THE TREATMENT OF TROCHANTERIC FRACTURES OF THE FEMUR BY THE ENDER METHOD

by

G.F. McCoy FRCS, G.R. Dilworth FRCS and H.A. Yeates FRCS

The Fracture Unit, The Ulster Hospital, Dundonald, Belfast

TROCHANTERIC fractures in the elderly are extremely common in orthopaedic practice. Indeed, in the United States, internal fixation of trochanteric fractures is the most commonly performed orthopaedic procedure. The incidence of this operation will undoubtedly increase as the population ages. Treatment of such fractures is complicated by two factors:

(a) High morbidity and mortality associated with advanced age, existing systemic illness, lengthy operation and blood loss.

(b) The fracture site is subjected to high bending stresses which preclude early weight bearing when nail-plate fixation is used.

In 1966, Kuntscher introduced a condylo-cephalic intra-medullary nail, claiming more stable reduction with reduced blood loss and risk of infection. Unfortunately, technical difficulties due to the rigid nature of the rod, and, a high incidence of post-operative knee pain, limited its use. Ender and Simon-Weidner, and subsequently, Kuderna and Bohler described fixation of trochanteric fractures with 4.5 mm diameter pre-bent flexible stainless steel rods introduced through the medial femoral condyle. Several series, detailing the efficacy of this method are now appearing in the English language literature.

In the Fracture Unit at the Ulster Hospital we commenced using Ender's nails in June 1981. Initially, we reserved their use to the older, debilitated patient with the relatively stable fracture (Types I and II, occasionally Type III). Early results were very encouraging, and so, we extended the use of Ender's nails to younger, lower risk patients with more unstable fractures.

MATERIALS AND METHODS

Between June 1981 and May 1983, 23 patients (20 females and 3 males) with a mean age of 82.9 years (range 74-91) underwent internal fixation of femoral fractures by the method described by Ender in 1978. The patient is anaesthetised (either general or spinal anaesthesia may be used) and placed on the Holley table. The fracture is reduced, the position being checked on the image intensifier. The legs are abducted to allow for access by the operator and the C-arm image intensifier. The patient is draped such as to expose a small area on the medial side of the knee. A complete set of nails, along with the tools illustrated in Figure 1 should be available. A skin incision 5-7 cm in length is made over the medial femoral condyle, running distally from the adductor tubercle. The fascia is split and the vastus medialis displaced anteriorly, exposing an almost flat bony surface, just above the tubercle. A nail is placed on the drapes with its distal end at the level of the entry hole, and the appropriate length determined with the aid of the image intensifier. The bone at the
FIG. 1  Tools required for Ender’s nail fixation.
1. A 37 cm Ender nail.  2. Awl used for penetrating the cortex.  3. Nail extractor.
4. Nail impactor.  5. Introducer with cross bar to control rotation.  6. Nail bender.

site of entry is penetrated carefully using the curved awl. This is performed using a twisting action, initially at right angles to the femoral shaft, but, following penetration, the awl is directed up the femoral shaft enlarging the entry hole. Undue force during penetration can result in supracondylar fracture of the femur, particularly when the bone is very osteoporotic. The entry hole should be sufficiently large to accept three nails with ease, otherwise, linear fracture of the shaft above the entry hole will occur.

The first nail is now inserted, and is hammered medially along the calcar into the femoral head. Two further nails are then inserted, and are placed so their distal tips are arranged fan-shape within the femoral head. If the medullary canal is wide, a fourth or even fifth nail should be inserted. The progress of the nail across the fracture site is checked on the image intensifier, and by rotation using an introducer, the correct position is obtained. A good reduction facilitates introduction of the nails, although accuracy of reduction is not as important as with blade fixation. The end result is as illustrated in Figure 2. The wound is closed in layers over a suction drain. The drain should ideally be removed within 48 hours, and subsequently, ambulation is encouraged.
Ender's nail fixation itself.

Grade of post-operative period.

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Patients were graded pre-operatively according to their socio-mobility status. Grade 1 was fully mobile (perhaps with stick) and fully independent. Grade 2 was mobile but requiring assistance and supervision (such as occurs with residents of old peoples's homes). Grade 3 was virtually non-mobile and institutionalised. Accordingly, 13 of our patients were Grade, 1, 7 were Grade 2, and the remaining 3, Grade 3. Mental state and previous medical history were also taken into account in the grading. There were no intra-operative deaths. Three patients died within 3 months of operation (mortality 13 per cent), this comparing favourably with mortality rates in other series where sliding screw fixation was employed.\(^{11,12}\) The causes of death were cerebro-vascular accident, renal failure, and bronchopneumonia.

