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Research Article

Treatment of femoral shaft fractures in young children by Ender's nail: indications & complications

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ABSTRACT

Background: Treatment of femoral fractures in age group of 6 – 12 years is controversial. Operative treatment is becoming better accepted. Various modalities of fixation include plate osteosynthesis, External fixation; Antegrade locked nailing, and flexible intramedullary nailing.
Methods: 60 children aged 6-12 years (Average age – 8.2 years) with 66 femoral diaphyseal fractures (61 closed and 05 open) in 60 patients were managed with closed Ender's nailing. Pathological fractures due to unicameral bone cyst were evident in 5 patients. Femoral shaft fractures at the level proximal to distal three fifth with canal diameter of ≥ 6mm were included in the study. Out of 66 traumatic fractures 42 fractures had stable pattern and 19 had unstable fracture pattern. The results were evaluated clinically and radiologically.
Results: All the 42 stable femoral fractures showed bridging callus in a mean time of 3.83 weeks (2.5 to 6.5 weeks). Full weight bearing was possible in a mean time of 4.19 weeks. Radiological union was seen in a mean time of 9.4 weeks. 34 fractures were evaluated by scanogram one year after injury and they revealed lengthening of 0.3cms. All the children returned to their previous level of activities. All the 19 unstable femoral fractures showed bridging callus in a mean time of 5.53 weeks (4 – 8 weeks). Full weight bearing was possible in a mean time of 6.21weeks. Radiological union was seen in a mean time of 12 weeks. 8 patients were readmitted for adjunctive procedures like nail impaction, traction and cast immobilization. 20% patients with unstable group had shortening of 1.3cms and 20% had external rotation of lower limb.
Conclusions: Ender's nailing is simple, cost-effective and minimally invasive procedure in 6-12 years of age. It offers stable fixation with rapid healing. There is prompt return of child to normal activity.

Keywords: Ender's nailing, Femoral diaphyseal fractures, Stable femoral fractures, Unstable femoral fractures

INTRODUCTION

Femoral shaft fracture is an incapacitating pediatric injury.[1,2] The treatment has traditionally been age-related, influenced by the type of injury, associated injuries and the location and type of the fracture. To a great extent, the treatment options vary according to the surgeon's preference.[3] Near the end of skeletal maturity accurate reduction is necessary as angular deformity is no longer correctable by growth[4] Availability of locked intramedullary nail has made the treatment of femoral shaft fractures in skeletally matured children well established. We report a prospective study with the objective of evaluating the role and efficacy of ender's nailing in diaphyseal femoral shaft fractures in 6-12 years of age group.

METHODS

60 children aged 6-12 years (Average Age- 8.2 years) with 66 diaphyseal femoral fractures (61 closed and 05 open) were stabilized with ender's nailing. Out of 66

fractures, 42 fractures were stable pattern and 19 fractures were unstable pattern. 5 of the fractures were pathological secondary to unicameral bony cyst [Figure 2].

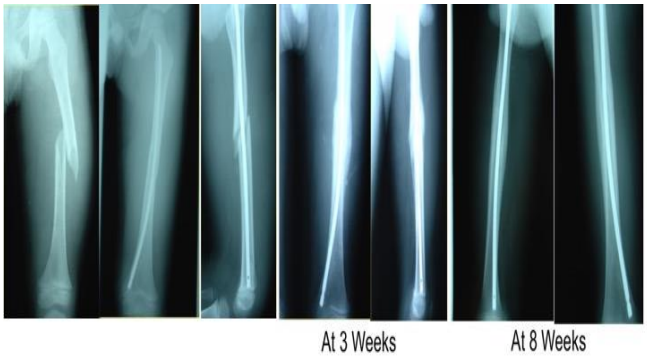

Figure 1: The pre-op, immediate post-op and follow up xrays at 3 weeks and at 8 weeks of the shaft femur fracture managed with Ender's nailing with excellent results.

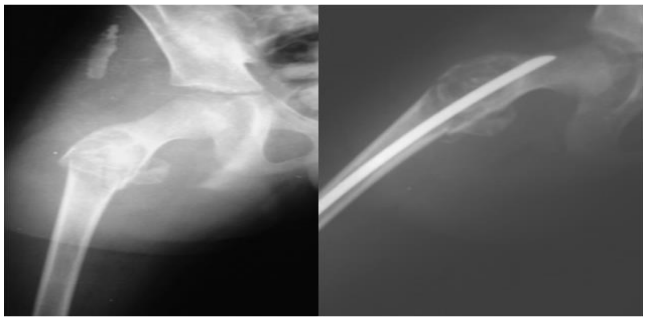

Figure 2: Pre-op and immediate X-ray of the pathological fracture of shaft femur secondary to unicameral bone cyst managed with Ender's nailing.

