



"A STUDY OF SURGICAL MANAGEMENT OF DIAPHYSEAL FRACTURES OF FEMUR IN CHILDREN USING ELASTIC NAILS"

Orthopaedics

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ABSTRACT

Background: Diaphyseal femoral fractures in children are common injuries requiring effective treatment. Flexible intramedullary nailing has emerged as a preferred technique due to its minimal invasiveness and early mobilization benefits. **Materials And Methods:** Twenty patients aged 5 to 15 years with closed diaphyseal femur fractures were treated with elastic intramedullary nails from September 2022 to December 2024 at SVS Medical College and Hospital, Mahabubnagar. Clinical and radiological evaluation was done. **Results:** Road traffic accidents accounted for 60% of injuries. Closed reduction was successful in 90% of cases. Average time to union was 13.9 weeks. Early mobilization was encouraged, and hospital stay averaged 9.4 days. Functional outcomes were excellent with minimal complications. **Conclusion:** Flexible intramedullary nailing is an effective and safe technique for diaphyseal femur fractures in children aged 5–15 years, promoting rapid union and early independent ambulation with minimal complications

KEYWORDS

Diaphyseal femur fracture, Children, Elastic intramedullary nailing, Flexible nailing, Pediatric orthopedics

INTRODUCTION

Femoral shaft fractures including subtrochantric and supracondylar fractures account for 1.6% of all paediatric bony injuries¹. 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 rods. There is little controversy over the treatment of adult femoral shaft fractures with intramedullary nail fixation. Similarly there is little controversy over the treatment of infants and toddlers with femoral shaft fractures by using spica casting², but the treatment of paediatric and adolescent (age 5 to 15 years) femur fractures remains controversial.

Current treatment options include early spica casting, traction, external fixation, ORIF with plating, flexible intramedullary nails and reamed intramedullary rods³. In children, fractures of the femoral shaft are commonly treated by various types of traction for about 3 weeks, followed by plaster cast immobilization. The two major drawbacks with this treatment are prolonged bed rest leading to separation of the child from routine activities and the expenditure incurred on the treatment during the stay in the hospital⁴. Time and experience of many clinicians have shown that children with diaphyseal femur fracture do not always recover with conservative treatment.

Angulations, mal-rotation and shortening are not always corrected effectively⁵. The management of paediatric femoral shaft fractures gradually has evolved towards a more operative approach in the past decade. This is because of a more rapid recovery and reintegration of the patients and a recognition that prolonged immobilization can have a negative effect even in children⁶. Plating of femoral shaft fractures offers rigid fixation, it requires a larger exposure with the potential for increased blood loss and scarring. It is a load bearing device and refracture is a risk. Antegrade nailing techniques have shown a risk of proximal femoral deformities and avascular necrosis of the femoral head^{7,8}. Elastic internal fixation in the form of flexible intra medullary nailing provides a healthy environment for fracture healing with some motion leading to increased callus formation⁹. Elastic nail fixation in the paediatric population is simple, effective and minimally invasive. It allows stable fixation, rapid healing and a prompt return of the child to normal activity. Functional results are excellent and complications are few.

MATERIALS AND METHODS

This prospective study titled "A Study of Surgical Management of Diaphyseal Fractures of Femur in Children Using Elastic Nails" was conducted at the Department of Orthopaedics, SVS Medical College & Hospital between September 2022 and December 2024.

Study Design: A total of 20 children aged between 5 and 15 years with diaphyseal femoral fractures were included in the study. All patients underwent surgical management using flexible intramedullary elastic nails.

Inclusion Criteria

- Isolated diaphyseal fractures of the femur in children aged 5–15 years
- Closed diaphyseal fractures
- Both male and female patients

Exclusion Criteria

- Patients below 5 years or above 15 years of age
- Patients lost to follow-up
- Patients treated conservatively
- Open diaphyseal femoral fractures

Demographics: Out of 20 patients, 15 (75%) were male and 5 (25%) were female, with a mean age of 9.25 years. Fractures were more common on the left side (60%) compared to the right side (40%). The mode of injury was road traffic accidents in 12 (60%) cases and falls in 8 (40%) cases.

Initial Management And Evaluation: Upon admission, a detailed clinical history and physical examination were carried out. Standard trauma assessment protocols were followed. All patients were initially stabilized using Thomas splint immobilization. Distal neurovascular status was assessed and documented. Pain management included appropriate analgesics and limb elevation.

