Research Article
Orthopaedics

MANAGEMENT OF DIAPHYSEAL LONG BONE FRACTURES IN PAEDIATRIC AGE GROUP BY FLEXIBLE TITANIUM ELASTIC NAILS

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Article submitted on: 25 august 2017
Article Accepted on: 02 September 2017

Abstract:

Background: Elastic intra-medullary nailing is a new technique for treatment of various paediatric fractures. The use of these titanium nails is preferred over conventional stainless steel nails used in the past.

Method: Thirty patients with various long bone fractures underwent operative treatment with elastic intra-medullary nails. The mean age was ten years and the mean follow-up period was 24 months.

Results: All children achieved union in a mean time of 10 weeks. Few technical complications were seen earlier on in the series. Two cases developed infection which resolved with antibiotics. Insignificant limb length discrepancy was seen in 3 children, but this remains a potential problem which needs close follow-up until skeletal maturity.

Conclusion: Elastic intra-medullary nailing of long bone fracture is an excellent technique in the surgical treatment of long bone fracture in children. It is safe, less invasive and associated with fewer complications.

Key words: *Intramedullary nail; Elastic; Pediatric fractures.*

Introduction

Treatment of long bone fractures in children continues to improve as newer techniques evolve. Conservative treatment remains the mainstay, given the excellent remodeling ability of the immature bone in children.[1] However, unstable fractures of long bones require operative treatment to maintain alignment and preserve function.[2] Several options are available for operative treatment but with the development of flexible nail the treatment of long bone fractures, particularly femur has undergone a dramatic change.[3]

A number of other intra-medullary devices like the Rush nail or Ender's nails are available for treatment of paediatric fracture, but these have poor rotational stability and require multiple nails to achieve fracture stability.[4]

We highlight the experience, technical details, pitfalls and complications in the use to these flexible nails for all long bone fractures in children.

Patients and Methods

A retrospective study of 30 children with various longbone fractures operated with elastic nails was performed.

The study period was from 2013 –2016 inclusive and all caserecords and radiographs were analyzed at MediCiti Institute Of Medical Sciences. There were 18 boys and 12 girls in the study. The mean age at the time of surgery was 10 years with a range from 6 years to 12 years. There were 16 femoral fractures, 6 tibia, 6 forearm, and 2 humerus fractures respectively. The injuries were due to falls, sportingaccidents and vehicular impact. All injuries were closed and all fractures were initially splinted in casts. The decision for surgery was based on the adequacy of reduction and fracture instability.

All patients were operated under GA, using IITV (imageintensifier television) for imaging the passage of nails and quality of reduction. The AO Synthes flexible nailing system was used in majority of cases. Pre-operative intravenouscefotaxime was used and 3 doses were given post-operatively. In six cases an open reduction was required to achievenail insertion. Post-operatively a plaster slab was used for the upper limbs for two weeks and a long knee splint was used for femur and tibial fractures. In 4 cases of femur fractures, 4 forearm fractures, and 3 tibial fractures supplementary casts were used to maintain rotational stability.

Ambulation was allowed as healing progressed and majority of the children were able to partial weight bear by 3- 4 weeks.

Technique of nail insertion

The patient was positioned on a radiolucent table with access to the IITV. The bone was exposed with a longitudinal incision and the soft tissues spread in the same direction with help of blunt tip scissors. The periosteum was also incised longitudinally and the cortex exposed. With the help of sharp awl, the outer cortex was perforated and the awl angled to enter the medullary cavity. Care was taken to ensure that the entry point is in the middle of the width of the presenting cortex. With too anterior or posterior entry points the direction of nail insertion is altered. In femur, an anterior entry point can cause in advertent penetration of the knee joint. In the humerus, two lateral entry points, one over the other are required to insert the nail.

A medial entry portal requires exposure of ulnar nerve and care while leaving the nail end protruded. Once the entry points were made, the nails were inserted with the curve tip into the medullary cavity. The nails were manually pushed with the help of a "T" insertion handle until resistance was met and then gently hammered with the curve tip sliding on the inner cortex. Once the nails reach the fracture ends, especially in the femur where both nails were inserted first up to the fracture site, then the fracture site was manipulated to allow reduction. An IITV here was very useful and can confirm reduction and correct passage of the nail.

