

Evaluation of Treatment of Fracture Shaft of Femur in Children with Titanium Elastic Nail

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Keywords: Pediatric femur Fracture, Titanium Elastic Nail(TEN), Flynn criteria, Functional Outcome.

Abstract:

Background : Femoral shaft fracture is an incapacitating paediatric injury. It is common in our country and also in orthopaedics OPD, DMCH. The best treatment between six and sixteen years of age is a matter of debate. There has been resurgence worldwide for operative fixation. Titanium flexible elastic intramedullary nailing has become a well accepted method of treatment of paediatric femoral shaft fractures.

Objective: To assess the success of fixation by Titanium Elastic Nail for fracture shaft of femur in children aged between 6-16 years.

Methods: This prospective interventional study (quasi experimental type) was conducted over a period of one and half year from Jan 2015 to June 2016. Thirty children (23 boys, 7 girls) aged 6-16 years with femoral diaphyseal fractures were stabilized with retrograde titanium elastic nail. The results were evaluated by using Flynn's TEN scoring criteria. Two nails were used in each fracture.

Results: All thirty patients were available for evaluation and follow up for a mean duration of 10.1±2.21 months. The results were excellent in 23 patients (76.7%), successful in 7 patients (23.3%) and there was no poor result. No major per operative or postoperative complications.

Conclusion: Titanium Elastic Nail fixation of paediatric femoral shaft fractures is a safe, simple and reliable method of treatment in children aged 6-16 years.

Introduction:

Femoral shaft fractures are the most common of the lower extremity fracture in children, with an annual incidence up to 1 per 500 (Rasool et al., 2013). Automobile accidents accounts for 90% of femoral shaft fractures in children. The injuries are more common in boys, especially during the toddler years of and early adolescence. These fractures present with pain, swelling, deformity and inability to bear weight. The mechanism of injury varies from simple falls to high energy trauma.

Since the last two decades there has been a growing tendency towards a more operative approach in patients over six years of age. Titanium Elastic

Nailing, which is variously known as Elastic Stable Intramedullary Nailing, has become the choice of stabilization in paediatric femoral shaft fractures. 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 (Saikia et al., 2007).

The use of TEN is technically easy to learn, facilitates the maintenance of anatomic alignment and reduces the frequency of complications when nailing is performed correctly. The generally accepted technical option is close reduction and internal fixation with intramedullary nailing under fluoroscopy control.

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Furthermore, minimally invasive surgery is often preferred for this fractures due to the reduction in patient morbidity, less soft tissue trauma and lower infection rates.

The ideal treatment of femoral shaft fractures in children is defined as one that controls the length and alignment, does not compress or elevate the extremity excessively, and is comfortable for child and convenient for family. Titanium Elastic Nail fulfills that qualities in children aged 6-16 years. From September 2010 to October 2012, total 30 children's were available for evaluation after 24 weeks of follow up. All the results were clinically evaluated using Flynn's scoring criteria. Result were excellent in 24 cases (80%) and good in 6 cases (20%) and poor in no cases. There was no post-operative infection, physeal injury and implant failure. (Mishra et al.,2012). Twenty children in the age group 6-16 years with femoral shaft fracture were stabilized with TEN from April 2007 to October 2009. The result were excellent in 14 patients (70%) and successful in 6 patient(30%). (Kumar et al.,2010). The aim of the present study is to evaluate the results of the use of Titanium Elastic Nailing in the treatment of femoral shaft fracture in children.

