IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 10 Ser.15 (October. 2019), PP 34-39
www.iosrjournals.org

Management of Diaphyseal Fractures of Femur and Tibia in Children Using Elastic Stable Intra Medullary Nailing

Dr. B.L.S. Kumarbabu, Dr. K.Lakshmi Sindhura
Department of Orthopedics, Narayana Medical College & Hospital, India
Department of Orthopedics, Narayana Medical College & Hospital, India
Corresponding Author: Dr. B.L.S. Kumarbabu

Abstract: *In children of age 5 years or less, early closed reduction and application of cast is the ideal treatment for most diaphyseal fractures. In skeletally mature adolescents, antegrade solid intramedullary nail has become the standard treatment. But, the best treatment for children aged between five to sixteen years is still under debate. Compared with younger children, patients in this age group have a high risk of shortening and malunion when conservative measures are used. Other modalities of treatment include external fixation, plates and screws, use of solid antegrade intramedullary nail. However, there are risks of complications, particularly pin tract infection and re-fractures after external fixation or osteonecrosis with solid nails. In the past seven years, fixation with flexible intramedullary nails became popular technique, for stabilizing long bone fractures in school-aged children. ESIN fixation system is a simple, effective and a minimally invasive technique giving stable fixation with rapid healing and prompt return to normal activity. The purpose of this study is to analyze the efficacy of ESIN in treatment of fracture shaft of femur & tibia in children aged between 5 to 16 years with emphasis on technical difficulties and complications.*

This prospective observational study was conducted on 30 children between age 5 to 16 years admitted to the Department of Orthopedics at Narayana Medical College & Hospital, Nellore with diaphyseal fractures of femur or tibia during the period from September 2017 to July 2019. Based on our results, we conclude that ESIN is an ideal method for the treatment of pediatric femoral and tibial diaphyseal fractures. It gives elastic mobility thereby promoting rapid union at fracture site which is ideal for early mobilization, with lower complication rate.

Date of Submission: 17-10-2019 Date of Acceptance: 02-11-2019

I. Introduction

The treatment of paediatric fractures dramatically changed in 1982, when J P Métaizeau and team from Nancy, France, developed this technique of flexible stable intramedullary pinning (FSIMP) using titanium pins. In last two decades, there was a heightened interest in the operative treatment of pediatric fractures, although debate persisted over its indications. ESIN became primary definitive care in paediatric orthopaedic practice which works by three-point fixation principle in the presence of cortical contact & soft tissue envelope. It permits biological healing & callus formation in abundance by minimizing periosteal stripping. The elasticity of the construct allows micromotion at the fracture site, which aids for rapid healing. Many studies have supported this technique, citing advantages that include closed insertion, preservation of the fracture hematoma and a physeal-sparing entry point. The current study aims to observe the union rates and functional outcome of closed reduction and internal fixation of paediatric widely displaced diaphyseal fractures of femur and tibia with TENS & its advantages.

II. Materials & Methods

This prospective observational study was carried out on patients of the Department of Orthopedics at Narayana Medical College & Hospital, Chinthareddypalem, Nellore, Andhra Pradesh from September 2017 to July 2019. A total 30 subjects of both sexes, of age 5-16 years were included in this study.

Study Design: Prospective observational study.

Study Location: This was a tertiary care teaching hospital based study done in the Department of Orthopedics, at Narayana Medical College & Hospital, Chinthareddypalem, Nellore, Andhra Pradesh.

Study Duration: September 2017 to July 2019.

Sample size: 30 patients.

Subjects & selection method: The study population was drawn from children who were admitted to Narayana Medical College & Hospital with diaphyseal fractures of femur or tibia during the period from September 2017 to July 2019. All the children who will be operated during this period are included in the study. The patients were evaluated clinically and radiologically. All the patients were followed up for an average of 6 months. The outcome was assessed using TENS SCORING SYSTEM USED BY FLYNN et al.

Inclusion Criteria:

1. Children of age 5-16 years with diaphyseal fractures of femur and tibia.
2. Children of both the sexes were included in the study.
3. Children with closed fractures.
4. Patients fit for surgery.

