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Joshi's external stabilization system in the management of distal tibial and fibular fractures with associated soft tissue injury in children

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ABSTRACT

Background: Injuries around ankle and distal third of tibial shaft are among common paediatric bone trauma. Some of these cases are associated with soft tissue injury over the lower third of leg or around the ankle joint as tibia is subcutaneous on the anteromedial aspect. This study was conducted to know the outcome of these injuries with minimal invasive external fixation.
Methods: Eleven patients in the age group of 4-14 years were included in this study. All patients had closed fracture of distal third tibial shaft or injury of distal tibial physis with associated soft tissue injury. Joshi's external stabilization system was used to retain the reduction of fracture and appropriate wound care was taken. JESS was removed after radiological signs of fracture union.
Results: Patients were followed up for mean period of 8.9 month. After JESS fixation healing of wound occurred at an average of 12.45 day and external fixator was removed at 6-8 weeks period. Three patients had grade 1 pin tract infection which was controlled by local dressing. No patient had stiffness of ankle at the time of JESS removal. No limb length discrepancy was seen in any of the patients in this study at their final follow up.
Conclusions: JESS gives good results in fractures of distal tibial with associated soft tissue injury. It helps in better management of wound and fracture stabilization.

Keywords: Distal tibial fracture, Epiphysis, Soft tissue injury, External stabilization

INTRODUCTION

Tibial and fibular shaft fractures are the third most common among long bones in children contributing up to 15% after radial/ulnar and femoral fractures.[1] Fifty to 70% of these fractures occur in distal third of tibia.[2] In children from 1 to 4 years of age group bicycle spoke injuries to tibia are common, whereas 4 to 14 years of age are due to sports and road traffic accidents.[2] Nine percent of fractures of tibia in children are open.[2]

These fractures are most commonly associated with concomitant fractures of the ankle. Fractures of the tibia constitutes up to 10-15% of all fractures in children and are also most common lower limb fractures in paediatric age group.[3]

Distal tibial and fibular physeal injuries account for 25% to 38% of all physeal fractures and are second most common to get injured among growth plate injuries.[4,5] Poland in his monograph (1898) pointed out that forces which result in ligament injury in adults causes fractures of the physis in children as ligaments are stronger than the physeal cartilage.[2] Distal tibial physeal fractures are classified according to Salter-Harris anatomical classification.

Closed fractures of tibial shaft in children are usually treated by non-operative methods. Open fractures and fractures with associated soft tissue injury requires operative fixation of fracture for proper wound care.[2] Distal tibial and fibular physeal fractures require accurate reduction and fixation to avoid future growth disturbance.

The aim of this study is to assess the role of Joshi's external stabilization system (JESS) in the management of these fractures associated with soft tissue injury

METHODS

From December 2013 to January 2016, 11 children with injury to the distal tibia and fibula with associated soft tissue injury were surgically managed by JESS. Institutional ethical committee clearance was taken for this study. All patients presented to emergency department with history of trauma to leg and associated wound over the ankle region. Patients were initially stabilized in the casualty department and radiograph of the involved leg was ordered after cleaning and dressing of the wound.

Patients below the age of 18 years with fractures of the distal third tibia and fibular shaft or distal tibial and fibular physeal injury with associated soft tissue injury over the fracture site were included in this study. Closed fractures of shaft of both bones of leg and closed undisplaced fractures of distal tibial and fibular physis without soft tissue injury and patients above 18 years of age were not included in the study.

Relevant patient data was collected after taking informed consent to participate in the study from the parent/guardian of the child. Surgical procedure and wound care process was explained to the attendant of the patient. Radiographs of all the patients were assessed for the fracture site, amount of displacement and type of growth plate injury in ankle fractures. Ankle fractures were classified according to Salter-Harris anatomic classification of physeal fractures.[6]

Patients were taken for surgery within 24 hours of injury after getting clearance from the paediatrician and anaesthetist. Under spinal anaesthesia thorough debridement and irrigation of the wound was performed. Fractures of the distal tibial metaphysis were reduced under image intensifier guidance and stabilized with two kirschner wires (K-wire) of 1.5 mm to 3 mm size both in the proximal and distal fragments as shown in Figure 1. During the surgery care was taken to avoid the wires passing through the injured soft tissue or wound. These wires were interconnected with JESS connecting rods on either side using JESS clamps. Patients with distal tibial physeal injury were also fixed with smooth pins or K-wires after accurate reduction of the fracture fragments under image intensifier. One or two K-wires were passed through the distal tibial epiphysis and physis up to the opposite cortex of metaphysis depending on the fracture pattern as given in Figure 2. Unstable fractures of the fibula after fixation of the tibia were fixed with an intramedullary K- wire. No fixation was done for stable fibular fractures.

