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Case Series

Functional outcome of TENS nailing for paediatric long bone fractures

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ABSTRACT

Musculoskeletal trauma constitutes a major portion of paediatric injuries. Titanium elastic nailing system (TENS) has emerged as a minimally invasive and effective method for internal fixation of long bone fractures in children.This study evaluates the functional outcome of TENS nailing in paediatric long bone fractures and compares the results with established literature. A prospective study of 20 children (aged 2–12 years) with diaphyseal fractures of femur, tibia, humerus, and forearm bones treated with TENS was conducted at ASRAM Medical College, Eluru, during 2023–2024. Patients were followed up clinically and radiologically at 1, 3, and 6 months postoperatively. Implant removal was planned at one year. The study included 14 males and 6 females. The most common cause of injury was accidental fall (65%), followed by road traffic accidents (25%). Excellent results were seen in 90% of cases and satisfactory in 10% of cases. The average hospital stay was 10 days, average blood loss was 45 ml, and the mean time to union was 4 months. Complications included knee stiffness (5%) and superficial infection (10%), which resolved with physiotherapy and antibiotics, respectively.

Keywords: TENS, Internal fixation, Pediatric Long bone fractures

INTRODUCTION

It is estimated that more than eleven million hospitalization and fifteen thousand deaths resulting from childhood injury every year. It has been estimated that 25% of children sustain an injury every year with 10% to 25% of these injuries consisting of a fracture in fact on both outpatient and inpatient side musculoskeletal trauma makes up largest share of paediatric injuries.

In 1979, Professor Jean Prévot and his young team of surgeons – Dr. Métaizeau, Dr. Ligier and Dr. Lascombes of the Centre Hospitalier Universitaire of Nancy, France, developed and introduced a technique for the treatment of long bone fractures in children using flexible IM nailing. In 1994, Professor Prévot passed his torch of paediatric orthopaedic leadership of the University Hospital in Nancy to Professor Pierre Lascombes, who has continued to improve and teach the flexible intramedullary nailing technique around the world.[1,3]

Concerning the availability of the Titanium elastic nails system (TENS), it's easy technical procedure and a smaller number of complications and with reasonable biological rigid fixation leading to early ambulation and low economic conditions of many of our Patients in India, our aim is to demonstrate that TENS may yield sufficiently satisfying results, to consider them as a proper choice when patient's access to modern and expensive alternatives is limited.

Titanium elastic nailing technique is a relatively new method for internal fixation of various long bone fractures, which uses pre bent (available in 2, 2.5,3.0, 3.5,4.0 and 4.5 mm) round, flexible, semi elastic nails and is having certain advantages over the other devices. TENS fixation is a form of multiple nail fixation, in which several nails of smaller diameter are inserted into a non-reamed medullary canal of a long bone. Fracture fixation is attained by each nail which gives its own three-point fixation. So, if two or three nails are used multiple point fixation is achieved, leading to good stability. Early fixation of long bone

fractures in poly trauma patients is a well-accepted and desirable treatment. Immediate titanium elastic nail fixation can be used for grade 1 and grade 2 open long bone fractures and in closed long bones in patients with small intra medullary canal.[2]

CASE SERIES

All the pediatric (2-12 years) long bone fractures of femur, humerus and forearm were admitted and underwent TENS nailing within 2-5 days. The inner diameter of the long bone isthmus was calculated and nail size was selected to occupy 80% of the volume of the medullary canal. The operated limb was immobilized for 3 weeks after which non weight bearing exercises were commenced. Regular follow up was done for all patients at 1 month, 3 months and at 6 months. Implant removal was planned at 1 year post surgery.

Diaphyseal long bone fractures in the age group 2-6 years comprising of 9 cases and age group 7-12 years comprising of 11 cases were taken in the present study, male sex had a clear preponderance with 14 cases, whereas only 6 female cases were studied during the study time. Twelve cases involved on right side and eight cases involved on left side. The common mode of injury was slip and fall in 65 percentage cases; 25 percentage of the patients due to road traffic accidents in the present study. Excellent results were obtained in 90 percent cases whereas 10 percent patients had satisfactory results.

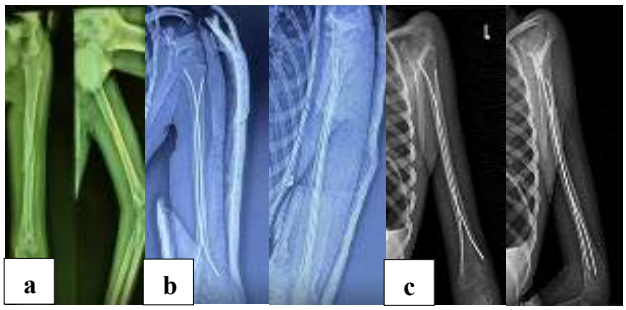

Figure 1: Case 1 (a) pre-operative radiographs, (b) immeadiate post-operative radiographs and (c) follow up radiographs.

