DOI: https://doi.org/10.53350/pjmhs22167230

ORIGINAL ARTICLE

Outcome of Pediatric Patients with Fracture of Femur Fixed with Intramedullary Elastic Nail

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ABSTRACT

Objective: To determine the effects of elastic intramedullary nails used for fixation of femur diaphyseal fractures in paediatric patients.

Method: This prospective observational research was done from April 2020 to June 2021**.** 52 paediatric patients diagnosed with femur diaphyseal fractures with mean age from 6 to 12 years were enrolled in this study. All patients were admitted and subsequently operated for treatment of femur fracture using elastic intramedullary nail in retrograde fashion. Patients were in structured follow up till radiological union realized. Flynn scoring criteria was applied to evaluate the functional outcomes at 6 months after surgery.

Results: The average age of patient enrolled was 9 years (6- 12 years), all 52 patients were in follow up for average 26 weeks (14-36 weeks). Fracture union was observed in all operated children in mean time of 9 weeks (range 6-12 weeks). Four participants suffered superficial skin infection at entry site. Two patients had limb length discrepancy upto1.5cm and two patients had varus angulations up to (10º) and in two patients proximal migration of nail was noted. According to Flynn Criteria outcome was excellent in 38 patients (73.1%), satisfactory in 12 patients (23.1%), poor in 2 patient (3.8%) respectively

Conclusion: Fixation of femoral diaphyseal fracture with intramedullary elastic nail in paediatric patients is better option. One can achieve excellent results, satisfactory radiological and clinical bony union, with lowest complication rate, so it could be regarded as a favorable fixation implant for management of diaphyseal femur fractures in pediatric age group.

Keywords: Fracture, femur shaft, elastic intramedullary Nail, Paediatric patients.

INTRODUCTION

Trauma is the most prevalent cause of mortality and morbidity in paediatric patients, second only to acute infections[1]. Fracture of femur in paediatric patients consist of 2% of overall bone injuries[2]. These femur fractures impact a considerable influence on the patient as well as on their families and utilization of financial expedient[3]. In past, these fractures were managed with different treatment modalities. Historically these fractures were managed without operation by applying hip Spica cast with admissible results but Such method of treatment was too much cumbersome for patient and his/her family[4,5].

Other treatment modality for pediatric femur is fracture and internal fixation using extramedullary devices like plate and screws. There are many drawbacks like big incision leading to more blood loss, increased risk for infection, more scar due to large incision and, prolong bed rest and more chances of a redo and similar magnitude for removal of implant. According to Shoemaker intramedullary fixation leads to ideal alignment, minimally invasive and less risk for complication. Elastic nail is also minimally invasive procedure that additional maintain physis, provide 3 point fixation[6].

Titanium elastic nailing (TEN) has acquired popularity over the last two decades and is now being used routinely for treatment of diaphyseal femur fractures in patients aged 6 and above[7]. Stable three point fixation which is required for bone union can be achieved with elastic intramedullary nail which cause rapid postoperative functional recovery. Despite of several advantages of Elastic Nails complication rate of about 60% been reported, mostly due to faulty operative technique and improper patient selection. Common complication related to (TEN) is soft tissue injury at the insertion side of the nail[8]. Nail migration, nail prominence which can lead to other serious complications include skin breakdown, superficial and deep abscess, osteomyelitis. .In 1982 Nancy group introduce flexible intramedullary nailing for femoral shaft fractures[9]. Elastic intramedullary nail has now become well known surgical tool for treatment of femur shaft fractures in pediatric patients as it gives favorable results and lack of major adverse effects, as it is mini-invasive surgery, avoid splint and bandages, early rehabilitation and early discharge. It is also cost effective.

