ORIGINAL ARTICLE

Our experience of open tibial shaft fractures treated by intra-medullary flexible nailing in paediatric age group

Waqar Alam, Faaiz Ali Shah, Vickash Kumar

Received:
31st August, 2018

Accepted:
16th October, 2018

Abstract

Objegctive: To determine the radiological and functional outcome of open tibial fractures treated with flexible intra-medullary nails in children.

Study design: Descriptive case series.

Place and duration of study: Department of Orthopedics and Trauma District Headquarter Hospital Timergara Dir Lower, Pakistan and Department of Orthopedics and Trauma, Medical Training Institution, Lady Reading Hospital Peshawar, Pakistan from March 2015 to August 2018.

Material and methods: All children with open tibial fracture meeting the inclusion criteria had intra-medullary flexible nail fixation under image intensifier. Post-operative results were evaluated with Flynn's scoring system and graded as excellent, satisfactory and poor.

Results: A total of 43 children with mean age 8.6(range 5-14)years were included in our study. Males were 29(66.4%) while female were 14(32.5%). Right leg was fractured in 24(55.8%) patients and left in 18(41.8%). All the children had intra-medullary flexible nailing under image intensifier with the same standard surgical technique. Post-operative results evaluated with Flynn's criteria produced excellent results in 36(83.7%) patients and satisfactory in 7(16.2%) patients. Superficial wound infection was documented in 8(18.6%) patients. No major complication was reported.

Conclusion: Flexible intra-medullary nailing of open tibial fractures in children produced excellent radiological and functional results in majority of our patients. We therefore, recommend flexible intra-medullary nails as implant of first choice to stabilize open tibial fractures in children.

Keywords: Open tibial fractures, intra-medullary nail, Titanium Elastic Nails(TENS), Flynn's criteria.

District Head Quarter Hospital, Temargarah, Lower Dir, Pakistan
W Alam

Lady Reading Hospital, Peshawar, Pakistan
FA Shah

South City Hospital Karachi, Pakistan
V Kumar

Correspondence:
Dr. Faaiz Ali Shah, Assistant Professor Orthopaedics, Department of Orthopaedics & Traumatology, Lady Reading Hospital, Peshawar, Pakistan
Cell: (+92)334-9125394
Email: faaizalishah@yahoo.com

Introduction:

Paediatric injuries are one of the common cause of mortality world wide. In Pakistan childhood injuries are a major burden on our health care services and accounts for major morbidities and mortalities in our country.[1,2] Tibial fractures accounts for 10 to 25% of all paediatric injuries.[3] Fractures of the radius ulna and femur are the first two common paediatric fractures followed by the third common fracture of tibia. Distal third tibia fracture is the most common location followed by midshaft and proximal third.[4] The management of open fractures of the tibia in a pediatric population remains a complex and challenging problem. Traditionally, open tibia fractures in children have been managed with closed reduction and casting techniques following irrigation and debridement. With increasing advances in pediatric sedation and anesthesia, wound care and antibiotics and a large variety of implants available for both internal and external fixation of these fractures, one would think that the approach to treatment of these fractures would have trended towards fixation in more recent years. In reality, only type II fractures have seen a significant change in treatment pattern

over the course of time, and the change has been increasingly to treat these fractures in a closed fashion (pins and plaster or casting after irrigation and debridement). Interestingly, data from several studies investigating open tibia fractures in children have low numbers and often do not have enough power to make meaningful conclusions.[5] Although some clinicians purport that these injuries may behave similarly in children and adults, others feel that these injuries are better tolerated in children, particularly young children.[6] Open tibial fractures are usually treated with external fixators but pin tract infection and scaring has resulted in alternative treatment options like flexible intra-medullary nails.[7] The advantages of these implants include shorter hospital stay, early mobility and least complication rate.[8] Flexible intra-medullary nail fixation is done with minimum surgical trauma in closed manner without any special equipments except image intensifier. The nails achieve three point fixation inside the medullary cavity thus maintaining length, alignment and prevents rotations. Callus formation at the fracture side is produced by the controlled motion at the fracture ends.[9]

