Comparative Study of Fracture Shaft of Femur in Children Treated with Titanium Elastic Nail and Early External Fixator

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Background: Although incidence of femoral shaft fracture in children is less than 2%, treatment of fracture shaft of femur is controversial.

Material and Method: In this study we divide 30 patient in to two groups blindly and treat group I with retrograde titanium elastic nail (TEN) and group II with early external fixator. We have followed these patients for nine months and compile their results after noting the time of union, weight bearing and also the parents satisfaction with a questionnaire.

Results: Duration of hospital stay was 4.7 days in group I and 2.8 days in group II. All the fractures healed satisfactorily. The average time for healing in the group I was 43.4 days and 70.26 days in group II. The average time for full weight bearing along with external fixator was 26 days while for group I was 42.7 days. Parents are more satisfied with intramedullary TEN.

Conclusion: TEN is better option than that of external fixator for the management of fracture shaft of femur in children. Patients and their parents are more satisfied with TEN as compare to heavy external fixators.

Introduction

Trauma is the leading cause of morbidity and mortality in children.[1] It accounts for 50% of mortality in children after the first year of life and fracture are the most adverse event in the life of children.[2] In pediatric fractures, femoral fractures have significant impact not only on the patient's and their family network but also on regional trauma resources.[1] They accounts for 1.6% of all fractures in pediatric population.[3]

Commonly reported mechanisms of injury are falls, traffic accidents, child abuse, sport injuries, fall of object on limb and pathological fracture (rarely).[1,4,5] Incidents of femur fracture has two peaks one at the age of 2 year to 3 year and other during adolescence 6 . Boys have higher rate of fractures than girls presumably due to a high level of exposure and active behavior.[7,2]

Treatment of the femoral shaft fracture in children is controversial especially in children of age 6-12 years.[4] The traditional method of treatment of femoral shaft fractures in children has been an initial period of traction followed by a spica cast until solid union occurs.[8] Various methods of treatment can be used successfully depending upon the age of the patient and the type of the fracture but there is no consensus on one method as the best option.[9] Commonly used options include conservative with skin or skeletal traction, hip spica cast and operative with external fixation, open reduction and internal fixation with plating and close reduction and internal fixation under image intensifier with the locked or flexible titanium elastic nails.[1,4]

During the last decade, there has been an increasing tendency to change from non-operative treatment to minimally invasive treatment by retrograde TEN and external fixation.[10]

In the present study we treated and compared the results femoral shaft fractures in children 6 to 12 years of age by two methods i.e.

1. Retrograde intramedullary titanium elastic nails.
2. Early external fixator application.

Material and Method

In this study we have treated total thirty children, of age 6 to 12 years, having fracture shaft of femur, fifteen of them were treated and remaining with early external fixator application and compare their results. The children were randomly allocated to the two equal treatment groups.

In first group the patients were admitted and treated with retrograde TEN. The surgery was performed under general anesthesia with the patient on the simple OT table in supine position and manual traction given to reduce the fracture. Two Titanium Elastic Nails of identical diameter were used one introduced through the lateral side while second through medial side. The diameter of the individual nail was selected as per Flynn et al's formula (Diameter of nail = Width of the narrowest point of the medullary canal on Anteroposterior and Lateral view x 0.4 mm).

Fractures were reduced using image intensifier guidance. Titanium elastic nails were inserted in retrograde fashion with medial and lateral incision 2.5 – 3.5 cm above the physis. Entry point in bone was made with awl. Nails were prebent in C-shape sufficiently to leave a significant recoil force, the tip of the nail was bent sharply over a length of 1 cm at an angle of 30 to 45 degree to the main portion of the nail to facilitate the advancement of implant in modularly cavity.[8,11] The nail was then manually advanced

