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Original Research Paper

Orthopaedics

ADOLESCENT MID SHAFT FEMUR FRACTURE MANAGED WITH CLOSED TITANIUM ELASTIC NAIL: A PROSPECTIVE STUDY

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ABSTRACT

Introduction: the lower limb fracture common in adolescent age group. The incidence of diaphyseal femoral shaft 20-25/100,000 per year in united states and Europe (1). For adolescent femoral diaphyseal fracture, various modalities of fixations are casting and traction, external fixation, ORIF, solid intramedullary nailing. The treatment of choice depends on age of patient, pattern and location of fracture. **Aims-** aim of the study was to assess the functional and clinical outcome after closed reduction and internal fixation with titanium elastic nail in diaphyseal femoral fractures between 10 to 16 years. **Materials And Methods-** we performed a prospective study of adolescents diaphyseal femur fracture managed with closed titanium elastic nailing. The study was approved by the ethics committee of government medical college and hospital. All patients were included in study, after trauma stabilized according to ATLS protocol and then anteroposterior/lateral radio graph was done. **Results-** In the present study, 15 cases of femoral shaft fractures in children were treated in the Department of Orthopaedics, tertiary care centre. All cases were treated with titanium elastic nail (TEN). In our series of 15 patients treated by titanium elastic nail, the age of children varied from 10 to 16 years. **Discussion-** In has been commonly accepted that surgical intervention is indicated in adolescent femoral shaft fracture in age group of 10-16 are generally open fracture, poly trauma, concomitant head injuries and neurovascular wounding. **Conclusion-** Based on our experience and results, we conclude that elastic stable intramedullary nailing technique is an ideal method for treatment of adolescent femoral shaft fractures.

KEYWORDS :

INTRODUCTION:

The lower limb fracture common in adolescent age group. The incidence of diaphyseal femoral shaft 20-25/100,000 per year in united states and Europe (1). Technique of intramedullary nailing by titanium elastic nail was developed by France dr.mataizeau and his team for forearm fracture and after that its use in various fracture of children's (2).

For adolescent femoral diaphyseal fracture, various modalities of fixations are casting and traction, external fixation, ORIF, solid intramedullary nailing. The treatment of choice depends on age of patient, pattern and location of fracture. In age lower than 5-year casting and tractions better options as patient having spontaneous correction of deformity and high remodelling capacity. While in adolescent age group, nonoperative treatment have more chance of loss of reduction, malunion and complication related to plaster immobilization. Specially in adolescent near skeletal maturity requires more accurate reduction as angular deformity is not going to correct spontaneously (3). So, debate on going for surgical treatment options specially in adolescent age group.

In Intramedullary tens nailing minimal soft tissue damage provides relative rotation stability to fracture and promote fracture healing and work as internal splint and load sharing device. While in external fixation associated with high chance of pin tract infection and refracture (4).

And in solid intramedullary nailing more chances of complications like AVN femoral head, thinning of femoral neck, growth arrest of the greater trochantar with secondary coxa valga (5). In addition, open reduction and internal fixation with plate associated with high soft tissue damage, infection and greater blood loss (4).

So, in our study we focusing on, measure functional and radiological outcome of tens nailing in diaphyseal femur shaft fracture in adolescent age group. We also note any complication of closed titanium elastic nailing.

AIMS-

aim of the study was to assess the functional and clinical outcome after closed reduction and internal fixation with titanium elastic nail in diaphyseal femoral fractures between 10 to 16 years.

MATERIAL AND METHOD-

We performed a prospective study of adolescents diaphyseal femur fracture managed with closed titanium elastic nailing. The study was approved by the ethics committee of government medical college and hospital Nagpur. Cases were included from January 2019 to October 2020.Total 15 patients were included in study 10 males and 5 females. Inclusion criteria of study consider all diaphyseal femur fracture closed or up to grade 2 compound according to Gustilo Anderson classification of compound fracture. The exclusion criteria of study are grade 3 compound diaphyseal fracture, pathological fracture, fracture with neurovascular abnormality, fracture in child with metabolic disorder. All patients were included in study, after trauma stabilized according to ATLS protocol and then anteroposterior/lateral radio graph was done. And surgery was performed in 3 days of admission.

