Original Research Article

Femoral shaft fractures in children: traction and spica casting (conservative treatment) versus closed titanium elastic nailing: A clinical study at Eastern India

Bikash Chandra Mondal[1], Kunal Subhas Mukherjee[2*], Subham Das[3], A Bandyopadhaya[4]

[1]Assistant Professor, Department of Orthopedics, Gouri Devi Institute of Medical Sciences & Hospital, G.T. Road, Rajbandh, Durgapur, West Bengal, India

[2]Associate Professor, Department of Orthopedics, Gouri Devi Institute of Medical Sciences & Hospital, G.T. Road, Rajbandh, Durgapur, West Bengal , India

[3]Associate Professor, Department of Pharmacology, Santiniketan Medical College, Gobindapur, PO Muluk, Bolpur, West Bengal, India

[4]Professor & Head, Department of Orthopaedics, R. G. Kar Medical College and Hospital, Kolkata, West Bengal, India

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Abstract

Background: Femoral fractures are among the most common fractures of long bones. 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. Multiple traumas may necessitate rapid stabilization of femoral shaft fractures to facilitate overall care. Not many years ago, traction and casting were standard treatment for all femoral shaft fractures in children, and femoral fractures ranked high in duration of hospitalization for a single diagnosis. The aim of my study was to compare the results of conservative treatment and closed intra-medullary titanium elastic nailing in cases of fractures shaft femur in children. **Materials & Methods**: The patients with fractures shaft of femur attending either emergency or outdoor and also patients referred from peripheral hospitals were selected. We included the patient of 5 year to 10 year with closed fractures shaft of femur in children including Gustillo type I fractures. We excluded patients with an active infection, Gustillo type II and type III open fractures of shaft femur, pathological fractures, and abnormal medullary cavity. Out of the 42 patients, 23 were treated by intra-medullary titanium elastic nailing and 19 were treated by surface traction for three weeks followed by one and a half hip spica. After titanium elastic nailing, physical therapy with touchdown weight-bearing was begun as soon as the patient was comfortable, generally around 3weeks. Gentle knee exercises and quadriceps strengthening were begun. Full weight-bearing generally was given by 8 weeks. In conservatively managed group the cast was used until six to eight weeks after the injury. After the cast has been removed, management included skin care and physical therapy with touchdown weight-bearing was begun. Ambulation was accomplished with weight bearing as tolerated. The patients were evaluated at the regular interval of 2, 4, 6 & 8 weekly and after that every month. **Results:** In the patients treated with titanium elastic nailing the results were excellent in 16 (69.5%) patient, successful in 6 (26%) patient, and poor in 1(4.5%) patient. In the patient treated with traction and spica cast the results were excellent in 11 (58%) patients, successful in 6 (31.5%) and poor in 2 (10.5%) patients. Compared with the children treated with traction and a cast, those treated with titanium elastic nails had significantly shorter hospitalization period($p<0.0001$), mean 8.5 days in operated group compared to mean 26 days in conservatively treated group. The time taken for full weight bearing was also significantly less in patient treated with titanium elastic nailing ($p<0.0001$); mean 9.1 weeks in operated group compared to 11.5 weeks in conservatively treated group. **Conclusion**: We conclude that closed pediatric femoral shaft fractures within the ages of 5-10 years can be treated successfully by any methods of traction followed by spica cast or intramedullary titanium elastic nailing. However, because of shorter immobilization period and earlier ambulation, we recommend internal fixation with titanium elastic nailing as the better choice to treat this fracture in school aged children.

Keywords: Fractures shaft of femur, conservative treatment, intra-medullary titanium elastic nailing, children, recovery outcomes

Introduction

Fractures of the femur usually are classified according to location as subtrochanteric, shaft (proximal, middle,and distal thirds), supra-condylar, and distal femoral physeal. Fractures occur most frequently in the middle third. Femoral shaft fractures, including subtrochanteric and supracondylar fractures, represent approximately 1.6% of all bony injuries in children. The male to female ratio of femoral fracture is 2.6:1 with a bimodal distribution [1-3].

**Correspondence*
Dr. Kunal Subhas Mukherjee
Associate Professor, Department of Orthopedics, Gouri Devi Institute of Medical Sciences & Hospital, G.T. Road, Rajbandh, Durgapur, West Bengal , India
E-mail: kunalmukherjee_123@yahoo.co.in

The first peak occurs in early childhood and the second in mid-adolescence.Although femoral shaft fractures are dramatic and disabling injuries, both to the patient and the family, most unite rapidly without significant complications or sequelae. The etiology of femoral fractures in children varies with the age of the child. In children younger than walking age, up to 80% of femoral fractures may be caused by abuse [4-6].

