Treatment of Paediatric Femoral Shaft Fracture with Flexible Intramedullary Nail

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ABSTRACT

Objective — *To find out the functional outcomes after placement of flexible intramedullary nail in paediatric femoral shaft fractures.*

Study design — *Retrospective study.*

Place & Duration of study — *Department of Orthopaedics, Civil Hospital Karachi, from July 2017 to June 2019.*

Methodology — *Children with femoral shaft fracture of both genders were selected. Data was recorded on a pre designed form. All surgeries were done under general anaesthesia with fluoroscopic guidance. Nail diameter was predetermined. After completion of the procedure, stability was assessed radiologically. Postoperatively patients were kept in hospital for 2 days and followed up for at least 3 months along with rehabilitation by Flynn's criteria. Data analysis was done by SPSS version 21.*

Results — *There were total of 54 children with 56 femoral shaft fractures. Male patients were 46 (85.2%) and 8 (14.8%) females. The age was between 6 – 16 years with mean age of 8.8 year. There were 52 unilateral femur shaft fractures and 2 patients had bilateral fractures. The commonest injury was road traffic accident (n= 40 - 71.4%), involving right femur most commonly (n= 33 - 58.9%). The middle part of femur was involved in 40 (71.4%) patients. Majority of fractures united at 8- 12 weeks. Flynn's criteria used for assessment of results, which showed excellent outcome in 47 (84%) children. Five (9.2%) children had limb lengthening, while varus mal-alignment noted in 3 (5.5%), failure of closed reduction in 5 (9.2%) and soft tissue discomfort at entry portal in 8 (14.8%) patients. Follow-up for one year was uneventful for all children.*

Conclusion — *Flexible intramedullary nail in paediatric femoral shaft fracture is safe, minimal invasive and cost effective option.*

Key words — *Femoral shaft fracture, Intramedullary flexible nail, Flynn's Criteria.*

INTRODUCTION:

Femoral shaft fractures represent 1–2% of all pediatric fractures with incidence of 20-25 per 100,000 children per year.[1,2] Treatment depends on different factors like age, type and location of fracture and associated injuries. Traditionally these fractures were treated conservatively with immobilization with pavlik harness, skin or skeletal traction and spica in younger patients due to rapid healing, while surgical management was reserved for selective cases.[3] Conservative management is associated with prolong hospital stay and psychological disturbances. Therefore surgical management is more superior as it provides accurate reduction without interference with growth and malunion.

Number of surgical options are available for paediatric femoral fracture with pros and cons, like closed

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reduction and external fixation, open reduction and internal fixation, MIPO and closed reduction and intramedullary nailing with either flexible or rigid nails.4 There is no consensus as to definitive approach.5 However nowadays flexible intramedullary nail is more popular as it is cost effective, minimally invasive, safe, easy learning curve and with less complications.

Elastic stable intramedullary nail was first introduced by Nancy group in 1979 for femoral fractures.6 Flexible intramedullary nail needs small incision for insertion and removal, therefore it is cosmetically well accepted. Due to minimal invasive technique, the patient can be mobilized within 48-72 hours of operative management, therefore due to early ambulation, less complications, no interference with growth and good cosmetics outcomes. This technique is favorable in the management of pediatric fractures of long bone. Our aim was to find out the short term outcomes of intramedullary nail placement in paediatric femoral shaft fractures.

METHODOLOGY:

This retrospective study was conducted from July 2017 to June 2019, in the Orthopaedics Department of Civil Hospital Karachi. We calculated sample size result from open epi version 3. Total estimated sample size is 56, with confidence interval of 95% and 5% is confidence limit on the basis of mean 82.5% (prevalence of satisfactory outcome).[7]

A total of 54 children with 56 femur shaft fracture of 6 – 16 years of both gender, with closed fractures of the femoral shaftÊwere included. Patients who were had open fracture, acute or serious illness, pathological or metabolic fractures, neuromuscular disorders and coagulopathy, were excluded from the study. Informed written consent was signed from patient/ parents or guardians.