Previously open tibial fractures were treated with external fixator or plaster of paris cast with window at the fracture site in our setup. These modalities of treatment were associated with complications like pin tract infection, deformity and joint stiffness. We started fixing open tibial fratures with flexible intra-medullary nails and received excellent results. The objective of this study was to evaluate the radiological and functional outcome of open tibial fractures treated with flexible intra-medullaray nails in children. The results of our study will help us in formulation of a standard protocol for treatment of paediatrictibial fractures in our institutions.

Material and Methods:

This multi-center descriptive study was conducted at Department of Orthopedics and Trauma DHQH Timergara Dir Lower, Pakistan and Department of Orthopedics and Trauma, Medical Training Institute, Govt. Lady Reading Hospital Peshawar, Pakistan from March 2015 to August 2018. The research protocols were approved by the Institutional Review Boards of the hospital before the commencement of the study. All children with open tibial fractures Gustillo Anderson type I, II and IIIA received within 72 hours of fractures were included. Pathological fractures, fractures with bone loss, fractures with intraarticular extension and poly trauma children requiring intervention for head injury, abdomen and thorax were excluded. Informed written consent for surgery and research and publication was taken from the parents of the children. The admitted children were resuscitated according to the ATLS protocols in the Accident and Emergency Department. The wound was examined and X-ray of the involved limb was taken and fracture classified according to the Gustillo Anderson classification of open tibial fractures.The fractures were initially temporarily splinted with a back slab and prepared for surgery.

Surgical Technique: All patients were operated under general anesthesia in the supine position on a radiolucent operating table. Tourniquets were not applied on any patient. Pre-operative antibiotics (Cefuroxime 1.5gm) was given to all the patients according to their age and weight. Wound debridement was performed on open fractures and the accompanying soft tissue injuries. The fracture line was visualized under fluoroscopy. The entry site was determined to be 2cm distal to the proximal physis of the tibia and caution was exerted not to injure the tibial apophysis. Two longitudinal incisions measuring 2cm on the medial and lateral sites of the tibia were performed. The fracture was reached bluntly with the aid of a haemostatic clamp. Two Titanum Elastic Nails(TEN) of equal thickness were selected to occupy 40% of the medulla that was defined pre-operatively. The cortex was penetrated with a drill 0.5cm thicker than the selected implants. Both wires were forwarded until they reached the fracture line. Following reduction, which was performed under fluoroscopy, the first wire was forwarded to pass beyond the fracture line. After checking the distal tibia by fluoroscopy in the lateral and antero-posterior plane for the first wire, the second wire was introduced similarly if the position of the first one

Table-1: Flynn's scoring system

Results	Excellent	Satisfactory	Poor
Leg length discrepency	<1cm	<2cm	>2cm
Pain	mild	moderate	severe
Angulation	<5 degrees	<10 degrees	>10 degrees
Complications	None	minor and treatable	Major with remaining morbidity

was deemed appropriate. Afterwards, fluoroscopy controls were performed in both planes again.

Result:

Wires were cut 1.5 cm away from the bone surface. Long leg splints were applied, which stayed in place for 2 weeks post-operatively. All patients were encouraged to walk on the first post-operative day without weight bearing. Full weight bearing was postponed until full union (when the bridge formed by callus tissue in all three cortices was observed). Flexible nails were removed after four to six months in most cases. Patients were advised for Follow up visits at 2,4,6,8,10,12 and 16th weeks and radiological and functional outcome evaluated with Flynn's criteria.[10] (table I) All data was entered into SPSS(Version 21) for statistical analysis. Categorical variables like fracture type, side of fracture and gender was represented as frequency and percentage while mean was calculated for numerical variables like age.