Older children are unlikely to have a femoral shaft fracture caused by abuse, because their bone is sufficiently strong to tolerate forceful blows or is able to resist torque without fracture. In older children, femoral fractures are most likely to be caused by high-energy injuries, such as motor vehicle accidents, which account for over 90% of femoral fractures in this age-group [2, 7, 8]. Pathologic femoral fractures are relatively rare in children, but they

may occur because of generalized osteopenia in infants or young children with osteogenesis imperfect [9]. Generalized osteopenia also may accompany neurologic diseases, such as cerebral palsy or myelomeningocele, leading to fracture with minor trauma in osteopenic bone. Pathologic fractures may occur in patients with neoplasms, most often benign lesions such as non-ossifying fibroma, aneurysmal bone cyst, unicameral cyst, or eosinophilic granuloma.

Although uncommon (4% of all stress fractures in children), femoral shaft or femoral neck stress fractures should be considered in a child with thigh pain because an unrecognized stress fracture may progress to a displaced femoral fracture. An unusual femoral fracture reported in infants is a greenstick fracture of the medial distal femoral metaphysis that occurs when the parent falls on a child who is straddling the parent's hip.

Most patients with femoral shaft fractures are unable to walk and are in extreme pain with an obvious fracture. A physical examination usually is sufficient to document the presence of a femoral fracture. Swelling, instability, crepitance, and tenderness usually are present. Hypotension rarely results from an isolated femoral fracture. Waddell's triad of femoral fracture, intra-abdominal or intrathoracic injury, and head injury are associated with high-velocity automobile injuries. Multiple traumas may necessitate rapid stabilization of femoral shaft fractures to facilitate overall care [8, 10]. Not many years ago, traction and casting were standard treatment for all femoral shaft fractures in children, and femoral fractures ranked high in duration of hospitalization for a single diagnosis.More recently, a variety of therapeutic alternatives, such as external fixation, compression or submuscular plating, and flexible or locked intramedullary nailing, have become available, decreasing impairment, increasing convenience, and decreasing cost of care. An increasingly aggressive approach to femoral shaft fractures appears to be continuing. It is important to note that treatment of pediatric femur fractures encompass the newborn to skeletally mature adolescent. Numerous treatment options are possible and should be tailored to each patient's case.

Aims and objectives

The aim of my study was to compare the results of conservative treatment and closed intra-medullary titanium elastic nailing in cases of fractures shaft femur in children.

Materials and methods

The study was conducted in the department of orthopedics, R.G. Kar Medical College, Kolkata. The duration of the study was being from from July 2008 to August 2010. A total of 48 cases were selected. 6 of which were lost during follow up. The patients with fractures shaft of femur attending either emergency or outdoor and also patients referred from peripheral hospitals were selected. After admission thorough history was taken particularly mode of injury and associated other injury and detailed clinical examination was done.

Selection of the patients

Inclusion Criteria

- Closed fractures shaft of femur in children
- Gustillo type I fracture
- Fracture shaft of femur in children aged 5years to 10 years

Exclusion Criteria

- An active infection
- Gustillo type II and type III open fractures of shaft femur
- Patients less than 5 year of age
- Patients more than 10 years of age
- Pathological fractures
- Abnormal medullary cavity
- Having distal neurovascular deficit
- Having any associated major injury(head injury,intra abdominal injury ,intra thoracic injuy , any associated other long bone fracture)

Assessment of Soft Tissue Injury

- Assessment of local wound, if present
- Assessment of peripheral nerve function (sensory function as well as motor function of the leg and foot.

Assessment of Blood Supply

Assessment of Bony Injury

- Type of fracture(transverse ,oblique, spiral or comminuted)
- Dislocation of hip joint
- Dislocation of knee joint
- Fracture of both bone leg

Then routine investigations as well as other special investigations if needed were performed. Selection of patient for operations and conservative management was done randomly. All the patients received oral and written information about the purpose and procedure of the study and written informed consent was obtained. The study was done after approval by the Institutional Ethics Committee.

