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A clinical study of treatment of paediatric femoral shaft fractures with elastic intramedullary nail

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Abstract
Background: The fractures of paediatric femoral shaft is a common major fracture treated by Orthopaedic surgeon. The treatment of femoral shaft fractures in children is a subject of controversy. It is conventionally managed by traction and hip spica casting. Although the majority heals without long term sequelae but the closed intramedullary operative procedure allows early weight bearing and early rehabilitation. It has the advantage of haematoma preservation and restoration of continuity of bone.
Methods: Twenty one children of aged 6-14 years with femoral shaft fractures were treated with elastic intramedullary nails. Seventeen fractures were in middle third, two in proximal third and two in distal third. Fourteen fractures were transverse, three oblique, two were spiral and two were comminuted. Average injury surgery interval was 5 days. All fractures were treated by closed reduction and elastic intramedullary nails. The patients were assessed clinically and radiologically for two years. The final results were evaluated using the criteria of Flynn *et al*.
Results: Results were assessed for range of motion (ROM), irritation at the distal end of nail, deformity, limb length discrepancies and union. Radiologically union was achieved in a mean time of 9 weeks (6-12 weeks). The most common problem encountered was soft tissue discomfort near knee joint. Excellent results were achieved in 14 patients (67%), successful results in 5 patients (23%) and poor results in 2 patients (10%).
Conclusion: It is concluded that paediatrics femoral shaft fractures treated by elastic intramedullary nail gives satisfactory results with minimal complications.

Keywords: Elastic intramedullary nail, paediatric, femoral shaft fractures

Introduction
Femoral shaft fractures are the second most common fractures that occur in children [1]. Femoral fractures constitute only 2% of the Orthopaedic trauma in children [2]. Traditionally they have been treated conservatively with hip spica casting or by traction, but recently the trend is towards internal fixation with dynamic compression plates, rigid intramedullary nails, external fixators and elastic intramedullary nails [3].
Femoral shaft fractures in children under the age of four years tolerate hip spica cast very well and fractures unites very well with great potential for remodeling [4].
In femoral shaft fractures in children over 12 years accurate reduction is necessary as angular deformity is no longer correctable by remodeling [5].
With external fixators, there is increase risk of knee stiffness, pin tract infection, evidence of delayed union and non union [6].
Availability of locked intamedullary nails has made the treatment of femoral shaft fractures in skeletally matured children well established. However the best treatment between 6 and 16 years of age is a matter of debate [7].
Elastic intramedullary nailing provides stable fixation, early union, sparing of proximal and distal physis, minimal scar, early weight bearing, easy implant removal [8].
Elastic intramedullary nails has its own set of problems including nail irritation, refracture, superficial and deep infection. In addition some investigators have suggested limited success in older and heavier children [9].
The present study was undertaken with the objective to study the outcome of femoral shaft fractures in children treated with elastic intramedullary nails.

Methods

This study was conducted in the department of Orthopaedics at Khaja Bandanawaz teaching and general hospital, Kalaburagi, for a period of 2 years from Jan 2017 to Jan 2019. The study received clearance from ethical committee of the institution. In this study 21 Childrens with displaced femoral shaft fractures underwent closed reduction and internal fixation with elastic intramedullary nails.

Inclusion criteria

- Age between 6-14 years.
- Closed diaphyseal femur fracture.

Exclusion criteria

- Open fractures
- Patients with pathological fractures
- Children having metabolic bone diseases, Neuro muscular disorders.

There were 16 boys and 5 girls in our study. Fractures were further divided into proximal third, middle third and distal third. All patients underwent surgery within 1 week of injury.

Operative procedure: All surgeries were performed under general anaesthesia in supine position on radiolucent operating table under image intensifier. Fracture was reduced by traction and manipulation. The point of entry was retrograde i.e distal to proximal. After making entry point first laterally and then medially at the level of the proximal pole of the patella about 2.5 – 3.5cms superior to the distal femoral physis, the nails were inserted proximally till the tips anchored 1-2 cm distal to proximal physis in divergent fashion confirmed on image intensifier on both antero posterior and lateral views. The nails were precontoured with the apex of the curve towards the fracture site. Two elastic nails were used. The nails were cut 1 cm distal to the cortex and bent slightly away from the bone for easy removal after fracture union.

Post operatively patients were followed up monthly for six months and then at three months intervals till completion of one year. patients were evaluated clinically and radiologically for 2 years. The final results evaluated using the criteria of Flynn *et al*. [7] Table 1.

Table 1: Flynn criteria for femoral shaft Fractures.

