

OUTCOME OF FLEXIBLE INTRAMEDULLARY NAILS IN FRACTURE SHAFT OF FEMUR IN CHILDREN

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ABSTRACT

Objective: To evaluate the functional outcome of fracture shaft of femur in children treated with flexible intramedullary nails.

Material & Methods: This was a multicenter study which was conducted simultaneously at Department of Orthopedics and Traumatology Khyber Teaching Hospital Peshawar, Saidu Teaching Hospital Swat and Lady Reading Hospital Peshawar, Pakistan from March 2013 to July 2016. All patients meeting the inclusion and exclusion criteria were included in the study. Two titanium elastic nails of identical diameter were passed retrograde from supracondylar region using traction table and image intensifier without opening the fracture site. All patients were followed up at 2, 4, 8, 12 and 24 weeks for radiological and clinical evaluation. The results were evaluated using Flynn et al scoring criteria.

Results: A total of 143 patients were included in the study. Males patients were 96(67.1%) while 47(32.8%) were females. Mean age of the patient was 8.4 years (range 5 to 14 years). Right side was involved in 86(60.14%) patients and left side in 57(39.9%) patients. Post operatively excellent results were reported in 133(93.01%), satisfactory in 9(0.063%) and poor results in 1(0.007%) patients according to Flynn et al scoring criteria. Superficial infection at nail insertion site was reported in 31(0.22%) patients and leg length discrepancy of 1.5 cm was observed in 18(0.13%) patients. No other major complication was observed.

Conclusion: Flexible intramedullary nails gave excellent functional results in majority of paediatric femur shaft fractures. We recommend it as treatment of choice for fracture shaft of femur in children.

Key Words: Shaft, femur, flexible nails, hip spica.

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INTRODUCTION

Childhood injuries are major attention needed issues throughout world. Internationally these injuries are counted for major cause of death in children.¹ Fractures are very common in children and femoral shaft accounts for less than 2% for all paediatric fractures.² Multiple treatment options are available for treatment of femur shaft fractures. Femur shaft fractures can be treated conservatively as well as surgically. Options for conservative treatment are hip spica, Thomas splinting and traction. In surgical treatment the options are

plating, intramedullary nailing and external fixators.^{3,4} The treatment depends on age of the patient, fracture personality, soft tissues status and social and family environment of the patient. Conservative treatment was favored for the reasons that if there is any complication, it will remodel with the passage of time. But this concept has been reevaluated in last few years.⁵ In last few years the surgical treatment is becoming more popular. The aim of treatment should be stabilization and attaining the anatomical restoration. The final goal of treatment should be avoiding any complication and making it easy for the children and their family.⁵ Children between the age of 5 to 14 years are treated more surgically than conservatively in last few years.^{6,7} Surgical for school going age children is plating with screws, external fixators and intramedullary nails.⁸⁻¹⁰ Titanium Elastic Nailing also known as Elastic Stable Intramedullary Nailing, is used more frequently in school going children for all long bones fractures specially for femoral shaft fracture.^{11,12} Titanium elastic nail (TEN) is the best method for femoral shaft fractures and it is a

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compromise between conservative and surgical therapeutic approaches with satisfactory results and minimal complications.¹³ This study evaluates the functional results of flexible intramedullary nailing in school going age group between 5 and 14 years of age according to Flynn's criteria.¹⁴

MATERIAL AND METHODS

This multicenter study was conducted simultaneously at Department of Orthopedics and Traumatology Khyber Teaching Hospital Peshawar, Saidu Teaching Hospital Swat and Lady Reading Hospital Peshawar from March 2013 to July 2016. We included displaced closed fracture shaft of the femur, type I fracture and age group range from 5 to 14 years. Exclusion criteria was age less than 5 years or more than 14 years, type II and III open fracture, pathological fractures, polytrauma patients, fractures associated with neurovascular injury and segmental fractures. The Ethics Committee of the hospitals approved the study and informed consent was obtained from all patients. All patients were admitted either from OPD or through emergency department. Two titanium elastic nails of identical diameter were used. The diameter of the individual nail was selected as per Flynn et al 14 formula (Diameter of nail = width of the narrowest point of the medullary canal on AP and lateral view X-rasy and intraoperative assessment of nail Diameter was chosen so that each nail occupied at least 1/3rd to 40% of the medullary cavity. The operative technique was standardized. The surgery was performed under general anesthesia with the patient on the operation table in supine position or on the traction table. Fracture was reduced under image. Incision was made 1 cm proximal to distal femoral epiphysis confirmed on image intensifier. With a 3.5 mm drill bit entry point was made at 90 degree to cortex, after drilling the first cortex the drill was directed proximally at an angle of 45 degrees, after 3.5 mm drill the entry point was enlarge with a 4.5 mm drill bit. The nails were contoured in bow shape before insertion, the tip of nail was towards the concave side. First nail was introduced and advanced till fracture site, the second nail was then introduced and advanced till fracture site. The nail which was easy to cross the fracture was advanced further to cross the fracture followed by the second nail. The nail proximal end was advanced till it reached one cm distal to greater trochanter physis. The nail were cut one to two cm outside the cortex distally and buried in skin after bending it (Fig 1). Quadricep exercise was started from day one, range of movement and mobilization without weight bearing was started as soon as patient became pain free. Stitches were removed after 15 days. Partial weight bearing using crutches or walker was started at three weeks and full weight bearing by six to eight weeks de-