Management on admission

Procedures

A-Titanium elastic nailing

After selecting the patients based upon the aforesaid criteria, the patients were taken for operation after proper counselling and pre-anaesthetic check up if needed. The width of the canal was measured at the narrowest point in the diaphysis on both the AP and lateral views , and this number was divided by 2. This represents the maximal diameter of titanium elastic nail that can be used, and generally a nail 0.5 mm smaller than this radius was used. Therefore, if the medullary canal measure 8 mm, a 3.5-mm nail was used filling approximately 80% of the canal diameter. The distance from the top of the inserted nail to the level of the fracture site was measured, and a gentle 30-degree bend was placed in the nail with the apex at what will be the level of the fracture.The nails used generally were 3.0 to 4.0 mm in diameter, depending on the size of the bone and the child. Two nails of the same size were always used, and varying sizes were avoided. The operations were done with the patient in the supine position and the table was positioned such that the C-arm could be brought beneath the table. The affected limb is prepared and draped with the thigh (hip to knee) exposed. The image intensifier was used to localize the placement of skin incisions by viewing the distal femur in the AP and lateral planes. Incisions were made on the medial and lateral side distal to the insertion site in the bone. The proximal end of the 3-cm incision was at or just distal to the level of the insertion site, which is about 2.5 to 3 cm proximal to the distal femoral physis. An awl was used to make a cortical hole in the bone. The distal femoral metaphysis was opened using an awl at a point 2.5 cm proximal to the distal femoral physis. The awl was then inclined 10 degrees anteriorly and steeply angled in the frontal plane to facilitate passage of the nail through the dense pediatric metaphyseal bone. Titanium elastic nails were inserted from the medial and lateral side and driven up to the level of the fracture. Upon insertion the nail glances off the cortex as it advances toward the fracture site. Both medial and lateral nails were inserted to the level of the fracture. At this point the fracture was reduced using longitudinal traction. After the first nail was driven across the fracture, approximately 2 to 3 cm, the second nail was driven across the fracture. The two nails then were driven into the proximal end of the femur, with one driven toward the femoral neck and the other toward the greater trochanter. After the nails were driven across the fracture and before they were seated, fluoroscopy was used to confirm satisfactory reduction of the fracture and to ensure that the rods did not comminute the fracture as they were driven into the proximal fragment. The nails were pulled back approximately 2 cm, the end of each nails were cut, and the nails were driven back securely into the femur.

Post Operative Protocol

Removal of stitches was at 14 days. For unstable long oblique fractures or comminuted fractures, immobilization with a long leg slab was done. Physical therapy with touchdown weight-bearing was begun as soon as the patient was comfortable, generally around 3weeks. Gentle knee exercises and quadriceps strengthening were begun. Full weight-bearing generally was given by 8 weeks. The patients were kept under follow up. Nails were removed when the fracture line was no longer visible radiographically, which typically was nine to twelve months postoperatively.

Conservative Treatment

The patients selected for conservative treatment were given adhesive skin traction for 3 weeks, followed by hip spica cast.

Method of giving skin traction

The malleolli and the fibular head were protected from pressure effect by piece of cotton. Starting at the ankle, leaving a loop of 5 cm beyond the distal end of the limb, widest possible strapping is applied to each side of the limb. On lateral side the strapping lied slightly behind and parallel to a line between the lateral malleolus and the greater trochanter on medial aspect lies slightly in front of the above line. A crepe bandage is applied tightly over the limb. The limb was put in a rightly measured Thomas splint. Then the required traction weight was attached and traction was given through a bed pulley. After 3 weeks of traction, the skin traction was removed and a hip spica cast is applied.

Spica Cast Application: Technique

The child is taken to the plaster room, where anesthesia or sedation is administered. A short leg cast is applied with the foot in neutral position. The cast is then extended to a long leg cast with the knee held in 50 to 90 degrees of flexion. The patient is then placed on a spica table, supporting the weight of the legs with manual traction, and a one and one-half spica cast, is applied with the hips in 50 to 90 degrees of flexion and 30 degrees of abduction, holding the fracture out to length. The leg should be placed in 15 degrees of external rotation to align the distal fragment with the external rotation of the proximal fragment. The spica is applied to a level between the umbilicus and nipple line with a ¼- to ½-inch-thick towel over the thorax and under the cast, which is to be removed later to allow for chest expansion. Reinforce the groin, inguinal, and buttocks areas with splints to avoid breakage. After the spica cast is in place, anteroposterior (AP) and lateral x-rays are obtained to ensure that length and angular and rotational alignment are maintained. We observe all patients for 24 hours after spica application to be sure that neurovascular compromise and compartment syndrome was not present. In most cases, the cast was used until six to eight weeks after the injury. After the cast has been removed, management included skin care and physical therapy with touchdown weight-bearing was begun. Ambulation was accomplished with weight bearing as tolerated.The patients were evaluated at the regular interval of 2, 4, 6 & 8 weekly and after that every month.

