

Temporary Hemi-epiphysiodesis with Hinged Tension Band Plates in Skeletally Immature Patients with Genu Valgum: Faster Correction in Younger Patients

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INTRODUCTION: More data on hemi-epiphysiodesis procedures in skeletally immature patients is needed to outline the expected alignment correction over time. Previous evaluations of hinged tension band plates for guided growth have included small patient cohorts. This study seeks to demonstrate the average rate of deformity correction for genu valgum using hinged tension band plates, while examining different age groups and sex-related differences.

METHODS: A retrospective chart review of patients who underwent hemi-epiphysiodesis with hinged tension band plates for valgus knee deformity by the senior author from 2012 to 2022 was performed. Only patients who subsequently had the hinge plates removed were included in the final analysis. Expected time of growth remaining (ETGR) was calculated based on bone age when a preoperative bone age radiograph was available. ETGR was calculated as the difference between the age of skeletal maturity and bone age at the time of surgery. The Greulich and Pyle method was used to assess bone age at surgery, and growth maturity was set at 14 years for females and 16 years for males. The mechanical lateral distal femoral angle (mLDFA), mechanical medial proximal tibial angle (mMPTA), mechanical femoral tibia angle (mFTA), screw divergence angle (SDA), and hinge angle (HA) were measured on the first radiograph immediately after implant placement and at the last radiograph prior to implant removal. The rate of correction was calculated as the difference in the angle between the two imaging timepoints divided by the total time the implant was in place. For statistical analysis, included patients were split into groups based on chronological age (females <12 and males <14 years vs. females ≥12 and males ≥14 years).

RESULTS: Fifty-four skeletally immature patients, 28 males (51.9%) and 26 females (48.2%), had 97 knees treated with 110 tension band plates for pathologic genu valgum. The mean age at time of surgery was 12.5±1.9 years. The mean duration of implant treatment was 17.9±7.6 months. Ninety-seven plates were implanted on the distal femur and 13 on the proximal tibia. The radiographic measurement of the valgus deformity between the beginning and end of treatment showed significant correction (mFTA: p<0.001, mLDFA: p<0.001, mMPTA: p=0.002). Moreover, SDA and HA both showed significant changes after treatment (femoral plates: SDA p<0.001, HA p=0.002; tibial plates: SDA p=0.001, HA: p=0.002). The mFTA correction per unit time was 6.8°/year (0.6°/month). The lower limb axis of the younger cohort corrected significantly faster (7.5±4.6 °/year) than the older cohort (5.3±2.8 °/year) (p=0.03). The mLDFA correction rate was also significantly different between the 2 cohorts (7.0±4.7 vs. 4.8±2.8 °/year, respectively) (p=0.002). The group with greater ETGR (mFTA: 7.4±4.2 °/year, LDFA: 6.9±4.3 °/year) demonstrated a significantly faster rate of correction than the group with less than 2 years of growth remaining (mFTA 3.4±2.3 °/year, LDFA 2.9±2.0 °/year), p<0.001).

DISCUSSION AND CONCLUSION: This study demonstrates that timing is essential when performing temporary hemi-epiphysiodesis for valgus knee deformity in skeletally immature patients. Females younger than 12 years, males younger than 14 years, and those with more than 2 years of ETGR have a faster correction when compared to older patients.

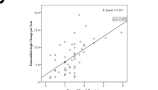
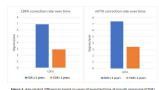
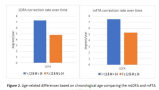
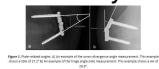


TABLE 1. Demographic of the entire cohort

Parameter	Value
Patients	54
Sex	28 M, 26 F
Age	12.5 ± 1.9 years
Age at surgery	12.5 ± 1.9 years
Plate type	97 plates
Location	97 distal femur, 13 proximal tibia
Number of plates per patient	1.8 ± 0.7
Duration of implant treatment	17.9 ± 7.6 months
Number of knees	97
Number of patients	54
Number of knees	97

TABLE 2. Preoperative and postoperative radiographic measurements

Parameter	Preoperative	Postoperative	p-value
mFTA	12.5 ± 4.2°	5.7 ± 3.1°	<0.001
mLDFA	12.5 ± 4.2°	5.7 ± 3.1°	<0.001
mMPTA	12.5 ± 4.2°	5.7 ± 3.1°	0.002
SDA	12.5 ± 4.2°	5.7 ± 3.1°	<0.001
HA	12.5 ± 4.2°	5.7 ± 3.1°	0.002

TABLE 3. Comparison of radiographic measurements between age groups

Parameter	<12	12-14	≥14	p-value
mFTA	7.5 ± 4.6°/year	5.3 ± 2.8°/year	4.8 ± 2.8°/year	0.03
mLDFA	7.0 ± 4.7°/year	4.8 ± 2.8°/year	4.8 ± 2.8°/year	0.002