Role of elastic intramedullary nail for the treatment of femur shaft fracture in children

Naseer Ahmed Ch,[1] Mohsin Bilal,[1] Asghar Ali,[1] Muhammad Azeem,[1] Saleem Akther Rana,[1] Muhammad Shahnawaz Ahmed[1]

Abstract

Background: Femoral shaft fractures are common in children and multiple management options are being practiced.

Objective: To assess the rate of union after closed elastic intramadullary nail fixation of femur shaft fracture in children.

Methodology: This cross sectional study was performed from 15th April to 15th October 2016, at Sheikh Zayed Medical College/Hospital, Rahim Yar Khan. There were total 55 patients. Femur fractures among children were treated with intramedullary nails. Convenient sampling technique was used for sample selection. Fractures union, age, sex was assessed as outcome variable. Data was analyzed by SPSS version 16.

Results: In this study out of 55 patients 33 were male. There were 33 patients with simple and 22 patients with comminuted fractures. Fracture union was seen in 47 (85.45%) patients. There was almost equal union in both male and females with p value of 0.88. Better union was seen in age group of 5 to 8 years with union in 26 out of 29 patients as compared to age group of 9-12 years but this difference was not statistically significant with p= 0.35. Union was better seen in patients with weight less than 20 kg and duration of fracture 5 days or less with p values of 0.06 and 0.45.

Conclusion: Intramadullary elastic nailing is a good procedure with effective results in most of the patients. Weight lower than 20 kg has significant association with its union rate and simple fractures also showed significance with fracture union with minimum complication rate. So we recommend flexible elastic nail should be considered as favorable treatment option for femoral diaphysial fracture in pediatric group.

Key words: Closed intramadullary elastic nailing, Femoral shaft, Fractures, Children.

Introduction

Femoral shaft fractures are reported commonly among children mostly in males, the male to female ratio of femoral shaft fractures is 2.6:1. The incidence occurs mainly in early childhood and in mid adolescence.[1,2] The bimodal variation is also seasonal with peak in March and August in a Swedish study.[3] Most fracture in children are the result of accidents. The pattern of accidental injury is poorly understood which is based on socio economic status and medical phenomenon of a country. Unfortunately poor funding for research to prevent accidents in children may result in high number of femoral fracture in children.[4]

Both surgical and non-surgical modalities have been used to treat these fractures. The choice of treatment is based on type of fractures, age of patient, mechanism of injury and associated injuries being the most important. Less invasive modalities include application of spica casting, which has problems in transportation, cast intolerance and hygiene problems.[5] Spica casting is associated with delayed union, malunion, growth disturbance and physiological problem.[6] External Fixator is associated with pin infection which is noted on initial application of cast or after removal of Fixator on reapplication of Fixator.[7] Use of intramedullary nailing was associated with over growth and AVN of femoral head.[8] Locking plates were used to fix these fractures. But more extensive surgical dissection is required in plate removal than the insertion.[9]

Flexible femoral medullary nailing is the best treatment for these fractures, because it gives immediate stability and mobilization with short hospital stay, small incisions and minimal blood loss and no special expertise are required, after union implant removal is easy with minimal scar mark and low risk of a vascular necrosis and implant failure. But are associated with infection, wound ulceration, leg length discrepancy and mal alignment.[10] There is

1. Department of Orthopeadic, Sheikh Zayed Medical College/Hospital, Rahim Yar Khan, University of Health Sciences, Lahore, Pakistan.

Correspondence: Dr. Naseer Ahmed Ch, Associate Professor, Orthopedic Surgery, Sheikh Zayed Medical College/Hospital, Rahim Yar Khan, Pakistan.

Email: ali.orthopaedic.ryk@gmail.com **Phone:**+92-300-9678595 **Received:** 30-05-2019 **Accepted:** 15-06-2019 **Published:** 23-09-2019

a great deal of good healing rates as well as the remodeling range in younger children. Closed intramadullary elastic nailing has shown promising results in healing and avoiding complications.[10] This study was to assess the rate of union after closed elastic intramedullary nail fixation of femur shaft fracture in children.

Methodology

This is descriptive cross sectional study including children from age group of 5 to 12 years of both sex having femur diaphyseal fracture treated with elastic intra-medullary nail during a period of six months from 15th April to 14th October 2016. Patients were registered by convenient sampling. Approval from Institutional Review Board was taken prior the commencement of study. Patient having metabolic bone diseases, pathological fractures, compound fracture and with neuromuscular disorders were excluded from the study. Surgical indications were displaced femur shaft fractures with open physis. Study was conducted on 55 patients having diaphyseal femur fracture of transverse, oblique, spiral and minimally comminuted variety. There were 33 male patients and 22 female patients.

