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Distal locking in short hip nails: Cause or prevention of peri-implant fractures?

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ABSTRACT

Objectives: The most common cause of femoral fractures after osteosynthesis of trochanteric fractures with short nails is weakening of the femoral cortex via distal locking and stress concentrations at the tip of the nail. The aim of the study was to verify whether the incidence of peri-implant fractures is dependent upon the distal locking technique.
Methods: We prospectively analysed a group of 849 pertrochanteric fractures (AO/ASIF 31-A1 + 2) managed with short nails from 2009 to 2013. Unlocked nailing was performed in 70.1% and distal dynamic locking was performed in 29.9%. The mean age was 82.0 years. Peri-implant fractures were divided into 3 groups according to the height of the fracture in relation to the tip of the nail.
Results: In total 17 fractures (2.0%) were detected. One peri-implant fracture occurred after locked nailing, whereas 16 cases occurred after unlocked nailing ($p = 0.037$). Patients without distal locking had an 85.7% greater risk of peri-implant fracture. Fractures of the proximal femur (Type I) occurred significantly earlier than fractures at the tip of the nail (Type II) ($p = 0.028$).
Conclusion: Unlocked nails do not guarantee sufficient stability. Distal locking serves to prevent postoperative femoral fractures. We recommend the routine use of distal locking when utilizing short nails.

Introduction

The increase in intramedullary nailing for surgical management of trochanteric fractures is associated with the introduction of Gamma nails in clinical practice [1]. The biomechanical advantages of nails over extramedullary plate osteosynthesis, which are associated with reduced incidence of varus instability and medialisation of the distal fragment, have led to a rapid global increase in their use [2]. A significant increase in the number of trochanteric fracture nailing procedures, at the expense of dynamic hip screws, first appeared in the USA in 2005, and this trend continues today [3,4]. However, it has been accompanied by serious peri-implant femur fracture complications. Reports emerged identifying distal locking, and the problems associated with it, as a cause of postoperative femoral fractures [1,5–8].

This led to a change in nail design, which was effective in reducing the number of postoperative femoral fractures [9,10]. When addressing the distal locking issue, some authors have stated that distal locking is not necessary for most pertrochanteric AO 31-A1 + 2 fractures [8,11–15]; they then used their samples to confirm that unlocked nailing was safe and not associated with increased complications.

Based on the analysis of our sample, we identified specific fracture patterns in which distal locking is necessary for pertrochanteric AO 31-A1 + 2 fractures [14]. Given the recent increase in the number of peri-implant fractures, we assessed a group of patients who had been surgically managed with short nails in an effort to determine the potential impact of the distal locking technique on the emergence of peri-implant fractures.

Patients and methods

Group of patients

We analysed a prospectively registered sample of 849 patients with pertrochanteric fractures (AO 31-A1 + 2), which had been surgically managed with short nails at our clinic from 2009 to 2013.

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Methods

The same type of intramedullary nail (PFN, fy Medin, Czech Republic) was used for each patient.

The nail length was 240 mm. The proximal portion had a diameter of 15 mm, and the distal portion was produced with a diameter of 11 mm or 13 mm. The two neck screws had the same diameter (7.9 mm) and thread length (25 mm). The cervical screw angle can be 130° or 135°. The nail enabled one distal dynamic locking and one distal static locking.

In the trochanteric region, standard pre-drilling was only performed for the wider portion of the nail. Distal pre-drilling of the medullary cavity along the length of the nail was performed in relatively few cases due to generally very narrow medullary cavities. Both lag screws were introduced axially in both views in a centre–centre position; in the sagittal view, the inferior screw passed near the lower cortex of the femoral neck. We strived to achieve a precise introduction of both cervical screws into the subchondral bone to ensure firm anchorage. Based on previously suggested guidelines, distal locking was only performed in specific cases that were thought to be at risk of rotational or longitudinal instability: (1) lateral comminution of the femoral wall, (2) secondary subtrochanteric lines, (3) large dorsal fragments, and (4) a wide intramedullary cavity. In other cases, osteosynthesis stability is not jeopardised and distal locking is unnecessary. Postoperative loading proceeded as tolerated by the patient.

