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Role of flexible elastic nails in diaphyseal fractures of long bones of lower extremities in children of 5-14 years of age

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Abstract

Femoral and tibial fractures are common long-bone injuries in children. Above five years of age all such fractures, when treated conservatively could lead to loss of reduction, malunion, intolerance and complications associated with plaster. The goals are to stabilize the fracture, to control length and alignment. Flexible Elastic Nailing has become the choice of stabilization in paediatric long bone fractures. The aim of our study was to see the outcome of Flexible elastic nailing system in diaphyseal fractures of children of 5-14 years age. The study included total of 50 children treated with flexible elastic nailing system and they were followed up at 3, 6, 12 and 24 weeks. The average duration of callus formation was 3.8weeks (4.2weeks in Tibia & 3.4 weeks in femur). Radiological union was seen in a mean time of 9.65 weeks. Full weight bearing was possible in a mean time of 10 weeks. According to Flynn's scoring criteria, excellent and satisfactory results were in 90% and 10% respectively. There were 2 cases of post-operative superficial infection which resolved with regular dressing and no cases of physeal injury and implant failure. Flexible elastic nail is a safe and satisfactory mode of treatment and is relatively easy to perform in diaphyseal fracture of femur and tibia in children. It avoids the chances of physeal injury, infection and offers early mobilisation and rapid healing.

Keywords: Paediatric femur or tibia fractures, flexible elastic nailing, Flynn's criteria

1. Introduction

Femoral and tibial fractures are common long-bone injuries in children. The injuries are more common in boys, especially during the toddler years and early adolescence [1, 2]. The mechanism of injury varies from simple falls to high energy trauma [3]. Because of rapid healing and spontaneous correction of angulation most of the shaft fractures in children younger than Five years of age can be treated conservatively [4, 5]. However management of fractures of long bones of lower extremity in growing children has been a subject of debate in paediatric orthopaedic community. In the past management of paediatric lower extremity fractures involved use of options like traction alone, early spica cast and traction followed by spica cast. Conservative treatment necessitates a long stay in hospital for traction and subsequent immobilization in an uncomfortable cast. This treatment is not well tolerated specially in adolescence [6]. Operative treatment results in shorter hospitalization and early mobilization, which has psychological, social, educational and economic advantages over conservative treatment. Above five years of age all such fractures, when treated nonoperatively could lead to loss of reduction, malunion, intolerance and complications associated with plaster. However, the best treatment between six and 16 years of age is a matter of debate [7]. Since the last two decades, there has been a growing tendency towards a more operative approach in patients over six years of age [8-10]. Between the age of 5 to 14 years, the available options for these fractures are: external fixation, flexible stable intramedullary nails, plate fixation, and locked intramedullary nailing. The goals are to stabilize the fracture, to control length, optimal alignment and early mobilisation. Excessive tissue dissection and tissue devitalisation is frequent during Open reduction internal fixation, which creates problems in wound healing and ultimately leading to infection, hence other less invasive methods were

developed to treat fractures of tibia and femur [11]. Flexible Elastic Nailing, which is variously known as Elastic Stable Intramedullary Nailing, has become the choice of stabilization in paediatric long bone fractures [12, 13]. Development of TENS has provided a simple, biocompatible, load bearing internal splint allowing early mobilization. As epiphyseal growth plate is not breeched, it avoids growth disturbance and has minimal risk of complications and has thus emerged as the most popular surgical modality for management of unstable paediatric lower extremity long bones fractures [14].

Materials and Methods

In our study, 50 patients between age group of 5 – 14 years having diaphyseal fracture of either femur or tibia were included. Patients less than 5 years of age, patients with pathological fractures, Compound Fractures, distal neurovascular deficit and any other fracture in ipsilateral limb were excluded. Routine investigations were done for all patients and operated under appropriate anaesthesia after prior informed consent. All patients were operated on radiolucent table under image intensifier guidance for visualizing reduction and verification of nail passage. Nails were inserted

from proximal to distal for tibia and from distal to proximal for femur. Bone was exposed with a longitudinal incision. With the help of sharp awl, entry was made through the cortex to obtain access to the medullary cavity. Care was taken to ensure that growth plate was not breached while making the entry point. Nails were bent prior to insertion so that apex of both nail rest at fracture site and were inserted using T-handle. Once fracture site was reached, fracture was manipulated under image intensifier guidance to obtain reduction and nails were passed further upto metaphysis and adequate three point fixation was ensured with tip of nails facing in opposite directions. All patients received antibiotic 30 mins prior to the surgery and on the 1st post-operative day. Thigh spica Cast was given to all patients operated for Femur Fracture and below Knee slab to all patients Operated for Tibia Fracture. On post-operative day 1, gradual movements at hip and knee were started and patients were encouraged to do non weight bearing walking with the help of walker. The patients were followed up at intervals of 3,6,12,24 weeks and were evaluated clinically as well as radiologically for union and callus formation. At 24 weeks follow up final evaluation was done by using Flynn criteria.

