Original Article

Journal of Orthopedic Education
Volume 7 Number 1, January – June 2021
DOI: http:// dx.doi.org/10.21088/joe.2454.7956.7121.1

A Study on Surgical Management of Diaphyseal Fractures of Shaft of Femur in Children and Adolescents Using Flexible Nails

[1]Prasad N C, [2]Shivashankarappa A, [3]Shaik Hussain Saheb

How to cite this article:
Prasad NC, Shivashankarappa A, Shaik Hussain Saheb, A Study on Surgical Management of Diaphyseal Fractures of Shaft of Femur in Children and Adolescents Using Flexible Nails. J orth. Edu. 2021;7(1):9–14.

Author's Affiliations: [1,2]Associate Professor, Department of Orthopedics, [3]Assistant Professor, Department of Anatomy, JJM Medical College, Davanagere, Karnataka 577004, India.

Corresponding Author: Shivashankarappa A, Associate Professor, Department of Orthopedics, JJM Medical College, Davanagere, Karnataka 577004, India.

Email: anatomyshs@gmail.com

Abstract

Background: Diaphyseal femur fractures are commonly encountered in association with other high-energy injuries. Fixation of femur fractures in children & adolescents by flexible intramedullary nailing is becoming widely accepted because of the lower chance of iatrogenic infection. The objective of the study was to observe functional outcome, healing time and the complications following the use of flexible nail for femoral shaft fractures. ***Methodology:*** Children and adolescents between the age group of 5-16 years with Femoral shaft fractures were admitted to Hospitals attached to J.J.M Medical College, Davangere. All patients were operated by closed reduction and internal fixation with flexible nailing. Patients were followed up after surgery. A minimum of 20 cases were studied. ***Results:*** The study comprised 16 male patients and 4 female patients aged from 5 to 16 years with mean of 8.5 years. The commonest duration from date of injury so far of surgery was 2 to 4 days. From 3 months to 1 year range was there to follow up. ***Conclusion:*** Rapid healing and fracture union by preservation of fracture hematoma and limited soft tissue exposure was observed in flexible intramedullary nail fixation. We conclude that flexible intramedullary nailing is a superb technique for the treatment of diaphyseal fractures of the femur in children and adolescents aged 5 to 16 years.

Keywords: Femoral shaft; Intra medullary; Diaphyseal; Flexible nails.

Introduction

Femoral shaft fractures account for 1.6% of all pediatric bony injuries. There is little controversy over the treatment of adult femoral shaft fractures with intramedullary nail fixation. Differences of opinion about treatment are greatest for patients who are too old for early spica casting and yet too young for adult type of treatment with a reamed rod. Current treatment options include early spica casting, traction, external fixation, ORIF with plating, flexible intramedullary nails and reamed intramedullary rods. In children fractures of the femoral shaft are commonly treated by various sorts of traction for about 3 weeks, followed by cast immobilization. The major drawbacks with this treatment are prolonged bed rest. The previous experiences proved that children with diaphyseal femur fracture do not always recover with conservative treatment. The management of pediatric femoral shaft fractures gradually has evolved towards a more operative approach. This is due to a more rapid recovery and reintegration of the patients and a recognition that prolonged immobilization can have a negative effect even in children.

Antegrade nailing techniques in more proximal fractures, due to the pull of the iliopsoas muscle, the upper main fragment may be flexed and externally rotated, and the distal segment lies posteriorly due to gravity. Reduction is performed under image intensification. A wrap around the femur, a schanz screw inserted into one of the fragments, use of a bone hook and poller screws. Flexible nail fixation in the paediatric population is simple, effective and minimally invasive. It allows stable fixation, rapid healing and a prompt return of the kid to normal activity. Functional results are excellent and complications are minor. The present study was conducted to study the functional outcome following the use of flexible nails for treatment of femoral shaft fractures in children and adolescents. To study the

duration of union in the above mentioned fractures. To study the complications of flexible intramedullary nailing for femoral shaft fracture.[1-5]