Demographic data like age (in years), gender (male/female), weight (in kilograms) was taken and other data like type of femur fracture i.e. simple or comminuted, fracture were classified according to AO pediatric (Arbeitsgemeinschaft for Osteosynthesefragen) classification for femoral shaft fracture 32-D (4.1,4.2,5.1 and 5.2) duration of fracture (in days) and the hospital stay (in days) after the procedure. This procedure was done by medical officer with at least two year experience in orthopaedics. In this procedure two nails made up of titanium of various sizes ranging from 0.5 to 4 mm which will be adjusted according to the bone diameter of the patients and inserted about 2 cm above the distal femoral physis from medial and lateral sides. Medial nail was directed till it is within 2 cm of proximal femoral capital physis whereas lateral nail will be inserted till it is about 1 cm from greater trochanteric physis. This all procedure was done in the operation theatre of Sheikh Zayed hospital Rahim Yar Khan under image intensifier control under general anesthesia. Postoperatively the operated leg kept elevated for 24 hours to reduce swelling and rehabilitation started including hip and knee motion exercise on 1st post operative day, followed by non-weight bearing mobilization on 5th to 7th day post operatively when there was no swelling. Partial weight bearing was started after 03 weeks followed by full weight bearing after 6 to 8 weeks once radiological union was observed. Union was described when bridging callus was seen within three months of surgery and non union after 03 months. Data analysis was done by SPSS version 16.

Results

In this study, there were total 55 patients out of which 33 were males and 22 females. The mean age was 8.33±1.65 years, while mean weight was 19.11±4.46 kg. Mean duration of fracture was 4.05±2.71 days, while mean hospital stay post operatively was 3.65±1.53 days. Twenty nine (52.73%) patients had age 5-8 years and rest of patients up to 12 years and 31 out of 55, (56.36%) patients had weight less than 20 kg. Results showed that 34 (61.82%) patients had fracture for 5 days or less. There were 30 patients with simple and 17 (40%) patients with comminuted fractures. Forty six (83.64%) patients had hospital stay less than 5 days post operatively.

Table I: Fracture union with respect to sex and age

Variable	Union			P.Value
	Yes	No	Total	
Gender				
Male	28	5	33 (100)	0.8
Female	19	3	22 (100)	
Age groups (years)				
5-8	26	3	29 (100)	0.5
9-12	21	5	26 (100)	

Fracture union was seen in 47 (85.45%) patients. There was almost equal union in both male and females patients with p value of 0.88 as in table I. Better union was seen in age group of 5 to 8 years with union in 26 (89.66%) out of 29 patients as compared to age group of 9-12 years but this difference was not statistically significant with p= 0.35. In < 20 kg weight patients, union was observed in 26 patients. Union was better seen in patients with weight less than 20 kg and duration of fracture 5 days or less with p values of 0.06 and 0.45. Thirty (90.91%) out of 30 patients had union in simple fractures as compared to comminuted in 17 out of 22

with p values of 0.16. Union was also higher in patients with duration of hospital stay less than 5 days with p= 0.47. Angulation was more than 15 degree observed in five patients and there was infected non union in two patients and simple non union in one poly trauma patient.

Discussion

Femoral shaft fractures, typically caused by direct trauma, are the major cause of pediatric injuries. Seventy percent of femur fractures involve the shaft. Femoral shaft fractures occur in approximately twenty per hundred thousand children in the USA, representing 1.6% of all fractures in the paediatric population.[11]

Both surgical and non-surgical modalities have been used to treat these fractures. The best mode of treatment among the wide variety of surgical and other nonsurgical modalities for children between 5 and 12 years of age, is still to be established. But in our study elastic nail is found to be best modality. Unlike spica casts and closed reduction, which is the treatment of choice in younger children, patients in this intermediate age group have a higher risk of complications including shortening and malunion.[12] The methods like flexible intramedullary and antegrade solid nails, external fixation, plates and screws have effective role. But each procedure carries the risk of certain complications, particularly pin track infection and re-fracture after external fixation removal or osteonecrosis coxa valga after fixation with a solid antegrade intramedullary nail (IMN). The results with flexible intramedullary nails are couraging.