Pre-operative Assessment: Routine pre-operative investigations included blood counts, renal function tests, coagulation profile, serology (HIV, HBsAg), urine examination, ECG, and chest X-ray. All patients received tetanus toxoid and a preoperative dose of intravenous antibiotics. Informed consent and anesthetic clearance were obtained.

Radiographic Evaluation: Standard radiographs of the entire femur including the hip and knee in both anteroposterior and lateral views, as well as pelvis AP views, were taken to assess fracture location and planning.

Surgical Timing: The time interval from injury to surgical intervention ranged from 1 to 7 days.

Anesthesia And Positioning: General anesthesia was administered to children below 8 years, while spinal anesthesia was used in older children.

Post-operative Management: Postoperatively, patients received intravenous antibiotics for 1–3 days followed by oral antibiotics. Active knee range of motion exercises were initiated from postoperative day two. Sutures were removed on the sixth postoperative day, and patients were discharged once stable and pain-free.

Follow-up And Outcome Assessment: Patients were followed up at 6

weeks, 3 months, 6 months, and 12 months. Radiological union was assessed using serial radiographs. Clinical union was confirmed by the absence of tenderness and pain at the fracture site. Outcomes were evaluated according to **Flynn's criteria**, which assess:

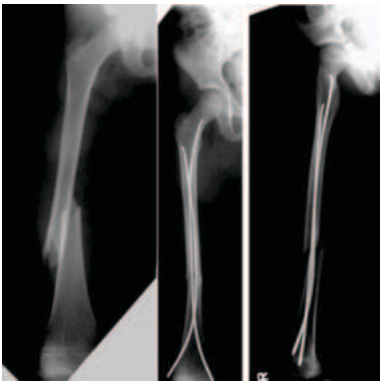
Grade	Limb Length Inequality	Malalignmen t	Pain	Complications
Excellent	< 1 cm	< 5°	None	None
Satisfactory	1–2 cm	5–10°	None	Minor/resolved
Poor	> 2 cm	> 10°	Yes	Major complications

RESULTS

This prospective study included **20 children** aged between **5 to 15 years** who underwent surgical management of femoral diaphyseal fractures using elastic nails. The highest incidence of fractures was observed in the **5–8 year** age group (50%), followed by the **9–12 year** group (40%). Only 10% of cases occurred in the **13–15 year** age group. Of the 20 patients, **15 (75%)** were male and **5 (25%)** were female, indicating a higher male preponderance. The most common mode of injury was **road traffic accidents (RTA)**, accounting for **12 cases (60%)**, followed by **fall-related injuries in 8 cases (40%)**. The **left femur** was involved in **12 cases (60%)**, while the **right femur** was affected in **8 cases (40%)**. **Transverse fractures** were the most frequent (9 cases, 45%), followed by **spiral fractures** (7 cases, 35%) and **oblique fractures** (4 cases, 20%). Closed reduction was achieved in **18 cases (90%)**, while **open reduction** was required in **2 cases (10%)**.

The majority of patients (15 cases, 75%) had a hospital stay between **5–10 days**. Two patients (10%) stayed for **11–16 days**, and three patients (15%) required hospitalization for **more than 16 days**. Union of the fracture was observed at **12 weeks** in 3 patients (15%), **14 weeks** in 15 patients (75%), **16 weeks** in 2 patients (10%)

Complications were observed in a few cases: **Limb shortening** in 4 cases (20%), **Limb lengthening**, **infection**, **malalignment**, and **knee pain** in 1 case each (5%). No instances of **non-union** were noted. Based on **Flynn's criteria**, the results were: **Excellent** in 15 patients (75%), **Satisfactory** in 4 patients (20%), **Poor** in 1 patient (5%).



