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Reverse oblique intertrochanteric femoral fractures treated with the gamma nail

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Abstract We studied 47 reverse oblique intertrochanteric femoral fractures that were treated with gamma nails between 1992 and 2000. Fracture reduction was satisfactory in 38 patients (81%), the hip screw position was correct in 42 (89%) and there were no peri-operative complications. However, in three patients the nail displaced, resulting in non-union in one and protrusion into the acetabulum in another. A logistical regression analysis of our series showed that an incorrect position of the hip screw in the femoral head was the only predictor for complications. Thus, we consider that the gamma nail is a good option for the treatment of these complex fractures.

Résumé Nous avons étudié 47 fractures fémorales intertrochantériennes obliques qui ont été traitées avec un clou Gamma entre 1992 et 2000. Il n'y avait pas de complication périopératoire. La réduction de la fracture était satisfaisante dans 38 cas et la place de la vis était correcte dans 42 cas. Dans trois cas il y a eu une mobilisation du clou qui a conduit une fois à une pseudarthrose et une fois à une protrusion dans le cotyle. Une analyse par régression à montré, comme seul élément prédictif de complication, le mauvais positionnement de la vis dans la tête. Le Clou Gamma est une bonne option pour le traitement de ces fractures complexes.

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Introduction

Recent articles have emphasised the specific biomechanical patterns of reverse oblique intertrochanteric femoral fractures as well as the difficulties in obtaining an adequate and stable fixation [6, 10]. Neither the sliding dynamic condylar screw (DCS) nor the 95° condylar blade plate specially designed for these fractures has demonstrated reliable and consistent clinical results. However, the use of dynamic screw–intramedullary nail devices has been recommended for the treatment of reversed obliquity fractures because of the shorter operative time, less blood loss, a shorter period in hospital and fewer implant failures when compared with the plate and sliding-screw technique [10].

Material and methods

Between 1992 and 2000, we treated 47 reverse oblique intertrochanteric fractures (type 31.A3 of the AO/OTA classification). Patients with previous hip fractures, those with associated fractures in the leg or those with pathological fractures were excluded from the study. The mean patient age was 78 (range: 24–98) years, with 39 women and eight men, and the left side was affected in 32. The mean follow-up was 3.7 (range: 2–8) years, and all patients were treated with an intramedullary gamma nail (GN). Routine prophylaxis for thrombosis was started pre-operatively and continued during the post-operative hospital stay. All patients were encouraged to walk fully weight bearing assisted by external support as soon as possible after operation.

All the pre- and post-operative radiographs were reviewed (AP and lateral of the hip and femur), and the fracture reduction was considered to be 'anatomical' when there was less than 4 mm of displacement between the major fragments and when the normal neck-shaft angle had been re-established. We followed the manufacturer's recommendations and those of previous investigators when assessing the hip-screw position [2, 3, 5]. This was considered satisfactory when the screw tip was in the inferior half of the femoral head as seen in the antero-posterior radiograph and

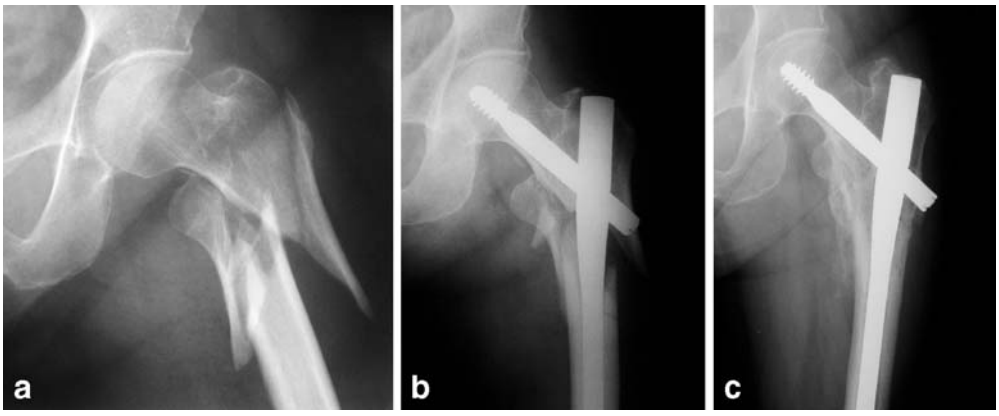

Fig. 1 Reverse oblique trochanteric fracture. Treatment with a long gamma nail (GN) using the closed method.