At every visit the patients were assessed for:

- Clinical and radiological evidences of exact reduction and correct alignment of the fracture fragment
- Clinically limb alignment and rotation
- The condition of the wound and skin
- Clinical and radiological examinations to assess fracture union
- Clinical examinations to see the range of motion of the hip and knee
- Clinical and radiological assessment of limb length discrepancy
- Any pain or other symptoms

Results

About 48 patients (48 fractures) were treated for fracture shaft of femur. A minimum 6 months of follow up was done and the maximum follow up period was 2 years. Out of 48 patients, 4 were lost to follow up and in 2 patients fracture site had to be opened. Remaining 42 patients were considered for study and evaluated. Out of the 42 patients, 23 patients were treated closed intramedullary titanium elastic nailing and 19 patients were treated traction followed by spica cast. The results were evaluated using Flynn et al scoring system (11).

Table 1: Flynn scoring system [11]

	excellent	successful	poor
Limb length discrepancy	<1cm	<2cm	>2 cm
Angulation	5°	10°	>10°
Pain	Absent	Absent	present
Complication	Absent	Mild	Major complication

Major complications were defined as nail irritation requiring revision surgery, infection, delayed union, rod breakage, and compartment syndrome due spica cast. Minor complications were defined as nail irritation, superficial infection, or superficial plaster sores not requiring surgery. Our age-based guideline for acceptable alignment and shortening at the time of union was based on the work by Kasser and Beaty (Table 2) [12].

Table 2: Age-based guideline for acceptable alignment and shortening at the time of union [12]

Age	Varus/valgus (degree)	Anterior/posterior (degree)	Shortening (mm)
Birth to 2 yr	30	30	15
2 to 5 yr	15	20	20
6 to 10 yr	10	15	15
11 yr to maturity	5	10	10

Age incidence: average age was 7.5 yrs

Table 3: Demographic and clinical characteristics of study participants

Age Group	Number of Patients (%)
5-6 Yrs	7 (16.67%)
6-7 Yrs	6 (14.29%)
7-8 Yrs	12 (28.6%)
8-9 Yrs	11 (26.19%)
9-10 Yrs	6 (14.29%)
Sex	
Male	27 (64.3%)
Female	15 (35.7%)
Side of Injury	

Right side	22 (52.3%)
Left side	20 (47.7%)
Mode of injury	
Road Traffic Accident	31 (73.8%)
Fall From Height	11 (26.2%)

Right side was more commonly affected than the left side. About 26 (62%) cases had transverse fracture, 9 (21%) had oblique fracture, 4 (9.5%) had comminuted fracture and 3 (7.5%) had spiral fracture [Table 3]. Out of the 42 patients, 23 patients were treated closed intra-medullary titanium elastic nailing and 19 patients were treated traction followed by spica cast.

Results of titanium elastic nailing

About 23 patients were treated by titanium elastic nailing. Average age was 7.6 years. Average operating time was 65 minutes (50 minutes to 120 minutes). The mean hospital stay was 8.5 days (5 days to 16 days). All fractures healed, and no child sustained a complication that was expected to cause permanent disability. Radiological union was achieved in all cases in a mean time of 8.9 weeks (6-12 weeks). Full weight bearing was possible in a mean time of 9.1 weeks (6-12 weeks). Two patients had varus angulation (15° and 10°). One patient had valgus angulation of 10°. Limb lengthening of 1.5 cm was noted in two patients. Limb lengthening less than 0.5cm cm was noted in one patient. In one patient limb shortening of 1cm was noted. Entry site irritation occurred in 4 patients. One patient had superficial infection at lateral entry site, which was controlled by giving oral antibiotic (cefuroxime) coverage. None of the case required premature removal of the nail. Re-fracture was not found in any of the cases. Functional range of movement of knee was achieved in an average of 9.5 weeks (6-30 weeks). The nails were removed after an average 11 month (9 month -12 months). There were no complications related to implant removal. The results were excellent in 16 patients (69.5%), successful in 6 patients (26%) and poor in 1 patient (4.5%) as per the scoring criteria by Flynn et al [11] [Fig. 1].

