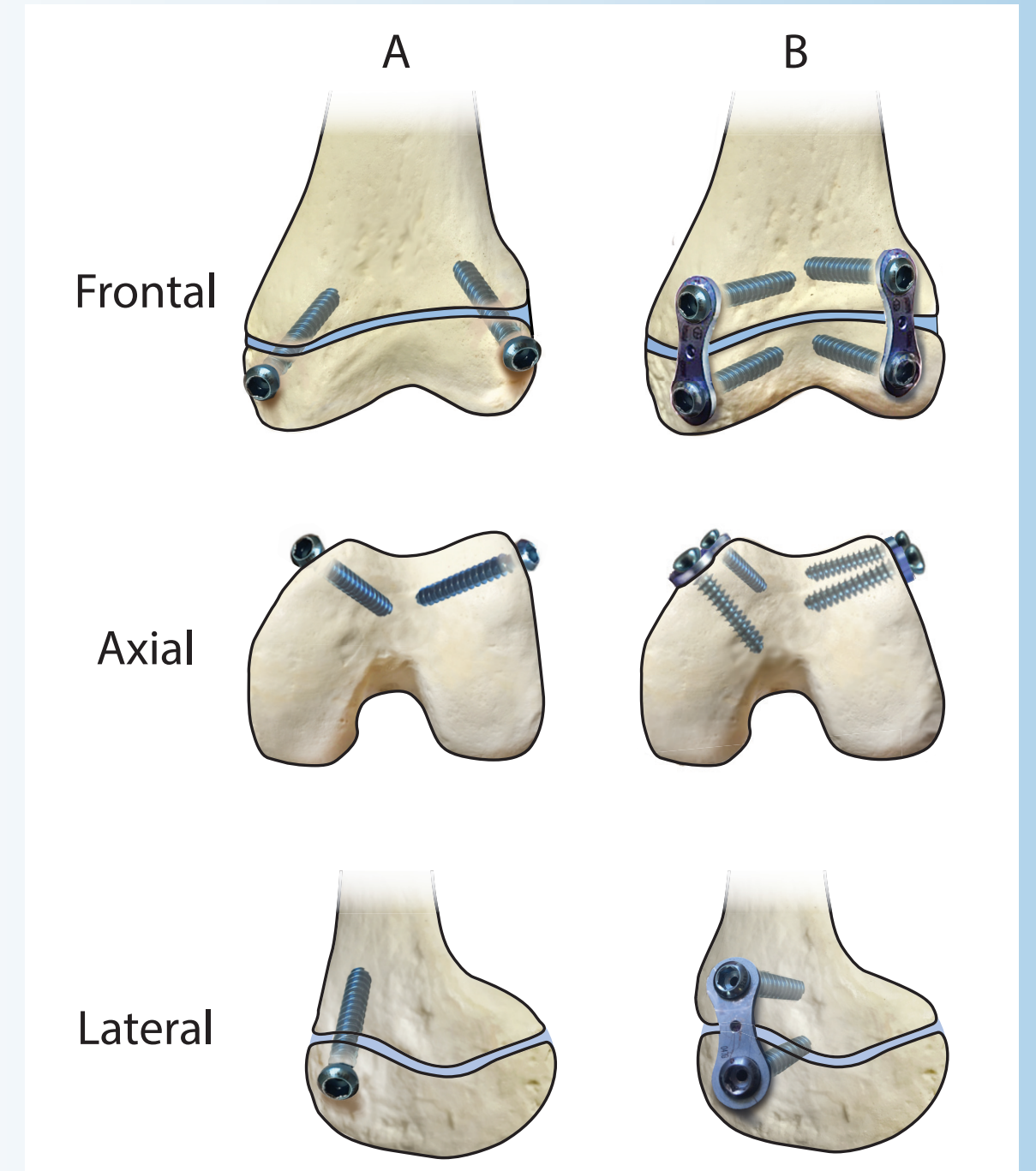


Figure 1. Frontal, axial, and lateral views of the screws-only (A) and tension-band plate (B) constructs.

