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RESULTS OF TITANIUM ELASTIC NAILING IN PAEDIATRIC TIBIAL SHAFT FRACTURES

Orthopaedics

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ABSTRACT

Aims and objectives: To evaluate the results of treatment of paediatric tibial diaphyseal fractures with titanium elastic nails(TENs).
Materials and methods : 25 tibial fractures treated with TENs were followed-up for 15 to 24 months.
Results : The fractures united in an average time period of 85 days ; 89% had united within 3 months. The nails were removed in 87.8% of cases after an average of 5.9 months. Soft tissue and skin problem (9.1%) in relation to nail ends at the entry points was noted.
75.8% of the results were excellent, 24.2% were satisfactory and there were no poor results.
Conclusions : With good knowledge of the technique of TEN fixation for paediatric tibial fractures, excellent and satisfactory results were achieved in all cases, with few minor complications.

KEYWORDS

titanium elastic nail ; paediatric tibial fractures.

INTRODUCTION

Treatment of paediatric fractures dramatically changed in 1982, when Métaizeau and the team from Nancy, France, developed the technique of flexible stable intramedullary pinning (FSIMP) using titanium pins [18,19]. In the last two decades there was an increased interest in the operative treatment of paediatric fractures, although debate persisted over its indications [1]. There is a little disagreement concerning the treatment of long bone fractures in children less than 6 years (POP cast) and adolescents older than 16 years (locked intramedullary nailing). Controversy persists regarding the age between 6 to 16 years, with several available options : traction followed by hip spica, external fixation, flexible stable intramedullary nails (Ender or titanium), plate fixation, and locked intramedullary nailing[2,3,5,16,26].

Whatever the method of treatment, the goals should be to stabilise the fracture, to control length and alignment, to promote bone healing, and to minimise the morbidity and complications for the child and his/her family [20,25].Orthopaedic surgeons will continue to be challenged to treat this age group with less morbidity at a lower cost, as no clear guidelines have been available until now despite efforts done initially by French surgeons, later on by European surgeons and recently by the Paediatric Orthopaedic Society of North America (POSNA) [1,2,6,9,15,17-19,24,30]. Titanium elastic nail (TEN) fixation was originally meant as an ideal treatment method for femoral fractures, but was gradually applied to other long bone fractures in children, as it represents a compromise between conservative and surgical therapeutic approaches with satisfactory results and minimal complications [2,6,9,15,18,19,24,30].

MATERIALS AND METHODS

This study was designed as a prospective clinical study to assess the results of operative treatment of 25 paediatric tibial fractures treated in our institute between july 2016-august 2019. Inclusion criteria were age above 5 years and below 16 years with traumatic closed or open tibial fractures at mid-shaft and junctional upper-middle third or lower-middle third. Patients with extreme proximal or distal tibial fractures closer to the epiphyseal plate and patients with grade III C open tibial fractures were excluded from the study. Patients with incomplete clinical and/or radiological data, patients with pathological fracture, and patients with follow-up less than one year were also excluded from the study.

25 patients with tibial diaphyseal fractures were included in this study. There were 18 males and 7 females. Mean age at time of injury was 9.4 years (range : 5.2 to 15.3 years). 17 fractures resulted from a road traffic accident and 8 from fall from height . 20 patients had closed fracture and 5 had open grade-1 fracture. The fractures were midshaft in 47.9% of cases. The most common fracture pattern was transverse or oblique .Most fractures (56.1%) were operated between two and four days after injury. All nails were inserted using the antegrade technique. Two TENs were used in all cases using the double-C construct in antegrade fashion . All nails were inserted on an ordinary operating table with full access to image intensifier. 1 cm incision is made over the lateral aspect of the leg below the proximal tibial epiphysis. Entry was taken using an entry awl and nail is inserted. Similarly 1 medial nail was inserted in the same fashion from the medial aspect. Both the nails pass through the medullary cavity upto the distal tibia and end slightly above the distal tibia epiphysis. Cases with tibial fracture associated with distal 1/3 fibular fracture were also fixed with antegrade TENs for the fibula before TENs fixation of the tibial fracture. Depending on the age of the patient, patient compliance, fracture patterns, and quality of fixation, postoperative immobilisation with a slab was given for a period of 3 weeks Special records were kept for every patient with all details related to the patient, the fracture, the surgical treatment, the postoperative evolution including complications such as malunion or limb-length discrepancy and pain. All patients were followed-up clinically every 2 to 3 weeks to observe knee and ankle range of motion and any complications till complete bone healing and then every 3 months till the end of the follow-up period, which was at least 12 months. Radiological follow-up included full-length anteroposterior and lateral radiographs at every clinic visit to check alignment, any loss of reduction and bone healing. The TENs were removed after clinical and radiological union.

