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A Clinico-Radiological Study of Hemi-Epiphysiodesis Using Eight-Plate In Adolescents and Pediatric Age Group with Idiopathic Bilateral Genu Valgum

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Abstract **Original Research Article**

Through this study, we endeavor to evaluate the results of hemi-epiphysiodesis of the distal femoral epiphysis with eight-plate for correcting the knock knee in the adolescent age group. This is a prospective longitudinal study in which 30 patients with idiopathic bilateral genu valgum were treated surgically by Hemi-epiphysiodesis using eight- plates. Patient evaluated with a radiograph and clinically assessed at every follow up till 36 months. We evaluated 30 patients who were surgically managed for idiopathic genu valgum over 36 months. The average age at surgery was 13 years and 7 months (range 11 years 8 months-14 years 6 months). The mean preoperative tibio-femoral angle was found out to be 17° with a standard deviation +/- 2.7°, and post-surgery the mean tibio-femoral angle was recorded to be 5° with a standard deviation +/- 1°. The total follow-up period was 36 months. Conclusions: Through the study, we conclude that hemi-epiphysiodesis using eight plates is a simple technique for correction of idiopathic genu valgum in adolescent and pediatric patients. It produces reproducible results, is cost-effective and ensures a rapid return to the pre-operative level of school and recreational activities.

Keywords: Genu valgum; Hemi-epiphysiodesis, eight-plate, Tibiofemoral angle.

INTRODUCTION

Genu valgum is considered physiological up to the age of 3-4 years. The peak value of genu is observed at the age of 3-4 years and this spontaneously gets resolved around 7 years of age. Persistence of Genu Valgum beyond this age is considered pathological and requires some form of treatment. The normal tibio-femoral angle is the angle defined as the angle made between the mechanical axes of the femur intersecting with the mechanical axis of the tibia [1, 2]. The value of normal TFA is 5-7 ° in the adolescent population. Spectrum for management of idiopathic Genu Valgum in adolescents and pediatric age group is varies widely. Recently growth modulation using various techniques has emerged as an attractive option and is considered in all patients having remaining growth potential as first-line treatment. Once the epiphysis is closed and skeletal maturity is achieved, osteotomy replaces epiphysiodesis as the treatment of choice. Haas in 1945 reported halting of physical growth by introducing nails through it. He did his studies over animals and later reproduced the results in children. Haas reported that after he removed the nail, longitudinal growth in the limbs was re-established. Thus, he suggested a new method for the treatment of dysmetria and angular deformities of the limbs [3]. It was Phemister, who for the first time described the epiphysiodesis in 1993 [4]. He removed a rectangular piece of bone across the epiphysis and then reinserted the piece in the exact opposite direction, thus creating a bone bridge in the epiphysis. This bone bridge halted the growth at the operated epiphysis. But this method of epiphysiodesis is permanent, and if the amount of growth remaining is not estimated precisely it can lead to the development of deformity in follow up. Boven and other researchers supported a percutaneous procedure for epiphysiodesis using image intensifier for accurate curettage of epiphysis [5]. Though there was a percutaneous technique it was a permanent epiphysiodesis plus damage of popliteal nerve during the procedure is a dreaded complication. Metaizeau reported better results using percutaneous transphyseal cannulated screws, but it is questionable whether the process of epiphysiodesis was reversible or not [6]. Stevens developed an implant made up of titanium that had 2 holes for two cannulated screws. This technique gave better results. Angular deformity corrected at a fast pace. The plate applied didn't produce any compression at the physeal region so there was no epiphyseal arrest. Loss of fixation and implant failure

were rare [7]. This eight-plate is a non-locking plate that is applied extra-periosteal and fixed with two screws can be of great use to avoid the complications brought with transphyseal screw and osteotomy. We have studied the clinical and radiological results of eight-plate in 30 patients with bilateral, idiopathic knock-knee.

MATERIAL AND METHODS

The present study was undertaken in the department of orthopedic surgery, Prathima Institute of Medical Sciences, Nagunur, Karimnagar, Telangana, India. Our study type was a prospective interventional study on 30 patients attending our OPD with bilateral genu valgum in lower limbs fulfilling the inclusion criteria. The study protocol was approved by our Institutional ethical committee. A total of 30 patients with idiopathic bilateral genu valgum were managed surgically with eight-plate were observed. Inclusion criteria: All patients who underwent surgery were examined radiographically with anteroposterior x-rays of both the knees and included in the study only if they had approximately one year of predicted growth left. Exclusion criteria: Patients with pathological genu valgum due to trauma, tumor, Warfarin, osteochondroma were not included in the study. The surgery was performed under general anesthesia. Single eight-plate was used per epiphysis. Under image intensifier guidance epiphysis is viewed and localized with 1.6 mm pin. A contoured eight plate was fixed over the pin using drill-guide and guide wires were put. Care was taken not to damage the epiepiphysis. Once the accurate placement of guidewire was achieved, the drill was done to a depth of 5 mm. First, the epiphyseal hole was drilled followed by metaphyseal. Self-tapping screws were used for fixation of plates. Screws were tightened in an alternating manner till the screws were fully merged with plate & plate was flushed with the bone. Postoperative management as no bone had been cut around and incision on medial aspect only of about 3-4 cm; the patient doesn't require any immobilization in the postoperative period. Every 3 months the deformity correction was assessed using clinical parameters like inter-malleolar distance and photographic records kept. Radiological improvements in deformity were assessed with anteroposterior X-Ray taken every three months. Once the deformity was corrected and the neutral axis was achieved, hardware removal was done. Periodic follow-up every 3 months was done till skeletal maturity or 36 months whichever was earlier. The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULTS

A total of 30 patients comprised the study population, and 60 knees were surgically treated for idiopathic genu valgum over a 36-month interval. The mean age at implantation was 13 year and 7 months with a range of 11 years 8 months to 14 years 6 months. The mean duration of treatment was 12 months with a range between 3 months to 16 months. Mean follow-up after surgery was 3 years. None of the patients required physical therapy, and full functional recovery was achieved post-surgery in all patients. The clinical and radiological preoperative evaluation was carried out with the patient in the standing position, during which time the tibio-femoral angle was measured to assess the degree of genu valgum. The tibiofemoral angle in the preoperative examination was found to be 17^o SD +/- 2.7^o with range 12^o-23^o. Angle corrections achieved was 8^o SD ± 2^o and range 5^o-10^o the tibiofemoral angle at plate removal was 5^oSD +/- $1.8^o$with range 4^o- 6^o. Degree of correction per month was 0.9^oSD +/- 0.7^o with range 0.6^o - 0.7^o. During the follow-up period, none of the patients complained of pain or discomfort while walking or during school physical activities. Satisfactory results were defined as an intermalleolar distance of less than 6 cm, and 100% of the treated epiphyses were considered to be satisfactory in this study. Complications no-repeat surgery was done. No rebound deformity occurred.

Table-1: Clinical outcome in a patient treated with eight- plate

Clinical Outcomes	Number of patients(n)	Percentage (%)
Total correction of deformity	30	100
Partial correction of deformity	00	00
Deformity not corrected	00	00
Total	30	100

Table-2: Clinical findings in patients in the study

Characteristics	Mean Value	Range
Age	13 years 7 months	11 years 8 months-14 years 6 months
Duration of treatment	12 months	3 months-16 months
Tibiofemoral Angle in Preoperative examination	17° SD +/- 2.7°	12° -23°
Angle Correction achieved	8° SD +/- 2°	5° - 10°
TibiofemoralAngleatplate removal	5° SD +/- 1. 8°	4° – 6°
Degree of correction per month	0.9° SD +/- 0.7°	0.6° – 0.7°

SD = Standard deviation; $^\circ$ = degree

A: Measurement of intermalleolar distance; B: Measurement of Tibiofemoral angle in scannogram; C: Postoperative lateral view showing plate position; D: Postoperative anteroposterior radiograph; E: Scannogram showing preoperative genu valgum; F: Scannogram showing postoperative 6 months correction in genu valgum; G: Preoperative clinical photograph of bilateral lower limb showing genu valgum; H: Clinical photograph of bilateral lower limb showing corrected genu valgum deformity

DISCUSSION

Knock knee patients are very common in orthopedics outpatient department. Considering the frequency it is obvious to have so many methods of treatment for the same [8]. In adolescents or pediatrics age group where almost one year of growth potential is still there, growth modulation using Hemi-epiphysiodesis for correction of the angular deformity has emerged as flag bearer in recent past. This technique has very fewer complications. It can be used in idiopathic as well as pathological angular deformity. Skeletal maturity and damaged epiphysis leading to closure are only a few contraindications. Idiopathic genu valgum patients were treated only after it was clear that physiological recovery is further not possible. Surgery is usually not done at an age of less than 8 years [9]. After the age of 8 years, any deformity of a magnitude of fewer than 10 degrees is usually managed conservatively [10-12]. But if there is a deformity within more than 16 degrees and if there are at least 12 months anticipated growth remaining in the skeleton. 8 plate epiphysiodesis is a better option. The 8 plate acts on the principle of flexible tension band rather than compression of the epiphysis and thus doesn't cause premature epiphyseal closure, that slow down the speed of growth at that particular site [4, 6, 13]. Doing Hemi-epiphysiodesis further has the secondary benefit of better alignment of body axis leading to efficient function at hip and ankle joint [4]. Using hemi-epiphysiodesis, we can avoid or delay osteotomy, rebound growth or reappearance of deformity. No hardware failure. No plate breakage is observed in the study which is in congruence with author studies found in literature [4, 8, 14].

CONCLUSION

At the end of this study, we concluded that eight-plate can be a better treatment option for idiopathic genu valgum in adolescents and pediatric population. It is a simple procedure which produces reproducible results with fewer complications. It is cost-effective and saves considerable time in rehabilitation as well and assures an early return to school activities and recreation.

Conflict of Interest: None

Source of Support: Nil

Ethical Permission: Obtained

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