Exclusion Criteria:

1. Patients less than 5 years and more than 16 years of age.
2. Patients unfit for surgery.
3. Comminuted and segmental fractures.
4. Open fractures.
5. Fracture involving the distal third of femoral shaft.

Procedure Methodology:

All children between 5-16 years of age with diaphyseal fractures of femur or tibia admitted at NMCH, Nellore - meeting the inclusion and exclusion criteria were subjects for the study. As soon as patient was brought to casualty, patient's airway, breathing and circulation were assessed and complete survey carried out to rule out other injuries. Plain radiographs of AP & lateral views of - thigh including hip & knee joints for femur or leg including knee & ankle for tibia to assess site of fracture, extent of comminution & displacement were taken.

On admission, detailed history taken & examination done, and posted for surgery. Routine preoperative precautions taken.

Intra operative assessment: Diameter of nail is chosen such that each nail occupies at least 1/3rd -40% of the medullary cavity. Pre-operative assessment of nail length done and appropriate nail chosen.

RETROGRADE FIXATION PROCEDURE FOR TENS NAILING OF FRACTURE OF FEMUR

Under anesthesia, patient in supine position, on a radiolucent table, operative extremity is prepped and draped. Physis is identified by fluoroscopy. A skin incision was made over medial and lateral surface of distal femur, 2 cm proximal to distal femoral epiphyseal plate, physeal sparing entry point made using a 3.2 mm drill bit. Nail was introduced with a T-handle, driven across the fracture site, at the same time second nail was advanced to enter proximal fragment, traction was released to avoid any distraction, and both nails were pushed further till the tips became fixed into cancellous bone of proximal femoral metaphysis without reaching the epiphyseal plate. The two-nail construct should be in symmetrical alignment with maximum curvature of nails at the level of fracture. Distally nails were cut leaving only 0.5 - 1 cm outside the cortex, to facilitate removal later on. Nails with similar diameters, are used to achieve double C construct to ensure 3-point fixation.

ANTEGRADE FIXATION PROCEDURE FOR TENS NAILING OF FRACTURE OF TIBIA:

Under fluoroscopy, fracture site & proximal tibial physis are marked. Physeal sparing entry point, sufficiently posterior in sagittal plane to avoid injury to tibial tubercle apophysis after giving a longitudinal skin incision on lateral and medial side of tibia metaphysis. Both nails are inserted and advanced past fracture site, until tips lie just proximal to distal tibial physis. Fluoroscopy is used to confirm fracture reduction & nail position. The nails were cut 0.5-1 cm outside the cortex. Incisions closed in a layered fashion, and wounds padded with gauze.

Routine post-operative was care given to the pati

Assessment was done at 6,12, 24 weeks and at each follow up patients are assessed clinically, radiologically and complications noted.

Statistical Analysis:

Descriptive statistics like numbers, percentages, standard deviations, were used. Data was presented in the form of tables and graphs wherever necessary. Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL).

III. Observation & Results

Table 1 showing the age distribution of the patients studied.

Age in years	Number of patients	%
5-8	16	53.3
9-12	7	23.3
13-16	7	23.3
Total	30	100

Table 2 showing the mode of injury of patients studied.

Mode of Injury	Number of patients	%
RTA	18	60
Self fall	10	33.3
Fall from height	2	6.66
Total	30	100

Table 3 showing the bone affected.

Bone affected	Number of patients	%
Femur	18	60
Tibia	12	40
Total	30	100

Table 4 showing the pattern of fracture.

Pattern of fracture	Number of patients	%
Transverse	11	36.6
Oblique	9	30
Spiral	10	33.3
Segmental	0	0
Comminuted	0	0
Total	30	100

Table 5 showing the duration of surgery in minutes.

Duration of surgery (min)	Number of patients	%
<30	5	16.6
30-60	16	53.3
61-90	7	23.3
91-120	2	6.7
Total	30	100

Table 6 showing the duration of stay in hospital in days.