METHODS

This prospective observational study was conducted at department of orthopaedic unit I, Chandka medical college (SMBBMU) Larkana from April 2020 to June 2021. This study enrolled children patients from age group of 6-12yrs diagnosed with fracture of diaphysis of femur and all were operated using intramedullary elastic nail. Patients fulfilling the inclusion criteria were enrolled. The project was presented in institutional ethical review committee and was conducted after getting approval from the committee. Every participant was informed regarding study and consent was documented. Patients having metabolic bone diseases, pathological fractures, compound fractures and with neuromuscular disorders were excluded from the study. Surgical indications were displaced femur shaft fractures with open physis. 26 patients having diaphyseal femur fracture of Transverse, Oblique, Spiral and minimally comminuted variety were enrolled in this study. 18 were boy patients and 08 were girl patients with average age 09yrs (range 6- 12yrs). All participants with femoral shaft fractures were managed with TEN. Diaphyseal fracture further divided on the basis of anatomical location as proximal third shaft, middle third and distal third shaft. Three children suffered from proximal third diaphyseal femur fracture, while nineteen and four had middle third and distal third of femur shaft respectively. Fractures were classified according to AO pediatric (Arbeitsgemeinschaft für Osteosynthesefragen) classification for femoral shaft fracture 32-D (4.1,4.2, 5.1 and 5.2). All patients were gone under the surgery within 1 week from injury. All operations were done with general anesthesia; patients were in lying supine during procedure on fracture table under image intensifier control by pediatric orthopedic surgeon more than 10 years of experience. Nail size determined pre-operatively from radiograph of contra lateral femur that each nail occupies at least one-third to 40% of narrowest part of the intramedullary region. Fractures were reduced by close methods using two flexible nails, which were inserted across the fracture through proximal to distal femoral physis in retrograde fashion. The nail entry points were 2.5-3.5cm proximal to the lower growth plate of femur. The pre-requisite for ensuring a good equal recoil force is to pre bend both nails of equal diameter sufficiently so that the apex of both bowed nails should lie and provide diagrammatically opposed curves at the fracture site. The nails were inserted in retrograde direction till the

tips anchored 1-2cm distal to proximal physis in divergent fashion, confirmed on image intensifier on both anterio-posterior and lateral views.

Postoperatively the operated leg kept elevated for 24 hours, post-operative rehabilitation included hip and knee motion exercise on 1st post operative day, followed by non-weight bearing mobilization on 5th to 7th day post operatively. Partial weight bearing was started at 03 weeks followed by full weight bearing at 6 to 8 weeks once radiological union was observed.

Outcome of all fracture pattern were assessed by using Flynn et al scoring criteria for titanium elastic nail as excellent, satisfactory and poor[10].

RESULTS

The Mean age of patient in our study was 9 year (range 6- 12) years, with mean weight of 23.88 (SD± 5.56). The median duration of surgery was 55 minutes (range 35-90) minutes. All 52 patients were in regular 26 weeks (14-36 weeks) follow up. Radiological union achieved in all patients in a mean time of 9 weeks (range 6-12 weeks). There were 22 transverse fractures (42.3%), 18 oblique (34.6%), 6 spiral (11.5%) and 6 comminuted fractures (11.5%). According to the functional scoring criteria proposed by Flynn the 38 patients (73.1%) had an excellent result, 12 patients (23.1%) had satisfactory outcome and 2 patients (3.8%) had a poor outcome. In present study it is found that outcome depend on fracture pattern, results were excellent in 100% in oblique fracture. In transverse fracture it was excellent in 72.7%and successful in 27.3%. In spiral fracture results were excellent in 33.3% and successful in 66.7% and in comminuted fracture results were excellent in 33.3%, successful in 33.3% and poor in 33.3 %. Results were significant having (p value ≤ 0.05) (i.e., $p < 0.05$ shows significant difference between groups) consider significant using Chi square test. Entry site irritation occurred in 06 patients secondary to prominence of nail. Four patients had skin breakdown at entry site, which lead to superficial infection. Two patients had limb length discrepancy upto1. 5cm and two patient had varus angulations up to (10º). Two patients required nail removal at 5th month due to wound break down at proximal thigh due to proximal migration of nail.

Table 1: Flynn criteria for femur shaft fracture

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

Table 2: Location and pattern of fracture

Location Of Fracture		
Proximal 1/3 Shaft	06	11.5%
Middle 1/3 Shaft	38	73.1%
Distal 1/3 Shaft	08	15.4%
Pattern Of Fracture		
Transverse	22	42.3%
Oblique	18	34.6%
Spiral	06	11.5%
Comminuted	06	11.5%

Table 3: demographics

	Mean +/- S.D	Range (max-min)
Age (years)	8.99 +/- 1.91	(6-16)
Weight (kg)	23.88 +/- 5.56	(15-36)
Surgical time(minutes)	58.08 +/- 15.23	(35-90)
Radiological union(weeks)	9.00 +/- 1.67	(6-12)

Table 4: outcome of patients on the basis of Flynn criteria

Outcome	No of patients	Percentage of patients
Excellent	38	73.1%
Satisfactory	12	23.1%
Poor	02	03.8%

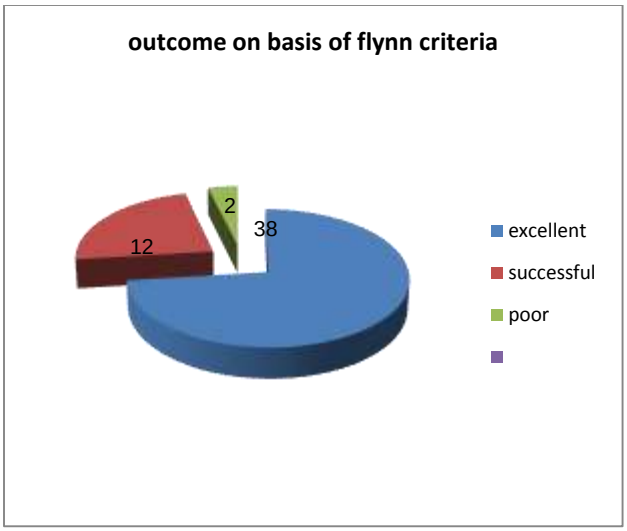

Chart 1: Showing outcome on the basis of Flynn criteria.