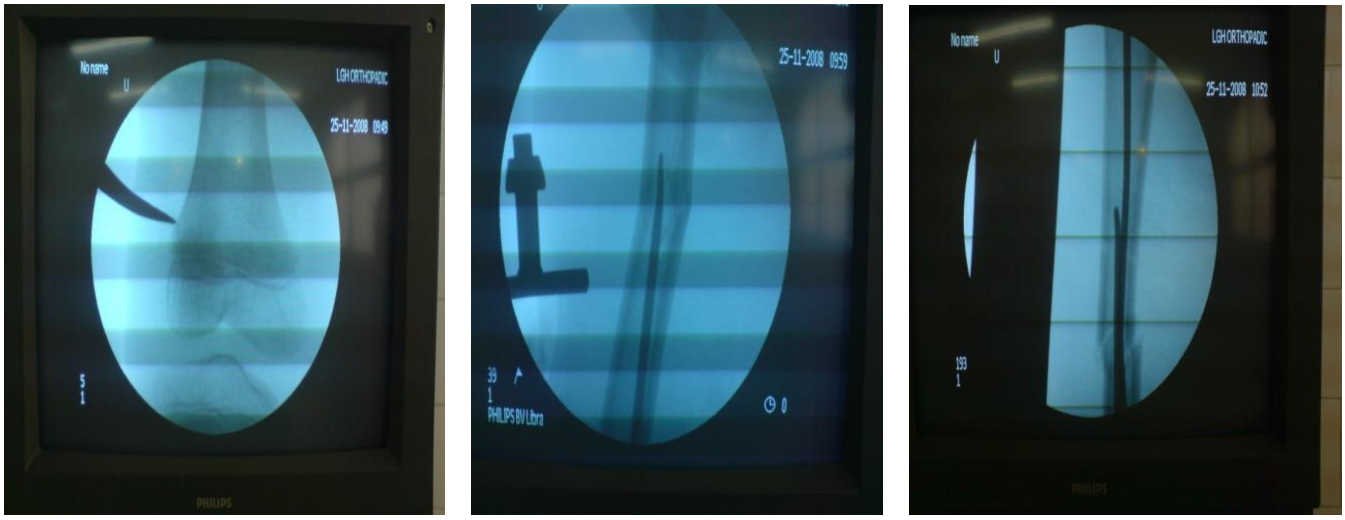

Figure 1: *Images of different steps of procedure from image intensifier*

Figure 2:

proximally under the image intensifier . The curved tip of medial nail was end in the neck of femur and that of lateral end in the region of greater trochanter to improve the rotational stability. Distal ends of the nails were cut off one to two cm from the surface of the bone to facilitate later removal of the implants.

Postoperatively, on next day knee movements were allowed. Partial weight bearing was started after 3-4 weeks of fixation and full weight bearing after 6-10 weeks depending upon the configuration of fracture and calus response. All the patients were followed up radiological and clinically till fracture healed. Nails were removed after 4 to 6 month of fixation when no line of fracture was visible.

In second group, we treated fracture shaft of femur with NA external fixator with 14 inches long bars with two 3 pin clamps was used. Assembly of the fixator fixed to the femur with the help of four shanz screws, two on each side of the fracture. Shanz screw of 5 mm × 170 mm for children above 5 years, and 4 mm × 150 mm were used for children below 5 years.

Under antiseptic conditions and general anesthesia, patient in supine position and traction was applied and all angular and rotational deformities corrected by close reduction of the fracture of the shaft of the femur, under image intensifier. N.A external fixator assembly placed along the femur outside the skin. Based on the study of the injury film, the shanz screw passed through the holes of the pin clamps, one on each of the fracture. The pin was placed