Materials and Methods

In this study 20 patients, aged 5 to 16 years, with fracture shaft of the femur were treated with retrograde flexible intramedullary nailing. The study includes patients with femoral shaft fractures admitted and examined consistent protocol. Clinical and radiological investigations were carried out and medical fitness for surgery to undergo flexible nailing fixation for the sustained fracture was taken. As soon as the patient was brought to casualty, patient's airway, breathing and circulation were assessed. Then an entire survey was administered to rule out other significant injuries. Plain radiographs of AP and lateral views of the femur were taken including both hip and knee joints, to assess the extent of fracture commination, the geometry and the dimensions of the fracture, i.e. fracture lines that propagate beyond the obvious fracture. Patients were operated as early as possible once the overall condition of the patient was stable and patient was fit surgery.

Flexible intramedullary nailing of pediatric femoral fractures either with stainless steel or titanium rods can be performed either antegrade or retrograde. The advantage of elastic internal fixation is that a healthy environment for fracture healing with some motion results in increased callus formation. Elastic nailing of femoral fractures carries with it a few controversies: straight versus bent rods, titanium versus steel, immobilization versus no immobilization postoperatively and antegrade versus retrograde insertion. Mechanical testing of femoral fracture fixation systems showed that the greatest rigidity is provided by an external fixation device and therefore the least by flexible intramedullary rodding. Stainless-steel rods are stronger than titanium in bending tests. Stainless-steel rods have greater intrinsic strength and therefore are not as dependent on the opposing bend technique.

After completing preoperative procedures general anaesthesia was used in younger children and spinal anaesthesia was used in older children and adolescents. Under anaesthesia, the patient was put in supine position on the fracture table. The opposite limb was held on a knee rest with the hip flexed 90 degrees and abducted 30 degrees and the knee in 90° of flexion to allow visualization of the whole femur in both AP and lateral views with image intensifier. The image intensifier unit was positioned on the unaffected side of the patient. Hip, thigh and knee regions were painted and draped. The image intensifier is employed to localize the location of skin incisions by viewing the distal femur within the AP and lateral planes. The level of the insertion of flexible nail should be 2.5 to three cm proximal to the distal femoral physis within the AP view and it should be in the middle of the cortex in the lateral view. Incision of about 2 to 3 cm is put on both medial and lateral aspects of the thigh at the site of insertion of the nail. Soft tissue was split and therefore the bone was exposed on each side. A hole was made in the cortex by using 4.5mm drill bit and then a bone awl was used to widen the cortical hole in the bone. The awl is then inclined 10° anteriorly and steeply angled within the frontal plane to facilitate passage of the nail through the dense paediatric metaphyseal bone.

A gentle 30° bend was placed in the nail with the apex at what will be the level of the fracture. Next the rod tip was bent to facilitate placement and to allow the rod to bounce off the opposite cortex at the time of insertion. Upon insertion, the rod glances off the cortex because it advances towards the fracture site. Both medial and lateral rods were inserted to the level of the fracture. At this point, the fracture was reduced using longitudinal traction and closed manipulation. After the first rod was driven approximately 2 to 3 cm across the fracture, the 2nd rod was driven across the fracture. The two rods then were driven into the proximal end of the femur with one driven toward the femoral neck and the other toward the greater trochanter. Fluoroscopy was used to confirm satisfactory reduction of the fracture and to ensure that the rods have not comminuted the fracture as they were driven into the proximal fragment. The rods are pulled back approximately 2 cm, the end of each rod is cut, and the rods are driven back securely into the femur. The end of the rod should lie adjacent to the bone of the metaphysis but should be at least 1 cm distal to the insertion hole to allow ease in later removal. Bending the rod ends should be avoided because it can cause a painful bursa over the rod end. Open reduction was done when closed reduction was not successful. The incised wounds were then washed with betadine and normal saline and skin was sutured. Sterile pads were put and compression bandage was applied.

