

Failed intramedullary nailing of femur: open reduction and plate augmentation with the nail in situ

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Abstract

Methods Fourteen patients with aseptic fractures that failed to unite after intramedullary nailing (IMN) of the femur were treated by augmentation of fixation by dynamic compression plate (DCP) with the nail in situ. In six of them that had axial or rotational malalignment, direct reduction of the bone fragments and plating were done. Iliac bone grafting was performed in nine cases, when there were gaps between the fragments and in atrophic non-unions. Patients were followed-up for an average of 26 months.

Results All patients had radiological union in an average of 4.3 months with an improvement in alignment, range of motion and shortening.

Conclusions For failed IMN of the femur, augmentation of fixation by compression plate, with the nail in situ, is a good line of treatment. In cases with malalignment, correction was possible followed by plate augmentation.

Introduction

Intramedullary nailing (IMN) is now the standard method of fixation of femoral shaft fractures. Despite recent developments in fracture treatment and introduction of different generations of nails, cases that fail to unite are still encountered. Causes of failure may include insufficient stability due to small nail size, lack of locking, malalignment in the upper or lower third fractures especially with comminution, and wide displacement of fragments. Other

causes of failure of union are devitalisation of tissues by trauma or open reduction, or the presence of distraction at the fracture site.

For the management of femoral non-union following IMN, four main methods of treatment have been described: nail conversion to plating, exchange nailing, retaining the nail and augmentation with plates, and Ilizarov external fixation.

Exchange nailing used to be the most acceptable method of treatment for femoral non-union [1–3]. However, recently a high incidence of failure requiring additional procedures has been reported [4–6]. Exchange nailing is not recommended for comminuted fractures and in fractures in the lower third of the femur, due to instability [7–9].

There are a few reports on the results of plate augmentation with the nail in situ for management of femoral non-union [6, 9–11]. We report retrospectively our experience with two techniques. The first technique is plate augmentation of IMN in femoral shaft fractures that show delayed or non-union, and the second technique is open reduction of the bone fragments and plate augmentation with the nail in situ in cases showing malalignment. This is the first time in the English literature, to our knowledge, that the second technique has been described.

Patients and methods

The focus of this study was 14 patients of failed IMN of the femur. The nail was of Küntcher (unlocked) type in five patients, unreamed locked nail in six and reamed locked nail in three patients. All the patients were referred from other centres. All the patients were males and the average age was 42 years (range 28–56). The knee arc of motion averaged 71.8° (SD 18.9°). All patients underwent blood tests to exclude the presence of infection preoperatively.

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The patients were classified into two groups. Group A comprised eight patients, five had atrophic non-unions while three were hypertrophic. The average time between the nail fixation and plate augmentation in this group was nine months (range eight to 11). In these patients, dynamic compression plate (DCP) fixation with the nail in situ was performed. Group B included six patients, four of whom had axial malalignment of 10–16° (average 12.8°), and shortening of 1.5–3 cm (average 2.25 cm); while the other two had 20° and 25° external rotational malalignment. These patients did not show any clinical or radiological evidence of progression of union. The average time between the nail fixation and plate augmentation was seven months (range four to nine months). Surgery included direct reduction of the bone fragments and plate augmentation on the existing nail (Fig. 1).

The fracture site was exposed through a postero-lateral exposure of the femur, reflecting the vastus lateralis anteriorly and securing any perforating vessels in the way. Motion was detected at the fracture site in all cases. In group A, a short, broad DCP with six to ten holes was applied to the lateral side of the femur and fixed with bicortical screws passed in front or behind the nail. Axial compression of the non-union site was assured by the DCP principle. In group B, the bone fragments were directly manipulated around the nail to correct any angular or rotational malalignment. This was achieved after removal of the superior or inferior locking screws, closer to the non-union site and excision of fibrous tissue between the fragments. Manipulation of the bone fragments was achieved by manual distraction, leverage by Hohmann retractor, laminar spreader and reduction forceps. A broad DCP of appropriate length was used to bridge all bone fragments. Eccentric position of the screw holes of the broad DCP facilitated the insertion of the screws in front of and behind the nail (Fig. 2).

Decortication of the exposed surface of the femur was performed to stimulate bone healing. Iliac corticocancellous bone grafting was done in nine cases to fill gaps at the fracture site and in atrophic nonunions. Mobility at the fracture site

was tested again and was found to be absolutely abolished. The wound was closed over a suction drain.

