Temporary hemiepiphysiodesis for idiopathic genu valgum

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Background
For correction of angular deformity, the medial eight-plate system has been proposed as a safe and minimally invasive technique. The purpose of this study was to assess the results and the degree of correction obtained with this procedure in patients with idiopathic genu valgum.
Patients and methods
This study was a prospective study of 19 valgus deformities of the knee in 11 patients treated with medial hemiepiphysiodesis using one medial eight-plate. The tibiofemoral angle and the anatomic lateral distal femoral angle were assessed on anteroposterior radiographs of the lower extremity taken at multiple time intervals.
Results
A total of 19 deformities in 11 patients were reviewed. The average time of follow-up from index surgery was 11.7 months, with an average correction time of 11.2 months. The tibiofemoral angle was corrected from a mean of 12.2° preoperatively to 4.6° postoperatively; the anatomic lateral distal femoral angle was also corrected from a mean of 79.7° preoperatively to a mean of 84.05° postoperatively. There were no instrumentation breakages.
Conclusion
Hemiepiphysiodesis with medial eight plate provides an effective and predictable correction of idiopathic genu valgum. There is a trend toward faster correction in younger patients.

Keywords:
genu valgum, hemiepiphysiodesis, tension band plate

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Introduction

Salenius and Vankka [1] described a predictable change in the alignment of the knee during early childhood development from varus to valgus.

At ~6 years of age, this transition stabilizes at ~5–7°of tibiofemoral valgus. By 10 years of age, a 10° valgus deformity cannot be expected to improve spontaneously [1]. The presence of deformity leads to abnormal joint overload, which can result in future degenerative joint disease. In addition, the deformity can lead to cosmetic concerns, functional limitations, and abnormal gait mechanics [2–5].

The treatment of angular deformities of the knee has evolved significantly over time. Phemister [6] and Haas [7], early in the 20th century through their different studies, showed that, by altering physeal growth, they could achieve angular correction that was simpler and safer than osteotomies. The technique of epiphyseal stapling was popularized by Blount and Clarke [8] who proposed the use of three staples, suggesting that this was the ideal construct to maximize correction while minimizing the risk of hardware failure. Blount also observed that, after removing the staples, the physis recovered its ability for continued growth [9]. This is in contrast to methods typically performed near the end of growth which cause complete, irreversible growth arrest [10]. The concern with Blount staples was that the stiffness of the staple construct and injury to the periosteum would occasionally lead to growth arrest. Therefore, it was recommended that stapling be done near the end of growth.

Recently, Stevens proposed a new construct consisting of a nonlocking extraperiosteal plate and two screws, serving as a tension band. Instead of the rigid fulcrum caused by the staples, the screws spread over time with the pivot point in the periphery. This would lead to a faster correction due to a longer moment arm. He also suggested that only one plate is required to obtain the desired tension band effect, with two plates offering no biomechanical advantage [11].

The purpose of this study was to assess the results and the degree of correction obtained with medial eight plate in patients with idiopathic genu valgum.

Patients and methods

This prospective study included a total of 19 idiopathic genu valgum knees in 11 patients who were treated with medial distal femoral hemiepiphysiodesis with a single medial eight plate through a medial approach at the Zagazig University Hospital during the period from May 2013 to June 2015. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Zagazig University, Zagazig, Egypt. Indications for surgery included genu valgum deformity, with anterior and/or lateral joint pain, patellofemoral instability, gait disturbance, or cosmetic concerns.

Inclusion criteria composed of patients 15 years of old or younger with idiopathic genu valgum, and sufficient clinical and radiographic follow-up. Patients were excluded if they suffered from nonidiopathic diagnoses such as Blount's disease, cerebral palsy, multiple hereditary exostosis, or spina bifida. Patients who had undergone previous surgeries such as an osteotomy were excluded as well. In all cases, the primary deformity was in the distal femur. Patients with a primary deformity only in the proximal tibia were excluded. All plate were placed using fluoroscopic guidance through a single medial incision.