There were two cases of superficial wound infection, but none of deep infection. Four cases remain as in-patients awaiting geriatric placement. Thirteen patients were ultimately discharged home (12 of these patients were pre-operatively socio-mobility Grade 1). Three were discharged back to old peoples' homes. The mean duration of stay of these 16 patients was 41 days (range 14-122).

Twelve patients had knee symptoms (swelling, pain or stiffness) in the immediate post-operative period. In only four cases did the symptoms persist beyond the first review (at 6 weeks post discharge). In eight patients an external rotational deformity of greater than 20\(^\circ\) was present post-operatively. In all cases this gradually corrected itself. This incidence of rotational deformity, although transient, was considered cosmetically unacceptable in the younger patient, and, because of this, we restricted Ender's nail fixation to those over 70 years with suitable fractures. Time to full
weight bearing was much shorter with Ender’s nails and we allowed unprotected weight bearing (from day three post-operatively) even in unstable fractures.

Based on pre-operative socio-mobility status and the type of fracture, we graded our results good (return to previous ambulatory status with minimal symptoms), fair (some mobility regained, but not as mobile as previously, or, persistence of troublesome symptoms), and failure (deaths as in-patients or no useful mobility regained). Accordingly, there were 15 good results, 3 fair results, and 5 failures. Of those who were ambulant, all showed radiological signs of union without any marked shortening within 16 weeks.

**DISCUSSION**

Condyl-o-cephalic pinning by the Ender method represents a new approach to the increasingly common problem of trochanteric fractures of the femur. Our results, admittedly from a small series, suggest the method is at least as good as conventional nail-plating or compression screw fixation. The advantages of Ender method are:

(a) It is based on sound bio-chemical principles. By fixing the fracture in relative valgus, the lever arm is reduced with intra-medullary Ender’s nails. The bending movement acting on the proximal fragment is reduced by a factor of 2 or 3 (Figure 3). The nails, which lie along the lines of trabeculation are therefore, subjected to axial rather than bending forces. This allows for early, unprotected weight bearing.

(b) Blood loss and operative stress are less than for nail-plate or compression screw fixation. Operative time is also reduced.

(c) Risk of infection is low. The fracture site is not disturbed and the incision is far removed from sites of incontinence.

The incidence of post-operative pain, swelling and stiffness of the knee has been reported as high as 41 per cent. We found a higher initial incidence (52 per cent), but the symptoms were, in most cases, transitory, and did not prejudice the end result. External, rotational deformity is a recognised problem, but again, tended to be temporary. Because of this rotational problem, we restricted Ender’s nail fixation to those over 70 years.

Early resumption of unprotected weight bearing was one of the greatest practical benefits of this procedure. With nail-plate fixation, unstable fractures often require a period of weeks either non weight bearing or partially weight bearing if the fracture is to unite without fixation failure or varus deformity. In the elderly, this partially defeats the purpose of internal fixation i.e. early mobilisation. With Ender fixation
we were able to mobilise with full weight bearing even those with unstable fractures from the third post-operative day. No significant shortening or fixation failure occurred as a result of this. The method is, therefore, particularly suited to those elderly patients who can only be mobilised with full weight bearing.

In conclusion, we have been encouraged so far by our experience with Ender's nails. Their bio-mechanical advantage over nail-plating allows for early unprotected weight bearing, even in unstable fractures. They constitute, therefore, a most useful addition to the armamentarium for the treatment of trochanteric fractures of the femur.

SUMMARY

Between June 1981 and May 1983, 23 patients had trochanteric fractures of the femur treated with Ender's nails. There were 20 females and 3 males in the series, ranging in age from 74 to 91 years (mean 82.9 years). Operative time and blood loss were much less than with internal fixation with a standard blade plate. Time to full weight bearing was also shorter using the Ender method. All but one of our patients who had previously been mobile and independent were discharged home without deterioration in their socio-mobility status. There were three deaths (13 per cent), a figure lower than for internal fixation using standard blade plate or compression screw devices. We described the method of operation, discussed the advantages and disadvantages of the technique, and, finally, we proposed the Ender method as a useful addition to the armamentarium for the treatment of trochanteric fractures of the femur.

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Correspondence to:

Mr. G. R. Dilworth FRCS, Consultant Orthopaedic Surgeon,
The Fracture Unit, The Ulster Hospital, Dundonald, Belfast.