In the postoperative period ankle movements were encouraged from day one. Appropriate antibiotics were given by intravenous route. Proper care of the wound and pin tracts were done to avoid infection. Radiographs were taken at 1 week, 3 weeks, and 6 weeks to see the fracture union and retention of reduction. After healing of the wound patients were encouraged partial weight bearing with JESS at 4 weeks or as the pain allowed. JESS was removed after radiological union of the fracture and care of pin tract wound was taken till they healed. Post JESS removal patients were followed up at 3 months and 6 months.

Figure 1: Distal tibial metaphyseal fracture with wound.
A) Pre-op, B) Post-op X-ray (C) Clinical picture of initial wound & (D) Healed wound, (E&F) After JESS removal.

Figure 2: Salter-Harris type II injury with wound managed by JESS.
a) Pre-op & b) Post-op X-ray, c) Clinical picture of healed wound, d) X-ray after JESS removal.

Data analyzed for type of fracture, wound healing period, duration of fracture union and complications.

RESULTS

This study included 11 patients aged between 5-14 years. All the patients had fractures of distal tibial metaphysis or epiphysis and distal fibula with soft tissue injury over lower part of leg and ankle joint. All the patients were managed by JESS apparatus after closed reduction of fracture with appropriate frames. Average age of the study population was 9.27±3.03 year. Males were predominant in this study with road traffic accident (RTA) being the frequent cause of injury. Four patients had fracture of distal metaphysis of the tibia and other seven had distal tibial physeal injury. No patients had any neurovascular injury. Other demographic data of the patients are as given in Table 1.

Table 1: Demographic data of the patients.

Variables	Number (%) (n=11)
Mean Age ± SD	9.27±3.03 year
Sex of the patients	
Male	8 (72.72%)
Female	3 (27.27%)
Fractures operated	
Right side	6 (54.54%)
Left side	5 (45.45%)
Mode of injury	
Road traffic accident	6 (54.54%)
Fall from height	4 (36.36%)
Fall of weight on leg	1 (9.09%)
Fracture type (distal tibial physis)	
Salter-Harris type 2	6 (54.54%)
Salter-Harris type 3	1 (9.09%)
Distal tibial metaphysis fracture	4 (36.36%)

Table 2: Results of JESS.

Variables	Mean ± SD	Range
Duration of wound healing	12.45 ± 3.88	6-21 Days
Partial weight bearing	5.09 ± 0.7	4-6 Weeks
JESS removal	6.63 ± 0.8	6-8 Weeks
Full weight bearing	7.09 ± 0.94	6-9 Weeks

Patients were followed up for an average of 8.9±2.38 months (6-12 months). Duration of wound healing ranged between 8-21 days in these patients with an average of 12.45 day. Time at which partial weight bearing was started ranged from 4 weeks to 6 weeks. JESS fixation was removed at an average of 6.63 week and full weight bearing was started at an average of 7.09 week as shown in Table 2. All the patients had radiological union at the time of full weight bearing. Three patients had grade-1 pin tract infection which healed with local care. No patients in the study had limb length discrepancy at their final follow up which ranged from 6 months to 12 months. All the patients had normal range of ankle movements after removal of the JESS.

DISCUSSION

Fractures around the ankle and distal third tibial shaft are common in pediatric age group. Incidence of distal tibial fibular physeal injuries account for 25-38% of all physeal fractures.[4] Another study reported that ankle fractures in children account for 5% of pediatric fractures and 15% of physeal injuries.[6] Physeal injuries are more common than ligament injuries in pediatric age group as ligaments are stronger than open physis.[6] Almost up to 58% of these distal tibial and fibular physeal injuries occurred during sports activities.[7,8] Incidence of physeal ankle fractures is more in male than in females.[9] Commonest age group for tibial physeal fractures is around 8-15 years.[9] Schurz et al found that an adduction trauma to the ankle being the common cause of injury followed by abduction trauma.[10]

Distal tibial physeal injuries require appropriate treatment otherwise which could lead to deformities and limb length discrepancy. Incidence of growth abnormalities is high in Salter-Harris type III and IV injuries and less in type II fractures.[9] Damage to the proliferative layer of cells in the growth plate may occur due to fracture passing through the physis in type III and IV lesions with high risk of growth disturbences.[11] Distal tibial physeal injuries require an absolute anatomical reduction by closed or open technique to decrease the rate of epiphysiodesis and related problems.[11]

