IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 3 Ver.10 March. (2018), PP 46-50
www.iosrjournals.org

Titanium Elastic Nailing for Paediatric Femoral Shaft Fractures: A Prospective Study

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Abstract: Background: *Management of femoral diaphyseal fractures in the age group of 6-16 years is controversial. There has been a resurgence worldwideforoperativefixation.* ***Methods :*** *Thirty pediatric patients in age group 6-16years with diaphyseal femoral fractures were stabilised with two titanium nails. Patients were followed up clinically and radiologically for 24 weeks. The final results were evaluated using the criteria of Flynn et al.* ***Results*** *: Overall results observed were excellent in 20, satisfactory in 9 and poor in 1 patients. Hospital time averaged 13 days days in our study. All the fractures healed with an average time to union of 10 (7-14) weeks. The soft tissue discomfort near the knee produced by the nails ends was the most common problem encountered. Shortening was observed in one case and none of the cases hadsevere restriction of knee movements at the final followup. There was no delayed union, infection or refractures.* ***Conclusion*** *: Titanium elastic Intramedullary nailing technique is an ideal method of definitive stabilization for diaphyseal fracture in paediatric population,It is an simple, easy, rapid, reliable and effective method of fixation with advantages like shorter operative time,minimally invasive and lesser blood loss ,reasonable time to bone healing and physeal-protective treatment method .*

Date of Submission: 03-03-2018 Date of acceptance: 20-03-2018

I. Introduction

Femoral shaft fracture is an incapacitating pediatric injury[1]. The treatment has traditionally been age-related, influenced by the type of injury, associated injuries and the location and type of the fracture. The remodelling capacity of the pediatric femur can compensate for less than a perfect reduction. But time and experience of many clinicians have also shown that children with diaphyseal femur fracture do not always recover completely with conservative treatment. Angulation, shortening and malrotation are not always corrected[2] . There is little disagreement regarding the treatment of younger children (usually less than 6 years of age) and these can be treated with immediate spica casting[3]. Older children (usually older than 16 years of age) show good response with standard locked intramedullary femoral nailing techniques[4]. However, the best treatment between six and 16 years of age is a matter of debate[5]. Titanium Elastic Nailing, which is variously known as Elastic Stable Intramedullary Nailing, has become the choice of stabilization in pediatric long bone fractures, particularly the femoral shaft fractures [5] .The perceived advantage of this technique includes early union due to repeated micromotion at fracture site, respect for the physis, early mobilization, early weight bearing, scar acceptance, easy implant removal and high patient satisfaction rate[6] .

II. Material and Methods

This prospective study was done from 2015 june to 2017 june in Department of Orthopaedics at Regional Institute of Medical sciences-IMPHAL ,childrens between age 6 to 16 with closed ,diaphyseal femur fracture was included in this study,all the patients were operated within a week from date of injury, The diameter of the individual nail was selected as per Flynn *et al*'s formula[5] (Diameter of nail = Width of the narrowest point of the medullary canal on Anteroposterior and Lateral view × 0.4 mm) and intraoperative assessment. The diameter of the nail was chosen so that each nail occupies at least one-third to 40% of the medullary cavity. The nails were prebent sufficiently so that apex of the bowed nails rested at the same level on the fracture site to ensure a good equal recoil force.

III. Operative procedure

Under general anaesthesia, the patient was placed on the fracture table and preliminary closed reduction done,then the image intensifier was used to localise the placement of skin incisions 2.5 cm above the

distal femoral physis by viewing the distal femur in both anteroposterior and lateral planes. After soft tissue dissection, distal femoral metaphysis was exposed and opened using an awl at a point 2.5 cm proximal to distal femoral physis. The drill was then inclined so that it made an angle of 10 degrees with distal metaphyseal cortex for easy passage of the nail through the dense metaphyseal bone.Then Nail was loaded on the T handle and advanced through the entry point by twisting movements until it reaches the fracture site, When this nail reached the fracture site, the fracture was reduced by manipulation and traction under image intensifier control. Once the fracture site was reduced the nail was pushed into proximal fragment. Then the medial incision was given and the second nail was inserted in a similar retrograde manner. The two nails were then driven into the proximal end of the femur. Distally the nail was cut so that 1 cm of nail remains outside the cortex. The extraosseous portion of the nail was bent slightly away from the bone for easy removal after fracture union. Too much bending was avoided to prevent the formation of painful bursa over nail ends.