In this study, the union in fractured shaft was seen in 47 (85.45%) patients. One study was conducted by Lohiya et al revealed that out of their 73 patients, 83% had fracture union and the rest of the 17% patients fractures gone to non union and the degree of angulations was more than 15 degrees, which they labeled as malunion and these patients were reoperated.[13] Another study carried out by Sela et al on 212 patients demonstrated the solid union in all the 100 % of their patients but in their study 10 (4.72%) patients had a malunion i.e. more than 15 degrees of angulations and needed re intervention.[14] The results of our study were almost similar to the previous ones with slightly lower rate.

There was almost equal union in both male and females with slight female predominance. Nineteen (86.36%) out of 22 females as compared to 28 (84.85%) out of 33 males had union with p value of 0.88. This was also observed by the other studies that also found a slight predominance in female gender healing. The reason of this can be due to males are more active and mobile as compared to females that lead to early and more extensive mobility and lower rate of union.[15,16]

Better union was seen in age group of 5 to 8 years with union in 26 out of 29 patients as compared to age group of 9-12 years where union was achieved in 18 patients, but this difference was not statistically significant with p= 0.35. Other studies also revealed almost the similar results but they used a little different age groups and included the patients up to age of 14 years. The higher failure rate in the older age groups as compared to younger can be extra motile habits and relatively more weight. On the other hand younger kids have more re generation and remodeling capability that ended in good results.[17,18]

Union was better seen in patients with weight less than 20 kg as compared to overweight patients. This difference was found to be close to statistical significance with p value of 0.06. This was similar to previous studies however they did not have the same weight division criteria and some used the BMI type, which was not used in this study. They also did not find the significant association of this with lower weight group. It was not assessed that the patients with higher weight had what sort of height. May be they had more BMI, which leads to extra pressure on the femur and result in failure of the union.[19,20]

The patients operated within 5 days had better union in contrast to those who were operated late. However, this difference was not statistically significant with p values of 0.45. Why is the success rate better in patients that reported early? They get better union due to easy manipulation and reduction. And those presented late have difficulty in manipulation and mal union has lower results.[21,22]

Thirty out of 33 patients had union in simple fractures as compared to comminuted in 17 out of 22. There was almost a significant was seen with p values of 0.16. The data has been revealed in previous studies as well, the simple fracture had good outcome. The reason of this can be as the simple fracture has only one site of fracture and union is

relatively easy. While in comminuted fractures, the chances of multiple pieces to unit together and heal is relatively lower and also there are chances of secondary infections as well.[23,24]

Union was also higher in patients with duration of hospital stay less than 5 days where it was seen in 86.96% patients; although this difference was also not found significant with p= 0.47. The time frame was not used by the other studies as was used in this study. But the data from previous studies strength our results as well. They described that the patients that had mean hospital duration longer, they had lesser union rates. The reason can be explained by the complex nature of the fracture, failure of the procedures, malunion or secondary infection that lead to slower rate of the union or non union and hence lower results.[25,26]

There were few **limitations of this study,** as we did not use the dislocated fractures in this. We also did not collect data regarding the BMI, one component of which, the weight has shown significant association with fracture union.

There were **much strength** too. We used the most common reported fracture types. The gender, weight, age groups, weight were extensively assessed in fracture union.

Further studies can be planned to check for different materials of intrameduallary nailing, BMI analysis, infection rate and the malunion i.e. assessed by degree of angulation after the union of fracture.

Conclusion

Intramedullary elastic nailing is a good procedure with excellent results. Weight less than 20 kg has significant association with it union rate and simple fractures also showed a significant results. This study document that flexible elastic nail should be considered as favorable treatment option for pediatric femoral diaphysial fracture.

Authors Contribution: NAC: Conception, drafting and final approval. **MB:** Design, revising and final approval. **AAC:** Interpretation, revising and final approval. **MA:** Design, drafting and final approval. **MSA:** Interpretation, revising and final approval. **SA:** Conception, drafting and final approval.

