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### A clinical study of Ender nails fixation in femoral shaft fractures in children

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### Abstract

**Background :** Fracture of femoral shaft is fairly common in children and should be considered serious because of blood loss and potential shock that accompany the primary trauma. Surgical procedure allows early mobilization, rapid callus formation and rapid restoration of continuity of bone.

**Method :** We studied 24 children with 24 femoral shaft fractures in age group 6-14 year (average 9.67 years). Eighteen fractures were in middle third, 4 in distal third and 2 in proximal third. Fifteen fractures were transverse, 4 oblique and 5 were spiral. Twenty-three cases were closed and one grade I compound. The injury surgery interval was 6 day. Mean hospital stay was 10.4 days. They were treated by closed reduction and Ender's nail fixation.

**Result :** The minimum follow up was 6 months. The average time to clinical union and full weight bearing was 6.6 week (5 to 12 week); full movement was achieved in 9 weeks (6 to 15 weeks). One case of intraoperative perforation occurred. Two cases of nail protrusion and infection occurred. No cases of deep infection, delayed union, nonunion were seen. Seven cases had no limb length discrepancy. Thirteen cases had lengthening (max 9 mm mean 4.23mm), 4 cases had shorting (max 7mm mean 4.25mm). On the Flynn criteria 20 denoted excellent and 4 had satisfactory results. No poor results were seen.

**Conclusion :** Healing in cases treated with Ender's nail can be with abundant callus attributed to non rigid fixation. This resulted in rapid fracture union and early return to full weight bearing while reducing hospital stay. Advantages that Ender nailing offers over other treatment modalities both consecutive as well as operative convinces us to recommend ender nailing in isolated femoral shaft fracture in children between 6-14 years.

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Abstract

Introduction

Materials and Me...

Results

Discussion

References

Article Figures

Article Tables

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## Introduction

Traditional management of pediatric femoral shaft fractures has been by immobilization in spica cast. Indications for surgical management were few and included children with associated injuries like head injury, abdominal injury or compound fracture with extensive soft tissue trauma. As the management of femoral shaft fractures in children evolved, complications such as limb length discrepancy, torsional and angular deformities were noticed with spica cast management even after proper precaution. To add to that were the psychosocial implications of spica cast treatment, with separation of child from his environment and the difficulties in taking care of a child in spica [1],[2],[3]. Because of the above complications indication of surgical management of pediatric femoral shaft fractures has been widened to include isolated femoral shaft fracture [4],[5],[6],[7].

In this study we report the use of Ender nails for flexible intramedullary nailing of femoral shaft fractures in children.

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## Materials and Methods

We included children between 6-14 years with fracture shaft femur at least 3cm distal to lesser trochanter and 3 cm proximal to physis. Patient with closed or open fractures with Gustilo grade I and II were included.

*Operative Technique:* On a fracture table, traction was applied under fluoroscopic guidance to reduce the fracture. Proper size Ender nails of 3 or 3.5mm diameter were taken. Nails were bent in an even curve. The tip was further bent 2cm from one end at 40 degree. This facilitates the nail to bounce of the opposite cortex into the canal rather perforate it. After incising the skin, insertion points were made one on medial and another on lateral side of distal femur, 2.5cm proximal to the distal epiphyseal plate. The nails were introduced right up to fracture site. Than one of the nail was passed across the already reduced fracture site followed by second nail. The nails were directed in such a way that medial nail was introduced into the neck and lateral just below trochanteric apophysis in a fan shaped manner. Two divergent Ender nails provide adequate fixations and stability in adolescent femur [8]. To prevent knee pain and problems of nail protrusion the distal end of nail should never project beyond distal epiphyseal plate on IITV and care should be taken to avoid bending the distal end of nails.

## Results

Between March 2003 and April 2005, 24 children with 24 femoral shaft fractures were treated with Ender nails. Ages of children ranged from 6-14 years (mean 9.67 years). There were 17 boys and 7 girls. The M: F ratio in 6-14 years was 7 males and 6 females respectively where as males far outnumbered females in 11-14 years group (10 males and 1 female). Eleven patients sustained injury due to fall from height while 13 patients sustained road traffic accident. Thirteen cases sustained right sided and 11 cases sustained left side fracture. No cases with bilateral fractures were seen. In all 18 fractures were in middle third, 4 in distal third, and 2 in proximal third. Fifteen cases had transverse fracture, 4 were in

oblique and 5 were spiral in pattern. Seven cases showed some comminution. On Winquist [9] grading system 3 were grade I, two were grade II, one was grade III, and one was grade IV. No segmental fractures were seen. Grade I and II open fractures were included. Associated injuries were seen in 4 cases, 2 had associated head injury, of which one also had ipsilateral fracture of shaft humerus and medial condyle of humerus. One case had a wound over back and another case had an undisplaced fracture of ipsilateral tibia.