DISCUSSION

Fractures of femoral diaphysis in children were used to be treated without operations using hip spica[4]. By the invention of newer devices or techniques shows the acceptable outcome in the management of shaft fractures in paediatric patients. In order to avoid prolonged bed rest, reduce the amount of absent days at school and to provide outstanding nursing care surgical interventions are become standard in treating of such kind of fractures. A different operated method has been used for internal fixation, including rigid fixation with plate[11], intramedullary nail, with external fixator[12] and recently flexible intramedullary nail[10]. Plate Osteosynthesis is easier to perform still widely used; it bears the risk of large exposure, delayed union, infection and later re do surgery for removal of implant. This method of fixation has relatively longer duration of immobilization as compare to flexible intramedullary nailing. External fixator has its own well known problems related to pins and tracks[12]. Every method of fixation has its advantages and disadvantages.

Flexible intramedullary nails had been in fashion for fixing peritrochentric fracture[13], but the use of titanium elastic nail in paediatric shaft fracture was popularized by Nancy in 1982[9]. Surgical procedure using TENS in children has advantages as it is easy to insert, shares the load of body on femur, and is putted inside the medullary canal, causes no damage to growth plate, allows early mobilization and maintains alignment. Elasticity of the titanium nail provides micro-motion, which promotes faster external bridging at fracture site and callus formation. The fixation of femur fracture is done with minimal invasion so causes no disturbance to fracture biology and less risks of infection.

In earlier days TENS was only used in-patient of 6-12 years age group, but later several studies showed an excellent outcome in younger children as well[14]. Currently surgical indications for TENS include all femoral shaft fractures with open physis. Flynn reported in his study that TEN has advantages over hip spica in treatment of femoral diaphyseal fractures[15]. Saikia K C reported that results were excellent in (59.0%), successful in (27.2%) and poor in (13.6%). He also reported that result were better for children less than 10 yrs of age (p value .0001)[16].

In our study what we found that functional outcome depend on the fracture pattern, oblique fracture had an excellent outcome as compare to other fracture pattern, all patient who registered in our study achieved radiological union in a mean time of 9 week our results are comparable to Lohyia who reported in his study the outcome of femur shaft fracture treated with TENS were excellent in 37, successful in 3 and poor in 3. They observed complete radiological union at an average of 11 weeks average[17].

Narayanan reported 79 femoral shaft fractures stabilized with TENS all were united without any difficulties and having good outcome[18]. Fracture pattern and its location is an important consideration for selection of surgical techniques. In our study we also found that fracture of mid shaft femur along with oblique or transverse pattern had a good outcome as compare to spiral or comminuted fracture. L.A Moroz in his study found that distal femur fracture carried a poor outcome in (18%) of cases, as compared with middle and proximal third, which was (9%), although it was not statistically significant[19].

The stability in communicated or long spiral fractures was adequate if treated with titanium elastic nail, than appropriate option other than elastic nail should be consider.

Our study also supports various other studies that most of these femur fractures when fixed with TENS heal well with fewer complications. Studies showed that outcome were better in children of age 10 years and below[16,18]. But in our study there was no significant outcome in different age group (p value= 0.455). The usual adverse side effect of using TEN was pain at nail site insertion and skin irritation. Similar complication reported in previous studies by Narayanan and Flynn[10,18]. In our study entry site irritation occurred in three patients due to nail tip prominence, while two other cases had skin breakdown at entry site which lead to superficial infection.

Other complication includes infections, angulations either varus or valgus and limb length discrepancy.

Sink reported that 60 % of complication of limb length discrepancy was either due to unplanned surgery or unstable fractures configuration, specifically long oblique fracture and comminuted variety[20]. But in our study we reported only one patient had limb length discrepancy upto1.5cm in comminuted fracture.

CONCLUSION

Fixation of femoral diaphyseal fractures with flexible elastic nail in pediatric age group gives satisfactory outcome with minimum complication rates because of simple operating technique with less operating time and satisfactory radiological union achieved time, so we recommend treatment of femoral diaphyseal fracture with flexible elastic nail in paediatric group should be considered as a favorable treatment option.

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