Duration of stay (days)	Number of patients	%
<7	21	70
8-10	3	10
11-15	4	13.3
>15	2	6.6
Total	30	100

Table 7 showing the time for union.

Time for union	Number of patients	%
</= 12 weeks	23	76.6
12-18 weeks	5	16.6
18-24 weeks	2	6.6
Total	30	100

Table 8 showing time of full weight bearing.

Time of full weight bearing	Number of patients	%
<12 weeks	23	76.6
12-18 weeks	5	16.6
>18-24 weeks	2	6.6

Table 9 showing complications.

	Minor	Major	Nil	Total
No. of patients	10	-	20	30
Percentage	33.3	-	66.6	100

Table 10 showing list of complications.

Complications	Number of cases	Percentage
Infection	1	3.3
Delayed union or nonunion	1	3.3
Limb length discrepancy	2	6.66
Nail backout	1	3.3
Malunion		
a. Varus angulation	2	6.6
b. Valgus angulation	1	3.3
Bursa at tip of nail	2	6.66

The final outcome is based on the above observations done as per Flynn's criteria.

Table 11 showing Flynn's criteria.

Results	Excellent	Satisfactory	Poor
Limb length inequality	< 1cm	< 2cm	>2cm
Malalignment	5 degrees	10 degrees	>10 degrees
Unresolved pain	Absent	Absent	present
Other complications	None	Minor & unresolved	Major & lasting morbidity

Table 12 showing additional variables.

	Excellent	Satisfactory	Poor
Range of movements	Full range	Mild restriction	Moderate to severe restriction
Time for union	8-12 weeks	13-18 weeks	>18 weeks
Full weight bearing	8-12 weeks	13-18 weeks	>18 weeks

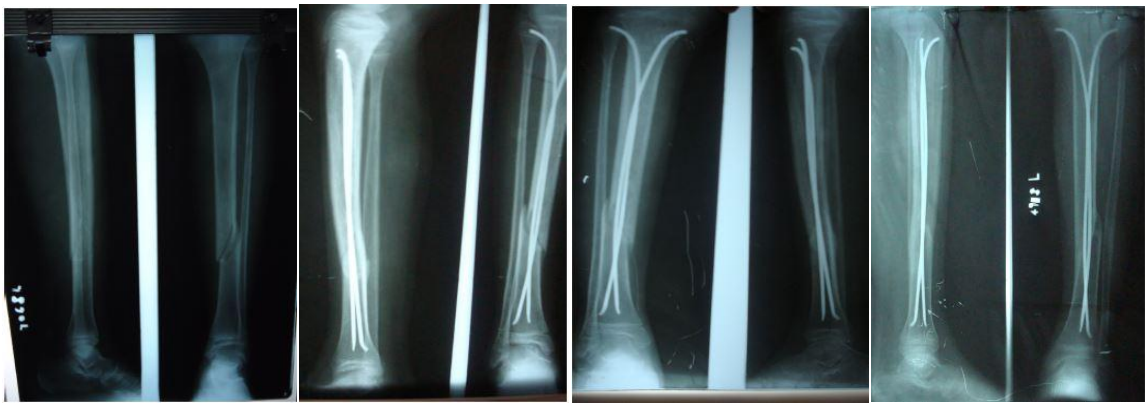
Excellent: when there is anatomical or near anatomical alignment, no leg length discrepancy, no pain.
Satisfactory: when there is acceptable alignment and leg length with mild pain.
Poor: when there is presence of unacceptable alignment or leg length with unresolved pain.

Table 13 showing outcome of treatment.

Outcome	Number of patients	%
Excellent	20	66.67
Satisfactory	10	33.34
Poor	0	0

Table 14 showing outcome of additional variables.