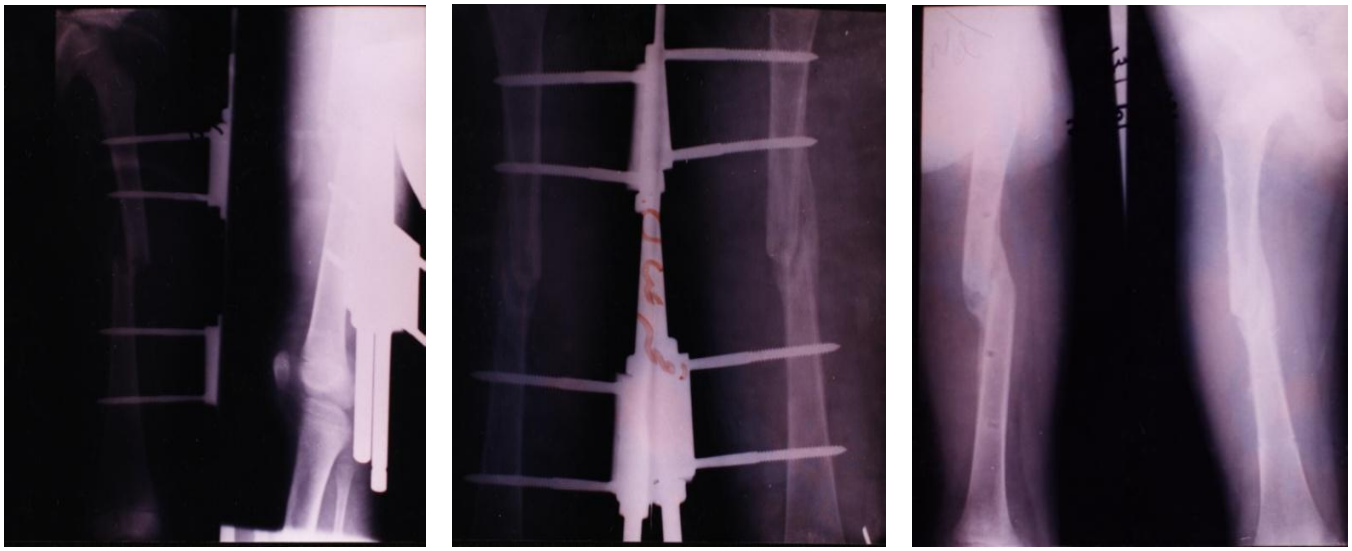

Figure 3:

through a 1 cm stab wound with the help of low speed power drill. N.A external fixator was stabilized by tightening the screws & bolts.

Post operative, parents were educated to keep the pin tracts clean with the help of antiseptics like spirit and pyodine solution. Also advised to keep the pin tracts covered with the help of clean clothes. Patient was kept in the ward for next 24 hour and patients were followed as:

First week: patient was clinically evaluated. Pin tracts examined for any signs of infection.

Third week: patient was examined radiologically and clinically. Patient was encouraged to start weight bearing and start active movements at hip and knee of the injured side.

Next radiological examinations were carried out with the interval of two weeks and continued for 12 weeks. N.A external fixator was removed when union was confirmed on x-rays of the fractured femur.

In both groups, after nine months (i.e. minimum period of follow-up in the present study), all patients were examined for any problem regarding function of the limb and limb length discrepancy. We also tried to know level of parent satisfaction about both treatment methods. Parents were asked the following questions:

1. Parents not satisfied.
2. Just accepted the method of treatment.
3. Will allow or recommend others the same treatment and
4. Can undergo the same treatment, if needed again.

Results

In this study, 30 patients with close fracture of femoral shaft in children were studied. 15 patients were treated with retrograde TEN and 15 were treated with early external fixation.

Out of 30 patients, 21 were males and 9 females; Ages of the children ranged from 6 to 12 years. Fractures were 22 (73.33%) due to fall from height, and 8 (26.66%) were due to road traffic accident. Right side was involved in 13 (43.33%) while left side in 17 (56.66%) patients. Fractures were located in the upper third in 7 (23.33%), middle third in 19 (63.33%) and lower third in 4 (13.33%) cases. All fractures were close in nature. Fracture pattern were transverse in 21 (70%), oblique in 6 (20%), and spiral in 3 (10%) cases.

In 15 patients, retrograde TEN were used as treatment and in the second group, 15 patients were treated by early N.A external fixation. Duration of surgery for TEN in average was 53.54 min (25-75 min) while for external fixator was 22.5 min in average. Duration of hospital stay was 4.7 days in group I and 2.8 days in group II.

All the fractures healed satisfactorily. The average time for healing in the group I was 43.4 days and 70.26 days in group II. The average time for full weight bearing along with external fixator was 26 days while for group I was 42.7 days.

In group I two patients developed entry point infection while there was no deep infection. There was no knee stiffness. Two patients developed shortening but less than 1.5 cm and there was no case of overgrowth. There was no angular or rotational deformity.

In group II four patients developed pin tract infections but no deep infection. Five patients developed knee stiffness. There was no leg length discrepancy and angular deformity. One patient had refractured after removal of external fixator.

Regarding group II (External Fixator), the majority of the parents were not satisfied due external heavy device. The majority were of the opinion that if needed again they will prefer to adopt other treatment modalities available. The parents of the children included in the group I (TEN) were asked the same questions. They were satisfied with

early return of children to the family environment and their return to the jobs.