pending on the fracture configuration, callus response and associated injuries. All patients were followed up at 2,4,8,12 and 24 weeks for radiological and clinical evaluation. At each follow-up, we documented the range of motion of the hip and knee, evidence of soft tissues irritation by nail ends, length discrepancy (measured by a tape from the anterior superior iliac spine to the medial malleolus), rotational alignment (by comparing hip rotation to the normal side), exteriorization, infection, gait, and status of weight-bearing. Radiographs were requested to document union, malunion, nail position, and remodeling. Nails were removed six to eight months post surgery when the fracture line was no longer visible radiologically (Fig 2). Removal was done as an outpatient procedure under general anesthesia or local anesthesia with sedation. Statistical analysis was done using SPSS version 17 for evaluation. The results were evaluated using Flynn et al scoring criteria as shown in Table 1.

RESULTS

In our study we included 143 patients, 96 were males and 47 were females. Age ranges from 5 to 14 years and mean age was 8.4 years. Right side was involved in 86(60.14%) patients and left side in 57(39.9%) patients. Causes for these injuries were road traffic accident in 61 cases, fall from height in 73 cases, assault in 5 patients and injury while playing in 4 patients. X-rays including AP and lateral views showing both hip and knee joints were taken. Fracture personality was i.e in 81(56.64%) patients it was transverse, in 36(25.17%) patients it was oblique and in 16(11.18%) patients the fracture was spiral. In our study the fracture distribution was such that in 69(48.25%) cases it was in middle one third of shaft of femur, in 48(33.56%) proximal one third of shaft was involved and in 26(18.18%) the distal one third was involved.

All patients were admitted through emergency or from OPD. The time interval between surgery and time

Table 1: Flynn et al criteria for final outcome

Results (variables)	Excellent	Satisfactory	Poor
Limb Length discrepancy	Less than one cm	Less than 2 cm	More than 2 cm
Malalignment	5 degrees	10 degrees	More than 10 degrees
Pain	none	none	present
Other Complications	none	Minor and resolved	Major and lasting morbidity

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Figure 1: Peri operative radio graphs (AP & lateral views)



Figure 2: Post operative radio graphs (AP & lateral views)

of admission was 3 days ranging from 2 to 7 days. The average time of surgery was 51 min in our study. The hospital stay was from 4 to 12 days with mean time of stay of 5 days. Post operatively AP and lateral views x-rays were taken to assess the position of the nails. In two of our patients who had oblique fractures one of the nail was out of the proximal fragments and both of them were reoperated to adjust the nails properly. Post operatively the patients were discharged on first or second post op day in most cases. Those who had type I open fractures were retained in the ward for

maximum of three days. All patients were reviewed after two weeks and stitches were removed. Then followed on 8th, 12th and 24th weeks and x-rays were taken to assess the clinical and radiological union of fractures. Patients were advised to start partial weight bearing on 6th week and full weight bearing on 10th week. Only five of our patients were advised to start full weight bearing on 12th week as they had some comminution at fracture site.

On the final follow up all results were assessed according to Flynn's criteria for flexible nails and we found excellent results in 133(93.01%), Satisfactory results in 9(0.063%) and poor results in 1(0.007%) patients. Complications were observed in some of our patients. 31(0.22%) patients had superficial infection at nail insertion site which were treated with oral antibiotics and resolved. 2(0.014%) patients had knee swelling due to synovitis but resolved without any surgical intervention. Leg length discrepancy was observed in 18(0.13%) patients which was 1.5 cm in all patients. Angulation of less than 7 degrees in varus/valgus and less than 10 degrees in anteroposterior direction was observed in 9(0.063%) patients. No deep infection, knee or hip stiffness, proximal nail migration, delayed union, nonunion or any other major complication was observed in any of our patients.