A review of interval radiographs from preoperative assessment to completion of treatment was performed. Radiographic evaluation was the primary source of analysis to document the degree of correction over time by evaluating the change in orientation that the joint surface underwent as the femoral condyle alignment was modified by hemiepiphysiodesis. A lower extremity long anteroposterior standing radiography of all patients was obtained at their preoperative visit and at periodic follow-up times.

The anatomic tibiofemoral angle (TFA) and the anatomic lateral distal femoral angle (aLDFA) were measured for each radiography using the methods described by Paley and Herzenberg [12]. The anatomic TFA is the angle between the anatomic lines of the femur and the tibia. The aLDFA is the angle formed between the anatomic axis of the femur and a line drawn through the knee joint line of the femur in the frontal plane.

Results

There were seven boys (13 knees) and four girls (six knees), with an average age of 11.5 years (range, 9–15 years) at the time of surgery. There was an average of 11.7 months follow-up from the date of surgery (6–18 months). The mean correction time was 11.2 months. All patients underwent removal of hardware and the average time to plate removal was 15.2 months (range, 8–20 months).

The average starting TFA for all 19 knees was 12.2° (7–16°) and the average TFA at the patients' last follow-up was 4.6° (0–9°), indicating an overall improved alignment. For the 19 knees, the average starting aLDFA was 79.7° (74–84°) and the average aLDFA at the patients' last follow-up was 84.05° (75–91°), also indicating overall improved alignment.

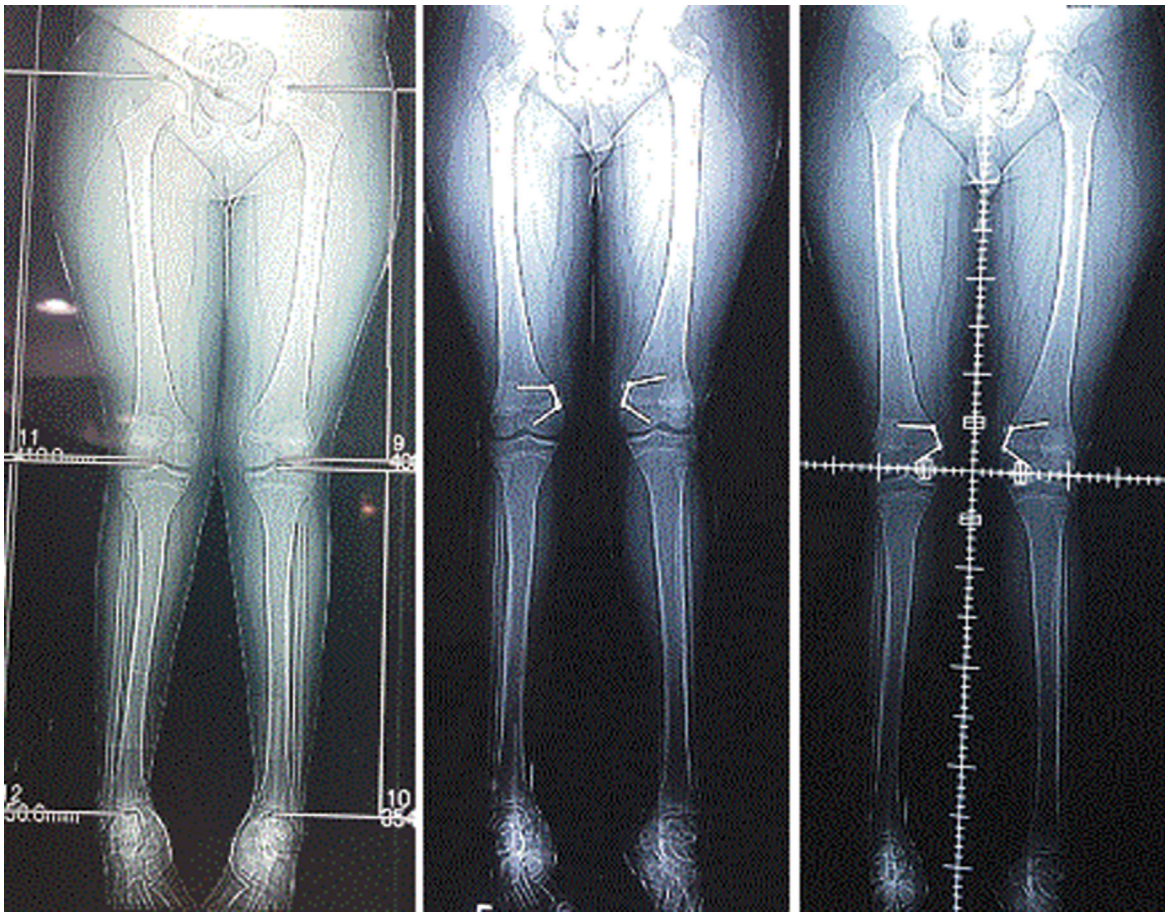
There were no perioperative complications. Two knees in two different patients had superficial infection which was treated with a course of oral antibiotics, while one patient with a unilateral deformity did develop recurrence of deformity after plate removal and this required a second surgery. None of the plates or screws failed in the study group (Fig. 1).