Discussion

Although femoral shaft fractures constitute less than 2% of all pediatric fractures, the choice of treatment remains a constant challenge to orthopedic surgeons. Various methods of treatment can be used successfully depending upon the age of the children and the type of fracture.[11] There are a wide variety of surgical and non-surgical treatment options are available as early spica casting; traction followed by casting; external fixation; plate fixation; intramedullary interlocking nails and flexible intramedullary nails with no clear consensus as to the preferred treatment.[1,12,13]

With the potential for rapid union and remodeling in children's bones excellent results are expected after conservative treatment for pediatric femoral shaft fracture.[14] Conservative treatment includes traction and subsequent immobilization in an uncomfortable spica casting.[15] This safe form of treatment has some draw backs : limb length discrepancy, angulations, loss of reduction, prolonged bed rest separates the child from his normal environment, maternal duties overload, redistribution of tasks among family members, difficulty in transporting child and high cost of bed for hospital for long period which might be able to serve other patients.[1,4]

Initially surgical treatment was limited to open fractures or for patients with head injury or multiple injuries16. However to avoid prolonged immobilization, loss of school days and for better nursing care the operative approach has been gaining popularity for last two decades.[12] Reeves et al reported that cost of non-operative treatment is 40% higher than operative treatment.[17]

There are several methods of operative treatment of femoral shaft fractures in children with some merits and demerits. Plating is a reliable method but the requirement of a second operation to remove the plate makes this technique not favored by many orthopedic surgeons.[18] Moreover two common complications of plating are implant failure and peri-prosthetic fracture.[4] Kunstchner and the interlocking nail that require modularly reaming are not widely used for children because of potential to injury to greater trochanteric growth plate and blood supply to the femoral head leading to AVN.[14] External fixator is a good alternative but with high rate of non-union (20%), pin tack infection (20%) and knee stiffness (45%), as reported in different series of fracture shaft of femur treated with external fixation.[9]

During last ten years Titanium Elastic Nails have become the most widely used implant for operative treatment of fracture shaft of the femur.[9] These have been specially designed for the treatment of diaphyseal fractures in children.[18] Titanium elasticity limits the amount that nail is permanently deformed during insertion. More importantly elasticity promotes callus formation by limiting stress shielding. Titanium also has excellent biocompatibility. These nails reduce chances of angulation in both anteroposterior and varus/valgus by achieving axial and rotatory stability through 3-point support and inner bracing.[13]

In this study we have compared the results of treatment of pediatric femoral shaft fractures with Titanium Elastic Nails to the results of early application external fixation. At the end of the follow-up period (nine months), all the 30 patients included in this study were assessed regarding any problem at the hip or knee. There was no stiffness or flexion contracture at the hip or knee in patients treated with TEN but 4 patients treated with external fixator have knee stiffness and were treated with manipulation under anesthesia and physiotherapy. One patient treated with external fixator have refracture and was readmitted and open reduction and internal fixation with plate done.

An effort was made to know the parents opinion about both treatment methods. Regarding group II (external fixator), the majority of the parents were not satisfied. Their main objections were:

- Heavy metallic external fixator frighten them and their children.
- Discomfort of the child and difficulties in taking care of child hygiene.
- Isolation of the child from the normal environment for longer duration.
- After external fixator application, the parent's main concern was about pin tract infections and their fear about externally placed metallic fexators.

The parents of the children included in the group I (TEN) were asked the same questions. They were more satisfied compared with problems faced with other treatment methods. The handling of the child was easy. They were satisfied with early return of children to the family environment. Parents were also satisfied with their return to their own jobs in less time and thus feel that TEN apparently looking costly are infect less costly. The majority of the parents were of the opinion that this treatment can be adopted again if needed.

Conclusions

From this study and the review of literature, several significant conclusions can be drawn regarding fractures of the femoral shaft in children. With TEN, there is early union and weight bearing and thus early return to the normal environment and reunion of the child with his school and friends. Easy handling and early return of parents to their jobs are additional benefits.

Thus close retrograde TEN of femoral shaft fractures in children of age 6-12 years due to its simple technique and advantages is better method of treatment and is recommended for use on priority in our society.

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