Ender’s Nail For Diaphyseal Long Bone Lower Limb Fractures in Children

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Abstract

Background: To assess the efficacy of flexible intramedullary Enders' nails (EN) for the treatment of femoral and tibial diaphyseal fractures in children.

Methods: In this descriptive study, thirty patients treated with EN, for femoral and tibial shaft fractures were included. Hole was drilled on medial and lateral sides of bone and passage was created by bone awl. EN, attached to the T-handle, was inserted into the bone. When the nail reached the upper end of fracture site, reduction of fracture was attempted and confirmed under image intensifier. Second nail was introduced from the other side. On fourth post operative day, ambulation with weight bearing was attempted.

Results: Twenty two children with femoral and eight with tibial shaft fractures were included. The average healing time for all the fractures was 8.4±4.8 weeks. Majority (90%) united in less than 3 months. Malunion and delayed union were the commonest complications. Reoperation was required in one patient with malunion. None of the patients developed nerve palsy or osteomyelitis.

Conclusion: Use of flexible intramedullary EN, in the treatment of femoral and tibial shaft fractures in children is feasible with lesser complications.

Key Words: Ender’s nail; fracture tibia; fracture femur

Introduction

Flexible unreamed intramedullary nails have long been used to manage diaphyseal fractures of long bones. Enders nail (EN) is an unreamed intramedullary nail used for femoral shaft and intertrochanteric fractures; and now also for tibial shaft fractures. ENs allow early weight-bearing and can be placed with closed technique, which avoids damage to soft tissue and blood vessels. Reports in literature indicating adverse effects of reaming with increased incidence of pulmonary complications and disruption of vascular supply of inner 2/3rd of cortex, have resulted in increased popularity of unreamed nails for fixation of such fractures. These nails rely on three-point fixation in the medullary canal and provide favourable mechanical conditions, as the forces are evenly distributed along the entire length of nails. As the fixation by these nails is not rigid, therefore some amount of micro-motion occurs between the two fragments which in turn stimulates fracture healing. These nails do not ensure sufficient longitudinal stability in grossly comminuted or long oblique fractures with resultant shortening.1,2

Ender and Simon-Weidner (1970) first reported the use of multiple flexible nails for the fixation of intertrochanteric and subtrochanteric fractures.3 This was later extended to femoral shaft fractures. Despite recent technical advances in equipment and design, the method of choice for the treatment of tibial shaft fractures is still unsettled. Except for the fractures with minimal displacement, treatment of these fractures is always surgical. Currently, locked medullary nailing is the preferred surgical treatment. However, use of these implants necessitates a set of instruments and specific facilities which are not currently accessible in many centers. Use of these nails in children will produce damage to epiphyseal plate and limb length problems.

Over the past few years there has been a marked increase in the use of intramedullary fixation in the management of fractures of long bones in children. To some extent this reflects a more interventionist attitude among paediatric orthopaedic surgeons but is also due to technical developments, notably that of the EN.4

Patients and Methods

This study included 30 patients in the age group of 5-12 years with fractures of shaft of femur or tibia; from January 2009 and June 2011 in the Orthopaedic Unit of Railway General Hospital (RGH) Rawalpindi. Cases with the less severe injuries which were treated with closed reduction and cast immobilization and high-energy unstable fractures which were treated with an external fixator, were excluded. Fracture cases with severe comminution, massive bone loss, severe osteopenia, an open infected wound about the knee at
the point of nail insertion, fractures within four centimetres of the knee joint or within three centimeters of the ankle joint were excluded. In most of the fractures, the wounds were left open at the initial debridement and the nailing was delayed for three to five days until the wound was clean.

Fracture healing was judged on X-rays by the presence of bone callus bridging the site of fracture. A fracture was considered to have normal union if there was osseous union in 4 months or less, delayed union if it healed between 4 and 8 months and non-union if it had not healed by 8 months.

The size and the number of nails to be used were determined from preoperative radiographs. Two holes were made on medial and lateral ends of the bones (metaphyseal area just above the epiphyseal plate). With the help of awl the medullary cavity was reached. EN, attached to T-handle, was inserted first through medial holes and when it reached the fracture site by traction and counter traction and passage of EN into other fragment which was confirmed under image intensifier. Then the second nail was passed through the lateral hole (Fig 1-4). The position was then confirmed under image intensifier.

Postoperatively isometric quadriceps and range of motion exercises for the knee and ankle joint were instituted from the first post-operative day. On the 4th day, ambulation with weight bearing as tolerated was initiated with crutches. Additional short leg cast immobilization was used in patients with unstable and/or distal third fractures. The type of postoperative immobilization was dependent on the inherent stability of the fracture and the stability of the internal fixation. All patients had monthly follow-up.