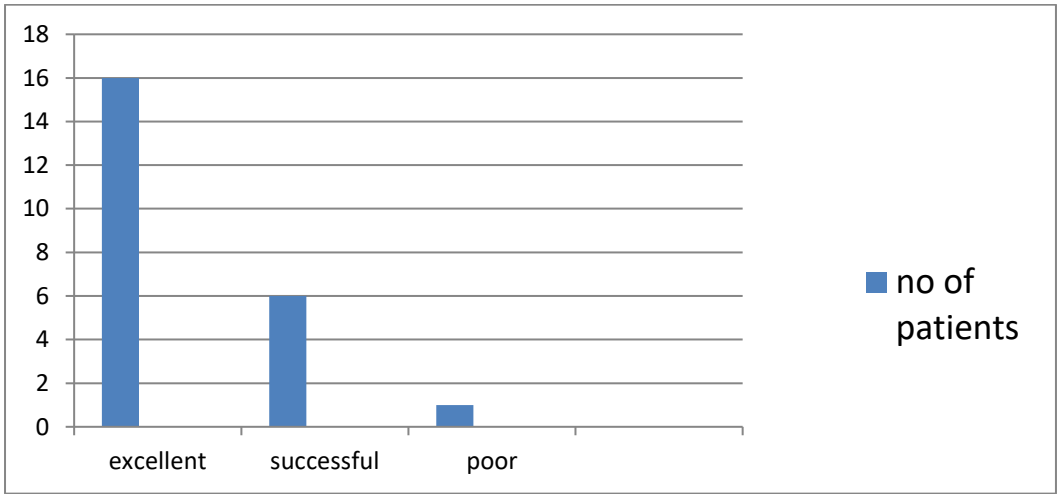


Fig. 1: Bar diagram showing results in patients treated with titanium elastic nailing

Results of traction followed by spica cast

About 19 patients were treated by traction followed by spica cast. Average age was 7.3 years. The mean hospital stay was 26 days (24 days to 31 days). All fractures healed, and no child sustained a complication that was expected to cause permanent disability. Radiological union was achieved in all cases in a mean time of 9.5 weeks (8-14 weeks). Full weight bearing was possible in a mean time of 11.5 weeks (9-14 weeks). Two patients had valgus angulation (18° and10°). One patient had varus angulation of 15°. Limb shortening of 2cm was noted in two patients. Limb shortening of 1.5 cm was noted in one patient. Limb shortening of 0.5 cm was noted in two patients. One patient had a substantial loss of reduction, was treated with re-manipulation and spica cast. One patient had pressure sore due to ring of the Thomas splint. Two patients had pressure sore due to plaster cast.One case of severe knee stiffness requiring manipulation with the patient under anesthesia was noted. The results were excellent in 11 patients (58%), successful in 6 patients (31.5%) and poor in 2 patients (10.5%) as per the scoring criteria by Flynn et al [11] [Fig. 2].

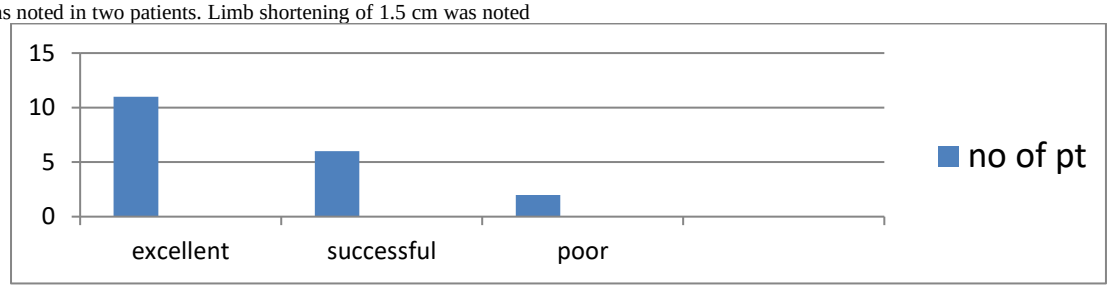


Fig. 2: Bar diagram showing results in patients treated with traction and spica cast

Table 4: Comparison between results of titanium elastic nail versus conservatively treated patients

	Titanium elastic nailing	Traction and spica cast
Excellent	16 (69.5%)	11 (58%)
Successful	6 (26%)	6 (31.5%)
Poor	1 (4.5%)	2 (10.5%)

Using Kruskal Wallis test chi square value was 0.000, degree of freedom was 2, p=1.000 i.e there was no significant difference between the result of two group [Table 4/Fig. 3].