DISCUSSION

Trauma in children is more in male patients in our set up. It is because the males are more actively participating in all activities as compare to females. In our study there were 96(67.13%) males and 47(32.87%) females. In two other series also the incidence of femur fractures is more in males with a bimodal distribution (16,17%).^{19,20} Right side was involved in 86(60.14%) patients and left side in 57(39.9%) patients. In a series of P Singh and R Kumar²¹ the fracture was more on right side as compare to left side i.e it was 62% on right side and 38% on left side. Mechanism of injury were road traffic accident in 61(42.66%) cases, fall from height in 73(51.05%) cases, assault in 5(0.35%) patients and injury while playing in 4(0.28%) patients. A study conducted in Nepal shows road traffic accident in 75% cases followed by fall from tree 23.2% cases.²³ In our study the fracture distribution was such that in 69(48.25%) cases it was in middle one third of shaft of femur, in 48(33.56%) proximal one third of shaft was involved and in 26(18.18%) the distal one third was involved. In a study conducted in India the involvement is 21% of proximal third, 68% of middle third and 11% of distal third of shaft of femur.²¹ Flynn's et al in their series on femoral fractures treated operatively in children have recommended Transverse, short oblique and minimally comminuted fractures for TEN.¹⁴ In our study

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81(56.64%) patients it was transverse, in 36(25.17%) patients it was oblique and in 16(11.18%) patients the fracture was spiral. In the series of Thapa SK et al most fractures were either oblique (41.1%) or transverse (37.5%) involving the middle third of the shaft.¹⁸ Ligier et al. reported that among 118 cases, 68 were transverse fracture out of which 16 were comminuted, 28 were spiral out of which nine were comminuted, 22 cases were oblique fracture out of which 10 were comminuted.¹⁹ In another series reported by Razak et al.²⁰ eleven out of 20 patients had transverse fracture, six had oblique and three had comminuted fracture. Average time of surgery was 51 min in our study. In another series of Rasool G et al and P Singh et al the average time of surgery was 45 min and 53 min respectively.^{21,22} In our series the time interval between surgery and time of admission was 3 days ranging from 2 to 7 days. In a study conducted by El-adl et al., fractures were operated within two to four days of injuries.²³ The hospital stay was from 4 to 12 days with mean time of stay of 5 days. In series of shrawan kumar et al 21 duration of hospital stay were between five to 12 days and in a study conducted by Houshian et al²⁴ the mean hospital stays was six days and range of hospital stay was two to 20 days.

In our study the final follow up results were assessed according to Flynn's criteria for flexible nails and we found excellent results in 133(93.01%), Satisfactory results in 9(0.063%) and poor results in 1(0.007%) patients. In Pulate A et al²⁴ study the results are excellent in 60% cases, 35% patients had satisfactory results and 5% patients had poor results. In another series in Nepal¹⁸ the results are excellent result in 87.5%, satisfactory in 10.7% and poor in 1.8%.

CONCLUSION

Flexible intramedullary nail is a less invasive and quick surgical procedure for treating paediatric femur shaft fractures. It had no major complications and gave excellent functional results. We recommend it as treatment of choice for fracture shaft of femur in children.