Operative treatment is recommended in unstable fractures of distal tibial metaphysis and physis or when these fractures are associated with soft tissue injury.[2] When these fractures are associated with soft tissue injury over the lower part of leg and ankle, appropriate wound care becomes difficult task with plaster cast. External Fixator serves both the purposes of fracture stabilization and soft tissue healing with minimal added trauma to the initial injury. JESS can be used these children with convenient frames according to the fracture stability and type and stiffness of the JESS can be adjusted depending on the K-wire size used.[13] In elder children the axial stability of the JESS can be increased by using thicker K-wires. In JESS as we are using smooth pins in the bone, these can be passed through the physis and connected to the frame to give stable fixation to fracture.

In literature closed reduction and cast application of closed distal tibial fractures and management of open fractures by internal or external fixation is discussed in detail. Not much of literature available on distal tibial fractures with soft tissue injury. Our study was conducted to see the results of these fractures managed with minimal invasive external fixation with JESS. Wound healing is better with JESS fixation and soft tissue injuries resolve faster in these patients. Stiffness of the nearby joints does not occur as we can mobilize the joints earlier. Partial weight bearing can be started along with

the JESS frame after callus becomes visible on radiograph and as pain allows. It is a cost effective treatment option in these patients where non operative treatment or internal fixation becomes difficult. As follow up period in our study is of short duration we could not comment on the limb length discrepancy in our patients. Further studies with similar treatment and longer duration of follow up are required to assess the long term outcome of JESS in these fractures.

CONCLUSION

Our study results shows fractures of the distal third tibial shaft and distal tibial physis with associated soft tissue injury can be well managed by JESS. In these patients who cannot be managed by cast application, JESS helps in the wound care and fracture stabilization without affecting the fracture healing process.

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REFERENCES

1. Shannak AO. Tibial fractures in children: follow-up study. J Pediatr Orthop. 1988;8:306-10.
2. Mooney JF, Heinrich SD. Fractures of the Shaft of the Tibia and Fibula. Cummings RJ, Shea KG, Distal Tibial and Fibular Fractures. In: Beaty JH, Kasser JR, eds. Rockwood and Wilkins Fractures in Children. 7th Edition. Philadelphia: Lippincott Williams & Wilkins; 2010: 930-1014.
3. Santili C, Gomes CMO, Akkari M, Waisberg G, Braga SR, Lino Junior W, et al. Tibial diaphyseal fractures in children. Acta Ortop Bras. 2010;18(1):44-8.
4. Hynes D, O'Brien T. Growth disturbance lines after injury of the distal tibial physis. Their significance in prognosis. J Bone Joint Surg Br. 1988;70(2):231-3.
5. Peterson CA, Peterson HA. Analysis of the incidence of injuries to the epiphyseal growth plate. J Trauma. 1972;12(4):275-81.
6. Kay RM, Matthys GA. Pediatric Ankle Fractures: Evaluation and Treatment. J Am Acad Orthop Surg. 2001;9:268-78.
7. Goldberg VM, Aadalen R. Distal tibial epiphyseal injuries: the role of athletics in 53 cases. Am J Sports Med. 1978;6(5):263-8.
8. Zaricznyj B, Shattuck LJ, Mast TA, et al. Sports-related injuries in school-aged children. Am J Sports Med. 1980;8(5):318-24.
9. Spiegel PG, Cooperman DR, Laros GS. Epiphyseal fractures of the distal ends of the tibia and fibula. A retrospective study of 237 cases in children. J Bone Joint Surg Am. 1978;60(8):1046-50.
10. Schurz M, Binder H, Platzer P, Schulz M, Hajdu S, Vécsei V. Physeal injuries of the distal tibia: long-term results in 376 patients. International Orthopaedics (SICOT). 2010;34:547-52.
11. De Sanctis N, Della Corte S, Pempinello C. Distal tibial and fibular epiphyseal fractures in children: Prognostic criteria and long term results in 158 patients. J Pediatr Orthop. 2000;9:40–4.
12. Buckley SL, Gotschall C, Robertson W, Sturm P, Tosi L, Thomas M, et al. The relationship of skeletal injuries with trauma score, injury severity score, length of hospital stay, hospital charges, and mortality in children admitted to a regional pediatric trauma center. J Pediatr Orthop. 1994;14:449-53.
13. Kumar R, Gupta RC, Mishra S. Stiffness Characteristics of Joshi's External Stabilization System under Axial Compression: a Finite Element Method Based Study. Int. Journal of Engineering Research and Applications. 2014;4(7):43-7.

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