

Mean duration of union in femoral shaft fracture in children treated with titanium elastic intra-medullary nailing

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Abstract:

Introduction: Elastic intramedullary nail was introduced for femoral fractures by Nancy group in 1979. It has gained popularity in the last two decades. It serves as a weight sharing device. The advantages of elastic intramedullary nails as a fixation device are well known and include closed insertion of the device, with preservation of the fracture hematoma and minimal risk of fracture site infection.

Objectives: To determine the mean duration of union in femoral shaft fracture in children treated with elastic intra-medullary nailing.

Settings: Department of Orthopedics

Study design: Case series study.

Study duration: 15th March 2017 to 14th September 2017

Materials & Methods: A total of 70 diagnosed cases of femoral shaft fracture presenting within 7 days of the injury and age 6-11 year of both genders were included. Patients with segmental femoral shaft fractures, osteogenesis imperfecta and congenital pseudoarthrosis of the femur were excluded. The titanium elastic nails (TEN) system was used in all patients according to the departmental protocols. All the patients were followed up in OPD on 2 weeks interval till union is achieved. The duration of union was recorded.

Results: Mean age was 8.31 ± 1.69 years. Majority of the females i.e. 37 (52.86%) were between 6 to 8 years of age. Out of these 70 infants, 44 (62.86%) were male and 26 (37.14%) were females with male to female ratio of 1.7:1. Mean duration of union in femoral shaft fracture in children treated with elastic intra-medullary nailing was 10.98 ± 0.602 weeks.

Conclusion: This study concluded that elastic intra-medullary nailing should be preferred in the treatment of femoral shaft fracture in children in order to achieve good outcome and reduce union time.

Keywords: femoral shaft fracture, intra- medullary nailing, union time

Introduction:

Femoral shaft fractures are common pediatric orthopedic injuries which constitutes less than 2% of all fractures in children.¹ Among all fractures in children femoral shaft fractures account up to 60%. Motor vehicle accidents account for 90% of femoral shaft fractures in children. The worldwide annual femoral shaft fracture incidence from road traffic accidents is between 1.0 and 2.9 million.²

A variety of treatment modalities have been used in the past like traction and spica casting, external fixator and compression plating,³ but all of these modalities have been plagued by a multitude of complications. Like poor tolerance for prolonged immobilization, loss of reduction, infection and stress fractures respectively.⁴

In recent years, closed intramedullary nailing has become the treatment of choice for close diaphysial fractures of the femur. But in com-

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minuted fractures and fractures associated with loss of bone it may result in excessive shortening or rotation around the nail. The basic concept of interlocking nailing is to combine the advantages of closed interamedullary nailing with the added fixation of transfixing screws; this prevents axial sliding and rotation.⁵ Interlocking nailing has biological and biomechanical advantages in comparison with plate osteosynthesis. Close interlocking nailing required appropriate pre-operative management, preventive antibiotics together with excellent operative techniques and skills and is not without complications.⁶ Errors in the positioning of the patient, incorrect portals of entry and inadequate reduction can lead to angulatory deformities, to inequalities in limb lengths and to implant failure.^{5,6}

Elastic intramedullary nail was introduced for femoral fractures by Nancy group in 1979. It has gained popularity in the last two decades. It serves as a weight sharing device. The advantages of elastic intramedullary nails as a fixation device are well known and include closed insertion of the device, with preservation of the fracture hematoma and minimal risk of fracture site infection. No reaming is required, and as such the endosteal blood supply is essentially preserved. It provides a stable three-point fixation. It is a load-sharing device that can permit early mobilization and weight bearing.⁷

Ruiz-Mejia O⁸ found mean duration of union to be 8 ± 4.2 weeks while studying union in pediatric femoral fractures fixed with elastic nails. However a mean duration of union of 11 ± 2.7 weeks is reported in a study by Yaokreh JB.⁹

The pediatric femoral fractures are very common in our population and represent a significant burden of cost and morbidity. Our fundamental population demographics, patient compliance, vitamin D level and nutritional status are different from western population. There has been no significant study in this arena in our country. Moreover the international data shows considerable variability. The aim of this study was to evaluate the mean duration of union in elastic

nailing in our population and if the results are found to be favorable this procedure can be used as a routine with its consequent healthcare and cost benefits.