Results

All the patients were followed until fracture union occurred. The follow up period ranged from 6 months to 2 years. Results were analyzed both clinically and radiologically. Majority of the patients i.e. 12 (60%) were in the age group of 5-8 years, followed by 7 (35%) patients in 9-12 years. The youngest patient was 5 years and oldest patient was 14 years. The mean age in our study was 8.5 years. Majority of the patients were males i.e. 16 (80%).In the present series, 11 (55%) were oblique fractures, 6 (30%) were transverse and 3 (15%) were spiral fractures. Level of fracture was middle 1/3rd of the shaft was involved in 11 (55%) cases and proximal 1/3rd in 6 (30%) cases. The type of fracture, 19 (95%) were closed fractures and 1 (5%) was open fractures. Open fracture belonged to Gustilo & Anderson Type I. The type of reduction was closed in 75% of ceases and opened in 15% cases. In 2 patients, fracture pattern was spiral. Closed reduction was attempted, but was not possible. Open reduction was done and fracture was fixed with flexible nails. In one patient, the fracture was in the proximal 1/3rd. Closed reduction was at tempted but was not possible. In 65% of cases titanium nails were used and in remaining 35 % of cases stainless steel nails were used. Selection of nails was done based on patient affordability. In most of the cases (40%) 3 mm diameter nails were used. 2 mm nails were used in 30% of the cases and in other 15 % cases 2.5 mm were used. Only in one case 4 mm nails were used (Table 1.)

Table 1: Size of nail.

Size of nail	No. of cases	Percentage
2 mm	6	30
2.5 mm	3	15
3 mm	8	40
3.5 mm	2	10

Table 2: Time for union.

Time for union	No. of cases	Percentage
8 weeks	8	40
10 weeks	6	30
12 weeks	6	30

Fig. 1: Showing Preoperative condition of fracture.

Fig. 2: Showing immediate postoperative condition.

Fig. 3: Showing post operative healed condition.

Fracture union was defined as the period between operation and full weight bearing without external support and a radiographically healed fracture. In our series, time to union ranged from 8 to 12 weeks average being 10.2 weeks (Table 2). Postoperative immobilization was done if fracture is unstable. All patients were allowed to walk with the help of walker, not bearing weight on the operated limb from the 1st postoperative day. Patients were followed up at intervals of 3 months, 6 months, 1 year and 2 years post-operatively. The functional outcome was assessed using Flynn's scoring criteria. According to Flynn's criteria, result was excellent in 18 (90%) cases and Successful in 2 (10%) cases (Table 3).

Discussion

The present study was conducted to assess the results of flexible nail fixation of femoral shaft fracture in children and adolescent patients. Because of the increasing costs of health care, surgical fixation of children's fractures with resultant early mobilization and discharge from the hospital has become increasingly popular. Recognizing the relative safety and efficacy of femoral fracture fixation with flexible intramedullary nails, several large medical centres in India and Europe have reported on series of femoral fractures in children and adolescents, proving the value of this method.

In the present study 12 (60%) of the patients were 5-8 years old and 7 (35%) were 9 to 12 years age group with the average age being 8.5 years. Fabiano Prata Nascimento et al[6] treated femoral shaft fractures in age range 5 to 14 years with average age being 9.6 years. Alenjandro Uribe Rios et al[7] conducted a prospective study regarding effects of chrome steel flexible nails in children aged between 5 and 12 years, in a study group of 48 patients. The average age