The study was approved by Independent ethics committee of our institution. We retrospectively analysed those patients who suffered postoperative peri-implant fractures. Vancouver classification system for peri-prosthetic hip fractures was found not sufficient in regards to different fracture patterns and further treatment. Peri-implant fractures were divided into 3 groups according to the established classification, which served as a therapeutic guide (Fig. 1):

Type I: Fractures of the proximal part of the femur above the tip of the nail:

- **IA**: Trochanteric fractures (capable of being locked distally).
- **IB**: Metadiaphyseal proximal fractures (requires conversion to a long nail).

Type II: Fractures in the area of the tip of the nail:

- **IIA**: Fractures at the tip of the nail (capable of being converted through the use of a long nail).
- **IIB**: Spiral fractures extending from the tip of the nail to the distal metaphysis (plate osteosynthesis).

Type III: Fractures of the distal femoral metaphysis.

Type III fractures were omitted from the final analysis because supracondylar fractures are not impacted by the distal locking technique.

The sample was statistically analysed using Fisher's exact test and exact logistic regression, the latter of which is a variant of logistic regression used for a low frequency of occurrence. The level of statistical significance was set to 5%.

Results

Total patient sample

The mean age of the sample of 849 patients was 82.0 years. The sample was comprised of more women than men (76.2% vs. 23.8%), and women were an average 7.6 years older (83.6 vs. 76.0 years) ($p < 0.001$).

Distal locking nails had not been used in the majority of the 595 fractures (70.1%). In the remaining 254 fractures (29.9%), the nail had been secured distally, and always dynamically. The age difference between the two groups was 1 year and was not statistically significant (81.7 years, unlocked nailing; 82.8 years, locked nailing) ($p = 0.136$).

Sample of patients with peri-implant fractures

Of the 849 patients we identified 21 postoperative femoral fractures (2.5%). No technical difficulties with the nailing were registered in this group. All of these second fractures occurred as a low-energy trauma after a fall from standing height. We found 4 fractures (2 with locked nails and 2 with unlocked nails) in the distal portion of the femur (Type III), and these were excluded from

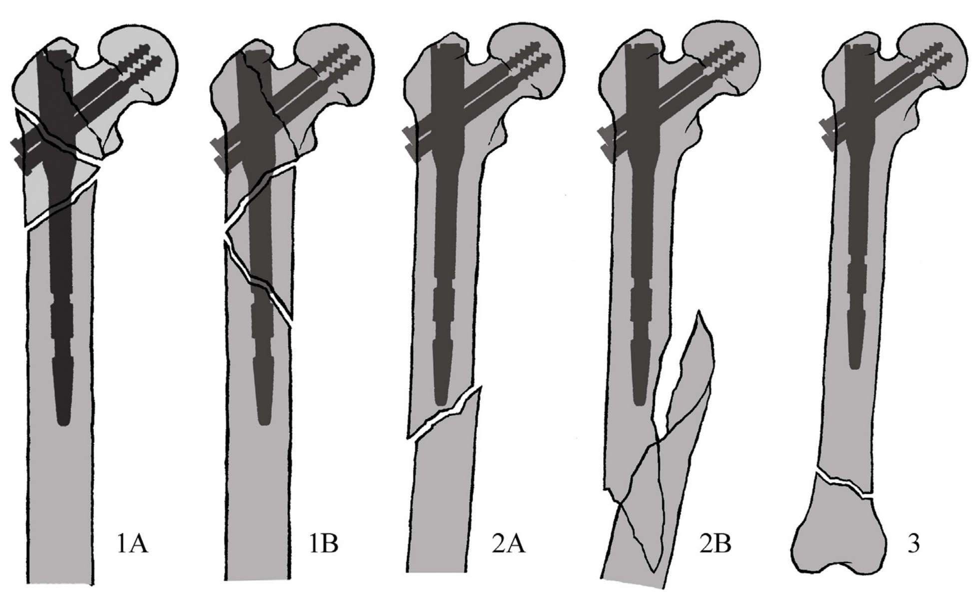

Fig. 1. Our classification of peri-implant fractures of the femur after osteosynthesis with short nails fractures: (a) trochanteric metaphyseal femoral fracture indicated for distal locking (Type IA); (b) proximal metadiaphyseal femoral fracture indicated for conversion to a long nail (Type IB); (c) fracture at the tip of the nail indicated for conversion to a long nail (Type IIA); (d) fractures extending from the tip of the nail to the distal metaphysis, indicated for plate osteosynthesis (Type IIB); (e) fracture of the distal femur with no relationship to short nails (Type III).