Material and Methods:

This Descriptive, Case series done at Department of Orthopedics, from 15th March 2017 to 14th September 2017. The sample size of 70 was calculated by significance level (α) = 95%, Mean duration of union = 8 ± 4.2 weeks.⁸ Margin of error (d) = 1 and Non-probability, consecutive sampling technique was used. Patient age between 6-11 years of either gender, Diagnosed cases of femoral shaft fracture presenting within 7 days of the injury, Closed femoral shaft fractures and Gustilo grade I open fracture presenting within 6 hrs of fracture were included in the study while Segmental femoral shaft fractures. (on radiographic and clinical examination), patients with osteogenesis imperfect. (on radiographic and clinical examination), congenital pseudoarthrosis of the femur. (on clinical examination) and Obese patients (BMI > 30) were excluded from the study. Data was collected from patients presented to department of Orthopaedics, fulfilling the inclusion and exclusion criteria from emergency and outpatient clinic. An informed consent was taken. The procedure was done within one day of presentation of the patient by the Post Graduate Resident (Researcher himself) under supervision of consultant of 5 years of experience. Under general anesthesia, patients were placed supine on a radiolucent table. The operative extremity was then be painted and draped. The elastic nails were inserted from distal part of femur under image intensifier. The close reduction was obtained under image intensifier. The titanium elastic nails (TEN) system was used in all patients according to the departmental protocols. All the patients were followed up in OPD on 2-weeks interval till union is achieved. The duration of union was recorded by the researcher himself on a pre-designed performa.

The data was analyzed using SPSS version 16, mean+standard deviation for variables like age, duration of union (as per operational definition)

Table-1: Stratification of Duration of union with respect to gender

Age groups	Duration of union		P-value
	Mean	SD	
6-8 years	10.95	0.569	0.655
9-11 years	11.01	0.637	

Table-2: Stratification of Duration of union with respect to gender

Gender	Duration of union		P-value
	Mean	SD	
Male	11.00	0.562	0.822
Female	10.96	0.676	

Table-3: Stratification of Duration of union with respect to duration of fracture

Duration of fracture (days)	Duration of union		P-value
	Mean	SD	
0-3	10.92	0.545	0.943
4-7	11.04	0.662	

and duration of fracture in days were calculated. Frequency and percentage of variables like gender was calculated and presented.

Result:

Out of these 70 infants, 44(62.86%) were male and 26(37.14%) were females with male to female ratio of 1.7:1. Age range in this study was from 6 to 11 years with mean age of 8.31 ± 1.69 years and mean duration of fracture was 1.77 ± 0.88 days. Mean duration of union in femoral shaft fracture in children treated with elastic intra-medullary nailing was 10.98 ± 0.602 weeks. Age range in this study was from 6 to 11 years with mean age of 8.31 ± 1.69 years. Majority of the patients i.e. 37(52.86%) were between 6 to 8 years of age while 33(47.14%) were between 9-11 years

Stratification of mean duration of union with respect to age groups and gender are shown in Table I & II respectively. Table III has shown the stratification of mean duration of union with respect to duration of fracture

Discussion:

Femoral shaft fracture is an incapacitating pediatric injury. The treatment has traditionally been age-related, influenced by the type of injury, associated injuries and the location and type of the

fracture. To a great extent, the treatment options vary according to the surgeon's preference. Because of rapid healing and spontaneous correction of angulation most of the femoral shaft fractures in children younger than six years of age can be treated conservatively.^{10,11} Above six years of age all such fractures, when treated non-operatively could have, loss of reduction, malunion, intolerance and complications associated with plaster. Near the end of skeletal maturity accurate reduction is necessary as angular deformity is no longer correctable by growth.¹²

