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Role of Enders Nail In Diaphyseal Fractures of Long Bones in Pediatric Age Group

Dr.S.K.Venkatesh Gupta *M.S,M.Ch(Ortho),* [1] , [2]Dr. S. Sirish Aditya[2]
[1]*Professor and HOD, Department Of Orthopaedics,*
Mamata Medical College/General Hospital,Khammam,AP,India.
[2]*Post Graduate, Department Of Orthopaedics, Mamata Medical College/General Hospital,Khammam,AP,India.*

***ABSTRACT**: B**ACKGROUND:** The need for operative fixation of paediatric diaphyseal fractures is increasingly being recognized in the present decade. The conventional traction and casting method for management of pediatric diaphyseal fractures is giving way for the operative stabilization of fractures.*
***Methods:** 28 pediatric patients in the age group 6-14 years with diaphyseal fractures were stabilized with minimum of two Enders nails. Patients were followed up clinically and radiologically for 2 years. The final results were evaluated using the criteria of Flynn et all. Technical problems and complications associated with procedures were also analyzed.*
***Results:** Overall results observed were excellent in 23, satisfactory in 5, and no poor results. Hospital stay averaged 10 days in the series. All fractures healed with an average time to union of 6 weeks. The soft tissue discomfort near the knee joint produced by the nailing was the most common problem encountered. Shortening was observed in two cases and restriction of knee flexion in 2 cases. There was no delayed union, infection or refractures. Per operative technical problems included failure of closed reduction in 6 cases. Residual angulation occurred in two cases of with the medial C and S construct, versus none with the double C construct.*
***Conclusion:** We believe that with proper operative technique and after care, Enders nail may prove to be one of the best implant for paediatric diaphyseal fracture fixation for Indian scenario. The most common complication associated with the procedure are infact features of improper technique and can be eliminated by strictly adhering to the basic principles and technical aspects. While the C and S construct were superior biomechanically, the double C construct is more reliable and straightforward and remains preferred technique.*

I. Introduction

Fracture shaft of long bones (Femur and tibia) in children are quiet common and are managed conservatively from time immemorial[1]. In recent past, the trend of management of femoral and tibial fractures in children is being shifted towards operative side[2,3,4]. The proponents of the operative treatment believe that, by this method complications like rotational mal-alignment, non union, mal union are low in addition to reduce cost as compared to non operative treatment[5,6,7]. The advantages of flexible
intramedullary nails as a fixation device are well known and include closed insertion of the device, with preservation of the fracture hematoma and minimal risk of fracture site infection. No reaming is required, and as such the endosteal blood supply is essentially preserved. The devices, when prebent, appropriately provide stable three-point fixation. They are load-sharing devices that can permit early mobilization and
weight bearing[6,7]. The aim of this study is to present our experience with operative management of the diaphyseal fractures of long bones, with Enders nailing in children.

II. Material and Methods

After obtaining the approval from our institutional board and informed consent, 28 paediatric patients having femoral and tibial diaphyseal fractures (20 femur and 8 tibia) were treated with Ender`s nail from 2010 to 2012. Patients selected as the subjects of the study were of either sex and in the age group of 6-14 years of age. Only cases having closed or grade I or Grade II open fractures as determined by Gustilo-Andersons Classification[8] were included in the study. Cases having sustained multiple system trauma were also included in the study. Children less than 6 years and more than 14 years of age, metaphyseal fractures, open Grade III Femoral and Tibial diaphyseal fractures, underlying neuromuscular disorder, metabolic bone disorders or pathological fractures were excluded. Two common implant configurations were compared: double or divergent C and medial C and S constructs[9].

The ages of children ranged from 6-14 years with average age being 9.06 ± 1.98 Years. There were 19 boys and 9 girls. The most common mechanism of injury was road traffic accidents in 40% of them. 21 fracutres were in the middle one third, followed by 4 in upper one third and 3 in lower third. Most common fractures were transverse fracture. Comminution was present in 5 cases. There were 8 open fractures (5 Femur + 3 tibia) and 20

closed fractures (15 femur + 5 Tibia). Associated injuries were present in 8 patients of which 5 had head injury and 3 had fracture of other bones.