Results

The age of the patients ranged from 5 to 12 years with a mean age of 9.06±1.98 years. Majority of the patients (70%) were males. Twenty children with femoral and 8 with tibial shaft fractures were included. These included 21 closed (17 femoral and 4 tibial) and 9 open (5 femoral and 4 tibial) fractures. There were no highly unstable fractures in this series. 16 (53.3%) were pedestrians who were struck by a motor vehicle, 6 (20%) had a fall, 7 (23.3%) were occupants of a motor vehicle that was involved in an accident and 1 (3.3%) patient had an athletic injury. Fixation was performed with 2 ENs in 21 patients and with 3 in the rest.

Operative time ranged from 30 to 80 minutes with a mean operative time of 47.3±14.9 minutes. The average healing time for all the fractures was 8.4±4.8 weeks. Of the 30 patients, 27 united in less than 4 months, and 3 were considered delayed unions as they healed between 4 and 8 months. All these cases of delayed union were open fractures.

<table>
<thead>
<tr>
<th>Complications</th>
<th>No(%)</th>
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<tbody>
<tr>
<td>Delayed union</td>
<td>3(10)</td>
</tr>
<tr>
<td>Malunion</td>
<td>3(10)</td>
</tr>
<tr>
<td>Superficial infections</td>
<td>3(10)</td>
</tr>
<tr>
<td>Soft tissue irritation</td>
<td>2(6.6)</td>
</tr>
<tr>
<td>Callus disturbance</td>
<td>1(3.3)</td>
</tr>
<tr>
<td>Peroneal nerve palsy</td>
<td>Nil</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>Nil</td>
</tr>
<tr>
<td>Osteomyelitis</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Malunion and delayed union were the commonest complications (Table 1). A reoperation was conducted in one case due to malalignment. Shortening of 2 to 5 mm occurred in 2 patients with comminuted fractures, but caused no significant disability. No case of osteomyelitis was encountered. Soft tissue irritation at the proximal part of tibia due to protruding EN was found in 2 patients and the nails were removed in them after the union. One (3.3%) patient developed swelling, redness, increased skin temperature and pain at the fracture site during the second month after operation. Radiographs showed an irregular structure of the periosteal callus (callus disturbance).
Discussion

The use of intramedullary devices to stabilize fractures is not new. In the mid-19th century, ivory pins were used for this purpose and were then gradually supplanted by various metal devices. These were rigid implants. More flexible devices were introduced, afterward. The school of rigid intramedullary fixation was typified by the Küntscher nail, which achieved great stability in all planes by occupying the entire medullary cross-sectional area of the bone. However, its use in growing children was limited by the difficulties encountered in trying to avoid the physes. The Rush nail was introduced along with the Küntscher nail. It was the forerunner of the modern elastic intramedullary nail, which achieved great stability in all planes by splaying the ends of the wires within the bone well beyond the fracture.1 Enders developed this further with his nails, which were the first to feature adaptations to both ends of the nail in order to improve control of insertion and quality of fixation. These nails can be safely inserted into the metaphysis, making these suitable for consideration in paediatric fractures.3,5

In the past, the majority of fractures of the femur in children were treated conservatively, and the only point of discussion concerned which form of traction was to be employed. Nowadays, pressure on hospital beds and the trend towards shorter stays in hospital has led to an increase in the number of surgical interventions for these injuries. There is no indication for the use of EN in these fractures in children under the age of four to five years. These can be treated very satisfactorily in hip spicas, with or without preliminary traction. Thus, the lower age limit for EN in femoral fractures is probably about five years of age. The risk of avascular necrosis of the head of the femur from the insertion of rigid intramedullary nails in teenagers is well described and this form of fixation is best avoided while the proximal femoral physe remains active. Early intervention and the use of a fracture table make closed reduction much easier. In most cases, it is possible to allow the child to mobilize immediately with light partial weight bearing, with or without a cast brace.5

In the present study, the results, in the age range of 5 to 12 years, were comparable with those of either external fixation or treatment with a spica. The stay in hospital is generally for a few days only. The fracture heals typically within four to eight weeks and the presence of the nails does not appear to impair bone healing.7,8 The tibia does not lend itself well to the potential benefits of EN stabilisation. The triangular cross-section makes it difficult to place nails in the symmetrically opposed configuration necessary for the technique to work properly. The marked proximal metaphyseal flare and the presence of the tibiofibular articulation make anagrade nail insertion awkward. Additional protection with a cast is probably indicated, and under these circumstances, surgeons might consider the benefits of nailing to be marginal.9 In EN technique casting of the limb appears to play a major role in management. The growing child has an ability to remodel its bones and in many cases will wipe out the evidence of a malunited fracture.10 A local study in adult patients showed effectiveness of closed intra-medullary nailing.11 The assessment of lower age limit for nailing and criteria for confinement and/or removal of the nails needs to be delineated.

In conclusion, the successful results, avoidance of growth plate damage and economic benefits make the use of Ender’s nailing an acceptable option in children with lower limb fractures.

References