A total of 43 patients were included in this study who presented with open tibial shaft fractures. Age range was from 5 to 14 years and mean age was 8.6 years. There were 29(66.44%) boys and 14(32.55%) girls. Right leg was involved in 24(55.81%) patients, left side was involved in18(41.86%) patients while 1(2.33%) patient had got fracture of both legs and results were evaluated for 44 cases instead of 43. Tibia alone was fractured in 17(38.64%) patients and both tibia and fibula were fractured in 26(60.4%) patients. 21(48.83%) patients had history of road traffic accident, 13(30.23%) had history of fall, 6(13.95%) had sports injury while 3(6.98%) had direct trauma to leg as etiological factors for these fractures. Gustillo Anderson type I fractures were present in 7(16.2%) patients, type II in 11(25.5%) patients, type IIIA in 17(39.5%) and type IIIB in 8(18.6%). Fracture pattern was different i.e. transverse, oblique or spiral, fragmentary and comminuted in 23(53.4%), 8(18.6%), 7(16.2%) and 5(11.6%) patients respectively. Location was distal 1/3 in 17(39.5%) cases, central 1/3 in 15(34.8%) cases and proximal 1/3 in 11(25.5%)patients. Post surgical outcome was evaluated according to Flynn's criteria and majority (81.82%, 36) of the children had excellent outcome while 8(18.18%) children had satisfactory results. Poor results were not recorded. Mean union time was 9.4 weeks(range 6-11 weeks)Mean degree of angulation was 3.5 degrees in sagittal plane and 4.5 degrees in coronal plane. Varus angulation was 4 degrees in one(2.3%) patient while valgus angulation was 5° in 3(6.9%) patients. Skin irritation was reported in many patients(51.1%, 22) however wire removal was not considered in any of our case. Superficial wound infection was seen in 8(18.6%) patients who were treated successfully with antibiotics and no second intervention was needed in any of our case. No deep wound infection or significant angulation or leg length discrepancy was noted in any of our patient. Mean hospital stay was 7 days (range 3-14 days). No non union or mal union was noted in our study. No in hospital mortality was reported.

Discussion:

Pediatric trauma is a common problem throughout the world. Tibial fractures are the third most common pediatric long-bone fracture after forearm and femoral fractures. Approximately 50% of pediatric tibial fractures occur in the distal third of the tibia. This is followed by midshaft-tibial fractures (39%), and least commonly, the proximal third of the tibia is involved.[11] The frequency of open tibial fractures in children is 9%.[12] Tibial fractures in the skeletally immature patient canusually be treated without surgery but tibial fractures resulting from high energy traumas are of special importance considering type of the selected treatment method affecting the children future.[13] Open tibial fractures are usually associated with sever soft tissue injuries which make them susceptible to infection

and no universal standard treatment is recommended.[14] Paediatric tibial fractures have been treated with flexible intra-medullary nails with good results.[15] Although open tibial fractures are traditionally treated with simple external fixator but the complication rate of this device is higher than intra-medullary nails. Infection, shortening, deformity and refracture have been reported with external fixator.[16] Unfortunately we could not find enough studies in literature addressing open tibial fractures in children stabilized with intra-medullary flexible nails.[17] In our study we documented excellent results in most of our cases treated with intra-medullary flexible nails after thorough debridement and wound irrigation. Although the most frequent complication we noted was irritation at nail entry site but it was of less severity and no patient went through removal of nails due to this complication. Deakin[18] studied thirty-five adolescent patients who underwent flexible intra-medullary nails for tibia and noted no non-union but the union time was higher than our study. Another study by Allamshetla[7] showed that flexible fixation is an easy and effective method of management of both open and closed unstable fractures of the tibia in children. In his study, the average time of union in intra-medullary nail was 10 weeks and the major complications were residual angulation of the tibia, leg-length discrepancy, deep infection and failures of fixation. Unlike his study, such complications were not observed in our patients, and our union time was shorter. The sample size of our study was small and the design was descriptive. We therefore, recommend randomized controlled trials with a larger sample size to confirm our results.