Ender`s nail were available in length (range 200mm - 380mm) and diameter of the nail ranged from 2.5 mm to 5 mm. Two nails were used. Nail diameter should measure 40% of the narrowest diameter of the diaphysis[9]. Nails should be contoured with long, gentle bend such that apex of the convexity will be at the level of fracture[9].

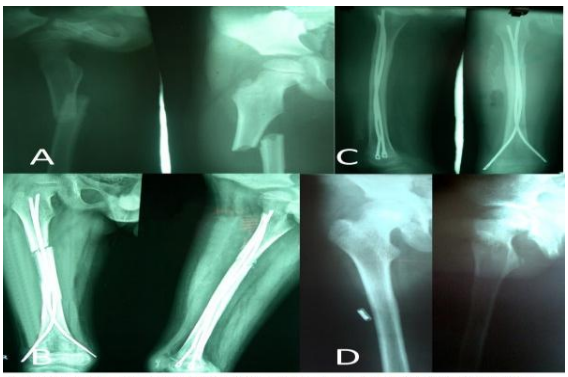
III. Operative technique

Torniquet was used unless a concern for compartment syndrome existed. The procedure is performed on a radiolucent table with a sterile bump under the operative extremity. In the setting of an open fracture, meticulous debridement precedes fracture fixation. In cases of compartment syndrome, completion of fasciotomy is advised prior to reduction and fixation. Fracture reduction is ensured under image intensification guidance prior to undertaking flexible nail fixation. After taking an entry by avoiding damage to the physis, an appropriately sized implant is selected and prebent according to the fracture location and planned fixation configuration. The implant diameter should be approximately 40% of the narrowest canal diameter. The implants should be prebent such that the apex of the bend abuts the inner cortex above and below the fracture site and will provide three-point stability. The bend should be broad and nonfocal to provide optimal three-point internal stabilization. A second nail is inserted from the lateral side through a similar exposure. An alternative technique is to insert the second nail from the medial side in an S fashion, referred to as the ‘‘medial C and S’’ configuration. The prebend is more difficult but equally crucial as the apex of the bend should provide endosteal cortical contact above and below the fracture site to achieve maximal stability.

Post operative immobilization was done for 4 weeks in the form of POP Cast (for all tibias) and knee immobilizer/Thomas splint (for all femurs). After 4 weeks, immobilization was discontinued and range of motion exercises were started. Partial weight bearing was allowed at 4-6 weeks followed by full weight bearing at 8-10 weeks. Regular clinical and radiological evaluation, initially for every 4 weeks for first 3 months, every 6 weeks for next 6 months i.e. till the completion of nine months was done.

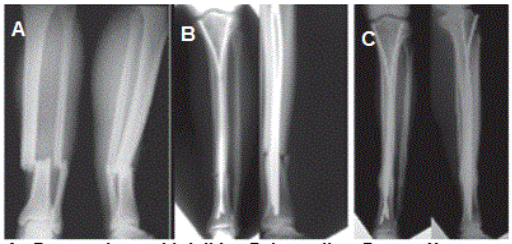
IV. RESULTS

In this series, 19 patients underwent a double C configuration, 9 underwent a medial C and S configuration (Fig 3). All twenty eight fractures treated healed with an average time to union of 8.8±3.8 weeks. The mean operation time was 40.2 ± 15.2 minutes (Range 32–100 mins) (FIG 1 & FIG 2). Callus was first noted on follow up radiographs at an average of 4 weeks (Range 1.8-8.6 weeks). Shortening was observed in 3 cases, and it was in femur and which were less than 1.5cm. Four patients had restriction of knee flexion due to post op immobilization, which recovered with physiotherapy. Two (7%) angular deformities of an average of 11.2 degrees were noted.There were 3(11%) delayed unions, but no cases of infection or refracture. Soft tissue irritation at the proximal part of tibia due to protruding Enders nail was found in 2 patients and the nails were removed in them after the union. The proportion of patients who experienced any complication did not differ significantly between the double C (19%) and medial C and S (33%) configuration groups (P = 0.5). The average angular deformity in the double C group was 5 degrees; it was 9.4 degrees in the medial C and S group (P = 0.04). Per operative technical problems included failure of closed reduction in four cases. Implant removal was done in 5 cases at average of 15.4±4.6months. 25(89.2%) patients had excellent outcome and rest 3(10.7%) had satisfactory functional outcome as calculated by Flynn et all scoring system[10]. The C and S configuration had a significantly lower range of motion (32 ± 4 degrees) compared with the double C configuration (71 ± 20 degrees) (P< 0.03).