Table 1: Flynn’s scoring criteria

Variables	Excellent	Satisfactory	Poor
Limb-length inequality	< 1.0cm	< 2.0cm	> 2.0cm
Malalignment	5 degrees	10 degrees	>10 degrees
Unresolved pain	Absent	Absent	Present
Other complications	None	Minor and resolved	Major and lasting morbidity

Results

In our study there were 32 boys (64%) and 18 girls (36%). Minimum age was 5 years and maximum age was 14 years while most fractures occurred between 8 to 11 years (56%). Major cause of fracture was road traffic accident in 76% cases followed by fall from height in 24% cases. Out of 50 fractures, there were 60% tibia fractures and 40% femur fractures. Right side was more commonly involved (68%). Majority of patients (44%) had oblique fracture pattern followed by transverse pattern (38%). In our study, 84% of patients were operated on the next day of admission and average duration of hospital stay was 6 days. Gradual range of movements at hip and knee joint were initiated on 1st post-operative day.

Partial weight bearing was started ones the splint (Thigh spica cast or Below knee slab) was removed. In 70% cases splint was removed on 6wks post-operative; in 26% cases early weight bearing (4 wks) was started due to good callus formation radiologically but in 4% cases delayed weight bearing (9 weeks) was done. We noticed patients in whom early weight bearing was started were between 5 to 8 years of age. Full weight bearing was started in 96% cases at 10 weeks

post operatively and in remaining 4% cases, it was started at 13 weeks.

In our study, average duration for complete range of movement at hip and knee was 5 days post operatively and once patient achieved full range of movement, they were discharged.

In our study, at 24 weeks follow up 90% patients had shortening less than 1cm, 8% patients had shortening between 1 – 2 cm and 2% patient had shortening of 2.5cm. 94% of patients had angulations less than 5° while remaining 6% had angulation between 5-10°. Two patients had superficial infection which were resolved with regular dressing. None of the patients had pain at operative site.

Table 2: Showing the results of flynn’s scoring criteria

Results	Number of cases	
	Tibia	Femur
Excellent	23(92%)	22(88%)
Good	2(8%)	3(12%)
Poor	0 (0%)	0 (0%)



(a) Pre-operative

(b) Post-operative

(c) 6 weeks

(d) 12 weeks



Fig 1: Series of femur fracture treated with elastic nailing



Fig 2: Series of tibia fracture treated with elastic nailing

Discussion

Surgical management of long bones of lower extremity in paediatric age group has been controversial. Multiple treatment options have been tried over past two to three decades. All treatment options were found to be associated with some complications. Multiple options like traction, hip spica, compression plates, external fixation, flexible/elastic stable intramedullary nail exist for treatment in age group of 5 -14 years. Plate osteosynthesis is widely used but associated with large exposure, relative longer duration of immobilisation, risks of delayed union, infection and large dissection for plate removal [15, 16]. Use of interlocking nails in skeletally immature children has reported complications like avascular necrosis of femoral head, coxa valga [17, 18]. External fixation has advantage of good stability and early mobilization but associated with problems of pin tract infections and refractures through tracts [19, 20]. Flexible elastic nail acts as load sharing device, allowing early mobilization, not disrupting blood supply of epiphyseal growth plates, maintaining limb length and alignment, hence ideal implant for treatment of paediatric lower extremity long bone fractures [21-23]. It is based upon the principle of three point fixation that works by balancing forces between two opposing flexible implants. This balance is attained by using a nail diameter of 40% of narrowest canal diameter leading to a double-C construct. In our study majority of cases had excellent or satisfactory results which is comparable to series reported by Pulate *et al* [24] results were excellent in 60%, successful in 35% and poor in 5% and Moroz *et al* [25] was excellent in 65%, satisfactory in 25%, and poor in 10%. In our study, duration of hospital stay was between 5 to 12 days where as in a study conducted by Houshian *et al* [26]. The mean hospital stay was six days and range of hospital stay was 2 to 20 days. Two cases had minor complication of

superficial wound infection which was healed after regular dressing. In study conducted by Khazzam *et al* [27], there were 14 complications, three re-fractures, two delayed unions, three varus or valgus malalignment, five nail-tip irritations, and one asymptomatic proximal nail migration.

Conclusion

Flexible elastic nail is simple, reliable and effective method for management of lower extremity long bone fractures in paediatric age as it takes short operative time, minimal blood loss, small operative scar, shorter hospital stay, early mobilisation and minimum complications.

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