

Article

Functional and anatomical outcomes of 8-plate fixation in angular deformities of knee in children

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Abstract: Background: Angular deformities of knee in children are a commonly encountered condition in orthopedic practice. Many of the cases are physiological and do not warrant any treatment.

Aim: To assess the functional and anatomical outcome of 8-plate fixation for genu valgum or genu varum deformities in children.

Material and Methods: The study was designed as a prospective and retrospective hospital based study in Dept. of Orthopaedics, Govt. Medical College, Kozhikode. Patients attending the Orthopedic outpatient department at Govt. Medical College, Kozhikode between 1/6/2017 to 31/3/2019. Sample size was found to be 24. SPSS was used for analysis.

Results: Out of the 24 cases, 3 were implanted at age < 10 years. Median age at intervention was 13 years. Average age at intervention was 12.25 with a range of 9 years to 14 years. The following results were observed after following up a total of 24 patients who has undergone 8-plate fixation for angular deformities of knee. 15 were boys and 9 were girls. 18 were having valgus deformity and 6 were having varus deformity. In total 39 limbs and 56 physis were intervened. Mean period for implant removal is more when only tibia is implanted and least when both tibia and femur are implanted. However, this can't be used to compare the efficacy of different implanting sites, as removal of implant is influenced by several factors like follow up visits and severity of primary deformity. More reliable measurement is the rate of correction of deformity.

Conclusion: In our study, we were able to demonstrate that hemiepiphysiodesis using eight plate is an effective and safe treatment for angular deformities of knee in children irrespective of the age group, sex and primary deformity. The rate of correction of deformity decreases as the age increases. So, early surgery is advisable in diagnosed pathological deformities. A proper follow up of the treated patients is needed to assess the response.

Keywords: Angular Deformities; Valgus; Varus; Plate fixation; Osteotomy.

1. Introduction

Angular deformities of knee in children are a commonly encountered condition in orthopedic practice. Many of the cases are physiological and do not warrant any treatment. Pathological deformities should be identified promptly and treatment initiated. Otherwise, progression of the deformity will cause gait alterations and degenerative changes of knee joint later in life [1,2].

The accurate diagnosis and treatment initiation needs a three joint x-ray showing hip, knee and ankle. Osteotomy has been the standard choice for many of our surgical interventions; advances in medical imaging and instrumentation have made this relatively safe, improving outcome. Nevertheless, immobilization and deferred weight bearing are still required [3,4]. While osteotomy is necessary for rotational correction and limb lengthening, angular correction may be achieved by other means: several techniques of epiphysiodesis have evolved, enabling gradual correction through guided growth. Growth modulation using reversible means is nowadays the first treatment of choice except in severe deformities and children with limited remaining growth of physis [5,6]. For a long period, Blount's staples were the implant of choice for temporary hemiepiphysiodesis. Since the first publication of a study report in 2007, figure of eight tension band plates

have become more popular [7]. They have been proved to have certain advantages over staples, like, fewer incidences of implant migration and breakage, faster correction and lesser chance of physeal damage. Eight plate also has shown to cause complications like screw breakage, rebound deformity after removal of implant and iatrogenic deformity in the opposite direction [8,9].

Eight plate fixations is the most common surgery for knee angular deformities performed in our institute. It is a novice technique and should be assessed for its efficacy and safety. Hence we have decided to conduct a study to assess the growth and outcome after applying eight plates.

2. Material and Methods

The study was designed as a prospective and retrospective hospital based study in Dept. of Orthopedics, Govt. Medical College, Kozhikode. Patients attending the Orthopedic outpatient department at Govt. Medical College, Kozhikode between 1/6/2017 to 31/3/2019. Sample size was found to be 24.

2.1. Inclusion criteria

1. Age at implantation – Above 6 years and open physis.
2. Treated with 8-plate for genu varum/ valgum for diseases affecting growth plate/ posttraumatic/post-infectious/ idiopathic causes.

2.2. Exclusion criteria

1. Neoplasm influencing the growth plate detected before or after the implantation.
2. Age at implantation <6 years or closed physis.
3. Treated with other surgical methods for the same condition previously.

During the study period, 24 patients who has undergone 8- plate fixation for coronal plane deformities of knee were evaluated after obtaining informed consent. Radiological and clinical follow up was done in outpatient department and all necessary data were collected.

2.3. Statistical Analysis

The statistical analysis was performed using SPSS for windows version 22.0 software (Mac, and Linux). The findings were present in number and percentage analyzed by frequency, percent, and Chi-squared test. Chi-squared test was used to find the association among variables. The critical value of P indicating the probability of significant difference was taken as <0.05 for comparison.