Patients were given Cephradin 1 g preoperatively and two doses in the next 24 hours. Postoperatively, patients underwent physiotherapy to improve knee range of motion (ROM). Partial weight bearing was allowed until union was achieved. Clinical healing was judged when full painless weight bearing on the affected limb was possible. Radiological healing was reached when there was continuity of three cortices in antero-posterior, lateral and oblique views. The outcome parameters were rate and time to union, correction of malalignment and shortening, and range of motion at the knee joint.

Results

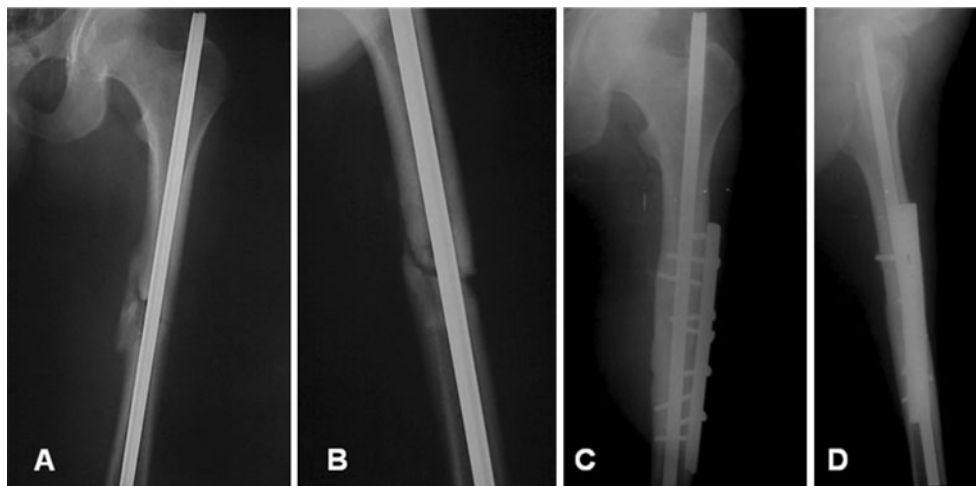
The duration of follow-up ranged between eight and 40 months (average 26 months). Malalignment was corrected in most patients with an average angle of 0.9° (range 0–3°). Limb length was restored to an average of 0.4 cm (range 0–1.3 cm), compared to the other side. Rotation was corrected on clinical assessment. Knee arc of motion improved to 96.2° (SD 13°). Twelve patients showed bony union at four months' follow-up, the remaining two had union at six months, with average healing time of 4.3 months.

Difficulty in insertion of bicortical screws was experienced if the existing nail was thick, with breakage of drill bits, tabs or screws in three cases. There was superficial infection of the wound in one patient that healed after a course of antibiotics.

Discussion

Although rare, delayed and non-union of femoral shaft fractures are the cause of significant morbidity [4].

Fig. 1 a, b Anteroposterior (AP) and lateral views of ununited fracture of the femur after Küntcher nailing showing atrophic non-union. **c, d** Eleven-months follow-up after augmentation plating and iliac bone grafting showing consolidation of the fracture