was 8.6 years. There were 4 (20%) girls and 16 (80%) boys in the present study. The sex incidence is like other studies with in the literature. Bar-on E, et al[8] conducted study on 20 femoral shaft fractures. Motor vehicle accident was the cause of injury in 15 (75%) cases. In the study conducted by Alenjandro Uribe Rios et al[7] the commonest mechanism of injury was road traffic accidents in 37 (77%) patients and 8 (16.7%) patients had fall from height. In the study conducted by Fabiano PN et al[6] RTA was the most common mechanism. RTA was seen in 19 (63.3%). In our study, oblique fractures accounted for 11 (55%) cases, transverse fractures accounted for 6 (30%) cases and spiral fractures accounted for 3 (15%) cases. Heinrich SD, et al[9], noted 35 (44.87%) transverse fractures and 14 (17.94%) oblique fractures in their study and Cramer KE. et al[10], noted 35 (61.4%) transverse fractures and 16 (28.07%) spiral fractures. Ozturkman Y et al[11], noted 18 (69.23%) fractures in the middle l/3rd and 3 (11.53%) fractures in the proximal l/3rdof the shaft, whereas Heinrich SD et al[9], noted 54 (69.23%) fractures in the middle l/3rd and 10 (12.82%) fractures in the proximal 1/3rd of the shaft. Cramer KE. et al[10], noted 40 (70.17%) fractures in the middle l/3rd and 13 (22.8%) fractures in the proximal l/3rd of the shaft. Most of the femoral shaft fractures in children are closed injuries. In our study 19 (95%) cases were closed fractures and 1 (5%) case was an open fracture of Gustilo & Anderson Type I. Fabiano Prata Nascimento et al[6] reported 28 (93.3%) closed and 2 (6.7%) open fractures. In the study conducted by AlenjandroUribe Rios et al[7] 42(82.3%) patients had closed fractures, 6 patients had type 1 compound fracture and 2 patients had type 2 compound fracture. In the present series, commonest duration between trauma and surgery was 2 to 4 days. 14 (70%) underwent surgery within 2 to 4 days after trauma. Average duration between trauma and surgery was 4. 5 days in the study done by KalendererO, et al[12] in our study 3 (15%) patients were operated within 24 hours. 23 (40.35%) patients were operated within 24 hours in Cramer KE, et al7 study. In the study conducted by AlenjandroUribe Rios et al[7] the average time elapsed from initial injury to surgery was four days.

In our study, closed reduction was done in 17 (85%) cases and open reduction was done in 3 (15%) cases. In 2 patients, fracture pattern was spiral. Closed reduction was attempted, but was not possible. Open reduction was done and fracture was fixed with flexible nails. In one patient, the fracture was in the proximal l/3rd. Closed reduction was attempted but was not possible. In 5 (6.41%) fractures, open reduction was done to facilitate passing the nail across the fracture site in Heinrich SD, et al[9] study. Closed nailing was done in all cases in a study conducted by Fabiano PN et al[6]. In the study conducted by Alenjandro UR et al[7] the fracture focus had to be opened to perform the reduction in 11 (21.5%) fractures.

In our present study stainless steel flexible nails were used in 7 cases and in 13 cases titanium nails were used. The type of nail used depended on the affordability of the patient. In our country, titanium implants are costly; therefore stainless steel nails present an effective, more economical alternative in the treatment of femoral shaft fractures. The results reached in both the short and the long term are the same as those reached with titanium nails, as reported in the literature. Mechanical testing of femoral fracture fixation systems showed that good rigidity is provided by an external fixation device and therefore the least by flexible intramedullary rodding. Stainless-steel rods are stronger than titanium in bending tests. Stainless-steel rods have greater intrinsic strength and therefore are not as dependent on the opposing bend technique[7]. In most of the cases (40%) 3 mm diameter nails were used. 2 mm nails were used in 30% of the cases and in other 15 % cases 2.5 mm were used. Only in one case 4 mm nails were used.

In our study, no postoperative immobilization was done either in the form of pop cast or supplementary immobilization. Infante AF, et al[13] treated 190 children with immediate hip spica casting, le average duration of immobilization in their study was 7 weeks. John Ferguson et al[14] treated 101 children with immediate hip spica casting. They immobilized children on an average duration of 6 to 8 weeks with spica casting. The average length of immobilization in plaster was 67.4 days in Gross R.H. et al15 study. In the study conducted by AlenjandroUribe Rios et al[7] no other immobilization treatments like plaster or orthosis were used.

The average duration of hospital stay in the present study is 10.5 days. The mean hospital stay was 12 days in Kalenderer O, et al[12] study. In a study conducted by Alenjandro UR et al[6] the average length of hospital stay was 7.8 days. After surgery, the average length was 2.1 days for the group of patients with no associated injuries. Greisberg J et al[16] compared the study of flexible intramedullary nailing with hip spica casting. They noted average hospital stay of 6 days in flexible intramedullary nail versus 29 days in hip spica casting group. Average hospitalization time was 11.4 days in the study conducted by Mann DC et al[17]. Gross RH, et al[15] conducted a study on cast brace management of the femoral shaft fractures in children and young adults. The average length of hospitalization in their study was 18.7 days.