3. Results

Out of the 24 cases, 3 were implanted at age < 10 years. Median age at intervention was 13 years. Average age at intervention was 12.25 with a range of 9 years to 14 years. The following results were observed after following up a total of 24 patients who has undergone 8-plate fixation for angular deformities of knee. 15 were boys and 9 were girls. 18 were having valgus deformity and 6 were having varus deformity. In total 39 limbs and 56 physes were intervened.

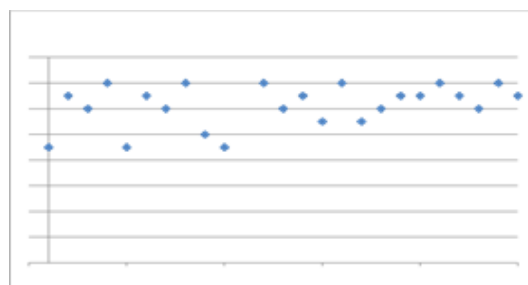


Figure 1. Age Distribution

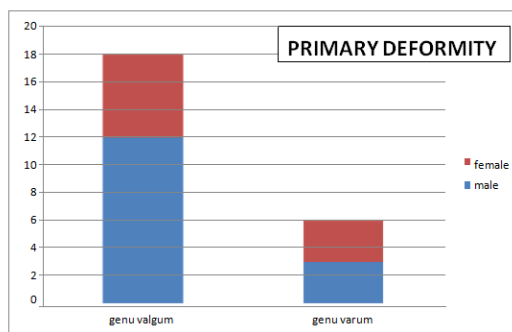


Figure 2. The primary deformity

18 were having valgus deformity and 6 were having varus deformity

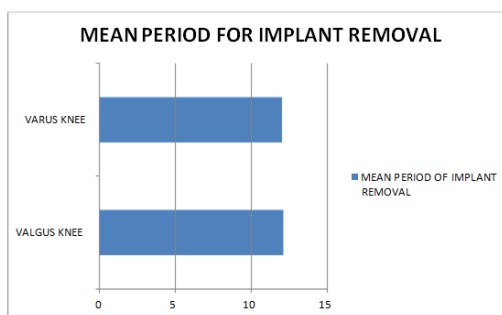


Figure 3. mean period for implant removal

In valgus knee – 12.1 months. In varus knee – 12 months. Thus, the mean period for implant removal is similar for valgus and varus knee.

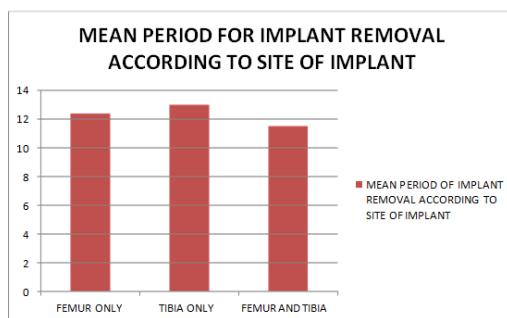


Figure 4. Mean period for implant removal according to site of implant

Femur only implanted – 12.4 months. Tibia only implanted – 13 months. Femur and tibia implanted – 11.5 months Mean period for implant removal is more when only tibia is implanted and least when both tibia and femur are implanted. However, this can't be used to compare the efficacy of different implanting sites, as removal of implant is influenced by several factors like follow up visits and severity of primary deformity. More reliable measurement is the rate of correction of deformity.

Table 1. Rate of correction of tibiofemoral angle in various age groups

| Age group | Rate of correction of MTFa (°C) month) |
|---------------|---|
| <10 years | 1.52 |
| 10 – 12 years | 1.2 |
| 12 – 14 years | 1.06 |

As per Table 1 as the age increases, the rate of correction of deformity decreases.

Table 2. Outcome at final follow up

| | |
|---------------------|----|
| Fully corrected | 19 |
| Partially corrected | 2 |
| Overcorrected | 3 |

3 cases of genu varum were slightly overcorrected. 2 cases of genu valgum were under corrected. Rest all the cases were corrected to neutral alignment.