The fractures were classified by Orthopedic Trauma Association classification. This classification helps to differentiate between stable and unstable fractures. The flexible intramedullary nail is not suitable for the unstable (long spiral and comminuted) fractures. All the patients were operated within 10 – 12 days of injury after proper preoperative evaluation. Full length radiographs in antero – posterior and lateral view of fractured femur were taken before surgery.

Prophylactic antibiotics were given under general anaesthesia. The child was kept supine on fracture table. Closed reduction was performed. The alignment was confirmed in anteroposterior and lateral view by fluoroscopy. A 2.5 to 3 cm skin incision was made proximal to the distal femur physes level over lateral and medial side of thigh and the entry point is made by bone awl to a 45° angle relative to the shaft axis. We used selected prebent 2 nails of same diameter, calculated by radiograph before operation by Flynn et al's formula, diameter of nail=width of narrowest point of the medullary canal on AP and Lateral view X 0.4 mm.[8]

Titanium elastic nails were inserted and advanced proximally to fracture site. After close reduction, nails were further advanced into the proximal fragment to diverge laterally towards the greater trochanter and medially within the femoral neck for proper rotational stability. The placement was seen by image intensifier. External parts of the nails were cut, leaving only 1cm outside and wounds were closed.

Postoperative splint was not used and antibiotics continued for 5 days. Quadriceps static exercises knee mobilization and non-weight bearing were advised on 2nd postoperative day. Initially patients were mobilized with non weight bearing walker for 2-3 weeks. Partial weight bearing was advised when bridging callus was observed on follow up imaging at an average of 5.2 weeks.

Patients were examined weekly for 4 weeks, 2 weekly till 8 weeks and then once every 6 months. Limb lengthening, varus angulation, rotational alignment, failure of close reduction and soft tissue problems were assessed in each follow up. Flynn's classification was used for outcome scoring.[8]

RESULTS:

Out of 54 patients, 46(85.2%) were males and 8(14.8%) females with mean age of 8.8 year. There were 52 unilateral femur fracture and 2 bilateral fractures. OTA fracture pattern is given in table I. Forty (74.1%) patients had road traffic accident and 14 (25.9%) with history of fall from height. Nine (16.6%) patients had associated injuries, 4 minor head injuries, 3 upper limb fractures and 2 tibial fracture. Right side femur (n=33 - 58.9%) was commonly affected by fracture. The commonest level of fracture was middle third (n= 40 - 71.4%). Mean interval between injury and definitive surgery was 4.5 days.

Mean duration of surgery was 38 minutes (30 - 45 minutes). The hospital stay was between 5 -10 days. Of the total, 51 cases were managed by closed reduction while 5 required open reduction. Size 2.5 mm to 4mm nail was used. No postoperative immobilization was offered. The duration of follow up was from 3 months to 39 months. The union was