In the present study, average time to union was 10.2 weeks. Oh C.W et al[18] reported average time for union as 10.5 weeks. Aksoy C, et al[19] compared the results of compression plate fixation and flexible intramedullary 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 Hers covici et al[20] study. Bar-On E, et al[8] noted 20° loss of internal rotation at the hip in one patient treated with external fixation. Flynn JM et al[21] noted one case of knee stiffness in patients treated with spica casting which required manipulation under anaesthesia. This is the most common sequele after femoral shaft fractures in children and adolescents. No patient in our study had significant limb length discrepancy (i.e. > ± 2cm). Beaty et al[22] reported, two patients had overgrowth of more than 2.5 cm necessitating epiphysiodesis, after conservative treatment. Huber RI, et al[23] noted children with femoral shaft fractures had a median difference in length compared with the other side of 0.5 cm. Gonzalez-

Herranz P et al[24] observed mean shortening of 32 mm (5 to 65 mm) and average over growth of 11.4 mm (5 to 20 mm) in their study conducted on spica casting of the femur in children. John Ferguson et al[25] noted more than 2cm shortening in 4 children after RLY spica treatment of pediatric femoral shaft fracture.

In the study conducted by Alenjandro UR et al[7] there were five cases of length discrepancy, two cases of 1 cm lengthening, and three cases of shortening (two of 1.5 cm, one of 1 cm). Fabiano PN et al[6] showed the final shortening on the limb, after a follow-up period of at least 24 months, occurred in 6.7% of the cases (two patients), with 0.25 cm on average. Mazda K et al[14] noted limb length discrepancy of more than 10mm in 3 (8%) of cases. Herndon WA, et al[26] noticed limb length shortening ranging from 1 to 4. 6 cm in 7 patients. Comparing to limb length discrepancy in conservative methods, limb length discrepancy in our study was within the acceptable limits.

Superficial infection was seen in 2 cases in our study which was controlled by antibiotics. Pin tract infection is a major disadvantage of external fixation application. Bar-on E, et al[8] reported 2 cases of deep pin tract infection in their patients treated with external fixation. Alenjandro UR et al[7] observed that there were two cases of superficial infection which were treated with oral antibiotics with no subsequent hospitalization, and without their final results being affected.

In the present series, nail impingement was seen in 2 (10%) patients. John Ferguson MB, et al[25] noticed 7° varus angulation in one patient in their study. Hemdon WA, et al[26] compared the results of femoral shaft fractures by spica casting and intramedullary nailing in adolescents. They noticed varus angulation starting 7 to 25° in 4 patients treated with spica casting and no varus angulation in surgical group.

In the present study, there was no anteroposterior angulation. Anteroposterior angulation ranged from 5.6° to 7.6° in children treated with immediate spica casting in Infante. A difference of quite 10° has been the criterion deformity. In toeing or out toeing was not reported in our study, Heinrich SD, et al[9] reported out toeing in 4 children with a mean of 6°and two children with 7.5° of in toeing following flexible intramedulary nailing. No patient in our study had significant rotational deformity. In our study no proximal migration of nails was seen in any of the cases. Bar-on E, et al[8] noticed proximal migration of the nail in one case. Kregor PJ, et al[27] reported 13° anterior angulation in one case and overgrowth of the injured femur averaging 0.9 cm in patients treated with compression plate fixation. Ward et al[28] managed 24 children between the ages of 6 and 16 years old with 4.5mm DCP. Six patients had a limb length discrepancy of 1cm or more. One patient had bending of the plate and another had a fracture after the late was removed. The advantages of this study include minimal scarring, closed reduction, load sharing device, fracture heals by secondary callus formation which is more stronger. Rigid intramedullary nailing is additionally described described, management of femoral shaft fractures. Raney EM, et al[29] noticed premature closure of the greater trochanteric physis consequent to intramedullary nailing.