REFERENCES

1. Al-Sayyad MJ. Taylor spatial frame in the treatment of pediatric and adolescent tibial shaft fractures. *Jpediatr orthop.* 2006;26:164-170.
2. Hinton R, Lincoln A, Crockett M. Fractures of the femoral shaft in children. *J Bone Joint Surg Am.* 1999;81(4):500-09.
3. Czertak DJ, Hennrikus W L. The treatment of paediatric femur Fractures with early 90 – 90 spica casting. *J paediatr orthop* 1999 : 229- 32.
4. Cases J, Gonzalez – Moran G, Albinana J. Femoral Fractures in children from 4 years to 10 years: conservative treatment. *J Pediatr Orthop B* 2001; 10: 56-62.
5. Metaizeau JP. Stable elastic nailing for fractures of the femur in children. *JBJS.* 2004;86:954-57.
6. Sanders JO, Browne RH, Money JF, Raney M, Horn BD, Anderson DJ, et al. Treatment of femoral fractures in children by pediatric orthopedists: results of a 1998 survey. *J Pediatr Orthop.* 2001;21(4):436-41.
7. Heyworth BE, Galano GJ, Vitale MA, Vitale MG. Management of closed femoral shaft fractures in children, ages 6 to 10 national practice patterns and emerging trends. *J Pediatr Orthop.* 2004;24(5):455-59.
8. Kanlic EM, Anglen JO, Smith DG, Morgan SJ, Pesantez RF. Advantages of submuscular bridge plating for complex pediatric femur fractures. *Clin Orthop Relat Res.* 2004;426:244-51.
9. Wright JG, Wang EE, Owen JL, Stephens D, Graham HK, Hanlon M, Nattrass GR, Reynolds RA, Coyte P. Treatments for paediatric femoral fractures: a randomised trial. *The Lancet.* 2005;365(9): 1153-58.
10. Beaty J. Operative treatment of femoral shaft fractures in children and adolescents. *Clin Orthop Relat Res.* 2005;434:114-22.
11. Bhaskar A. Treatment of long bone fractures in children by flexible titanium nails. *Indian J Orthop.* 2005;39:166–68.
12. Sanders JO, Browne RH, Mooney JF, Raney EM, Horn BD, Anderson DJ, et al. Treatment of femoral shaft by pediatric orthopedist: Results of a 1998 survey. *J Pediatr Orthop.* 2001;21:436–41.
13. Gamal EA, Mohamed FM, Mohamed AK, Ahmed E. Titanium elastic nail fixation for paediatric femoral and tibial fractures. *Acta Orthop.* 2009;75:512-20.
14. Flynn JM, Skaggs DL, Sponseller PD, Ganley TJ, Kay RM, Kellie Leitch KK. The operative management of pediatric fractures of the lower extremity. *J Bone Joint Surg Am.* 2002;84:288–300.
15. Flynn JM. Early application of hip spica led to higher malunion rates in pediatric femoral fracture. *J Bone Joint Surg Am.* 2005;87(8):1891-96.
16. Carey TP, Galpin RD. Flexible intramedullary nail fixation of paediatric femoral fractures. *Clin Orthop Relat Res* 1996;332:110-18.
17. Casas J, Gonzalez-Moran G, Albiñana J. Femoral fractures in children from 4 years to 10 years: conservative treatment. *J Pediatr Orthop B* 2001; 10: 56-62.
18. Thapa SK, Poudel KP, Marasini RP, Shankar Dhakal

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- S, Shrestha R. Paediatric diaphyseal femur fracture treated with intramedullary titanium elastic nail system. Journal of College of Medical Sciences. 2015;11(2):20-22.
19. Ligier JN, Metaizeau JP, Prevot J, Lascombes P. Elastic stable intramedullary nailing of femoral shaft fracture in children. JBJS 1988;70-B:74-7.
20. Razak MYA, El-Karef EA, Soliman AS, Tanagho A. Result of flexible intramedullary nailing in paediatric femoral fractures. Bull Alex Fac Med. 2008;44:729-35. Gulrez S. Titanium elastic nailing for paediatric femoral shaft fractures: a prospective descriptive study. International Journal of Research in Orthopaedics. 2017;3(3):501-07.
21. Rasool G; Malik Z, M. Ashraf N, Azhar. Comparison of Titanium Elastic Nails (TEN) Vs Traction and Hip Spica Cast for Treatment of Femoral Shaft Fracture in Children Age 6-12 years. JRMC 2013;17(2):211-214 211.
22. El-adl G, Mostafa MF, Khalil MA, Enan A. Titanium elastic nail fixation for paediatric femoral and tibial fractures. Acta Orthop Belg. 2009;75:512-20.
23. Houshian S, Gothgen CB, Pedersen NW. Femoral shaft fractures in children. Acta Orthop Scand. 2004;75(3):249-51.
24. Pulate A, Jadhav A, Shah BN. Study of the outcome of titanium elastic nail system in diaphyseal femoral fractures in children. MOA Journal. 2012;7(3):6-8. Pediatr Orthop. 2006;26:164 e 170. Pediatr Orthop. 2006;26:164 e 170

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

Hayat S:	Idea /design organization
Alam W:	Study design
Shah SDBA:	Article review and correction
Shah FA:	Literature review
Qayum A:	Bibliography

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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