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Fracture of the femoral shaft related with bone overgrowth in children admitted at tertiary care institute of Gujarat

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Abstract

Background and Aim: Femoral shaft fractures represent 1.6% of all fractures in the pediatric population. There is abnormal distribution of incidence with the first peak being from two to four years of age and the second in mid adolescence. Present study was conducted to investigate the degree of overgrowth and have attempted to correlate clinical factors that may influence the outcome with such overgrowth.

Material and Methods: Present retrospective study was conducted in Children between the ages of 0 to 14 years presented in, the Department of Orthopedics, at tertiary care institute of Gujarat for the period of 3 years. A Total of 31 patients were admitted for femoral fracture during this period of study treated with conservative non-operative management for femoral shaft fractures. These children were reviewed with regard to the differences that were observed in the limb length after treatment.

Results: The mean difference in overgrowth between this age group was statistically significant ($p < 0.05$). Nine of the fractures were in the upper third of the femur; eighteen were in the middle and four were in the lower third. Mean overgrowth of fractures in the upper third group was 0.90 cm; for the middle third the mean was 0.81 cm and lower third mean was 1.05 cm. The mean overgrowth for transverse fractures (18 cases) was 0.89 cm; oblique fracture (6 cases) 0.85 cm and spiral fracture (7 cases) 0.81 cm.

Conclusion: Overgrowth after fracture of the femur in children is a universal phenomenon. Gender, level and pattern of fracture do not affect the quantity of overgrowth.

Keywords: Children, Femoral shaft fractures, lower limb, overgrowth

Introduction

Femoral fractures are among the most common fractures of long bone ^[1]. Femoral shaft fractures represent 1.6% of all fractures in the pediatric population. There is abnormal distribution of incidence with the first peak being from two to four years of age and the second in mid adolescence. During childhood, remodeling in the femur causes a change from primary weaker bone to stronger lamellar bone. Up to age sixteen years, there is geometric increase in the femoral shaft diameter and relative cortical thickness of the femur resulting in a markedly increased area movement of inertia and strength. This partially explains the bimodal distribution of injury pattern, in which younger patients experience fracture under local conditions like normal play or minor trauma.

It is important to recognise the factors that influence overgrowth, so that overriding of bone fragments can be adjusted in such a way as to minimize the final leg length discrepancy. There are many studies that have been published related to the overgrowth of femur after fracture in a growing child. In 1921, Truesdell ^[2] was the first to report on post-traumatic increase in growth. This overgrowth phenomenon was studied by K Speed ^[3] who concluded that this was due to a compensatory mechanism. Others regarded this increase to be associated with hyperemia which would occur with the healing process in the fracture of these children. Recognizing the factors that influence overgrowth is important in this study so as to adjust the overriding of bones, in a way that would minimize the final length discrepancy. Various authors have recommended differing amounts of overlap ranging from 1.5cm to 3cm ^[4, 7].

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The management of paediatric femoral fractures depends primarily on the age of the child although the bone age and size of a child may determine the choice of treatment^[8]. The choice of management may also be determined by surgical experience and local trends in practice. Non-operative management plays a role in some cases still though current practice has veered towards operative fixation as it allows early mobilisation and shorter hospital stays. Present study was conducted to investigate the degree of overgrowth and have attempted to correlate clinical factors that may influence the outcome with such overgrowth.

Materials and Methods

Present retrospective study was conducted in Children between the ages of 0 to 14 years presented in, the Department of Orthopedics, at tertiary care institute of Gujarat for the period of 3 years. Patients with bilateral fractures and fractures treated with internal fixation were excluded from this study. The treatment received by the patients was age dependent. Bryants traction was used for children under the age of two years or less than 6.8kg. The treatment protocol followed in the conservative management of these fractures was the application of traction for about 3 weeks. This was followed by Hip spica for an additional 3 weeks for older children, skin traction would be applied for 3 weeks using a Thomas splint in which the adjustment of weight was based on radiographs so that the fragments overlapped by around 1 cm. This would be followed by application of Hip spica for an additional 3 to 5 weeks.

Radiographs taken at the time of admission till callus formation were reviewed. Final limb length discrepancy was evaluated after squaring of the pelvis and the patient lying in a supine position. The measurement between the tip of the medial malleolus and the anterior superior iliac spine was taken. The average of three measurements was used as the recorded discrepancy. Subtraction of the final limb length from the initial limb length was done to determine the overgrowth.