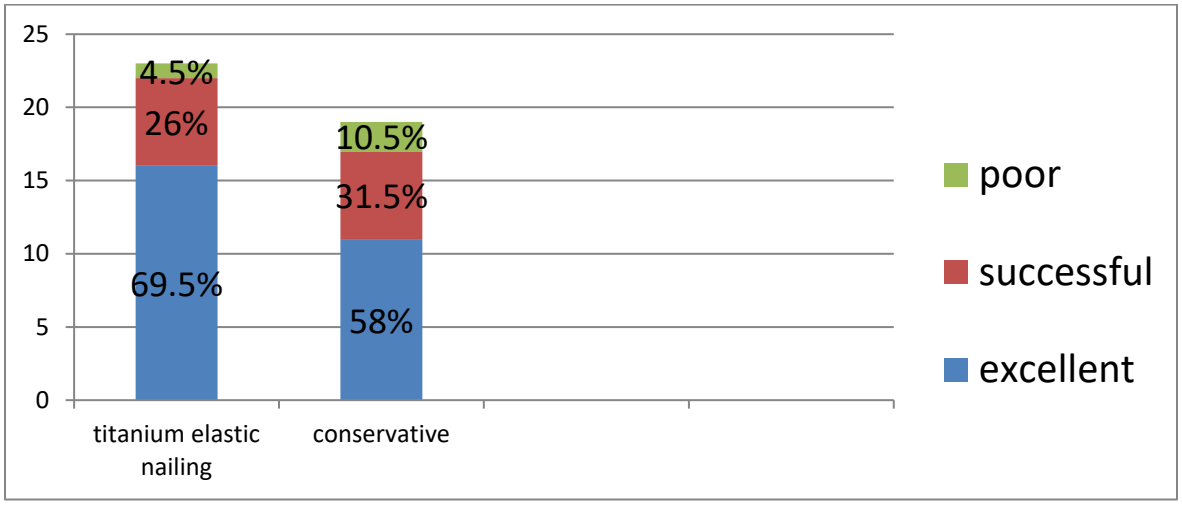
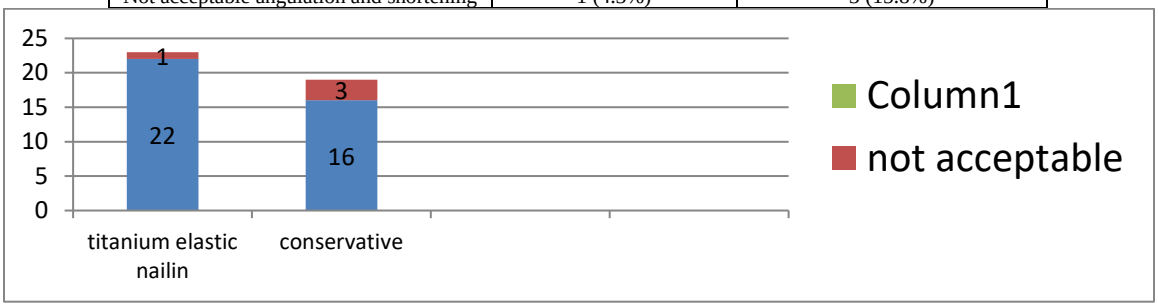


Fig. 3: Bar diagram showing comparison between results of titanium elastic nail versus conservatively treated patients

On the basis of the criteria based on the work by Kasser and Beaty, 38 out of total 42 children had acceptable alignment at the time of union. One child treated with titanium elastic nailing and three children treated with traction and application of a spica cast had unacceptable angulation or inequality between the lengths of the lower extremities at the time of union [Table 5/Fig. 4].

Table 5: Comparison acceptable angulation and shortening by titanium elastic nail versus conservatively treated patients

	Titanium elastic nailing	Traction followed by spica cast
Acceptable angulation and shortening	22 (95.7%)	16 (84.2%)
Not acceptable angulation and shortening	1 (4.3%)	3 (15.8%)



p=0,643,9962 using Fischer exact test (2 tailed), confidence interval was 1 [Table 5].

Fig. 4: Bar diagram showing acceptable and not acceptable outcome in both groups

Table 6: Recovery outcomes for each treatment group

	Titanium elastic nailing	Traction and spica cast	p value
Mean hospital stay	8.5 days	26 days	p<0.0001,t=23.67, df=40
Radiological union	8.9 weeks	9.5 weeks	P=0.2776,t=1.07, df=40
Full weight bearing	9.1 weeks	11.5 weeks	p<0.0001,t=4.9, df=40

Using unpaired t test the p value was calculated; df- degree of freedom [Table 6]