Materials &Methods:

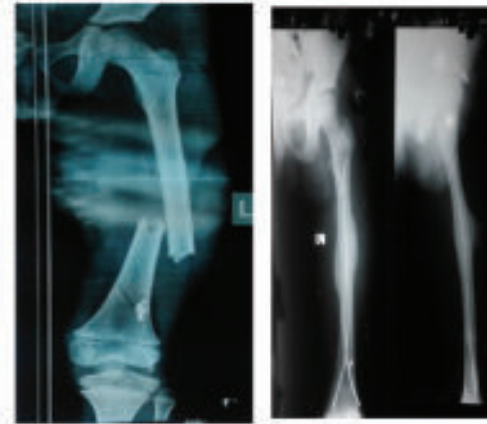
This was aProspective interventional study(quasi experimental type) conducted in Department of Orthopedics and Traumatology, DMCH after ethical committee approvalfrom January 2015 to June 2016 (18 months).Atotal 30 patients(23 boys,7girls)with femoral diaphyseal fracture (age 6-16yrs) fixed with TENS under C-ARM guidance. An informed consent was obtained from all patients. Patients were followed up regularly. Functional status of the patients assessed with Flynn's criteria for TEN. Purposive sampling (non randomized) according to availability of the patients and strictly considering the inclusion and exclusion criteria.

Inclusion Criteria:

1. Femoral mid-diaphyseal transverse, short oblique or short spiral fractures with minimal comminution.
2. Closed fractures of the shaft of femur.
3. Cases are purposively selected irrespective of sex, mechanism of injury and associated other injuries.
4. All patients between 6 to 16 years of age.
5. Patients come within 03 weeks of fracture are included

Exclusion criteria:

1. Open fractures of the shaft of femur.
2. Undisplaced fracture treated by non operative method.
3. Age of the patient before 6 years and after 16 years.
4. Infected cases.
5. Pathological fractures.



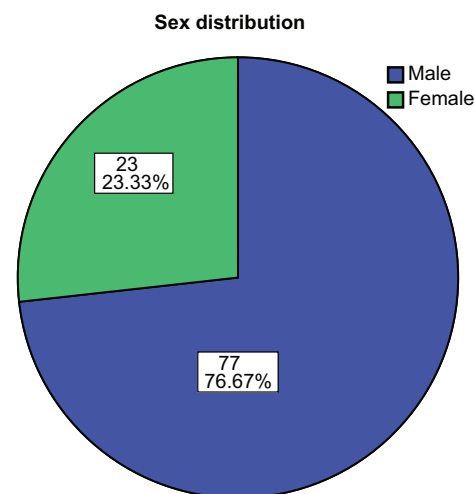
Results

Age of the patients in this series ranged from 6 to 16 years. Maximum patients 19(63.3%) were age 11-16 years, 11(36.7%) patients were age range 6-10 years. Mean age was 11.2 ± 1.96 years.

Table-I: Age distribution of the patients (n=30)

Age	Number of patient	Percentage (%)
11 – 16	19	63.3
6 – 10	11	36.7
Total	30	100.0
Mean $\pm$ SD	11.2 ± 1.96	

Sex distribution:



Pie chart: Distribution of subjects by sex (n=30)

In the present series, maximum patients were male 23(76.7%) and female 7(23.3%) female. Male female ratio 3.3:1. Male patients were predominant in this study.

Table-II: Type of fracture (n=30)

Type of fracture	Number of patient	Percentage (%)
Transverse	18	60.0
Oblique	10	33.3
Spiral	2	6.7
Total	30	100.0

In this series, type of fracture were observed that 18(60%) cases were Transverse, 10(33.3%) cases were oblique and spiral 2(6.7%).

Table-III: Duration of hospital stay (n=30)

Duration of hospital stay (wks)	Frequency	Percentage (%)
1-2 weeks	23	76.7
2-3 weeks	7	23.3
Total	30	100.0
Mean±SD	14.0±3.93	

Among 30 patients, maximum 23(76.7%) patients stayed in the hospital for 1 to 2 weeks and the rest 7(23.3%) patients 2-3 weeks. mean duration of hospital stay was 14.0±3.93 day.

Table-IV: Duration of union time (n=30)

Union time (weeks)	Frequency	Percentage (%)
7-10 weeks	20	66.7
10-13 weeks	10	33.3
Total	30	100.0

Among 30 patients, radiological evaluation of fracture site union showed that 20(66.7%) cases united within 7-10 weeks and 10(33.3%) cases united within 10-13 weeks. The mean union time was 9.6±1.9 weeks.