The interval between injury and surgery varied from 2 days to 15 days. The mean hospital stay was 10.4 days. The average duration of surgery was 39 min. The mean fluoroscopy time was 66 f/sec.

In 2 cases antegrade nailing was done whereas in 22 cases nails were inserted in a retrograde manner. In two cases fracture site had to be opened to engage the proximal fragment. In rest of the cases operation could be performed in a closed manner with small incisions and minimal blood loss.

Postoperatively no patient needed any protective splint. Knee bending and quadriceps strengthening exercises were begun as soon as patient was comfortable. Any attempt to passively bend knee is not desirable as it causes reflex quadriceps spasm. Partial weight bearing on axillary crutches was begun around 4 weeks depending on fracture configuration and patient tolerance. Full weight bearing could be commenced in about 2-3 weeks time more in most of the cases. The average time to full weight bearing was 6.6 week (5 to 12 week), full movement was achieved in 9 weeks (6 to 15 week).

*Complications:* Two cases of nail protrusion due to long nails occurred. In both cases the nail was removed at one and half month and 1 month and 25 days respectively. No deep infection occurred. Fracture proceeded to union without any other sequel. In one case the opposite cortex got perforated but the nail was reintroduced. This occurred probably because the nail was not bent in an even curve. Since then care was taken to bend the nail in an even curve and further bend the tip at 40 degree 2 cm from its tip so that rather than perforating the nail bounces off the opposite cortex.

*Follow up:* The mean follow up was 8.1 month (6 to 14 months) by this time all the patients had full-unrestricted activity. None of the patients had any pain, limp or gait abnormality Angular deformity was observed in 11 patients, but it exceeded 5° in only 2 patients (7 degrees varus deformity and 6 varus deformity). Lengthening was observed in 13 patients (Max 9mm; Mean 4.23 mm). Shortening was seen in 4 patients (Max 7mm; Mean 4.25 mm). No discrepancy was seen in 7 patients. On clinical examination significant malrotation was not seen in any patient.

According to the Flynn criteria [10] [Table - 1] 20 patients had excellent result [Figure - 1], 4 satisfactory and none poor result.

## Discussion

The treatment of children with femoral shaft fractures in age group 6-14 years is highly controversial. Many orthopedician reserve surgical management for multiply injured patients. This study aimed to treat isolated femoral shaft fractures surgically. The advantages of flexible intramedullary nailing (FIN) over spica management have convinced us to treat isolated femoral shaft fractures in 6-14 year with flexible intramedullary nailing. Spica treatment has disadvantages such as prolonged hospital stay, shortening, angular and torsional deformity and the psychosocial implication of treatment of femoral shaft fractures. These were avoided in treatment with FIN [7],[11]. External fixation although is associated with minimal soft tissue dissection but it causes patient apprehension on account of external device, high rate of pin track infection and real danger of refracture after removed of fixator [12],[13],[14]. Rigid intramedullary nailing may damage the blood supply to the femoral head resulting in AVN or causing growth arrest at the greater trochanter resulting in coxa valga. They were not advised for children. Flexible nailing

requires less operative as well as fluoroscopy time <sup>[11]</sup> . Compression plating is associate with large soft tissue dissection opening of fracture site major operation for removal.

Some limb lengthening may be seen in femoral fractures treated by surgery. Ligier et al <sup>[15]</sup> in their series showed a mean lengthening of 1.2 mm, and residual angulations never exceeding 10<sup>0</sup> .

This surgical procedure is technically simple, time saving and can be done in a closed manner <sup>[11]</sup> . It allows early mobilization, rapid external callus formation and rapid restoration of continuity of bones even as allowing ease in patient care <sup>[7],[15],[16]</sup> . Two divergent ender nails provide adequate fixation and stability in adolescent femur fracture <sup>[8]</sup> . The major advantages of FIN is in rehabilitation and healing with abundant callus, attributed to non rigid fixation <sup>[17]</sup> . This results in rapid fracture union and early return to full weight bearing while reducing hospital stay and treatment cost.

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## Figures

[Figure - 1]

## Tables

[Table - 1]



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