	Excellent result	Satisfactory result	Poor result
Length discrepancy	<1.0cm	<2.0	>2.0
Mal- alignment	5 grades	10 grades	>10 grades
Pain	No	No	Yes
Complications	None	Minor and solved	Major and / or residual morbidity

Results

The mean duration of surgery was 80 minutes (60 min-120 min). Full weight bearing was started at 9 weeks. 13 fractures were on right side and 8 fractures were on left side.

The cause of fracture was road traffic accident (RTA) in 14 patients, 5 fractures were caused by fall from height and 2 were by sports injuries. All fractures were closed. Nails were removed between 6-8 months.

The average follow up was 16 months (14- 24 months).

At the final follow up excellent results were achieved in 14 patients (67%), successful in 5 patients (23%) and poor results in 2 patients (10%). Fig -1

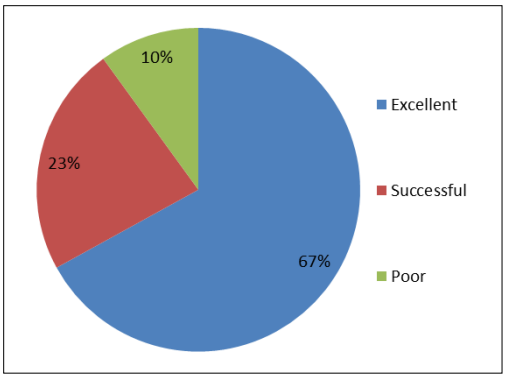

Fig 1: Flynn"s criteria.

4 patients had entry site irritation due to prominence of nail. One patient had skin breakdown at entry site leading to superficial infection which was treated by antibiotics, and nail was driven after infection was controlled under general anaesthesia.

Three patients had varus angulation of $5^{0,}$ 6^{0} and 12^{0}. One patient had valgus angulation of $14^{0.}$

Three patients had limb shortening. Two pts had 1.2 cm shortening and one patient had 1.6 cm shortening. No patient had limb lengthening.

In our study no pt had osteomyelitis, physeal growth disturbances.

At final follow up all patients had full range of motion at the knee joint.

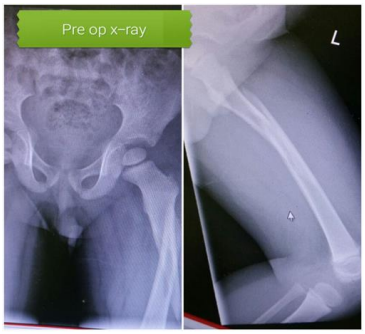

Fig 2(a): pre-op x-ray.

Fig 2(b): Post op x-ray.

Discussion

Femoral shaft fractures in children had been treated previously with non operative methods by traction and hip spica casting [10]. However to avoid the effect of prolonged immobilization and to decrease the loss of school days and for better nursing care, the operative treatment gained popularity for the last three decades [11].

Flexible unreamed intramedullary nails have long been used to manage diaphyseal fractures of long bones. These nails rely on three point fixation principle, and provide favorably mechanical conditions, as the forces are evenly distributed along the entire length of nails [12].

Elastic intramedullary nails had the advantage of being load sharing device that does not violate open physis, allow early mobilization and maintain alignment. Elasticity of the nails provides micromotion, which promotes external callus formation at fracture site, since it is a closed procedure haematoma is not disturbed, so healing will be fast and thereby less risk of infection [13].

In our study excellent results were achieved in 14 patients (67%), successful in 5 patients (23%) and poor in 2 patients (10%). Saikia KC reported excellent results in 59.2%, successful in 27.2% and poor in 13.6%.

Flynn reported that titanium elastic nailing (TEN) has advantage over hip spica in management of femoral shaft fracture in children [7].

In our study radiological union was achieved in a mean time of 9 weeks. Lohiya in his study of femoral shaft fracture treated with TEN, reported radiological union at an average of 11 weeks [14].

In our study the most common complication was pain at nail insertion site and skin irritation. Flynn and Narayanan, in their studies reported similar complaints [7, 8].

In our study there were 3 cases of limb discrepancies. Sink EL *et al*. reported that 60% of limb length discrepancy was either due to unplanned surgery or due to unstable fracture configuration [15].

Conclusion

From our study we conclude that elastic intramedullary nailing for femoral shaft fractures in children gives satisfactory results with minimum complication rates because it provide good biological fixation and good radiological union.

So we recommend elastic intramedullary nailing for paediatric femoral fractures over other modalities of treatment. To achieve better results pre operative planning is very important.

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