

# Role of Flexible Intramedullary Nailing in Pediatric Femoral Shaft Fractures

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## ABSTRACT

**Introduction:** Flexible nailing is a safe and effective method of treatment of pediatric femoral shaft fractures study aimed to observe results of flexible intramedullary nailing in pediatric femoral shaft fractures.

**Material and methods:** We studied 100 cases of unilateral, closed shaft femur fractures in age group of 6 to 11 years children who were operated with stainless steel flexible nails.

**Results:** All patients were operated with stainless steel flexible nails and all fractures united with no case of delayed or non union. There were 54 complications in our series with pain at insertion site in 20 patients, bursitis in 10, superficial infection in 1, proximal nail migration in 2, malunion in 7, and limb length discrepancy in 12 patients. Removal of hardware was done in all patients and none of the patients required further surgery and were functionally well.

**Conclusion:** Flexible intramedullary nailing is a safe and effective method of treatment of pediatric femoral fractures in properly selected patients but can be associated with a variety of complications if suitable precautions before, during and after surgery are not taken.

**Keywords:** Flexible nail, pediatric, femur fractures.

## INTRODUCTION

Diaphyseal fractures of femur are among the most common pediatric orthopedic injury requiring hospitalization, constituting approximately 1.6% of all bony injuries in children.<sup>1</sup> Treatment of femoral shaft fractures vary from conservative methods like pavlik harness, skin or skeletal traction and spica casting to operative methods like closed reduction and external fixation, Open reduction and internal fixation, MIPO and closed reduction and intramedullary nailing with either flexible or rigid nails with each method having its own merits and demerits.<sup>2-4</sup> Flexible intramedullary nailing has become a well established, safe, minimally invasive and cost effective method for treatment of pediatric femoral fractures with easy learning curve and minimal reported complications.<sup>4</sup> However a variety of complications have been described to occur in up to 62% of cases including pain at nail insertion site, hardware prominence, delayed union, malunion, nerve injuries, knee synovitis and infection both superficial and deep.<sup>5-8</sup>

Aim of this study was to observe results of flexible intramedullary nailing in pediatric femoral shaft fractures.

## MATERIAL AND METHODS

This was a prospective study conducted in postgraduate department of orthopedics, Government hospital for bone and joint surgery Srinagar from April 2011 to may 2016. One hundred cases of pediatric shaft femur fractures in the age group of six to eleven years were included. Patients were followed for at least six months period. Patients with pathologic

fractures, neurologic diseases and open fractures were excluded from study. After addressing life threatening injuries patients were put on below knee skin traction and were operated on an average of 2.5 days after injury. Radiographs of femur along with knee and hip were taken in two orthogonal views to determine the location and pattern of fracture. Detailed and informed consent was taken from parents or legal guardians of patients after discussing various treatment options with its merits and demerits. We recorded age, sex, side involved, injury mechanism, fracture pattern, any associated injury and any intraoperative or post operative complications. All patients were operated by same group of surgeons using similar surgical technique using stainless steel nails by using two small incisions over medial and lateral sides of distal femur to expose medial and lateral distal femoral metaphyseal flares for retrograde insertion under fluoroscopic guidance on a traction table with diameter of stainless steel nails depending upon the size of medullary canal of femur. Postoperatively intravenous antibiotics and analgesics were given and check X-rays were taken. Physiotherapy and toe touch weight bearing was started as per patient comfort. Gentle knee ROM exercises and quadriceps exercises were started and advanced to full weight bearing was started at 6 to 7 weeks. Patients were initially followed weekly for two weeks and then two weekly for 8 weeks and then monthly for six months. Final follow up was done at six months. At each follow up condition of wound, range of motion of knee joint, limb alignment, any discrepancy in limb length, status of fracture healing and development of any new complication was noted. Various complications which occurred were analyzed as per incidence, time of occurrence, likely predisposing factor, impact on fracture healing and remedial measures were specifically looked for.

## STATISTICAL ANALYSIS

Microsoft office 2007 was used for statistical analysis. Mean and percentages were used to interpret the data.

## RESULTS

This study was conducted on 100 consecutive patients with pediatric femur fractures. The age of the patients ranged from 6 to 11 years with mean age of 8.2 years. In present study, there were 68 males and 32 females. Right limb was involved in 65 whereas left limb was involved in 35 cases. About 50% patients suffered the fracture because of a simple fall on a level ground

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(table 1).

Mean surgical time was 40 minutes ranging from 30 to 60 minutes. All fractures united without any further intervention and no case of delayed or non union was found. Nail removal was done from 3 to 7 months. No patient was lost to follow-up. Figure 1 and 2 are X-rays of one of the patients with femoral shaft fractures managed by flexible intramedullary nail. Complications are shown in Table 2. Most common complication was pain over insertion site (20%) and bursitis (10%).

**DISCUSSION**

Flexible intramedullary nailing in pediatric diaphyseal femur fractures is now widely accepted treatment method with fewer complications. Nonetheless a variety of complications even up to an incidence of 62% have been reported by various authors.<sup>4,9,10</sup> Complications have been grouped into those not requiring further treatment for example pain, prominent hardware, delayed union, clinically insignificant malunion, neuropraxia and superficial infection and those complications that require further treatment like excessively prominent hardware, loss of reduction, compartment syndrome, nerve injuries and deep infection.<sup>5,11</sup> Pain at nail insertion site was most common complication in our

series and was reported in 20% of our patients. Most of other authors have also found pain as most common complication after flexible intramedullary nailing of femur fractures.<sup>5</sup> Narayanan et al has reported that patients with nails protruding more than 10 mm from the cortex were 4.5 times more likely to complain of insertion site pain.<sup>12</sup> Shital N. Parikh et al recommend leaving 1 to 2 cm of nail outside with nail ends flush and parallel to metaphysis and nail ends should not be bent and ends should lie at the level of the physis.<sup>13</sup>