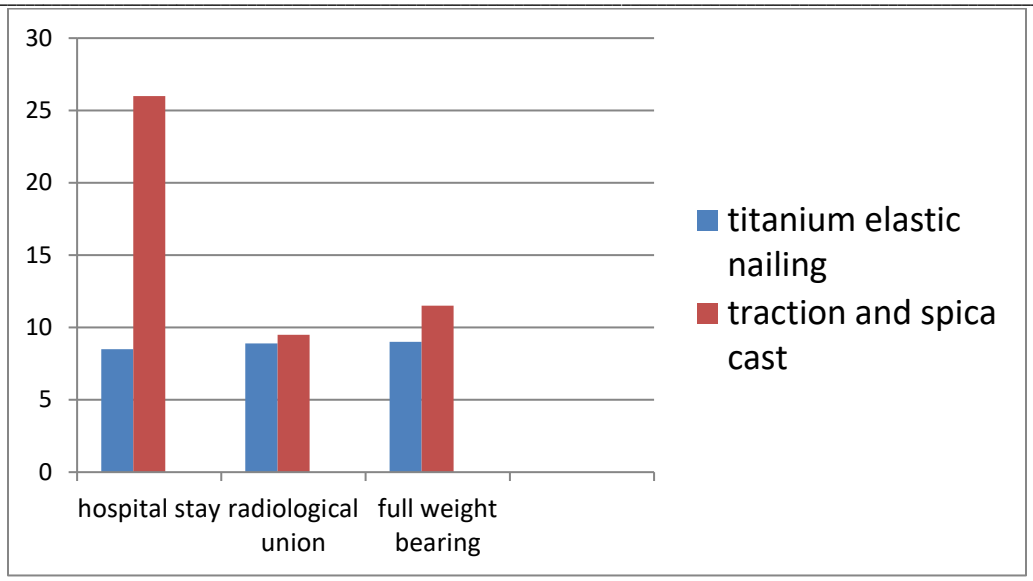


Fig. 5: Bar diagram comparing the recovery outcome in each patient group

Discussion

The ideal treatment of femoral shaft fracture in children is defined as one that controls alignment and length, is comfortable for child and convenient for family and causes the least psychological impact possible [13]. In the present study, the children from 5-10 years of age were treated for femoral shaft fractures. Treatment of femoral shaft fracture in this age group is highly controversial. Historically, femoral shaft fractures in children above 5 years and adolescents have been treated by non operative methods but the children of this age group tolerate the prolonged immobilization of traction less for physical, psychological and social reasons [14].For the last two decades the management of the femoral shaft fractures has evolved more towards the operative approach to decrease prolonged hospitalization and plaster complication. By internal fixation, the management of multiple trauma is made easier. This procedure tends to satisfy many of the parents of our patients who insisted upon a "perfect alignment" at initial treatment and will not accept any overriding of the bones even when reassured that overriding will correct itself with time [15].Until recently, skeletal traction and application of a cast was the preferred method for treatment of diaphyseal femoral fractures in children and young adolescents. This method stood the test of time because it was relatively conservative and permanent complications impairing future function were rare [16]. However, orthopaedists increasingly have tried a variety of methods to avoid prolonged immobilization. The ideal device for the treatment of most femoral fractures in children would be a simple, load-sharing internal splint that allows mobilization and maintenance of alignment and extremity length until bridging callus forms. The device would exploit a child's dense metaphyseal bone, rapid healing, and ability to remodel, without risking damage to the physes or the blood supply to the capital femoral epiphysis. Both Ender nails and titanium elastic nails offer these features [17].For more than two decades, French surgeons have used titanium elastic nails to achieve stable intramedullary fixation. Recently, titanium elastic nails have become widely available in India. An initial multicenter study by Flynn JM (11) et al showed excellent or satisfactory results in fifty-seven of fifty-eight cases treated with such nails. No child lost rotational alignment in the postoperative period. Irritation of the soft tissue near the knee by the nail tip occurred in four patients and led to a deeper infection in two of them. Although some surgeons feel strongly that titanium nails are more suitable for the treatment of fractures in children, we are aware of no study directly comparing the two methods. We have no data from our study to support the notion that titanium nails are superior to Ender nails. A similar study on Comparison of Titanium Elastic Nails with Traction and a Spica Cast to Treat Femoral Fractures in Children (6 to 16 yr) by Flynn JM (18) showed thirty-five children (thirty-five fractures), with a mean age of 8.7 years, were treated with traction and application of a spica cast, and forty-eight children (forty-nine fractures), with a mean age of 10.2 years, were treated with titanium elastic nails. At one year after the fracture, eighty of the children had acceptable alignment and no inequality between the lengths of the lower extremities. The remaining three children, who had an unsatisfactory result, had been treated with traction and a spica cast.Twelve patients (34%) treated with traction and a cast had a complication compared with ten patients (21%) treated with titanium elastic nails. Compared with the children treated with traction and a cast, those treated with titanium elastic nails had shorter hospitalization, walked with support sooner, walked independently sooner, and returned to school earlier. These differences were significant ($p < 0.0001$). They could detect no difference in total hospital charges between the two groups.