The nails were inserted retrograde in the femur, humerus and ulna and antegrade in the radius and tibia. Nail sizing was crucial and was determined by measuring the width of the isthmus of the long bone, subtracting 20% for the magnification factor and dividing the remaining by two. Two nails of equal sizes appropriate for the width of the medullary cavity were selected. If nails of unequal sizes are used the torque imparted by the larger nail would be asymmetrical causing fracture angulation. Once across the fracture site, the nails were inserted unto the metaphysis with the tips facing opposite directions to give good three-point purchase in the cancellous bone. The nails were cut 1.5 cms long and bend to lie along the bony cortex to prevent skin and soft tissue impingement.

Results

All fractures had uncomplicated union. The mean healing time was 10 weeks (range from 6–16 weeks) depending on the type of long bone. In general the mean healing for femur and tibia was 12 weeks and 11 weeks respectively. The healing time for

upper limb fractures was shorter: 8 weeks for forearm and 10 weeks for humerus fracture.

The mean follow-up period was 28 months (17–48months). We looked at the postoperative complications, healing time, rotational deformities, and limb length discrepancy, range of motion of adjacent joints and return to function.

Few complications were seen. There were two cases of superficial wound infection, one tibia and one femur. Both resolved with antibiotics. In three cases there was hardware prominence, two in femur and one radius. In all cases the implant was removed after fracture healing was observed. In two cases, there was loss of fracture position and a re-operation was required. In two femur fractures, an anterior entry point caused the nail to penetrate into the knee joint causing synovitis and pain. These resolved successfully after the nails were removed.

No obvious rotational deformities were present on clinical examination and all children recovered range of motion compatible with good function. In 3 femur fractures there was overgrowth of the affected limb, but it was clinically insignificant. This needs further evaluation at skeletal maturity, as overgrowth may not correct with age.

Pre- op radiograph

Immediate post-op

6 months follow-up

Pre-op radiograph

immediate post-op

6 months follow-up

Discussion

Intramedullary fixation has always been the preferred treatment technique in long bone fractures, even in adults. The initial experience was with Kuntsher nails and Rush nails, but their use in children fractures was limited. Also these nails were rigid and difficult to insert through the metaphysis of children bones.[5] Enders nails were devised to over come this problem but usually multiple Enders nail were required to achieve fracture stability.[6] The titanium flexible nail with its newer design and better material has an advantage over the older Enders type nail. Because of the inherent stiffness of titanium even 2 mm nails have adequate strength and elasticity compared to Kirschner wire or stainless steel pin of the same diameter.[7]

In a large series reported by Vrsansky, 308 fractures were treated by flexible nailing technique and all children had fracture union and reported satisfactory function. However,they cautioned that these nails should not be used in children under 5 years of age.[8] In a recent article, Barry and Paterson have described the role of titanium nails in paediatric fractures,with emphasis on technique in various long bones.[9] Although in most cases the fracture

can be manipulated and the nails inserted by closed technique, in six cases we encountered difficulty. A small incision was made at the fracture site to negotiate the nail into the intramedullary cavity.

The healing time was not altered in these cases and there was no wound infection. Careful placement of insertion point in the distal femur is important as an anterior entry point can cause the nail to migrate into the knee joint.[10]

In the humerus, the pins were inserted from the lateral side in 3 cases, and both medial and lateral in 3 cases. It was felt that the exposure to locate the ulnar nerve would offset any advantages of closed nailing technique.

Limb length discrepancy is a problem especially after femoral fractures. It has been recommended to leave at least 1.5 cms overlap between fracture ends to prevent over growth. With end-to-end alignment with these nails, over growth remains a potential problem.[11,12] These patients must be followed up until skeletal maturity.

Implant removal was undertaken when there were problems with the metal work. Routine metal removal of these implants is advocated and we recommend the metal work to be removed after nine months in children. Patients must be warned that implant removal may entail a bigger incision and can lead to unsightly scars.

We did not have a control group nor did we compare other methods of treatment. However, we feel that flexible nailing can have a place in the management of paediatric long bone fractures, which fail skilled conservative treatment. There are distinct advantages in terms of duration of hospital stay, fracture stability and early return to function. However, the surgeon must be well versed with the technique and limitation of these devices. With correct technique and attention to detail, some of the aforementioned complication scan be avoided.

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