Surgical Technique-

all surgery was performed in supine position under spinal anaesthesia and fluoroscopy guidance. Under fluoroscopic guidance, the entry point was made with an awl. The nail diameter selected was 40% of the width of the canal of the narrowest part of the intramedullary canal. Two nails with the same diameter were selected to counteract the bending forces and avoid malalignment. Nail bends in a C shape to create 3-point contact fixation after insertion of nail. After making entry, curved nail passed from lateral and medial side up to the fracture site. Now close reduction was done with traction and manipulation. When nails crossed the fracture site, medial nail passed up to base of femoral neck and lateral nail up to greater trochanter base. Both nails should be just shortened to epiphysis. Then nails cut at insertion site and slightly bends

towards the cortex. Now closer done in standard manner. Post operatively distal neuro vascular status checked, and limb elevated over a pillow and above knee slab applied.

Fig 1- Complete Draping After Painting

Fig 2- Entering The Nail In The Hole Made By Bone AWL.

Fig 3- Post Op Union

Fig 4- Post Of Functional Outcomes

Fig 5: Post Of Functional Outcomes

Postoperative follow up- follow at 14 days for stitch removed.

At 3-4 weeks slab was removed and knee and hip mobilized.

At 5-6 weeks x ray ap/lateral view done and patient advised for partial weight bearing according to fracture pattern.

At 7-8 weeks x ray ap / lateral view done and if that x ray suggests three cortex union patients advised for full weight bearing.

After this every 3 month follow up to 1 year advised.

After full weight bearing Flyn's score calculated in every patient and note any complication related to tens nailing (infection, bursitis, limb length discrepancy, rotational deformity)

Outcomes-

Flyn's score at full weight bearing for functional outcome.

RUST scoring system for radio-logical union of fracture.

Complication (infection, bursitis, limb length discrepancy, rotational deformity).

Table No 1- Flyn Scoring For Functional Outcome Measurements-

	Excellent	Satisfactory	poor
Limb length discrepancy	< 1 cm	< 2 cm	> 2 cm
Mal-alignment	5 degrees	10 degrees	>10 degree
Pain	none	none	present
Complication	none	Minor and resolved	Major or/and lasting morbidity

Rust Scoring For Radiological Union-

The Radio graphic Union Scale for Tibia fractures (RUST) score was used to assess the callus formation and radio-logical union. Each femur cortex (anterior, posterior, medial and lateral) was assigned a score from one to 3. A cortex with a visible fracture line and no callus was given a score of one, a visible fracture line but with callus present was given a score of 2 and callus without a fracture was scored as 3. The minimum total score was 4 and the maximum was 12 (healed). This scoring was used to guide the post-operative rehabilitation in our patients at follow ups. Once a total score of 6 was achieved, the patients were allowed partial weight bearing with a walker. Full weight bearing was commenced

when a minimum RUST score of 8 was achieved (6).

RESULTS -

In the present study, 15 cases of femoral shaft fractures in children were treated in the Department of Orthopaedics, tertiary care centre. All cases were treated with titanium elastic nail (TEN). In our series of 15 patients treated by titanium elastic nail, the age of children varied from 10 to 16 years. Out of 15 patients, 10 were male and 5 were female. The most common cause of the fracture was road traffic accident (RTA) in 10 cases, followed by fall from height in 5 cases.9 patients had fractures of right side while 6 cases had fractures of left side.12 cases were closed and 3 cases were open fractures among which 2 cases were Gustilo grade-I compound and 1 case were grade-II compound. Among the 15 femoral shaft fractures in 15 patients, 11 fractures were present in the middle 1/3rd, 2 were in upper 1/3rd and 2 in distal 1/3rd. In our study of 15 femoral shaft fractures, 11 patients had transverse pattern, 3 had oblique, 1 had spiral fractures. The cases without any associated injury were operated within 5 days of injury after stabilization of general condition. Patients with head injury and chest injury were operated within 5-10 days of injury. Close reduction was possible in all 15 cases.2.5 mm in 5 cases, 3 mm in 9 cases and 3.5 mm in 1 case was used.

Table 2: The Demographic And Clinical Characteristics Of Subjects

Clinical variables	Total number of patients (n=15)
Age in years	
10-12	4(26.7%)
13-16	11(73.3%)
Gender	
Male	10(66.7%)
Female	5(33.3%)
Mode of Injury	
RTA	10(66.7%)
Fall	5(33.3%)
Pattern of fracture	
Transverse	11(73.3%)
Oblique	3(20%)
Spiral	1(6.7%)
Segmental	0(0%)
Comminuted	0(0%)
Time interval between trauma & surgery	
< 2days	4(26.7%)
3-4 days	9(60%)
5-7 days	2(13.3%)

Union was assessed clinically and radiologically every month till complete healing.