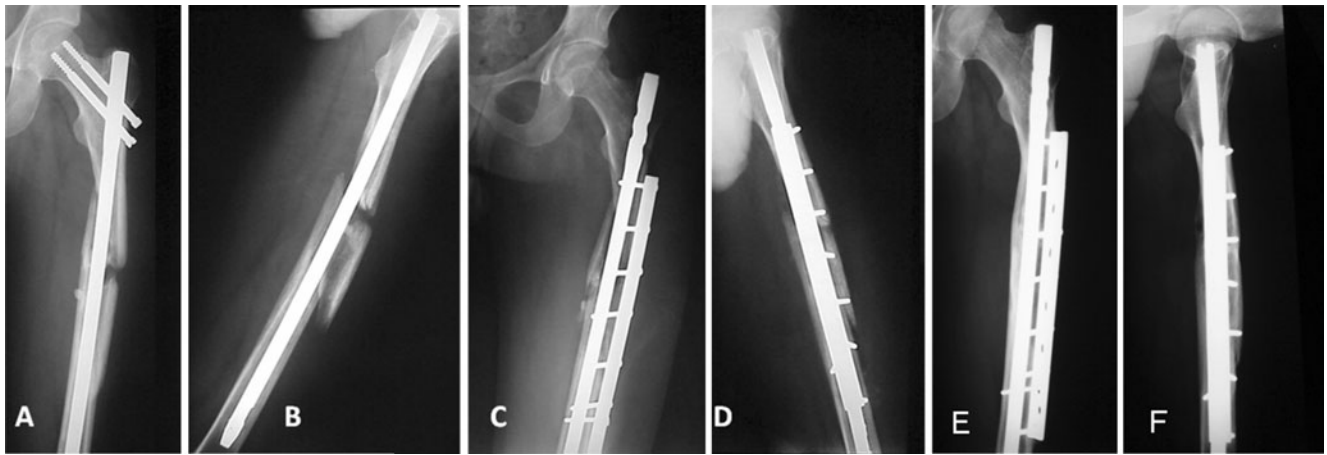


Fig. 2 a, b Anteroposterior (AP) and lateral views of ununited fracture of the femur eight months after locked reamed intramedullary nailing (IMN). Distal locking screws were removed earlier elsewhere due to prominence and pain. There is separation of a large wedge fragment and angulation of 11° . c, d AP and lateral views after direct

reduction and augmentation plate fixation. Note removal of proximal locking screws, reduction and fixation of the antero-lateral wedge fragment and correction of the axial alignment. No bone graft was needed. e, f AP and lateral views three years later showing consolidation of the fracture

Prolongation of the healing time of fractures has adverse somatic, psychological and socioeconomic impacts on the patient. Though non-union of fractures is defined as failure to achieve union in six to eight months [12], earlier interference was preferred in some of our cases. The decision to interfere was based on clinical and radiological considerations. The clinical criteria were the presence of pain, tenderness and increased heat at the fracture site. Radiological criteria were absence of signs of progressive healing and if there was unacceptable malalignment. The policy of early interference in fractures that are unlikely to unite was also adopted in other reports [2, 13].

Conversion of failed IMN to plating has the disadvantage of a long incision to fix the plate, prolongation of the operative time to remove the nail in addition to loss of the stabilising effect of the nail. Surface fixation provided by the plate is mechanically weaker than medullary fixation and does not allow weight bearing until the fracture unites.

Dynamisation is not a reliable procedure to enhance healing as it sometimes results in significant instability and shortening [6]. Exchange nailing is historically the best line of treatment for failed IMN of femur [4]. Bone dust resulting from reaming to a wider diameter stimulates osteogenesis. Exchange nailing with a thicker nail, provides better stability. However, the IMN is an implant that provides only partial stability. Recent reports have shown limited success of exchange nailing in the management of non-union of the femoral shaft in comminuted fractures and fractures in the lower third [4–6].

Iliizarov external fixation was practiced by Menon et al. for non-union of femur, tibia and humerus [14]. Although bony union was reported in all cases, the average time of application of the fixator was 6.2 months. External fixation of the femur is quite cumbersome and inconvenient to the

patient. It delays rehabilitation, and is liable to a long list of complications when applied for a long period of time [15, 16].

Reports on the results of plate augmentation with the nail in situ for management of femoral non-union are few. The number of cases of these studies is less than 20 and excellent results with bony union in all cases were reported [6, 9–11].

In this report, bony union was achieved in all cases after an average of 4.3 months. This healing time is shorter than other published results (6.2, 7 and 7.2 months) [9–11]. This could be attributed to axial compression of the bone fragments in group A, reduction of the bone fragments in group B and bone grafting when indicated. Excision of the fibrous tissue between the fragments and removal of the locking screws on one side allowed correction of the malalignment, shortening and compression of the fragments. Freshening of the non-union surfaces, decortication and addition of bone grafts to fill gaps are all procedures that enhance osteogenesis. Retaining the nail is advantageous as it maintains alignment, adds to the stability of fixation and allows early weight bearing and rehabilitation [11]. It also allows a short plate to be used in most cases, through a small wound, that would be required for bone grafting, if needed.

Most cases of exchange nailing need exposure of the non-union site for bone grafting. Short plate augmentation through the same small wound abolishes all motion at the non-union site and enhances healing. It is only in comminuted fractures with deformity that a longer plate is needed. Broad DCP is the recommended plate in this technique, as it allows axial compression of the fragments, and the eccentric position of its holes allows passing the screws in front of and behind the nail. The use of LCP

might also be useful in cases where unicortical screws can be inserted; this would diminish the incidence of screw breakage and bending by the nail [9].

Conclusion

In failed IMN of femur, augmentation of fixation by compression plating, and bone grafting when indicated proved to be a good line of treatment, and in cases of malalignment, correction was possible followed by plate augmentation with the nail in situ.

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