in the centre part of the head in the lateral radiograph. In addition, the sum of the distances from the screw tip to the apex of the femoral head as measured on antero-posterior and on lateral views had to be less than 25 mm [2, 3]. Secondary displacement of the system was considered when the screw changed its position inside the femoral head, and 'cutting-out' of the screw was defined when the hip screw had penetrated into the acetabulum. The fracture was considered to have healed when hip movement and walking was painless. Radiological consolidation was defined when there were visible bone trabeculae between the fragments in the frontal and lateral radiographs. Delayed union was defined as the absence of radiological and clinical union four months after surgery and non-union after nine months.

The chi-square test was used to analyse the distribution of categorical variables among comparison groups, and Student's *t* test and ANOVA were used to analyse continuous variables such as age, presence or absence of complications and implant type. A multi-variate logistic regression model (enter and stepwise methods) was designed to analyse the dependent variable 'complications' measured dichotomically with a set of independent variables as predictors. Ninety-five percent confidence intervals were obtained for all independent variables. All hypothesis tests were considered as significant when $p<0.05$, and the statistical analysis was carried out with SPSS 10.0 (SPSS Inc., Chicago, IL, USA).

Results

According to the AO-OTA classification, 15 fractures were of type 31-A3.1, three were type 31-A3.2 and 29 type 31-A3.3. In 23 patients we used the long GN without locking (Fig. 1), in 17 the standard GN with locking and in seven the trochanteric GN also with distal locking.

There were no peri-operative complications, but 24 patients developed one or more major complications during their hospital stay. These included heart failure, respiratory insufficiency and pulmonary or urinary infection. The average period of hospital stay was 14.6 (range: 2–25) days. Fracture reduction was considered satisfactory in 38 cases (81%), and the position of the hip screw was correct in 42 (89%). There were three major 'orthopaedic' complications —displacement of the nail, cutting-out and non-union (Fig. 2).

Bone union was achieved in 44 patients (94%). There were three screw displacements, including one 'cutting-out' with fracture non-union. In 27 patients (57%) there was no pain after fracture consolidation, in 17 (36%) there was slight pain that was controlled with analgesics and in three there was moderate pain. In one patient this was associated with radiographic hypertrophy of the anterior femoral cortex at the distal tip of a long GN. The pain disappeared after nail removal. Two patients complained of pain at the level