The surgery was performed within 9-10 days of injury. Duration of surgery on an average 80-100 minutes. Mean follow up was 10-12 months. Elastic Nail was removed after 6-8 montes.

Discussion:

The femoral shaft fractures constitute less than 2% of all children fracture and the ideal choice of treatment has remained a constant challenge. Conservative treatment for children diaphyseal femoral fractures was preferred in children and young adolescents. However to avoid the effects of prolonged immobilization, the operative approach has been gaining popularity for the last two decades (Mishra et al., 2012).

The ideal treatment of diaphyseal femoral fractures in children is defined as one that controls the length and alignment, does not compress or elevate the extremity excessively, and is comfortable for child and convenient for family and cause the least physiological impact possible. The device would exploit a child's denser bone, rapid healing, and ability to remodel, without risking the physes or blood supply to the femoral head, titanium elastic nail offers these features. The Titanium elastic nail seems advantageous over other surgical methods particularly in the age group of 6-16 because it is simple, a load-sharing internal splint that doesn't violate the physis, allows early mobilization and maintains alignment (Flynn et al., 2002 & Saika et al., 2007).

Pediatric femoral fractures are treated by a variety of methods including traction, immediate spica cast, traction followed by spica cast, internal fixation with plate and. screws, external fixation and intramedullary fixation. The indication for TENs for fixation of pediatric femoral shaft fractures are expanding as their advantages are realized and complications of other operative methods of stabilization are reported. Compression paintings are associated with high incidence of refracture. External fixators are associated with pin tract infection, loss of reduction; refracture after removal of external fixator, Rigid intramedullary nailing is associated with greater trochanter physis leading to growth arrest with subsequent coxavalga. It is also associated with damage to blood supply of femoral head leading to osteonecrosis of femoral head.

The ideal device to treat pediatric femur fractures would be a simple, load-shearing internal splint allowing mobilization and maintenance of alignment for a few weeks until bridging callus forms. The device would exploit a child's denser bone, rapid healing, and ability to remodel, without risking the physis or blood supply to the femoral head.

In this study, the total numbers of cases were 30 which are similar to the number of cases in the study of Mishra et al., (2012). The mean age at injury of this study was 11.2 ± 1.96 years; range 6 to 16 years almost similar to Kumar (2010) who found mean age 10.8 years; range 6 to 16 years and Hassan (2006) found the age incidence in the series ranged from 8 years to 12.5 years, mean age 10.5 years. Moroz et al. (2006) documented that mean age at the time of fracture 10.3 years.

In present study among 30 patients 23(76.7%) were male and 7(23.3%) were female. Male-female ratio was 3.3:1. In the study of Kumar et al. (2010) male- female ratio was 3:1.

In this study, in terms of deformity in Sagittal plane like anterior-posterior angulation and in the coronal plane like varus deformity occurred $5-6^\circ$ in 3(10.0%) patients, $6-8^\circ$ valgus deformity occurred in 4(13.3%) patients and majority of the patients 23(76.7%) had no malalignment were observed. Kumar et al. (2010) reveals that out of 20 patients 3 patients showed 10 degree or less angulations in the lateral plane and one patient had an eight degree angulation in the anterior-posterior plane, this findings correlate our study. Al-Sayed (2006) noted angular alignment was normal in 20 cases, valgus angulation of 8° occurred in one case.

In current study 21(70.0%) exhibited wide range of knee fixation more than 130 degree, 2(6.7%) patients restricted knee motion range 120-130 degree and 7(23.3%) patients restricted knee motion range of 100-120 degree. Razzak et al. (2008) noted the mean range of knee flexion score at the end of follow up was 5.3 ± 0.98 points ($> 120^\circ$). Kumar et al. (2010) stated at the end of study period 75% patients could do full range of motion at knee joint.