Femoral shaft fracture of right side in a 6 year old child treated with Ender's nail. Radiographs revealed displaced femoral shaft fracture (A) of right side. Excellent fracture reduction (B) was achieved which was maintained till fracture union (C) and final follow up radiographs at 6 years postoperatively (D) demonstrated neutral alignment in both anteroposterior and lateral views

Fig 2 :



A : Fracture lower third tibia ; B: Immediate Post op X ray showing reduction; C: 6 months post op x ray showing callus.

Fig 3:

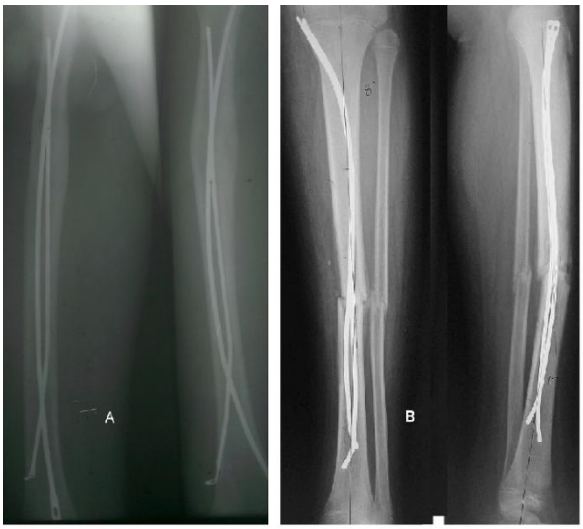


Fig 3 : A) Radiographs of a case treated with Double C construct ; B) Radiographs of a case with medial C and S construct.

V. Discussion

The general concept of treating a paediatric femoral fracture differs from that of an adult one. Conservative treatment with a spica cast with or without traction produces a satisfactory outcome in patients younger than 6 years of age[5,11,12,13,14,15]. Primary indications for surgical treatment include polytrauma, severe head injury, open fractures, multiple long bone fractures and ipsliateral tibia fractures[16,17,18]. Rigid internal or external fixation with a plate is a standard treatment method, but intramedullary flexible nail fixation achieves the same results with less surgical dissection and closed methods[16,18,19,20].

It is generally accepted that compression plating is a traditionally safe and effective method but flexible intramedullary nailing provides a high rate of union with closed reduction, shorter operation time and small incision for insertion of nail, which is cosmetically more acceptable[21,22,23]. Radiation exposure is the major disadvantage of the method. Soft tissue irritation is a frequent complication of this method but this can usually be solved by removing the nail[24,25].

Despite achieving union in all cases, the percentage of complications from flexible intramedullary fixation of tibia shaft fractures in this study was significant. The most common major complication observed was malunion of at least 10 degrees in either the sagittal or coronal plane. None of the patients treated with the double C construct had malunions, while two of the nine patients (23%) treated with the medial

C and S construct had malunion at final follow-up. While these numbers are not statistically significant, they do suggest that the double C construct provides a more stable construct for maintenance of reduction. When considering the average deformity present at final follow-up, the double C group had an average of 5 degrees of deformity, while the C and S group had an average of 9.4 degrees. This difference was statistically significant and suggests once again that the double C construct is superior at maintaining alignment.

Now a days, there is emphasis on using Titanium Elastic Nail as elasticity of titanium is more and it limits permanent deformation of nail, which promotes callus formation by limiting stress shielding[26,27,28]. Titanium has good biocompatibility in comparision to stainless steel[27]. On the other hand we have Ender`s nail which is a stainless steel implant and 4-5 times cost effective, and has time long proven that it gives equally good results in paediatric fractures. So just if developed countries have come up with titanium nails, it is not necessary that developing countries like ours should also use Titanium Nails, as the results of this study suggest

that Enders nails have very much comparable results with TENS in the femoral/tibial fractures in patients over 6 years of age and less than 16 years of age.

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