Conclusion:

Flexible intra-medullary nailing of open tibial fractures in children produced excellent radiological and functional results in majority of our patients. It has a very low complication rate. Children have good compliance and are mobilized early. We therefore, recommend flexible intra-medullary nails as implant of first choice to stabilize open tibial fractures in children.

Conflict of interest: None

Funding source: None

Role and contribution of authors

Dr. Waqar Alam, conception and design.

Dr. Faaiz Ali Shah, data collection, Interpretation, and final approval of the study for publication.

Dr. Vickash Kumar, revised the article critically for important intellectual content.

References:

1. Norton R, Kobusingye O. Injuries. N Engl J Med 2013; 368:1723.
2. RehmaniR.Childhood injuries seen at an emergency department. J Pak Med Assoc 2008; 58(3): 114-118.
3. Landin LA. Epidemiology of children's fractures. J PaediatrOrthop B 1997;6:79-83.
4. Settera KJ, Palominob KE. Pediatric tibial fractures: Current concepts. CurrOpinPediatr. 2006; 18:30-5.
5. Keith D. Baldwin, Oladapo M. Babatunde, G. Russell Huffman, and Harish S. Hosalkar. Open fractures of the tibia in the pediatric population: A systematic review. J Child Orthop. 2009 Jun; 3(3): 199-208.
6. Jones BG, Duncan RD. Open tibial fractures in children under 13 years of age-10 years' experience. Injury 2003; 34(10):776–780.
7. Vallamshetla VR, De Silva U, Bache CE, Gibbons PJ. Flexible intramedullary nails for unstable fractures of the tibial in children. An eight-year experience. J Bone Joint Surg Br 2006;88(4):536-40.
8. Pandya NK, Edmonds EW. Immediate intramedullary flexible nailing of open pediatric tibial shaft fractures. J PediatrOrthop 2012;32(8):770-6.
9. Wiss DA, Segal D, Gumbs VL, Salter D. Flexible medullary nailing of tibial shaft fractures. J Trauma 1986 Dec;26(12):1106-12.
10. Flynn JM, Hresko T, Reynolds RA, Blasier Rd, Davidson R, KasserJ.Titanium elastic nails for pediatric femur fractures a multicenter study of early results with analysis of complications. J PediatrOrthop 2001;21:4-8.
11. Settera KJ, Palominob KE. Pediatric tibial fractures: Current concepts. CurrOpinPediatr 2006;18:30-5.
12. Beaty J, Kasser JR. Rockwood and Wilkins' Fractures in Children. Philadelphia, PA, USA: Lippincott; 2001.
13. Mashru RP, Herman MJ, Pizzutillo PD. Tibial shaft fractures in children and adolescents. J Am AcadOrthopSurg 2005;13(5):345-52.
14. Shannak AO. Tibial fractures in children: Followup study. J PediatrOrthop 1988;8:306-10.
15. Vallamshetla VR, De Silva U, Bache CE, Gibbons PJ. Flexible intramedullary nails for unstable fractures of the tibial in children. An eight-year experience. J Bone Joint Surg Br 2006;88(4):536-40.
16. Evanoff M, Strong ML, MacIntosh R. External fixation maintained until fracture consolidation in the skeletally immature. J PediatrOrthop 1993;13:98-101.
17. Aslani H, Tabrizi A, Sadighi A, Mirblok AR. Treatment of open Pediatric tibial fractures by external fixation versus flexible intramedullary nailing: A Comparative Study. Arch Trauma Res 2013 Dec; 2(3): 108-112.
18. Deakin DE, Winter H, Jain P, Bache CE. Malunion following flexible intramedullary nails for tibial and femoral fractures in adolescents. J Child Orthop 2010;4(6):571-7.