Table No 3- Time Of Union

Time of union	No. of patients	Percentage (%)
6-8 weeks	11	74
8-10 weeks	2	13
>10 weeks	2	13
Total	15	100

In our study union was achieved in <2 months in 11 (74%) of the patients, 2 – 2.5 months in 2 (13%) and >2.5months in 2 (13%). Average time to union was between 6-8 week. Unsupported full weight bearing walking was started in <12 weeks for 12 (80%) of the patients, between 12 and 18 weeks in 2 (13.3%) and at 20 weeks in 1 (6.7%) patient.

Three patients had nail site irritation with bursitis leading to infection in 1 case which required early removal of implant. There was no case of nonunion or delayed union in our series. There was no rotational malalignment. No case of implant failure or refracture after implant removal was noted. Limb length discrepancy occurred in 2 cases. 1 case had stiffness in knee. Angular malalignment occurred in 3 cases which were >5 degree.

Table No 4: Post Operative Complications.

Complication	No. of patients	Percentage (%)
Nail site bursitis	3	20
Infection (ulceration at nail tip)	1	7
Limb length discrepancy	2	13
Stiffness of knee	1	7
Angular malalignment (>5 degree)	3	20
Nonunion	0	0
Delayed union	0	0
Rotational malalignment	0	0
Implant failure	0	0
Refracture	0	0

Limb length discrepancy was measured clinically comparing with the other limb. Average lengthening of 10 mm (8-12 mm) was noted in 1 case and average shortening of 5 mm (4-6 mm) was noted in 1 case after 6 months of surgery. 13 cases had no limb length discrepancy.

Table 5: Limb Length Discrepancy

Limb length discrepancy	No. of patients	Percentage (%)
Lengthening	1	7
Shortening	1	7
No discrepancy	13	86

Restriction of knee joint range of motion was noted in 1cases with average range from 0-110 degree.21 cases had 0-5 degrees of malalignment, 3 cases had 5-10 degree and 1 case had >10 degrees of angular malalignment.

Table 6: Angular Malalignment

Angular malalignment	No. of patients	Percentage (%)
0-5 degree	12	80
5-10 degree	2	13
10-15 degree	1	7

Functional assessment was done by TEN scoring criteria by Flynn et al. After analysing the final score of each patient according to the above criteria, results were classified as excellent, satisfactory and poor. In our series excellent results were obtained in 19(76%) cases, satisfactory in 4 (16%) cases and poor in 2(8%) cases.

Table 7: Functional Assessment

Results	No. of patients	Percentage (%)
Excellent	11	73
Satisfactory	3	20
Poor	1	7
Total	15	100

DISCUSSION-

In has been commonly accepted that surgical intervention is indicated in adolescent femoral shaft fracture in age group of 10-16 are generally open fracture, poly trauma, concomitant head injuries and neurovascular wounding. However, there are number of publications, suggesting that surgery can also be considered for isolated femoral fractures. Due to achievements such as earlier return to function, less joint stiffness, lesser wound complication, malunion, non-union, reduction in duration of hospitalization and cost makes intramedullary nailing one of the best methods of choice in adolescent too. In children, intervention using elastic nails are technically easier than the use of rigid nails. Using Ender's nails is little bit difficult because it is very hard and canal diameter is a restrictor factor in Ender's nail. The studies have shown that the intremedullary fixation with TENS can be performed successfully in age group of 10-16 years. Some

authors reported that they were using elastic nails in compound fracture up to Grade 3. We have used for 3 cases of compound G II injuries in our series. It appears that most of the femoral fractures we treated were transverse. However, Ligier et a have demonstrated that it can be successfully used in oblique and spiral fractures (10). Flynn et al & Ligier et al reported mean hospitalization was about 5-10 days in this method (8). In our series mean hospitalization was 10.1 days. The most common complication in treating femoral shaft fractures in adolescent is limb length discrepancy. Significant discrepancy is LLD > 2cm. We had 1 case of LLD between 5mm and 1 cm. It didn't give any problem for the patients. Another complication in a pediatric femoral shaft fracture in angulatory malunion. We analysed rotational deformities by clinically measuring the foot progression angle and looking for in-toeing or out-toeing when the child stands. We never had rotatory malunion as seen by clinical methods. Other complications in our series in the protrusion of nail in 3 cases causing skin irritation and knee stiffness. Luhmann et al. indicated that the technical problem can be minimized if the part of the nail which in left outside the femur in smaller than 2.5cm. Flynn et al found very few complications in a multicentre study with 58 cases on whom they performed TENS (7). First callus tissue emerged in four weeks on the average. In this study the nail was routinely removed in the 6th month. While early removal was required in five cases due to soft tissue irritation. But it has reported that it did not affect stability. We have removed nail between 6 to 9 months in our series.