All the femoral shaft fractures were at the level proximal to distal three fifth. The canal diameter of the femur was ≥6 mm. The surgery was performed under general anesthesia with the child in supine position. Pre-contouring of the nails was done to three times the diameter of the isthmus with maximum band at the level of fracture site. The diameter of the nail was chosen so that each nail occupies at least one-third to 40% of the medullary cavity. Fractures were reduced under C-arm guidance. Two rods were inserted from medial and lateral incision above the physics. [Figure 6] At the end the proximal nail ends are reconfirmed on image intensifier [Figure 7]. After checking under Image Intensifier the fracture stability is checked and hip and knee is mobilized through full range [Figure 8]. Postoperatively child operated leg was elevated on a pillow. Ambulation was allowed as soon as comfort allowed. In stable pattern of fractures full weight bearing was possible in a mean time of 4.19 weeks and in unstable pattern full weight bearing was possible in a mean time of 6.21 weeks.

All patients were followed radiologically as well as clinically until fractures healed and for any complication. Child was questioned about their pain status, functional status, return to activities and school. Clinical examination of hip and knee including rotational asymmetry, gait, and limb length discrepancy were measured and recorded, if any. Evaluation and follow up at 2 weeks was done to check the rotations at hip.

Figure 3: 10th day post-op X-ray of pathological fracture secondary to unicameral bony cyst reveals collapse & shortening of 1 Cm. Child was readmitted for traction for 2 weeks. Fracture & cyst continued to heal with no limb length discrepancy.

Figure 4: Pre-op and immediate post op X-ray of the fracture shaft femur managed with Ender's nailing. The immediate post-op X-ray showed 2mm of distraction so immediate weight bearing was started in this patient.

Figure 5: X-ray showing backing out of nails after 2 weeks of surgery causing painful restriction of knee motion. Child was readmitted for nail impaction and skeletal traction.

Figure 6: The clinical picture showing incision given just above the epiphysis.

Figure 7: At the end of the surgery the proximal ends are reconfirmed under image intensifier.

Figure 8: At the end of the procedure the fracture stability is checked and hip and knee is mobilized through full range.

RESULTS

The median surgical time was 55mins (45 mins. to 90 mins.). The median hospital stay was 3.2 days (2 – 9 days). All the stable femoral fractures showed bridging callus in a mean time of 3.83 0.853weeks(2.5 to 6.5 weeks) and unstable fractures showed bridging callus in a mean time of 5.53± 1.172 weeks (4-8weeks) [Table-2] and this difference was statistically significant chi square test [Table-1].

Table 1: Pearson chi-square tests.

	Value	df	Asymp. Sig. (2-sided)
Stable/Unstable Vs. Wt. bearing	52.799[a]	12	.000
Stable/Unstable Vs. Age	11.868[a]	18	.854
Stable Unstable Vs. Bridging Callus	32.302[a]	12	.001

Full weight bearing in stable fractures was possible in a mean time of 4.19 .634 weeks and in unstable pattern full weight bearing was possible in a mean time of 6.21±1.475 weeks [Table-2] and this difference was statistically significant by chi square test [Table-1]. Radiological union was seen in a mean time of 9.4 weeks in stable pattern [Figure 1] and radiological union was seen in a mean time of 12 weeks in unstable pattern. In one patient immediate weight bearing was started as postoperative films showed 2 mm distraction. [Figure 4] 34 fractures were evaluated by scanogram one year after injury and they revealed lengthening of 0.3cms. All the children returned to their previous level of activities. There were no psychological complications in present study group. 8 children were readmitted for adjunctive procedures like nailing impaction, application of traction and cast immobilization for brief period [Figure 5] 20% patients had shortening of 1.3cms and 20% had external rotation of lower limb.

Table 2: Group statistics.

	Stable/Unstable	N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Age	Stable Fracture	42	8.19	2.121	.327	0.761
	Unstable Fracture	19	8.37	2.060	.473	0.759
Bridging Callus	Stable Fracture	42	3.83	.853	.132	0.000
	Unstable Fracture	19	5.53	1.172	.269	0.000
Full wt. bearing	Stable Fracture	42	4.19	.634	.098	0.000
	Unstable Fracture	19	6.21	1.475	.338	0.000

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10th day X-ray of pathological fracture revealed collapse & shortening of 1 Cm. Child was readmitted for traction for 2 weeks. Fracture & cyst continued to heal with no limb length discrepancy [Figure 2]. The mean age of the closed fractures was 8.21±1.945 years and that of the open fractures was 8.46±2.470. The Bridging callus was seen in closed fractures was in a mean time of 4.26±1.288 weeks and that for the open fractures was 4.77±1.092weeks. The full weight bearing in closed fractures was possible in mean time of 4.68±1.312weeks and that for the open fractures was 5.31±1.377weeks [Table-3].

