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Augmentation plating in management of failed femoral nailing

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KEYWORDS

Non-union
Failed femoral nailing
Augmentation plating

ABSTRACT

Introduction: Non-union following interlocking nailing is a troubling complication in treatment of shaft femur fractures. There is no clear consensus on the treatment of this problem. This research was undertaken to study the role of augmentation plating combined with exchange nailing in such cases.
Patients and methods: A prospective clinical study was undertaken from January 2010 to December 2015. Patients with aseptic femoral shaft non-union, with or without implant failure following intramedullary nailing were included in the study. Augmentation plating combined with Exchange Nailing with a 4.5 mm LCP was done.
Results: Fifteen patients (nine male and six female) with an average age of 43.7 years (range 18–67 years) were treated. Average timing from the first surgery was 7.3 months. Complete clinical and radiological union was achieved in all cases in a mean duration of 5.2 months. Average duration of follow up was 12.6 months. All the patients retained the preoperative hip and knee range of motion till the last follow up.
Conclusion: Augmentation plating combined with exchange nailing in non-unions following intramedullary nailing of femur shaft fractures is a reasonably good and effective procedure with a very high success rate.

Introduction

Interlock nailing is a standard and accepted method of treatment of acute femur shaft fractures with a reported success rate of more than 90% [1,2]. Although good outcomes have been reported in most of the studies, non-union can always be a troubling complication. There is no clear consensus regarding the treatment of non-union after interlocking nail fixation [3–5]. The surgical options include: exchange nailing, dynamisation, revision to a plate fixation, bone grafting and plate augmentation.

Exchange nailing in non-unions has not shown consistent results across literature [6,7], dynamisation is not applicable in all cases and has only a marginal effect on union [8], bone grafting alone does not address the problem of rotational instability which is a major factor in non-union following interlock nailing. Augmentation plating has promising results in non-union following intramedullary nailing [9–11] but retaining the same intramedullary nail in a case of where it has not worked once adds to the prevailing confusion. Also it is not unusual to find the broken implant in cases of non-union shaft femur, where it is not possible to rely simply on augmentation plating.

This study presents experience in augmentation plating combined with exchange nailing for femoral non-unions initially treated with intramedullary nailing.

Patients and methods

A prospective clinical study was undertaken from January 2010 to December 2015. Fifteen adult patients with aseptic femoral shaft non-union with or without implant failure following intramedullary nailing were included in the study. Non-union was considered when the patient had pain on weight bearing, or there was gross motion and pain at the fracture site on physical examination with obvious radiographic signs of bone healing cessation at 6 months postoperatively.

Written informed consent was obtained from all the patients. The patients were operated under spinal anesthesia on a traction table. Exchange nailing was carried out first. The Implant was removed by means of its extraction devise. In cases with broken implant, a special broken nail extraction set was used. After removal of the nail a guide wire was inserted into the medullary canal. The canal was reamed by progressively increasing sized reamers with a goal of inserting the nail which has a diameter of 2 mm more than the initial nail diameter or of at least 12 mm. Following exchange nailing, distal interlocking screws were inserted first. The fracture ends were compressed with the help of a back hammering device. This was followed by locking of the proximal interlocking screws. Rotational stability of the interlocking nail was assessed by applying an external rotation force at the distal thigh. Rotational instability at the non-union site was detected in all patients and was considered to be the main underlying cause of non-union. Once the fracture had been stabilized, a standard lateral approach to shaft femur was used to expose the non-union site. In contrast to primary plate fixation

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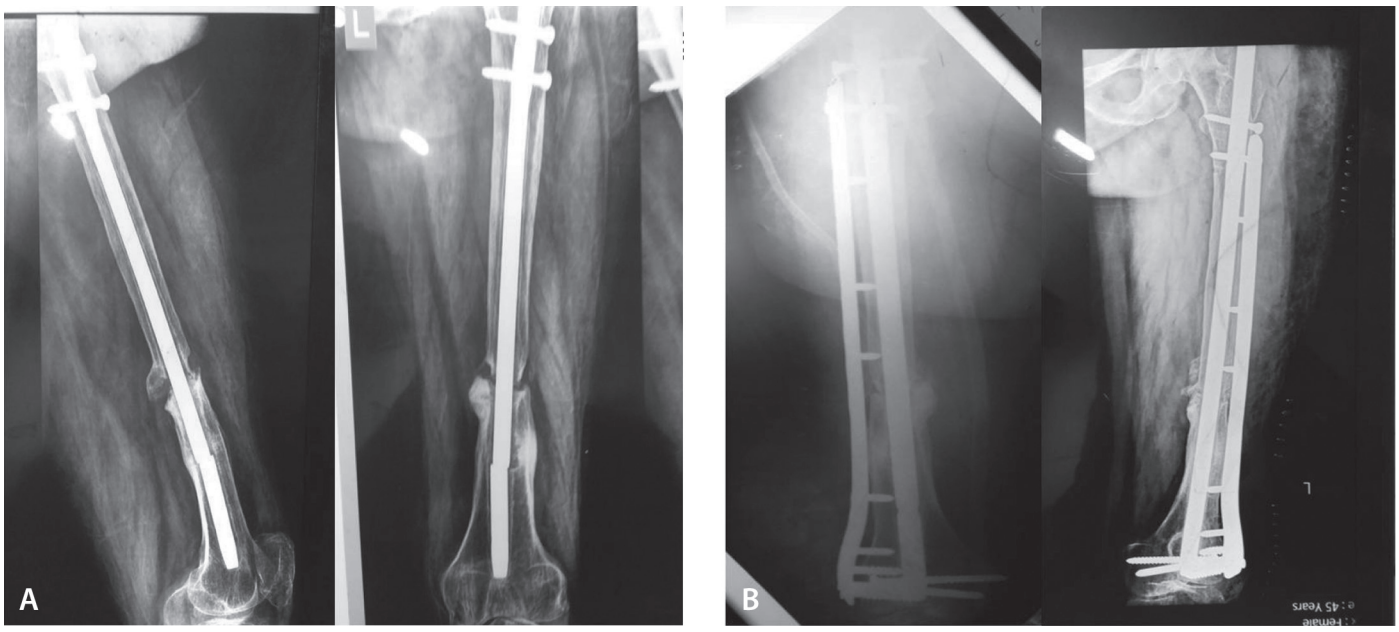