In this study follow up period was observed that 70% patients complete follow 8-10 months and rest 30% of the patients complete 10-14 months. Mean follow up period was 10.1 ± 2.21 months. Our findings similar with study of Moroz et al. (2006) noted mean length of follow up was 14.2 months.

In present study out of 30 cases, 2(6.7%) patients had nail-tip irritation and rest of the patients 28(93.3%) had no complications developed.

In the final outcome of the study according TEN outcomes scoring by Flynn et al demonstrated that successful results in 7(23.3%) cases and excellent

results were found 76.7% patients. Mishra et al. (2012) noted similar results out of 30 patients, excellent in 80% cases and good in 20% cases. Kumar et al. (2010) observed result out of 20 patients excellent in 14(70%) cases and successful in 6(30%) cases. Gamal et al. (2009) reveals 75.8% were excellent and 24.2% were satisfactory outcome. There is no poor results.

Conclusion:

In this study outcome of mid-diaphyseal pediatric femoral shaft fractures treated by closed reduction and internal fixation with Flexible elastic intramedullary nail demonstrated excellent to successful result in all of the cases. Intramedullary fixation with TEN may be the preferred method for the treatment femoral shaft fractures in children aged 6 to 16 years. It is a minimal invasive procedure, appears to be safe, low morbidity and good functional outcome.

References:

1. ADL, G.E., MOSTAFA, M.F., KHALIL, M.A., ENAN, A., Titanium elastic nail for paediatric femoral and tibial fractures, *Acta Orthop. Belg.*, 2009; vol.75, 512-520.
2. Barry, M., paterson, J.M.H., (2004), Flexible intramedullary nails for fractures in children, *J Bone joint surgery (Br)*, Vol. 86-B: 947-53.
3. Bar-On E, Sagiv S, Porat S (1997), 'External fixation or flexible intramedullary nailing for femoral shaft fractures in children', *J Bone Joint Surg Br*, vol. 79, pp. 975-8.
4. Grant P, Mata MB, Tidwell M (2001), 'Experience and reason, femur fracture in infants: A possible accidental etiology', *Pediatrics*, vol. 108, pp. 1009-2.
5. Gregory P, Sullivan JA, Herndon WA (1995), 'Adolescent femoral shaft fractures: Rigid versus flexible nails', *Trauma*, vol. 18, pp. 645-9.
6. Kumar N, Chaudhary L (2010), 'Titanium elastic nails for pediatric femur fractures: Clinical and radiological study', *Surgical Science*, vol. 1, pp. 15-19.
7. Luhmann, S, Schootman M, Schoenecker P et al. (2003), 'Complications of titanium elastic nails for pediatric femoral shaft fractures', *J Pediatr Ortho*, vol. 23, pp. 443-444.
8. Martinez AG, Carroll NC, Sarwark JF et al (1991), Femoral shaft fractures in children treated with early spica cast, *J Pediatr Orthop*, vol. 11: 712-6.

9. MetaizeauJP(2004), 'Stable elastic intramedullary nailing for fracture following the femur in children'. *Journal of Bone and Joint Surg*, vol. 86-B, no. 7, pp. 954-957.
10. Mishra, A.K., Chalise, P.K., Shah, S.B., Adhikari, V., Singh, R.P., (2012), 'Diaphyseal femoral fractures in children treated with titanium elastic nail system', *Nepal Med Coll J*, vol. 15, no. 2, pp. 95-97
11. Saikia KC, Bhuyan SK, Bhattacharia TD, Saikia SP (2007), 'Titanium elastic nailing in femoral diaphyseal fracture of children 6-16 years of age', *Indian Journal of Orthopaedics*, pp. 44-45.
12. Sayed HA (2006), 'Titanium elastic nail fixation for paediatric femoral shaft fractures', *Pan Arab J. Ortho. Trauma*, vol. 10, no. 1, pp. 7-16.
13. Winkquist RA, Hansen ST, ClawsonDK(1984), Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases.. *JBone Joint Surg [Am]* ,vol. 66: 529-39.