Proximal nail migration where the proximal end of nail penetrates the proximal posterior aspect of neck or trochanteric region was seen in 2 of our patients. Both of our patients were asymptomatic and were observed and removal of hardware was done at six months after fracture healing by giving incisions proximally with further uneventful postoperative course. Kelly D et al observe proximal nail migration in 2 of their 19 patients and they did elective hardware removal without any further complications. They also found that good quality radiographs at the completion of surgery can detect this complication at the time of surgery.<sup>6</sup> Narayanan et al have reported one case of proximal penetration of tip of nail through the femoral neck which led to sciatic neuropraxia that resolved with nail reposition.<sup>12</sup>

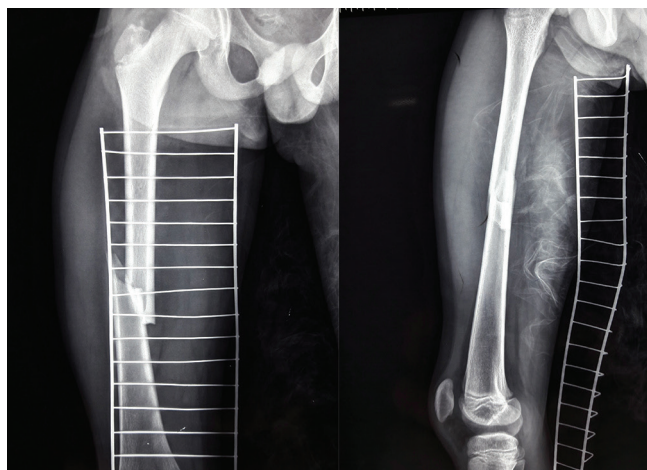
Procurvatum or increased anterolateral bowing was seen in four and varus malalignment was seen in 3 patients. Other authors have found the rate of malunion to vary from 0%<sup>13</sup> to 16%.<sup>14</sup> Malunion can occur due to inability to achieve reduction at fracture site or subsequent loss of reduction in post operative period. 3 out of 5 malunion patients of our series were seen in length unstable fractures. Marion Rapp et al in their study found that addition of third nail provided significantly higher stiffness than classical 2 C configurations and reduces axial deviation.<sup>16</sup> Narayanan et al also reported more complications in fractures with fragmentation of > 25% of shaft diameter.<sup>11</sup> Ho et al in their study found 12% rate of unplanned surgery in case of unstable fractures as compared to only 5% in case of stable fractures.<sup>15</sup> All patients were clinically asymptomatic and did not require any further treatment. Luhman et al concluded that combination of increased body weight and smaller nail diameter would lead to increased sagittal angulation post operatively.<sup>17</sup> Sagan et al recommended that at least one of two nails should be inserted with its tip directed anteriorly to prevent Procurvatum.<sup>18</sup>

S. No	Mode of Trauma	Number of Patients	Percentage
1.	Fall	50	50%
2.	RTA	10	10%
3.	Direct Trauma	5	5%
4.	FFH	20	20%
5.	Cycling	15	15%

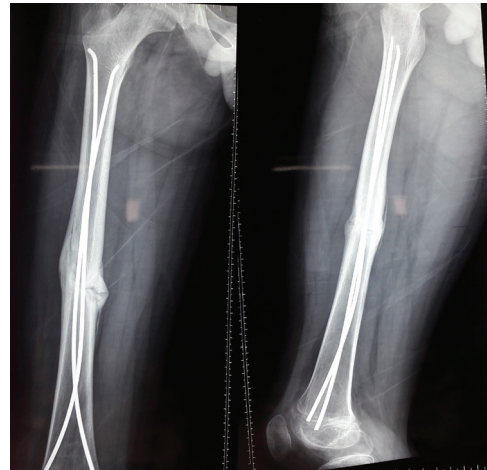
**Table-1:** Mode of Trauma

S. No.	Complication	No. of patients	Percentage
1.	Pain over insertion site	20	20%
2.	Bursitis	10	10%
3.	Superficial infection	1	1%
4.	Malunion	7	7%
5.	Limb length discrepancy	12	12%
6.	Nail migration	2	2%

**Table-2:** Complications



**Figure-1:** Pre operative x-ray AP and Lateral views of Fracture femur in 11 years old male patient.



**Figure-2:** 6 months post operative x-ray AP and Lateral views of same patient showing fracture union.

Over lengthening of less than 1 cm is more common than shortening especially in less than 10 year age group.<sup>12,13</sup> Average lengthening of 8mm was noted in 7 patients. Average shortening of 7mm was noted in 5 patients. All of these cases were seen in length unstable fractures oblique and comminuted fractures. N. Gogi et al in a study on 37 children with femur fractures treated with flexible nailing found lengthening in 15 and shortening in 4 patients. Mean lengthening was 10.6mm and mean shortening of 12.6 mm at the time of nail removal. They concluded that lengthening was a common phenomenon and gradually decreases with time and return to normal in majority of children.<sup>19</sup> Quantitative shortening was considered more important as compared to lengthening and also corrects slowly with time. Flynn et al found that shortening after flexible nailing of pediatric femoral fractures was a surgical complication and can occur due to physeal damage, postoperative fracture collapse due to poor stability or due to wrong technique.<sup>6</sup> All of our patients were functionally good and did not require treatment.

## CONCLUSION

We conclude that Flexible intramedullary nailing is a safe and effective method of treatment of pediatric femoral fractures in properly selected patients but can be associated with a variety of complications if suitable precautions before during and after surgery are not taken.

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