Based on our experience and results, we conclude that flexible intramedullary nailing is good technique for the treatment of diaphyseal fractures of the femur in children and adolescents. Road traffic accident is that the commonest mode of injury resulting in femoral shaft fractures in children and adolescents. Closed reduction is typically successful. Flexible intramedullary nail introduction is simpler. It provides stable fixation. It is a superb mode of treatment easy transverse and oblique fractures of femoral shaft. Closed intramedullary nailing is an efficient method and doesn't expose the patient to an undue risk of infection or non-union. Flexible intramedullary nailing results in rapid union by means of preservation of the fracture haematoma and limited soft tissue exposure. It appreciably reduces the length of the hospital stay and eliminates the necessity for prolonged rest in bed by providing early independent ambulation. Thus it reduces the morbidity and dependency of the patients. There is no risk of serious limb length discrepancy. Varus/valgus, anteroposterior and rotational malignants are within limits with this procedure. In our country, titanium implants are costly; therefore chrome steel present an efficient, more economical alternative within the treatment of femoral shaft fractures. There is no risk of premature greater trochanteric arrest, progressive coxavalga, avascular necrosis of the top of the femur and damage to the distal femoral physis to rigid intramedullary nailing. There is no risk of pin tract infection and refracture compared to external fixator application. Functional results are excellent and complications are minimal. This safe procedure are often recommended in children with multiple injuries, co-existent head injury and in children and adolescents aged 5 to 16 years.

References

1. Scherl SA, Miller L, Lively N, Russinof S, Sullivan M. Accidental and nonaccidental femur fracturers in children. Clin Ortho Rel Research. 2000;376:96-105.
2. Momberger N, Stevens P, smith J, Santora S, Scott S. Intermedullary nailing of femoral fracturers in adolescents. J Pedia Ortho. 2000;20:482-484.
3. Lee Ss, Mahar AT, Newton PO. Ender nail fixation of pediatricfemurfractures. A Bio mechanical analysis. J Pedia Ortho. 2001;21:442-445.
4. Townsend Dr, Hoffinger S. Intramedullary nailing of femoral shaft fracturers in children via the trochanteric tip. Clin Ortho Rel Res. 2000;376:113-118.
5. Kasser JR, Beaty JH. Femoral shaft fracturers. 5thEdition , Philadelphia Lippocott Williams and Wilkins. 2001;941-980.
6. FabianopratаNascimento, Claudio Santil, Migual AG, Waiberg. Short hospitalization period with elastic stable intramedullary nails in the treatment of femoral shaft fracturers in school children. J Child Ortho. 2010;4:53-60.