Conflict of Interest: None

Sources of Funding: Self

References

1. Loder RT, O'Donnell PW, Feinberg JR. Epidemiology and mechanisms of femur fractures in children. J Pediatr Orthop. 2006;26(5):561–566.
2. Hinton RY, Lincoln A, Crockett MM, et al. Fractures of the femoral shaft in chil-dren. Incidence, mechanisms, and sociodemographic risk factors. J Bone Joint Surg Am.1999;81(4):500–509
3. Heideken J, Svensson T, Blomqvist P, et al. Incidence and trends in femur shaft fractures in Swedish children between 1987 and 2005. J Pediatr Orthop.2011;31(5):8.
4. McClain, R.F. Clark, C.R. El-Khoury, G.y. C6-7 Dislocateion in the neurologically intact neonate: A patient report. Spine 1989:14:125-126.
5. Hughes BF, Sponseller PD, Thompson JD. Pediatric femur fractures: Effects of spica cast treatment on family and community. J Pediatr Orthop. 1995;15(4):457–460..
6. Reeves RB, Ballard RI, Hughes JL. Internal fixation versus traction and casting of adolescent femoral shaft fractures. J Pediatr Orthop.1990;10(5):592–595.
7. Aronson J, Tursky EA. External fixation of femur fractures in children. J Pediatr Orthop. 1992;12(2):157–163.
8. Beaty JH, Austin SM, Warner WC, et al. Interlocking intramedullary nailing of femoral shaft fractures in adolescents: Preliminary results and complications. J Pediatr Orthop. 1994;14(2):178–183.
9. Pate O, Hedequist D, Leong N, et al. Implant removal after sub muscular plating for pediatric femur fractures. J Pediatr Orthop. 2009;29:709-712.
10. Mazda K, Khairouni A, Pennecot GF, et al. Closed flexible intramedullary nailing of the femoral shaft fractures in children. J Pediatr Orthop. 1997;6(3):198–202.
11. Hedlund R, Lindgren U. The incidence of femoral shaft fractures in children and adolescents Pediatr Orthop 1986;6:47-50.
12. Kirby RM, Winquist RA, Hansen ST Jr. Femoral shaft fractures in adolescents: A comparison between traction plus cast treatment and closed intramedullary nailing. J Pediatr Orthop. 1981;1(2):193–197.
13. Lohiya R, Bachhal V, Khan U, Kumar D, Vijayvargiya V, Sankhala SS, et al. Flexible intramedullary nailing in paediatric femoral fractures; a report of 73 patients. J Orthop Surg Res. 2011;64(6):01-10.
14. Sela Y, Hershkovich O, Sher-Lurie N, Schindler A, Givon U. Pediatric femoral shaft fractures: treatment strategies according to age - 13 years of experience in one medical center. J Orthop Surg Res. 2013;23(8):08-23.
15. Barry M, Paterson JM. A flexible intramedullary nails for fractures in children. J Bone Joint Surg Br. 2004; 86(7): 947-953.
16. Flynn JM, Hresko T, Reynolds RA. Titanium elastic nails for pediatric femur fractures: A multicenter study of early results with analysis of complications. J Pediatr Orthop. 2001; 21: 4–8.
17. Timmerman LA, Rab GT: Intramedullary nailing of femoral shaft fractures in adolescents. J Orthop Trauma. 1993; 7: 331–337.
18. Kissel EU, Miller ME. Closed Ender nailing of femur fractures in older children. J Trauma. 1989; 29: 1585-1588.
19. Aktekin CN, Ozturk AM, Altay M, Toprak A, Ozkurt B,

Tabak AY. Flexible intramedullary nailing of children. Ulus Travma Acil Cerrahi Derg 2007; 13(2): 115-121.
20. Singh R, Sharma SC, Magu NK, Singla A. Titanium elastic nailing in pediatric femoral diaphyseal fractures. Indian J Orthop. 2006; 40(1): 29-34.
21. Houshian S, Gothgen CB, Pedersen NW. Femoral shaft fractures in children: elastic stable intramedullary nailing in 31 patients. Acta Orthop Scand. 2004; 75(3): 249-251.
22. Narayanan UG, Hyman JE, Wainwright AM, Rang M, Alman BA. Complications of elastic stable intramedullary nail fixation of pediatric femoral fractures, and how to avoid them. J Pediatr Orthop. 2004; 24(4): 363-369.
23. Luhmann SJ, Schootman M, Schoenecker PL. Complications of titanium elastic nails for pediatric femoral shaft fractures. J Pediatr Orthop. 2003; 23(4): 443-447.
24. Salem KH, Keppler P. Limb geometry after elastic stable nailing for pediatric femoral fractures. J Bone Joint Surg Am. 2010 Jun;92(6):1409-1417.
25. Ozdemir HM, Yensel U, Senaran H. Immediate percutaneous intramedullary fixation and functional bracing for the treatment of pediatric femoral shaft fracture. J Pediatr Orthop. 2003; 23(4): 453-457.
26. Cramer KE, Tornetta P 3rd, Spero CR. Ender rod fixation of femoral shaft fractures in children. Clin Orthop Relat Res. 2000; 376: 119-123.

Article Citation: Ahmad NC, Ali A, Azeem M, Rana SA, Ahmed MS. Role of elastic intramedullary nail for the treatment of femur shaft fracture in children JSZMC 2019;10(3): 1708-1712