Variables	Excellent (%)	Satisfactory (%)	Poor (%)
Range of movements	86.6	13.3	-
Time for union	76.6	23.3	-
Full weight bearing	76.6	23.3	-



Pre operative Post-op 3 weeks Post-op 6 weeks Post-op 12 weeks

KNEE EXTENSION

KNEE FLEXION

PLANTAR FLEXION

DORSI FLEXION

IV. Discussion

In our study RTA was the most common mode of injury accounting for 18 (60.0%) cases, followed by self fall, 10 (33.3%) cases & fall from height in 2 (6.66%) cases. The average age of study group is 9.03 years. In present study, duration of surgery was < 30 minutes in 5(16.6%) cases, 30- 60 minutes in 16 (53.3%) cases, 61-90 minutes in 7 (23.3%) cases and 91-120 minutes in 2 (6.7%) cases. Among those 2 cases in which duration was more than 90 minutes – one was proximal third femur fracture and other was spiral proximal third femur fracture, extended duration was due to difficulty in reduction & passage of nail across the fracture site. Duration of stay in hospital was 7 days for 21 (70%) patients, 8-10 days for 3 patients (10%), 11-15 days for 4 (13.3%) and more than 15 for 2 (6.6%) patients. The average duration of hospital stay in the present study is 6.6 days. Gross RH, et al conducted a study on management of femoral shaft fractures in children using cast brace. The average length of hospital stay in their study was 18.7 days. Compared to the above study conducted on conservative methods and cast bracing, the average duration of hospital stay was less in our study. The reduced hospital stay in our study is attributed to stable fixation of fracture and less incidence of complications. Average time to union in our study was 10.2 weeks. Aksoy C, et al compared results of fixation with compression plate and flexible intramedullary nailing. Average time to union was 7.7 (4 to 10) months for plating group and 4 (3 to 7) months for nailing group. In our study, closed reduction of fracture, leading to preservation of fracture hematoma, improved biomechanical stability and minimal soft tissue disruption led to a rapid union of fracture compared to compression plate fixation. The average time for full weight bearing in our study was 12.06 weeks. Infection was present in 1(3.3%) case in our study which was controlled by use of antibiotics. All patients had a full range of hip & ankle motion in the present study, 4(13.33%) had mild restriction in knee flexion at 12 weeks, but normal range of knee flexion was achieved at 8 months. Limb length discrepancy is the most common sequelae after femoral shaft fractures in children and adolescents. 2(6.66%) patients had lengthening of the femur. No patient in this study had major limb length discrepancy (i.e. > ± 2cm.) John Ferguson et al noted more than 2cm shortening in 4 children after spica treatment of pediatric femoral shaft fracture. Comparing to conservative methods, limb length discrepancy in our study was within the acceptable limits. 2 (6.7%) patients presented with varus angulation, 1(3.3%) patient presented with valgus angulation. Herndon WA, et al compared the results of femoral shaft fractures by spica casting and intramedullary nailing in adolescents. They noticed varus angulation ranging from 7 to 25° in 4 patients treated with spica casting and no varus angulation in the surgical group. The varus and valgus malalignment that occurred in our study are within the acceptable limits. No patient in our study had a significant rotational deformity. In present study, final outcome was excellent in 20 (66.66%) cases, satisfactory in10 (33.33%) cases and there were no cases with poor outcome.

V. Conclusion

Based on our results, we conclude that ELASTIC STABLE INTRAMEDULLARY NAILING technique is an ideal method for treatment of pediatric femoral and tibial diaphyseal fractures. It is a simple, rapid, minimally invasive, reliable and physeal protective method for management of paediatric femoral and tibial diaphyseal fractures between the age of 5 to 16 years, with shorter operative time, lesser blood loss, less radiation exposure, shorter hospital stay. It gives elastic mobility which promotes rapid union at the fracture site and stability which is ideal for early mobilization. It has lower complication rates & good outcome when compared with other methods of treatment**.** Because of early weight bearing, promoting rapid healing and minimal disturbance of bone growth, ESIN is considered to be a treatment of choice for fixation of these fractures.