Discussion

It has been well demonstrated that hemiepiphysiodesis, regardless of the technique, is a safe and easy approach to address angular deformity of the knee. Corrective osteotomy is still a viable option in cases of residual deformity at maturity and in severe cases. Temporary epiphysiodesis using a medial eight plate is gradually becoming the gold standard in the treatment of angular deformities, particularly in the coronal plane around the knee. It is a minimally invasive technique and seems to be effective at any age during growth. Complication rates including hardware failure and longitudinal growth inhibition are reduced compared with other techniques such as staples and transphyseal screws [13–15].

Our series of 11 patients is comparable to the current literature studying correction of deformity using the eight-plate device in idiopathic genu valgum. The mean correction time in our series was 11.2 months. Stevens [11] published a group of 34 patients 'with 65 deformities due to a variety of pathological conditions' in 2007 and correction was achieved in this group after a mean of 11 months. Ballal *et al.* [16] described 25 patients with symptomatic genu valgum and varum also managed with the eight-plate device who had a mean correction time of 16.1 months. Guzman *et al.* [17] were the first group who focused solely on the treatment of idiopathic genu valgum with the tension band plate and reported on two cases which had a mean correction time of 13.5 months. All authors noted a faster and greater potential for correction in

Figure 1



An 13-year-old man with bilateral genu valgum (left aLDFA: 79°, right aLDFA: 75°). The patient underwent bilateral hemiepiphysiodesis with a single medial eight plate. He underwent removal at 15 months from the index procedure (left aLDFA: 88°, right aLDFA: 82°). aLDFA, anatomic lateral distal femoral angle.

younger patients particularly those less than 10 years of age. The mean overall correction of aLDFA and TFA in our study was comparable to those previously published using the standard eight-plate. Stevens [11] described complications in four patients under the age of 11 years, where he detected the rebound phenomenon and the requirement for further surgery. The same series also reported hardware loosening in one patient with Blount's disease. Otherwise no complications including premature physeal closure or overcorrection were noted in this study. In our series, two knees in two different patients had superficial infection which was treated with a course of oral antibiotics while one patient with a unilateral deformity did develop recurrence of deformity after plate removal and this required a second surgery, a similarly low complication rate as compared with other studies. All of our patients were treated using the eight-plate system and no hardware loosening or failure was observed.

Guided growth using the eight-plate system gives reliable results and it is effective and safe in patients with idiopathic genu valgum. We have shown efficacy with regard to the overall correction time and demonstrated a low and acceptable complication rate in our patients.

Conclusion

Hemiepiphysiodesis with medial eight plate provides an effective and predictable correction of idiopathic genu valgum. There is a trend toward faster correction in younger patients.

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Conflicts of interest

There are no conflicts of interest.

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