7. Alenjandro UR, Diego FA, Carloss O. femoral shaft fracture treated stainless steel flexible nails in children aged between 5 and 12 years at the HUSVP. J Child Ortho. 2009;3:129-135.
8. Baron E, Sagiv S, Porat S. External fixation or flexible intramedullary nailing for femoral shaft fracturers in children. J Bone and Joint surg. 1997;79B:975-78.
9. Heinrich SD, Drvaric DM, Karr K, Macevan GD. The operative stabilization of pediatricdiaphyseal femur fractures with flexible intramedullary nails. A prospective analysis. J Pedia Ortho. 1994;14:501-07.
10. Carmer KE, Torrentta P. Spero Cr, Alter S, Miralikakbar H. Endor rod fixation of femoral shaft fracture in children. ClinorthoRel Res. 2000;376:119-123.
11. Oztukman Y, Dogrul C, Balioglu MB, Karli M. Intramedullary stabilization of pediatricdiaphyseal femur fracture with elastic ender nails. Acta Ortho Traumatol Jure. 2002;25(10):1067-70.
12. Kelenderer MG. Ender nailing. Text book of Orthopaedics and trauma. Jaypee Brothers, New Delhi. 1999;2:1438-39.
13. Infante AF, Albert MC, Jennings WB, Lehner JJ. Imdiatehispica casting for femur fracture in peditric patients- A review of 175 paients. Clin Ortho and Rel Res. 2000;376:106-112.
14. Ferguson J and Nicol RO. Early spica treatment of pediatric femoral shaft fractures. J Pedia Ortho. 2000;20:189-92.
15. Gross RH, Davidson R, Sullivan JA, Peeples RE, Hufft R. Castbrace management of the femoral shaft fracture in children and young adults. J Pedia Ortho. 1983;3(5):572-82.
16. Greisberg J, Bliss MJ, Eberson CP, Solga P, Amato C. Social and economic benefits of flexible intramedullary nails in the treatment of pediatric femoral shaft fractures.Orthopedics. 2002;25(10):1067-70.
17. Mann DC, Weddington J, Devenport K. Closed ender nailing of femoral shaft fractures in adolescents. J Pedia Ortho. 1986;6(6):651-5.
18. Oh Cw, Park BC, Kim PT, Kyung HS, Kim SJ, INN JC, Retrograde flexible intramedullary nailing in children`s femoral fracture. Int Ortho. 2002;26(1):52-55.
19. Aksoy C, Caolar O, yazyoy M, Surat A. Pediatric femoral fractures. A comparison of compression plate fixation and flexible intramedullary nailfixation. J Bone& Joint Surg(Br). 2003;263.
20. Herscovisi DJ, Scott Dm, Behrens F, Nelson B, Benton J. The use of ender nails in femoral shaft fractures: what are the remaining indications. J orthotrau. 1992;6(3):314-17.
21. Flynn JM, Luedtke LM, ganley TJ. Comparison of titanium elasticnails with traction and a spica cast to treat femoral fractures in children. Bone and joint surg. 2004;86A(4):770-7.
22. Beaty JH, Austin SM, Warner WC. Interlocking intramedullary nailing of femoral shaft fractures in adolescents: Priliminary results and complicatios. J Pedia Ortho. 1994;14:1781-83.
23. Huber RI, Keller HW, Huber PM, Rehm KE. Flexible intramedullary nailing as fracture treatment in children. J Pedia Ortho. 1996;16:602-605.
24. Gonzalez HP, Burgos FJ, Rapariz JM, Lopez MJ, Ocete JG, Amaya S. Intramedullary nailing of the femur in children. Effects on its proximal end. J Bone and Joint Surg(Br). 1995;77B:262-66.
25. Canale TS. Fractures and dislocations in children. Campbell`s operative orthopaedics. 10th ed. St Louis, Mosby. 2003;2:1391-99.
26. Herndon WA, Mahnken RF, Yngve DA, Sullivan JA. Management of femoral shaft fractures in adolescent. J Pedia Ortho. 1989;9(1):29-32.
27. Kregor PJ, Song KM, Chip Routt ML. Plate fixation of femoral shaft fractures in multiple injured Ward WJ, Levy J, Kaye A. Compression plating for children. J Bone & Joint Surg. 1993;75A(12):1774-80. child andadolescent femur fractures. J Pedia Ortho. 1992;12:626-32.
28. Raney EM, Ogden JA, Grogen DP. Premature greater trochanteric epiphysiodesis secondary to intramedullary femoral rodding. J pediaortho. 1993;13:516-520.

Journal of Orthopedic Education

Library Recommendation Form

If you would like to recommend this journal to your library, simply complete the form given below and return it to us. Please type or print the information clearly. We will forward a sample copy to your library, along with this recommendation card.

Please send a sample copy to:

Name of Librarian

Name of Library

Address of Library

Recommended by:

Your Name/ Title

Department

Address

Dear Librarian,

I would like to recommend that your library subscribe to the Journal of Orthopedic Education. I believe the major future uses of the journal for your library would provide:

1. Useful information for members of my specialty.
2. An excellent research aid.
3. An invaluable student resource.

I have a personal subscription and understand and appreciate the value an institutional subscription would mean to our staff.

Should the journal you're reading right now be a part of your University or institution's library? To have a free sample sent to your librarian, simply fill out and mail this today!

Stock Manager
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)
Phone: 91-11-79695648, 22754205, 22756995,
Cell: +91-9821671871
E-mail: sales@rfppl.co.in