Table 3: Group statistics (closed/open).

	Closed/Open	N	Mean	Std. Deviation	Std. Error Mean
Age	Closed Fracture	61	8.21	1.945	0.267
	Open Fracture	5	8.46	2.470	0.685
Bridging Callus	Closed Fracture	61	4.26	1.288	0.177
	Open Fracture	5	4.77	1.092	0.303
Full wt. bearing	Closed Fracture	61	4.68	1.312	0.180
	Open Fracture	5	5.31	1.377	0.382

DISCUSSION

Although femoral shaft fractures constitute fewer than 2% of all pediatric fractures, the choice of treatment has remained a constant challenge to the orthopedics fraternity. Until recently conservative treatment was the preferred method for the treatment of diaphyseal fractures in children and young adolescents. However, to avoid the effects of prolonged immobilization, and to reduce the loss of school days and for better nursing care, the operative approach has been gaining popularity for the last two decades. Plate osteosynthesis is still widely used. It is associated with a large exposure, relatively longer duration of immobilization and the risks of delayed union, infection and a large dissection for plate removal[5,6] The external fixator provides good stability and early mobilization, but is associated with the risk of pin tract infections and it takes a longer time for weight bearing[7,8] Intramedullary K-wire fixation has also been used for pediatric femoral fracture. But stability and fracture angulation is a disadvantage to be taken care of. Interlocking nail is ideal for skeletally mature children. Reports of avascular necrosis of femoral head, coxa valga have been reported with interlocking nail when attempted in skeletally immature patients.[9,10] However there have been proponents for using interlocking nail in the 11-16 years of age group, avoiding the piriformis fossa as entry site, with good results.[11]

Derived from Ender's elastic nail and from other fixation techniques, elastic stable intramedullary nailing (ESIN) provides a combination of elastic mobility and stability. The operation uses only small incisions, is rapid, blood loos is minimal and physeal area stands intact.[12] Because of early weight-bearing, rapid healing and minimal disturbance of bone growth, ESIN may be considered to be a physiological method of treatment.[13]

Healing in cases treated with Ender's nail can be with abundant callus attributed to non-rigid fixation. This resulted in rapid fracture union and early return to little weight bearing while reducing hospital stay. Advantages that Ender nailing offers over other treatment modalities both consecutive as well as operative convinces us to recommend ender nailing in isolated femoral shaft fracture or in polytraumatised children with femoral shaft fractures in children between 6-14 years.[14]

Bar-On et al reported outcome of femoral shaft fractures in children of age group 5-13 years requiring surgery randomly treated with external fixator or flexible intramedullary nailing (10 patients each). They recommend flexible intramedullary nailing for fractures of the femoral shaft and reserved external fixation for open or severely comminuted fractures.[15]

Salem et al concluded elastic stable intramedullary nailing with six month (4-7 month) follow up can provide satisfactory results in terms of limb length and axial alignment, but has a high rate of early torsional malalignment (47%).[16] In a study, 36 children with 37 closed fractures were treated by flexible intramedullary nailing. Follow-up radiographs revealed that 44% of the children had malalignment at the fracture site in one or both planes. However none of the children presented with clinical malalignment of the fractured limb. Fifty percent of the children had a leg-length inequality but none of them complained of a functional problem.[17] Houshian et al reported a series of 31 children (4-11 years) with femoral shaft fractures treated with ESIN. All fractures radiographically united at a median of seven weeks. Limb length discrepancy of up to one cm was found in six children and ten degrees of rotational deformity in one child and no case of angular deformity.[18]

Ozdemir et al reported a retrospective study on percutaneous Ender’s nail fixation and functional bracing

for the treatment of 53 pediatric femoral shaft fractures in the age group 6-14 years. There were no significant intra or postoperative complications. The main advantages of this method are early weight bearing, immediate mobilization, short hospitalization and fewer complications.[19]

CONCLUSION

Thus we conclude that Ender's nailing is simple, cost-effective and minimally invasive procedure and is best for this age group between 6-12 years. The procedure is technically easier and less time consuming than currently employed nailing techniques. It offers stable fixation with rapid healing. There is prompt return of child to normal activity. Functional results are excellent without psychological complications. Most complications are minor and many are preventable. Results of Ender's nailing have more reliable outcome than conservative treatment for pediatric femoral fractures.

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