Table 3. correction of individual angles(Valgus knee)

| Angle | Mean value | |
|-------|----------------|-----------------------|
| | Before surgery | At final follow Up |
| Mtfa | 15.6 | 1.9 |
| Ldfa | 74.5 | 86.1 |
| Mpta | 95.1 | 88.5 |

Table 4. correction of individual angles(Varus knee)

| Angle | Mean value | |
|-------|----------------|-----------------------|
| | Before surgery | At final Follow up |
| Mtfa | 12.6 varus | .85 valgus |
| Ldfa | 97.6 | 88.4 |
| Mpta | 78 | 88 |

Table 5. Rate of correction of individual angle

| Angle | Valgus Knee | Varus Knee |
|-------|-------------|------------|
| Mtfa | 1.18 | 0.97 |
| Ldfa | 1 | 0.68 |
| Mpta | 0.61 | 0.67 |

As per Table 3 mechanical tibiofemoral angle was corrected fastest both in varus and valgus knee, followed by lateral distal femoral angle and medial proximal tibial angle. Correction of LDFa was faster in valgus knee and correction of MPTa was faster in varus knee.

4. Discussion

The management of angular deformities of knee in growing age is an evolving subject. In skeletally mature patients, osteotomy remains the gold standard. Prior to the introduction of Phemister's technique, osteotomy was the only surgical option for angular deformities of knee. Later, reversible techniques became

popular. Since the introduction in 1940s, Blount's staple became very popular and was in use until recently. Most surgeons reserved the use of staples in adolescents, fearing permanent physal closure. The popularity of Blount's staple decreased also due to complications like hardware breakage and migration. Dr. Stevens introduced figure of 8 tension band plates in 2007 [8,9]. 8-plates have surpassed staples for the management of coronal plane deformities of knee.

Out of 24 cases studied, 19 cases were fully corrected. 3 cases of genu varum were slightly overcorrected to valgus. 2 cases of genu valgum were partially corrected. This is similar to the success of 8-plate observed in previous Indian studies [10-13].

In our study, majority of the patients were treated at age of above 10 years. Only three patients were implanted at below 10 years age. Average age at implantation in our study was 12.25 years, ranging from 9 years to 14 years. In Burghardt's study published in 2010, average age at implantation was 9 years 7 months. In our study median age at intervention was 13 years, similar to 12.7 years in a study [14].

Average duration of 8-plate implantation in our study was 13 months with a range of 11 to 16 months. The average duration to implant removal was similar with respect to the primary deformity in our study. It was 13.3 months in genu valgum group and 12.8 in genu varum group [15,16].

Several studies have given insights into the rate of correction of deformity with respect to the site of 8-plate implantation. In our study, rate of correction of mechanical tibiofemoral angle was 1.04°C per month if only femur is implanted and 0.96°C per month if only tibia is implanted. Two studies have given similar results. According to Raju et al, the rate of correction was 0.7°C per month if femur only implanted and 0.5°C per month if tibia only implanted [16]. In the study by Khaled et al, rate of correction was 1.9°C per month if only femur is implanted and 1.1°C per month if only tibia is implanted. Both studies are showing higher rate of correction if femur only is implanted compared to if tibia only is implanted. Our study shows rate of correction is higher i.e. 1.37°C per month if both tibia and femur are implanted, similar to the above mentioned studies. The rate was 2.1°C per month according to Khalid et al. [17].

According to Venkataramana et al, the rate of correction of tibiofemoral angle was 1.1°C per month in genu valgum cases and 0.77°C per month in genu varum cases. In our study, rate of correction of TF angle in genu valgum was 1.18°C per month and in genu varum was 0.97°C per month [18,19].

There were no studies comparing the rate of correction of tibiofemoral angle in males and females. In our study, the rate of correction of TF angle in males is 1.09°C per month and in females is 1.14°C per month. Gheldere et al in an abstract described three types of complications of 8-plate use in correction of pathologic deformities [20].

5. Conclusion

In our study, we were able to demonstrate that hemiepiphysiodesis using eight plate is an effective and safe treatment for angular deformities of knee in children irrespective of the age group, sex and primary deformity. The rate of correction of deformity decreases as the age increases. So, early surgery is advisable in diagnosed pathological deformities. A proper follow up of the treated patients is needed to assess the response. Iatrogenic deformity due to lack of proper follow up can be curtailed by adhering to a fixed protocol. The rate of correction of deformity is higher if both femur and tibia are implanted. Hence if deformity is present in both tibia and femur, implantation of both sites is desirable at the first surgery itself. In children with significant remaining growth, some amount of overcorrection is desirable. A large sample study comprising various etiologies and age groups should be done with an extended follow up to monitor the incidence of complications including rebound deformity.

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Conflicts of Interest: The authors declare that they do not have any conflict of interests.

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