Figure 2: Case 2 (a) pre-operative radiographs, (b) immeadiate post-operative radiographs, and (c) follow up radiographs.

The complications observed. Slight limitation of joint movements was seen in 1 patient which improved after physiotherapy. Two patients (10%) were diagnosed with post op superficial infection. In the present study there were no cases of deep infection. None of them required re-operation (Figures 1 and 2).

DISCUSSION

The present study consisted of 20 cases of various long bone diaphyseal fractures (femur, tibia, humerus and both bones forearm) in children; treated in the department of Orthopaedics, ASRAM medical college, Eluru during the year 2023-2024. The results obtained have been compared with the results obtained by other works using the same technique.

In the present study, there were 14 males (70%) and 6 females (30%). Road traffic accident was responsible for 25percent of the patients and accidental fall was responsible for 65 % patients. In two patients the mode of injury was fall from height. Most of the patients reported within 3 days of injury (89%). Concomitant systemic diseases were found in only one patient (rickets).

In this series, 5% cases of associated fractures were found whereas Todd and Schein reported 2.6 percent incidence of associated fractures in their series.

The average operating time in the present study was 40 min. Iwegbu and Patel reported the average operating time of 40 minutes whereas Paustoff and Schein reported average operating time of 100 minutes.[3] This is marked contrast to the other types of fixations like interlocking nailing and plating techniques.

No patient in the current study required blood transfusion. The average blood loss was 45 ml. Iwegbu and Patel reported an average blood loss of 180 ml.[3] Passoff and Schein reported an average blood loss of 100 ml and Pankovich and Tarabishy reported a blood loss of 120 ml.[4] This is also more contrast to other types of fixation devices where blood transfusion is necessary.

The average hospitalization time in the present study is 5 days. Majority of the patients had operation within 2-4 days. In our study mortality rate is zero.

Atul Bhaskar took into consideration 60 patients with various long bone fractures underwent operative treatment with elastic intra-medullary nails.[5] The mean age was 10 years.

In our study, 20 paediatric age group patients with various long bone fractures were treated with flexible intramedullary nails. The mean age group in present study is 6.95 years.

Singh et al studied 35 pediatric patients in age group 6-14 years with diaphyseal femoral fractures were stabilized

with two titanium nails.[6] Patients were followed up clinically and radiologically for two years. Overall results observed were excellent in 25, satisfactory in 8 and poor in 2 patients. Hospital time averaged 12.30 days in the series. All the fractures healed with an average time to union of 9.6 (6-14.4) weeks.

In present study follow up was done clinically and radiologically for a period of 6 months. All fractures in our study showed evidence of union on average of 4 months.

Berger et al encountered complications as four low-grade infections and one delayed union. Leg length discrepancy was only seen in five patients (18%) and was less than 2 cm.[7]

In our series, complications encountered were knee stiffness in 1 case (5%), superficial infections in 2 cases (10%), no shortening, malunion or malrotation. Knee stiffness cases improved on physiotherapy.

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 paediatric fractures was limited. Also, these nails were rigid and difficult to insert through the metaphyses of paediatric bones. Enders nails were devised to overcome this problem but usually multiple Enders nail was required to achieve fracture stability. 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.

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 25. 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.[8]

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.[9]

Rohde et al observed complications such as malunions, non-unions and 2 cases of acute synovitis of knee joint following intra articular penetration of knee by migration of a flexible nail.[10]

In our series there were no cases of non-union, acute synovitis or flexible nail migration. The functional results according to Flynn's criteria revealed excellent results in 90 % (18 patients) of the patients and 10% (2 patients) had satisfactory results.

In the humerus, the pins were inserted from the lateral side in 1 case, and both medial and lateral in 1 case. 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 cm overlap between fracture ends to prevent overgrowth. With end-to-end alignment with these nails, over growth remains a potential problem. These patients must be followed up until skeletal maturity.

Implant removal was done 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 larger 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 complications can be avoided.

We conclude that the results shown by our study compares favourably with that shown by reporters using the same technique. However, this method must be used with caution in unstable fractures where few weeks protection is necessary post operatively. This method is ideally suited for the paediatrics patients' groups and patients with anaesthesia risk also.

CONCLUSION

TENS nailing offers a reliable and minimally invasive treatment option for paediatric long bone fractures, with early mobilization, minimal complications, and favourable functional outcomes.

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