Availability of locked intramedullary nail has made the treatment of femoral shaft fractures in skeletally matured children well established. However, the best treatment between 6 and 16 years of age is a matter of debate.¹³ Since the last two decades, there has been a growing tendency towards a more operative approach in patients over six years of age.¹⁴ 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.^{15,16} 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.^{15,17}

I have conducted this study to determine the mean duration of union in femoral shaft fracture in children treated with elastic intra-medullary nailing. Age range in this study was from 6 to 11 years with mean age of 8.31 ± 1.69 years. Majority of the females i.e. 37(52.86%) were between 6 to 8 years of age. Out of these 70 infants, 44(62.86%) were male and 26(37.14%) were females with male to female ratio of 1.7:1. Mean duration of union in femoral shaft fracture in children treated with elastic intra-medullary nailing was 10.98 ± 0.602 weeks. Ruiz-Mejia O⁸ found mean duration of union to be 8 ± 4.2 weeks while studying union in pediatric femoral fractures fixed with elastic nails. However a mean duration of union of 11 ± 2.7 weeks is re-

ported in a study by Yaokreh JB.⁹

In a study, the average age of patients was 8.14 years with a minimum age of 5 years and maximum age of 13 years. The author has shown the average time to unite the fracture as 9.57 weeks (6-14 weeks).¹⁸ Cramer Kathryn E et al¹⁹ evaluated 57 femoral shaft fractures fixed with Ender nail in patients younger than 14 years and found that all the fractures healed within 12 weeks without complications. In a study of Sink et al,²⁰ all the fractures treated with sub-muscular bridge plating united within 12 weeks. Flexible nail treatment facilitates alignment and opposes fracture fragments, which allows certain controlled movement over the fracture site and helps the formation of external callus. External callus then helps to bridge the fracture fragments early, and gives strength to the bone.²¹ Fracture healing in children is fast and age-dependent. In children below 5 years old, fracture usually heals between 4 and 6 weeks. In children between 5 and 10 years old, fracture unites in 8-10 weeks. While in adolescence, the healing process is longer and takes 10 to 15 weeks.²²

Several authors have reported satisfactory results with the use of elastic nails in pediatric femoral fractures. Union occurs readily, and joint motion is preserved, with only a few, mostly minor, complications.²³⁻²⁵ Another study has shown radiological union in all cases achieved in a mean time of 8.7 weeks. Full weight bearing was possible in a mean time of 8.8 weeks. Mean duration of hospital stay was 9.8 days. The results were excellent in 13 patients (59.0%), successful in six (27.2%) and poor in three patients (13.6%). All patients had early return to school.²⁶ Oh C.W, et al,²⁷ reported average time for union as 10.5 weeks. Aksoy C, et al,²⁸ compared the results of compression plate fixation and flexible intra-medullary nail insertion. Average time to union was 7.7(4 to 10) months in the plating group and 4(3 to 7) months for flexible intramedullary nailing. In the study conducted by Fabiano Prata Nascimento, et al,²⁹ average healing time was 7.73 weeks.

Conclusion:

We concluded that mean duration of union in femoral shaft fracture in children treated with elastic intra-medullary nailing was 10.98 ± 0.602 weeks. So, we recommend that elastic intra-medullary nailing should be preferred in the treatment of femoral shaft fracture in children in order to achieve good outcome and reduce union time.

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Role and contribution of authors:

Dr Saad Ilyas, collected the data, references and did the initial write up

Dr Subhan Shahid, collected the references and helped in introduction writing

Dr Sohail Razzaq, collected the data and helped in interpretation the data

Dr Jamil Ahmed, collected the references and helped in introduction writing

Dr Ashfaq Ahmed, helped in collecting the refernecees

Dr Saeed Ahmad, helped in collecting the data

Dr Rizwan Akram, critically review the article and helped in introduction writing

Dr Amer Aziz, critically review the article and made the fianl changes

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