References

[1]. Metaizeau JP. [Osteosynthesis in children: techniques and indications] (In French)n*Chir Pédiatr* 1983 ; 69 : 495-511.
[2]. Metaizeau JP. *Osteosynthèse chez l' Enfant: Embrochage Centro Médullaire*m*Elastique Stable.* Sauramps Med Dif - fusion Vigot, Montpellier, 1988, pp 61-102.
[3]. Beaty JH, Austin SM, Warner WC *et al.* Interlocking intramedullary nailing of femoral shaft fractures in adolescents: preliminary results and complications. *J Pediatr Orthop* 1994; 14: 178-183.
[4]. Scheri SA, Miller L, Lively N, Russinof S, Sullivan M Tornetta P III. Et al. 'Accidental and nonaccidental femur fractures in children'. Clin Orthop and Rel Research 2000;376:96-105.
[5]. Momberger N., Stevens P., Smith J., Santora S, Scott S and Anderson J. 'Intramedullary nailing of femoral fractures in adolescents'. J Pediatr Orthop 2000; Vol.20:482-484.
[6]. Lee SS, Mahar AT and Nowton PO. 'Ender nail fixation of pediatric femur fractures. A biomechanical analysis'. J Pediatr Orthop 2001; Vol. 21: 442-445.
[7]. Ligier JN., Metaizeau JP., Prevot J. and Lascombes P. 'Elastic stable intramedullary nailing of femur fracture in children'. J Bone & Joint Surg (Br) 1988; Vol 70B: 74-7.
[8]. Heinrich SD., Drvaric DM., Karr K. and Macevan GD. 'The operative stabilization of pediatric diaphyseal femur fractures with flexible intramedullary nails. A prospective analysis'. J pediatr Orthop 1994 Vol. 14: 501-507.
[9]. Kasser JR. and Beaty JH. 'Femoral shaft fractures'. In: Beaty JH. And Kasser JR eds. Rockwood and Wilkin's fractures in children. 5th edition, Philadelphia, Lippincott, Williams and Wilkins, 2001: 941-980pp.
[10]. Flynn JM, Hresko T, Reynolds RA, Blasier RD, Davidson R, Kasser J (2001) Titanium elastic nails for pediatric femur fractures—a multicenter study of early results with analysis of complications. J Pediatr Orthop 21(1):4–8
[11]. Gross RH. Davidson R., Sullivan JA., Peeples RE. And Hufft R. 'Cast brace management of the femoral shaft fracture in children and young adults'. J Pediatr Orthop 1983; 3 (5): 572-582.
[12]. Bar-on E, Sagiv S. and Porat S. 'External fixation or flexible intramedullary nailing for femoral shaft fractures in children'. J Bone Joint Surg (Br) 1997; 79-B: 975-8.
[13]. Greisberg J., Blisss MJ., Eberson CP., Solga P and d'Amato C. 'Social and economic benefits of flexible intramedullary nails in the treatment of pediatric femoral shaft fractures'. Orthopedics 2002; 25(10): 1067-70.
[14]. Aksoy C., Caolar O., yazyoy M and Surat A. 'pediatric femoral fractures A comparison of compression plate fixation and flexible intramedullary nail fixation'. J Bone & Joint Surg (Br) 2003;85-B: Supp III: 263 pp.
[15]. S.Terry Canale, James H.Beaty. Campbell's operative Orthopaedics. (2007) 11:23.
[16]. Robert W.Bucholz, James D.Heckman, Charles Court –Brown. Rockwood and Wilkins's fractures in children. 7th edition.
[17]. Ferguson J, and Nicol RO. 'Entry spica treatment of pediatric femoral shaft fractures'. J Pediatr Orthop 2000; 20: 189-92.
[18]. Flynn JM., Luedtke LM., Ganley TJ. Et al. 'Comparison of titanium elastic nails with traction and a spica cast to treat femoral fractures in children'. J Bone and Joint Surg 2004; Vol. 86-A (4) :770-7.
[19]. Herndon WA., Mahnken RF., yngve DA. And Sullivan JA. 'Management of femoral shaft fractures in the adolescent'. J Pediatr Orthop 1989, 9(1): 29-32.

Dr. B.L.S. Kumarbabu. "Management of Diaphyseal Fractures of Femur and Tibia in Children Using Elastic Stable Intra Medullary Nailing." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 10, 2019, pp 34-39.