Pre-operative radiograph **Post-operative radiograph**

RESULTS

Most fractures (56.1%) were operated between the second and the fourth day after admission.

All nails were inserted using the antegrade technique . All nails were inserted in a closed fashion under fluoroscopy guidance The average operative time for nail insertion was 28 minutes with a range of 15 to 75 minutes. The average hospital stay was 5.7 days with a range of 2 to 28 days. All patients were given postoperative immobilisation using a slab.

Most of the fractures united within 3 months (89%), and only 4.1% required 5 months to unite. Mean time to bone healing was 85 days, with a range between 42 to 140 days. The TENs were removed in 87.8% of patients, on average 5.9 months after operation (range, 3 to 9 months). Soft tissue irritation in relation to the ends of the TENs at the entry points was reported in 9.1% of patients. There were no instances of osteitis or septic arthritis or rotational deformity there was also no refracture after nail removal and no need for any secondary surgical action or readmission after discharge, except for nail removal.

According to the outcome scoring system developed by Flynn *et al* [6], 75.8% of results were excellent and 24.2% were satisfactory. No poor esults were noted in this study.

DISCUSSION

The decision regarding the best line of treatment of paediatric lower limb fractures is based on several factors : age of the patients, nature of the injury (isolated or combined), fracture type (open or closed), fracture pattern (stable or unstable), patient and family compliance, social, psychological and economic status, and finally the surgeon's preference[3,20,24-26]. Over the past 20 years, paediatric orthopaedists have tried a variety of methods to treat paediatric lower limb fractures to avoid prolonged immobilisation and complications. Each method has had its own complications : spica cast immobilisation alone or following traction had resulted in limb-length discrepancy, angulations, rotational deformity, psychological and economic complications [16,24,28]. External fixation had resulted in pin-tract infection, loss of knee range of motion, delayed union, non-union, and refracture after fixator removal [5,20,26].

The ideal device to treat paediatric tibial fractures should be a simple, load sharing internal splint, allowing early mobilisation while maintaining length and alignment for several weeks until bridging callus forms, without endangering the blood supply to the epiphysis [2,6,9, 15,18,19,24,30]. .Ender nails are stainless steel implants that proved to be inadequate for adult femoral and tibial fractures but may be effective for paediatric fractures although they may be not elastic enough as their modulus of elasticity is higher than titanium nails. TENs are more elastic, thus limiting the amount of permanent deformation during nail insertion ; they promote healing by limiting stress shielding in addition to their biocompatibility without metal sensitivity reactions [6,10-12,15,24]. .The principle of Ender nail fixation is canal filling with the nails, while TENs work by balancing the forces between the two opposing flexible implants. To achieve this balance, the nail diameter should be 40% of the narrowest canal diameter or more ; the nails should assume a double-C construct. They should have similar smooth curve and same level entry points [14,15].

Tibial nailing can be performed retrograde or antegrade, although the antegrade technique is easier and mechanically more stable with less soft tissue irritation, but in general there has been no difference in outcome. Three fractures of the distal 1/3 of the fibula associated with tibial fractures were fixed with one antegrade TENs through a small incision in the middle or upper third before fixing the tibial fractures, without any complications. Our average operative time, radiation exposure, hospital stay, bone healing time, and nail removal time were similar to other data in literature [2,6,9-11,14-15,17-19,25,30].

CONCLUSIONS

With good knowledge of the technique of TEN fixation for paediatric tibial fractures, excellent and satisfactory results were achieved in all cases, with few minor complications. TENs can give stable fixation allowing early mobilisation and shorter hospitalisation with less disruption of routine life.

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