Fig. 1. Fifty year old male with right distal one third femoral non-union. X-rays at (A) time of presentation and (B) 7 months postoperative.

for femoral fracture, there was no need for extended exposure of the non-union site and the plate could be applied with minimal soft tissue dissection and vascular supply preservation.

Eight holes to twelve holes, a 4.5 mm locking compression plate was used for plate augmentation. The length of the plate was chosen so that 3–4 screws could be placed both proximally and distally to the fracture. Unicortical locking screws were used for fixation however in some cases 3.5 mm cortical screws had to be used to ensure bicortical fixation. Pre-contoured plates were used for non-union of the lower shaft, at other anatomical sites the plates were contoured when required and applied on the lateral surface of the bone. The rotational stability was confirmed in all cases. Shingling and raising osteo-periosteal flaps close to the fracture line was also done. The fracture site was circumferentially packed with cortico-cancellous bone graft from iliac crest. The muscle, fascia lata, subcutaneous tissue, and skin were repaired sequentially over a suction drainage.

Patients were put on knee and hip exercises from the next post operative day. All patients received thromboprophylaxis for a period of 6 weeks (low molecular heparin). Weight bearing was allowed as tolerated from the second post operative day after removal of the suction drainage. Clinical follow-up was conducted at 2 weeks, 6 weeks, and then monthly until union was achieved. Union was defined clinically by absence of pain at the non-union site and radiologically by the appearance of satisfactory bridging callus across three cortices in two different views.

Results

Fifteen patients (nine male and six female) with an average age of 43.7 years (range 18–67 years) were treated by augmentation plating with exchange nailing for non-union following intramedullary nailing of fracture shaft femur. Eleven out of 15 patients had been primarily treated by close antegrade femur interlocking nail, one by K nail, and the remaining three by proximal femur nail for accompanying pertrochantric and shaft femur fractures with mini incision technique(<5 cm) for directing the guide wire through the distal fragment . Non-union in all cases with proximal femoral nail was present at the shaft femur level. Six patients, four with femur interlocking nail and one each with proximal femoral nail and K nail had implant failure (broken nail) around the non-union site. Average timing from the first surgery was 7.3 months (range 4 months to 3 years). Complete clinical and radiological union was achieved in all cases in a mean duration of 5.2 months (range 3–8 months) (Figures 1–3). Superficial infection was encountered in two patients which resolved by oral antibiotics. Three patients had a limb length discrepancy of more than 2 cm. Average duration of follow up was 12.6 months (range 8–24 months) .All the patients retained the preoperative hip and knee range of motion till the final follow up.

Discussion

Intramedullary nailing is the treatment of choice for acute femoral shaft fractures, with a low complication rate [1]. Despite advances in surgical technique, implant designs and adjuncts to healing femoral non-union continues to pose a clinical challenge, as well as a treatment dilemma for orthopaedic surgeons [12–19].

Various biological or mechanical factors such as poor bone quality, comminution, bone loss, soft tissue damage, infection, insufficient mechanical stabilization, multiple surgeries, or smoking may lead to non-union [20,21]. When we consider the implant related factors, rotational instability constitutes a major component. Johnston [22] reported rotational instability of the interlocking intramedullary nailing. Rotation of 10–15° occurred at the fracture site without resistance in the femur with intramedullary fixation. This means that despite using a relatively thicker intramedullary nail, rotational instability cannot be completely eliminated [23]. Augmentation plating eliminates this factor and facilitates union.

A concern of combining exchange nailing with plate augmentation was the loss of vascularity of the fracture ends. Cole [24] examined the vascular supply of the femur after intramedullary nailing and showed the whole vascular supply of the femur was restored within 2 weeks after nailing. Our study utilized a biological approach for plate augmentation, with limited soft tissue dissection and periosteal stripping of the fracture ends. Maintaining the alignment and placement of the plate was easy with the nail in situ. Extensive exposure of the fracture site was not required and augmentation could be achieved with limited soft tissue handling and preserving the blood supply of the fracture ends. The retained nail acted as a load-sharing device, neutralizing the shear forces on the non-union site and maintained alignment of the fracture, the plate augmented the fixation and provided rotational stability. There was no incidence of vascular compromise and all our cases united uneventfully.