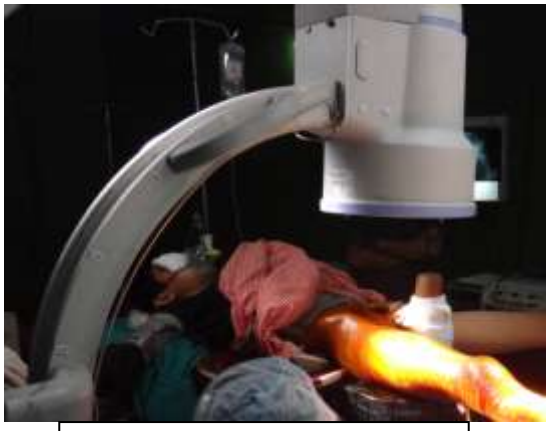

Fig 1:preop positioning

Fig 2:closed reduction achieved with c-arm guidance

Fig 3:Incision given 2.5 cm proximal to growth plate

Fig 4:Hole made in cortex using AWL

Fig5:passing TENS nail using T

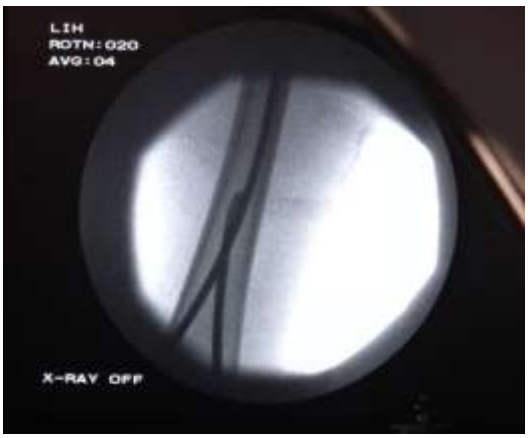

Fig 6:TENS nail passing under C

Fig 7:proximal end of the

Fig 8:cutting distal end of nail

IV. Results

Patient followup was done at 2, 6, 12 and 24 week. Postoperatively Quadriceps strengthening exercises was started as soon as the pain subsides. Partial weight bearing with crutches was started at 4-8 weeks with an average of 4.56 weeks. External callus was visible on roentgenograms when partial weight bearing was started. Full weight bearing was started at 8-12 weeks depending on the clinical and roentgenographic progress of fracture union.

Time for union	Number of patients	%
</= 12 weeks	23	76.7
>12 – 18 weeks	6	20.0
>18 – 24 weeks	1	3.3
Total	**30**	**100.0**

None of the patients had severe restriction of range of movements at 24 month.

Range of movements(degrees)	Number of patients	%
Full range	27	90.0
Mild restriction	2	6.7
Moderate restriction	1	3.3
Severe restriction	0	0
Total	**30**	**100**

Fig 9:preop x ray

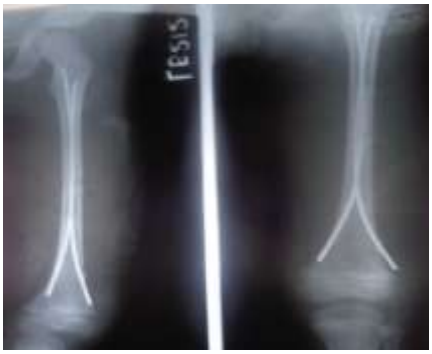

Fig 10:postop x ray

Fig11:xray at 6 weeks

Fig 12:xray at 12 weeks

Fig 13,14,15,16:Range of motion at final follow up

The most common problem encountered was pain at nail insertion site due to distal nail ends ,Pain at the nail insertion site -6(20%),other complications encountered was Limb lengthening-3(10%) ,Limb shortening-1(3.3%) ,Sinking of nail into medullary cavity-2(6.6%),Varus angulation-1(3.3%). No soft tissue infection or osteomyelitis was seen in our study.

The nails were routinely removed at about 1 year after fracture fixation. No complications were associated with the nail removal procedure and no refractures were observed after nails removal. The results as evaluated using the criteria as suggested by Flynn et al [5] ,were 20 excellent, 8 satisfactory and 1 poor .

V. Discussion

Femoral shaft fracture in the pediatric patients have traditionally been treated nonoperatively with either early spica cast or a period of traction followed by application of hip spica cast until the time of fracture union. This is the accepted standard of care for the young children but complications such as malunion, joint stiffness and delay in functional recovery are common in older children if managed in this manner[7]. Moreover, conservative treatment results in prolonged hospitalization causing more burden on the hospital and financial losses to the family with parents attending their children in the hospital. Recent studies have also increased awareness of the psychosocial and economic effects of spica casting on children and their families[5,8,9] . During the past few decades some form of internal fixation as plate fixation, rigid intramedullary nailing, Ender nailing, titanium nailing has been advocated but the controversy regarding the ideal implant to treat pediatric femoral fractures still exists [10]. 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. TENs offer these features[11]. Mazda et al treated 34 femoral shaft fractures with TENs. They observed that elastic properties of titanium provide a very good stability and it is a safe surgical treatment for immature femoral shaft fractures[10] . In the present series all the fractures united within 4 months of fixation with TENs with no nonunion or delayed union. The time when the patient had no pain at the fracture site on full weight bearing without support and roentgenographically the fracture had united was considered the union time. The patients belonging to the age group <10 years and those who had a transverse fracture pattern had a shorter union time. Hospitalization times have considerably decreased with titanium elastic nailing. Average hospitalization time was 13 days in our study. The decreased hospitalization time has resulted in the decrease in the hospital bed occupancy, early return of patients to their home environment. And, it is also a cost effective treatment modality, as the parents can get back to their work earlier. Flynn et al reported that compared with children treated with traction and cast, those treated with TENs had shorter hospitalization, walked with support sooner, walked independently sooner, and returned to school earlier. These differences were significant ($p<0.0001$)[12] . Excessive rotation of nail during difficult negotiation of the fracture site leads to wounding of the nail around the other. This "cork screw phenomenon" must be detected using image intensifer and avoided at all costs. Once the phenomenon has been detected, the nail in question must be removed during the same operation and replaced by correctly placed one[13,14] .

VI. Conclusion

Titanium elastic Intramedullary nailing technique is an ideal method of definitive stabilization for diaphyseal fracture in paediatric population,It is an simple, easy, rapid, reliable and effective method of fixation with advantages like shorter operative time ,minimally invasive and lesser blood loss ,reasonable time to bone healing and physeal-protective treatment method .

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