Results

Table 1. Summary of the main underlying causes of fixed flexion contracture among the study population.

Condition	Patients	Knees
Cerebral palsy	6	10
Arthrogryposis	3	5
Idiopathic FFC	2	2
Pterygium syndrome	3	3
Pierre Robin syndrome	1	2
Marden-Walker syndrome	1	2
Other neuromuscular	1	2
Polio syndrome	1	1
Tibial hemimelia	1	1
Congenital femoral deficiency	1	1
Total	20	29

FFC, fixed flexion contracture.

- Six patients (10 knees) were excluded due to inadequate follow-up or radiographs.
- 29 knees (20 patients) (Table 1) were included in the study and were treated with:
 - Anterior tension-band plate construct: 13 knees (9 patients)
 - Screws-only construct: 16 knees (11 patients)
- Duration of follow-up: 45 months (range, 10–96 months)
- Average age: 10.7 years (range, 3–14 years)
- Improvement in sagittal alignment was noted in both groups (Tables 2 and 3).
 - Statistically significant changes were noted in the PDFA in the tension-band plate group ($p=0.0095$), but not in the screws-only group ($p=0.1813$).
 - Anterior cortical line measurements demonstrated non-significant improvement of 28° on average in the plate group ($p=0.0811$), and minimal non-significant improvement in the screw-only group ($p=0.6443$).
 - PPTA did not significantly change in tension-band plate group ($p=0.5242$) or the screws-only group ($p=0.6666$).
- Rate of hardware migration was significantly different ($p=0.008$):
 - Anterior tension-band plate construct: 1 of 13 cases
 - Screws-only construct: 9 of 16 cases

Table 2. Comparison of final correction obtained in cases treated with tension-band plates or transphyseal screws.

	Mean Change in PDFA	Mean Change in PPTA	Mean Change in ACL Measurement
Tension-band plates	11.9°	1.4°	28°
Transphyseal screws	3.6°	0.8°	1.4°
P-value	0.0742	0.4391	0.0992

ACL, anterior cortical line; PDFA, posterior distal femoral angle; PPTA, posterior proximal tibial angle.

Table 3. Pre- and post-operative sagittal plane deformity measurements.

	PDFA			PPTA			ACL Measurement		
	Preop Mean	Postop Mean	P-value	Preop Mean	Postop Mean	P-value	Preop Mean	Postop Mean	P-value
Tension-band plates	86.8°	98.7°	0.0095*	84.2°	85.6°	0.5242	29.2°	1.2°	0.0811
Transphyseal screws	87.3°	90.9°	0.1813	83.5°	82.7°	0.6666	30.7°	29.3°	0.6443

*statistically significant; ACL, anterior cortical line; PDFA, posterior distal femoral angle; Postop, postoperative; PPTA, posterior proximal tibial angle; Preop, preoperative.

Discussion

- Anterior distal femoral growth modulation improves sagittal alignment of the femur without affecting the sagittal alignment of the proximal tibia.
- We recommend anterior tension-band plating instead of retrograde transphyseal screws to treat fixed flexion contracture of the knee due to the high failure rate secondary to screw migration.
- Correction magnitudes with tension-band plates are comparable to other series,^{2,3} with improvement in but not necessarily resolution of contracture measurements.
- Patients should be closely monitored for sagittal and coronal alignment during growth modulation for fixed flexion deformity.
- Analysis of other hardware configurations is warranted.

References

1. Saran N, Rathjen KE. Guided growth for the correction of pediatric lower limb angular deformity. *J Am Acad Orthop Surg.* 2010;18(9):528–36. Review.
2. Klatt J, Stevens PM. Guided growth for fixed knee flexion deformity. *J Pediatr Orthop.* 2008;28(6):626–31.
3. MacWilliams BA, Harjinder B, Stevens PM. Guided growth for correction of knee flexion deformity: a series of four cases. *Strategies Trauma Limb Reconstr.* 2011;6(2):83–90.