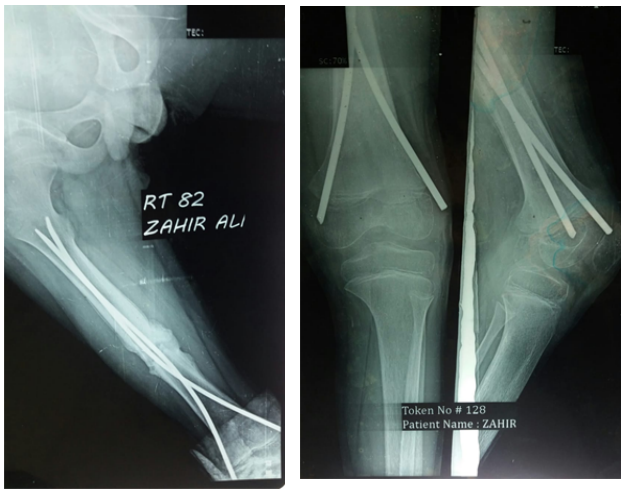

Fig I: Postoperative radiograph after 6 weeks of surgery

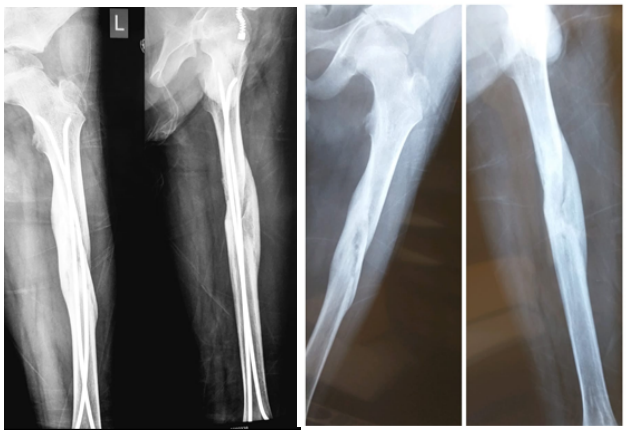

Fig II: Radiograph taken before and after removal of nail, showing healing of fracture

assessed by clinical method (absence of pain on walking) and with radiological criteria (Fig I & II). The mean union period was 11 weeks (6 -16 weeks), and then full weight bearing was started.

Full range of motion was achieved in majority of cases (n = 50), while 6 patients had terminal restriction of knee flexion (20-30 ^{0}), that was improved after removal of nail. Flynn's scoring system was used to evaluate the functional outcomes. The results were excellent in 91.4% of transverse fracture, 80% of spiral fracture, 75% of oblique fracture and 33.3% of wedge fracture. We found excellent result in middle third of shaft fracture, accounted for 82.5%.

There was no non - union, delayed union or refracture. Varus angulation was observed in 3 (5.5%) cases, while rotational alignment in 1 (1.8%) patient. We found limb lengthening in 5 (8.9%) cases. Soft tissue problem and discomfort at the entry site of nail was observed in 8 (14.2%) cases. Nails were removed after mean period of 24 weeks (16-32 weeks). No complications were noticed during or after nail removal like refracture.

DISCUSSION:

Femoral shaft fractures account 1–2% of all paediatric fractures.[1] There are variety of conventional technique (spica casting[9,10]) for the treatment of fracture. There are many approaches available for femoral fracture in children like external fixator, compression plating, rigid intramedullary nailing,[11] but for the past few years, satisfactory results were achieved by flexible intramedullary nails. External fixator is a good option but complications are frequent such as pin tract infection, re-fracture and prolonged non weight bearing.[12-14]

Titanium elastic nails (TEN) are recent materials and being popular due to its minimal invasive nature. It works as internal splint which maintains alignment and bone length without interfering the physis, 3 point fixation and also shares the load. These nails do not damage periosteum. There is no risk of avascular necrosis, disturbing fracture hematoma and low risk of infection. TEN can also be used in children of >100 pound without risk of malunion, which is an added advantage.[15]

The duration of surgery in different studies were similar to our study.[16-18] There are controversies regarding the exact age for the management with intramedullary nails, but majority of literature supports the age between 6- 16years.[7,16,19] Most of the children in Pakistan are not obese therefore, this modality can easily be used in adolescents (> 10-16 years) without major complications. However intramedullary nail is a good option in obese patients. In this study partial and full weight bearing started

Table I: OTA fracture pattern.

Fracture	Pattern	Number
32 – A1	Simple Spiral	10 (17.8%)
32 – A2	Simple Oblique	08 (14.8%)
32 – A3	Simple Transverse	35 (64.8%)
32 – B2	Simple Wedge	03 (5.5%)

at an average of 5.2 weeks and 16 weeks respectively after bridging callus was noticed, which was also followed by other studies.[8,16,18] The pattern and site of fracture are important for surgical outcome. In index study excellent results were noted in transverse, spiral and oblique fractures. This was comparable with other studies.[19-21] In our study, excellent results were found in 84% of cases and satisfactory in 16% according to Flynn Criteria. The same was stated by others.[19,21-23]

CONCLUSION:

Titanium elastic nail in paediatric femoral shaft fracture is safe, minimal invasive and cost effective option. It allows early immobilization, reduces the hospital stay, and rate of complications.

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Dileep Kumar: Analysis and interpretation.
Syed Ghulam Mujtaba: Result interpretation.
Shah, Maratib Ali: Final approval.

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