Time of union

In group I the mean time of union was 9.6 wks in patients treated with dynamic compression and K Nails & mean time of union for patients treated with Rush nail was 9.4 wks. In group II, the mean time of union was 9.9 wks. There was no significant difference in the mean time of union of two groups. In group I there were very few complications which were not significant. There was no evidence of early closure of trochanteric apophasis and vascular necrosis of femur in the series due to operative treatment.

In group II, 5 cases (25%) had limb length discrepancy up to 0.5 cm, 9 cases (45%) up to 0.5-2cms & rest 6 cases (30%) had no limb length discrepancy. In five cases (25%), there was angulation of less than 10 and in 2(10%) cases, there was angulation of 10-15 and there were 2 cases having rotation less than 10 and one case had rotation of more than 10. In the series the hospital stay was 9-10 days in operative group and in non-operative group it was 21-23 days and was statistically significant ($p<0.05$).

Our current study was designed to evaluate outcomes prospectively in the first year following treatment of a diaphyseal femoral fracture in children between five and ten years of age. The

focus of this study was the treatment and recovery period. We did not attempt to determine the long-term results of treatment with titanium elastic nails or skeletal traction and a spicacast, since the long-term result after a diaphyseal femoral fracture in this age-group is almost always satisfactory, regardless of which of several methods is used for treatment. With the focus on the first year, we cannot comment on the exact final lower-extremity length and alignment of each child. In this series, all of the fractures healed and it is unlikely that any of the patients with problems or complications will experience a permanent loss of function.

Nineteen children (nineteen fracture), were treated with traction and application of a spica cast, and twenty three (twenty three fractures), were treated with titanium elastic nails [Photos 1-3]. So as compared to study by Flynn et al which showed 8.5 % unacceptable outcome in patient treated with traction and spica cast, and no unacceptable outcome in patient treated with titanium elastic nailing, our current study showed 15.8 % unacceptable outcome in patient treated with traction followed by spica cast, and 4.3 % unacceptable outcome in patient treated with titanium elastic nailing. We used surface traction as the form of traction in conservative treatment, whereas Flynn et al used skeletal traction in conservatively treated patients. This could be a factor giving poorer result of conservatively treated patient in our study. The time taken for full weight bearing was longer in comminuted or spiral fracture, irrespective of treatment method. In one comminuted fracture which was treated with titanium elastic nail there was shortening, probably due to overlapping of fragment. The time to return to school was remarkably less in children treated with titanium elastic nailing. Compared with the children treated with traction and a cast, those treated with titanium elastic nails had shorter hospitalization, walked with support sooner, walked independently sooner, and returned to school earlier. Range of motion of the knee and hip joints were normal at final follow–up in both groups of patients. In patients treated with titanium elastic nailing, patients families were more satisfied of surgical treatment and shorter hospital stay. The most common problem encountered in the present series with titanium elastic nailing was skin irritation due to distal nail ends which occurred in 4 cases. It disappeared in all these cases after nails removal following union. Preoperative radiation exposure was a disadvantage of titanium elastic nailing.

Fig 1: A transverse fracture in a 9 yrs 4 months patient

Fig 2: Post operative x-ray after fixation with titanium elastic nail

Fig 3: Post operative x-ray [after 10 weeks] after fixation with titanium elastic nail

Conclusion

In the patients treated with titanium elastic nailing the results were excellent in 16 (69.5%) patient, successful in 6 (26%) patient, and poor in 1(4.5%) patient. In the patient treated with traction and spica cast the results were excellent in 11 (58%) patients, successful in 6 (31.5%) and poor in 2 (10.5%) patients. Compared with the children treated with traction and a cast, those treated with titanium elastic nails had significantly shorter hospitalization period ($p<0.0001$), mean 8.5 days in operated group compared to mean 26 days in conservatively treated group .The time taken for full weight bearing was also significantly less in patient treated with titanium elastic nailing ($p<0.0001$); mean 9.1 weeks in operated group compared to 11.5 weeks in conservatively treated group. We conclude that closed pediatric femoral shaft fractures within the ages of 5-10 years can be treated successfully by any methods of traction followed by spica cast or intra-medullary titanium elastic nailing. However, because of shorter immobilization period and earlier ambulation, we recommend internal fixation with titanium elastic nailing as the better choice to treat this fracture in school aged children.

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