Picture 1: Picture showing pre and post operative xrays



Picture 2 : Implant removal following union

DISCUSSION

The management of diaphyseal femoral fractures in children aged 5 to 15 years remains an area of ongoing debate. While non-operative methods have traditionally been preferred, operative fixation is increasingly being adopted, particularly due to the advantages of early mobilization, reduced hospital stay, and quicker return to function. Among operative methods, elastic stable intramedullary nailing (ESIN) has emerged as a reliable and minimally invasive technique offering effective stabilization with minimal complications. The present study was conducted to evaluate the clinical outcomes of femoral shaft fractures in children treated using ESIN. **Age Incidence:** In our study, the majority of patients (50%) were aged between 5–8 years, followed by 40% in the 9–12 year age group, with a mean age of 9.25 years. This age distribution is consistent with other published data, such as Kalenderer O et al. (mean age 10 years) and Cramer KE et al. (8.5 years). **Sex Distribution:** Male predominance was noted in our study (75%), which mirrors the findings of Kalenderer O et al. and Cramer KE et al., both reporting 73.07% male patients. The higher male incidence may be attributed to increased outdoor activity and trauma exposure. **Mode of Injury:** Road traffic accidents (RTA) were the leading cause of injury in 60% of our cases, followed by falls (40%). Bar-On E et al. reported similar findings with RTAs accounting for 75% of injuries. **Fracture Pattern:** Transverse fractures were the most frequent (45%), followed by spiral (35%) and oblique (20%) types. These results closely align with those reported by Heinrich SD et al. and Cramer KE et al. **Type of Reduction:** Closed reduction was successful in 90% of our patients. Open reduction was necessary in 2 cases (10%), comparable to Heinrich SD et al., who required open reduction in 6.41% of their cases.

Hospital Stay: Our study showed a reduced average hospital stay of **9.4 days**, which is favorable compared to other studies.

Study	Average Hospital Stay
Gross RH et al.	18.7 days
Kalenderer O et al.	12 days
Mann DC et al.	11.4 days
Present Study	9.4 days

The shorter hospitalization in our series is attributed to early mobilization, minimal soft tissue trauma, and stable fixation. **Time for Union:** The average time to radiological union in our study was **13.9 weeks**. This is comparable to Oh CW et al. (10.5 weeks) and Cramer KE et al. (12 weeks), but shorter than the plating group reported by Aksoy C et al. (16 weeks).

CONCLUSION

Based on our experience and results, we conclude that flexible intramedullary nailing is an excellent and reliable technique for the treatment of diaphyseal fractures of the femur in children and adolescents. Road traffic accidents are the most common mode of injury causing femoral shaft fractures in this age group. Closed reduction is generally successful and preferable. Flexible intramedullary nail insertion is straightforward and provides stable fixation. Stainless steel Ender's nails are a cost-effective alternative to titanium nails. This method is especially suitable for simple transverse and oblique fractures of the femoral shaft. Closed intramedullary nailing is an efficient technique that minimizes the risk of infection and non-union. Preservation of fracture hematoma and limited soft tissue dissection facilitate rapid fracture union. Early independent ambulation is possible, reducing hospital stay, morbidity, and patient dependency. There is negligible risk of significant limb length discrepancy. Varus/valgus, anteroposterior, and rotational malalignments are within acceptable limits. Compared to rigid intramedullary nailing, there is no risk of premature greater trochanteric arrest, progressive coxa valga, avascular necrosis of the femoral head, or damage to the distal femoral physis. Unlike external fixators, flexible nailing carries no risk of pin tract infections or refracture. Functional outcomes are excellent with minimal complications. This safe procedure is recommended for children with multiple injuries, coexisting head injuries, and those aged between 5 and 15 years.

Summary

This prospective study included twenty patients with diaphyseal femoral fractures treated using elastic intramedullary nails between September 2022 and December 2024 at SVS Medical College and Hospital, Mahabubnagar. The age range was 5 to 15 years, with a mean age of 9.25 years. Half the patients (50%) were aged 5–8 years. Males

constituted 75% of the cases. Road traffic accidents accounted for 60% of the injuries. All fractures were closed injuries. Fracture types included transverse (45%), spiral (35%), and oblique (20%).

Clinical and radiological assessments were performed preoperatively. Surgery was done as early as the patient was medically stable, with an average delay of 2 days from injury to surgery. Operations were performed on a fracture table. Closed reduction was achieved in 90% of cases, with open reduction necessary in 10%. Postoperatively, patients were mobilized with a walker from day one but were advised to avoid weight-bearing on the affected limb initially. Quadriceps and knee exercises began during the first postoperative week. Average hospital stay was 9.4 days. Fractures united within 14 to 16 weeks, with a mean time to union of 13.9 weeks. Full hip range of motion was achieved in all patients; one patient had a transient 10-degree knee flexion limitation at 12 weeks, which resolved by 6 months.

In conclusion, elastic intramedullary nailing for diaphyseal femoral fractures in children and adolescents is a simple, effective procedure that allows early mobilization and rapid healing. It yields excellent functional outcomes with minimal complications and is recommended for children aged 5 to 15 years.

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