Studies with ender nails for paediatric femoral shaft fracture by Kareglu et al (11) and Ozturkmen et al found increased incidence of varus valgus angulation when compared with elastic nails (9). Bar et al compared ESIN with external fixation for paediatric femoral shaft fractures and concluded that increase in number of complications is associated with external fixation technique. Many studies recommended allowing walking using crutches after the pain subsided. But Flynn et al suggested that it is ideal to allow partial weight bearing, when there is development of callus and full weight bearing only after clinical and radiographically complete union has occurred. Kiely biomechanically compared the application by two nails in 'C' shape and two nails one in S shape and another in 'C' shape and concluded that there was basically no difference between there 2 groups. Several case reports of avascular necrosis of femoral head were observed while using antegrade rigid interlocked nails for children and these complications were not reported in elastic nailing technique.

CONCLUSION-

Based on our experience and results, we conclude that ELASTIC STABLE INTRAMEDULLARY NAILING technique is an ideal method for treatment of adolescent femoral shaft fractures. It gives elastic mobility promoting rapid union at fractures site and stability which is ideal for early mobilization. It gives lower complication rate, good outcome when compared with other methods of treatment.

REFERENCES-

1- Saigal A, Agrawal AC. Role of titanium elastic nailing in pediatric femoral shaft fractures. J Orthop Traumatol Rehabil 2013; 6:70-3
2- Fricka KB, Mahar AT, Lee SS, Newton PO. Biomechanical analysis of antegrade and retrograde flexible intramedullary nail fixation of pediatric femoral fractures using a synthetic bone model. J Pediatr Orthop. 2004 Mar-Apr;24(2):167-71. doi: 10.1097/00004694-200403000-00006. PMID: 15076601.
3- Baldwin K, Hsu JE, Wenger DR, Hosalkar HS. Treatment of femur fractures in school-aged children using elastic stable intramedullary nailing: a systematic review. J Pediatr Orthop B. 2011 Sep;20(5):303-8. doi: 10.1097/BPB.0b013e32834671d0. PMID: 21829144.
4- Kawalkar A, Badole CM. Percutaneous titanium elastic nail for femoral shaft fracture in patient between 5 and 15 years. Journal of Orthopaedics. 2018 Jun;15(2):695-700. DOI: 10.1016/j.jor.2018.05.019. PMID: 29881223; PMCID: PMC5990292
5- Lohiya R, Bachhal V, Khan U, Kumar D, Vijayvargiya V, Sankhala SS, Bhargava R, Jindal N. Flexible intramedullary nailing in paediatric femoral fractures. A report of 73 cases. J Orthop Surg Res. 2011 Dec 22; 6:64. doi: 10.1186/1749-799X-6-64. PMID: 22192682; PMCID: PMC3320542.
6- Leow JM, Clement ND, Tawonsawatruk T, Simpson CJ, Simpson AH. The radiographic union scale in tibial (RUST) fractures: Reliability of the outcome measure at an independent centre. Bone Joint Res. 2016 Apr;5(4):116-21. doi: 10.1302/2046-3758.54.2000628. PMID: 27073210; PMCID: PMC5009237.
7- Flynn JM, Skaggs D. Femoral shaft fractures. In: Flynn JM, Skaggs D, Waters P, Eds. Rockwood & Wilkins' Fractures in Children. Philadelphia: Wolters Kluwer 2014; pp. 987-1026.
8- Ligier JN, Metaizeau JP, Prévot J, Lascombes P. Elastic stable intramedullary nailing of femoral shaft fractures in children. *J Bone Joint Surg Br.* 1988;70(1):74–77.
9- Bar-on E, Sagiv S. and Porat S. 'External fixation or flexible intramedullary nailing for femoral shaft fractures in children'. J Bone Joint Surg (Br) 1997; 79-B: 975-8.
10- Ligier JN., Metaizeau JP., Prevot J. and Lascombes P. 'Elastic stable intramedullary nailing of femur fracture in children'. J Bone & Joint Surg (Br) 1988; Vol 70B: 74-7.
11- Karaoglu S. et al. 'Closed ender nailing of adolescent femoral shaft fractures. Injury1994: 25(8): 501-506.