Range of movements of the knee and the hip was assessed along with equity into the limitation in sports or daily activities of the patients. Investigation was also done to assess complications such as postural scoliosis which could occur as a result of limb length discrepancy and abnormal gait. Results were analyzed using SPSS (Statistical Package for Social Sciences).

Results

A Total of 31 patients were admitted for femoral fracture during this period of study. All patients included in this study had at least 12 months of follow up. A total number of 23 males and 08 female were included in the current study. (Table 1) There was division of the children into three different age groups; 9 were < 3 years; 13 were between 3 to 8 years and 9 were 8 to 14 years of age. Mean age of all the children was 6 years and 8 months. Mean overgrowth of the femur in children below the age of two was 0.36 cm. Older children between the ages of 3 to 8 had a mean overgrowth of 0.94 cm and those between the ages of 8 to 14 had a mean overgrowth of 1.24 cm. The mean difference in overgrowth between this age group was statistically significant ($p < 0.05$). Nine of the fractures were in the upper third of the femur; eighteen were in the middle and four were in the lower third. Mean overgrowth of fractures in the upper third group was 0.90 cm; for the middle third the mean was 0.81 cm and lower third mean was 1.05 cm. There were no statistically

significant differences found between the three groups (Table 1).

The mean overgrowth for transverse fractures (18 cases) was 0.89 cm; oblique fracture (6 cases) 0.85 cm and spiral fracture (7 cases) 0.81 cm. There were no statistically significant differences found between the three groups (Table 1).

There was a positive correlation between initial shortening and subsequent overgrowth of the fractured limb, based on the Pearson correlation test. There was one case of postural scoliosis which was correctable with a raised shoe in a child with 2.0 cm shortening. Clinically, all patients had full range of hip and knee movements.

Table 1: Mean overgrowth and predictors of study participants

Factor	Number	Mean in CM
Age		
> 3 years	9	0.36
3 to 8 years	13	0.94
8 to 14 years	9	1.24
Gender		
Male	23	0.92
Female	8	0.68
Pattern of fracture		
Spiral	7	0.81
Oblique	6	0.85
Transverse	18	0.89
Level of fracture		
Upper third	9	0.90
Middle third	18	0.81
Lower third	4	1.05

Discussion

The treatment of diaphyseal femoral fractures in children remains controversial as there are a number of effective treatment modalities. Irrespective of trends in treatment, a decision on the type of fixation used should be based on the current evidence available. Where controversy exists, other factors must be considered. According to Blount^[9], open reductions of diaphyseal fractures were practically never indicated as they were associated with a risk of significant increase in growth. He was of the opinion that the diaphyseal femur fractures in children be allowed to heal with a shortening of 1-2 cm, which would likely be eliminated during the course of further growth. During his study, he did not find any relationship between the distance of fracture from the growth plates and the degree of overgrowth.

In the present study, we found that there was influence of the age of the patient at the time of fracture on the final quantity of femoral overgrowth. There was more overgrowth in the 3 to 8 compared to the other years age group. Overgrowth being related to age was concluded by many authors^[10, 12]. Clement and Colton were of the opinion that the most important factor that was influencing overgrowth was gender. We found that the level of the femoral fracture did not influence overgrowth, which was similar to findings in various other studies^[13, 14].

From our findings we could conclude that we did not find any difference in the amount of overgrowth between oblique, transverse and spiral fractures, unlike findings reported by Barford and Christensen^[15].

It was also found that overgrowth did not appear to be influenced by level of the femoral fracture, similar to findings reported by several other studies^[16, 17], whereas Staheli (1967)^[11] reported more overgrowth in proximal fractures. From our data, we did not find any difference in the amount of overgrowth between oblique, transverse and spiral fractures, unlike findings reported by Barford and Christensen

(1958) ^[15]. In their follow-up study of 114 femurs, oblique and comminuted fractures were shown to produce more overgrowth.

Conclusion

Overgrowth after fracture of the femur in children is a universal phenomenon. Gender, level and pattern of fracture do not affect the quantity of overgrowth. Although a majority of patients end up with equal limb length, we expect all patients to achieve a reduction of the initial discrepancy in length; of those patients who do not show equal leg length at the last follow up, most have slight shortening, while a smaller number will have slight lengthening.

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