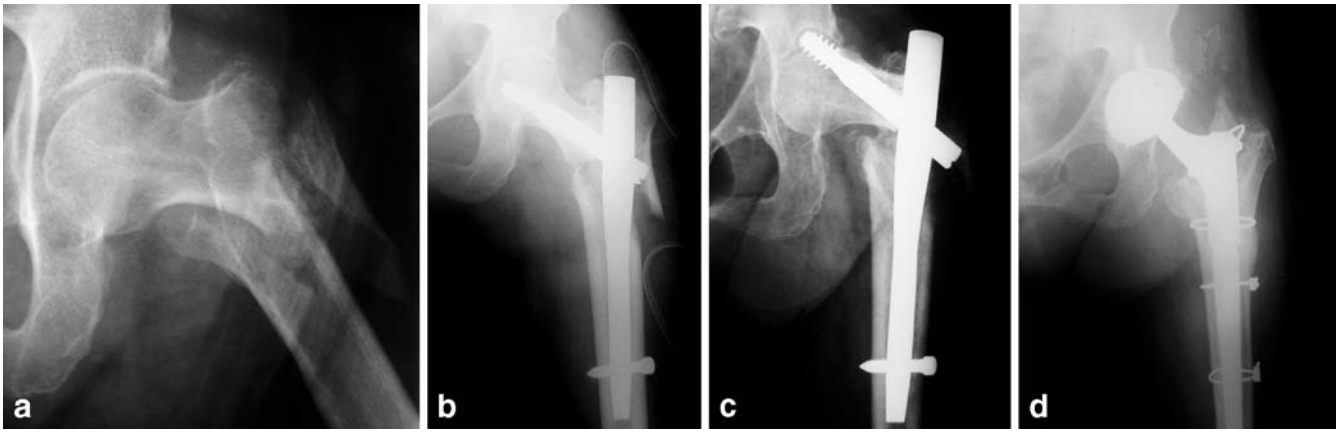

Fig. 2 Failure of the fixation, cutting-out. Treatment with a total hip replacement and modular stem

of the distal locking screw, and one patient complained of a transient trochanteric bursitis that healed with conservative measures. A highly significant association was found between the presence of major fracture complications and incorrect positioning of the GN (chi square test, $p<0.001$).

Six patients (13%) were unable to walk, of whom three had Alzheimer's disease. Twenty-four patients (52%) walked independently or with a single walking aid, five (11%) needed two crutches and 12 (26%) used a four-point walker. Twenty-five patients (53%) needed some assistance with daily activities, 12 patients (26%) needed continuous assistance and were living in residences for the elderly, and ten (21%) were completely independent.

A multivariate logistic regression model was analysed for the binary dependent variable 'complications' and for a set of independent variables as predictors: age, gender, type of fracture, type of implant, position of the implant, days in hospital and blood transfusion. An odds ratio with 95% confidence interval was obtained for all predictor variables, but only the incorrect position of the screw in the femoral head showed association at a statistically significant level (OR=55) ($p=0.008$).

Discussion

Although reverse oblique intertrochanteric fractures were described some years ago [4, 15], their characteristics, their epidemiology [6, 12] and the criteria for their management [6, 10, 12] are more recent developments. These fractures have been included in a larger subgroup of unstable and subtrochanteric fractures of the proximal femur [13], with the result that some confusion arises when their treatment and outcome are analysed. In our institution reverse intertrochanteric fractures constituted 8% of all extracapsular proximal femoral fractures during the nine-year period we studied. In other published series the percentage was only 5% [6]. Some investigators [12] also state that the true incidence could be higher than is currently stated. The frequency of the subtypes is also unknown and in our series 62% were classified as 31-A3.3, which is the most complicated fracture pattern. However, while all but two of our patients achieved bone union within nine months, one patient with non-union required a total hip replacement. Although there were more complications in the older patients, there was no significant relation between the outcome and the type of GN, the fracture subtype, the need for blood transfusion or gender. Four patients were unable to walk before their fracture occurred, and another two were unable to walk after the fracture had been surgically treated. In our series incorrect placement of the hip screw, which was seen in five patients, was the only single factor affecting the outcome. However, we were unable to relate these surgical technical errors to the fracture type.

The good results that have been obtained with the GN in the treatment of intertrochanteric and subtrochanteric femoral fractures have resulted in an increasing use of the GN, which is replacing both extramedullary fixation implants and the dynamic hip screw [1]. Many different fixation devices have been proposed for the treatment of these fractures. Haidukewych et al. [6], based on the frequency of mechanical complications, recommended the use of fixed-angle devices instead of the sliding hip screw. In a retrospective review they found a satisfactory outcome in 20 of 25 reverse oblique fractures treated with fixed-angle devices and only seven with a satisfactory result in 16 patients treated with a sliding hip screw. Sadowski et al. [10] reported good results in 19 out of 20 fractures treated with an intramedullary nail and unsatisfactory results in seven of 19 patients treated with a 95° screw plate. In a prospective study they demonstrated that the intramedullary nail was of value in the treatment of reverse oblique intertrochanteric fractures.

Steinberg and Stocks [12] suggested a hip prosthesis as a valid alternative in elderly people with marked osteoporosis. We have reserved this last procedure, as have others, for the revision of GN failures in patients in good medical condition [11, 13]. Zickel [14, 15] suggested intramedullary nailing, and all the fractures reviewed achieved bone union without bone grafting, other complications or additional surgical procedures. However, he included fractures that we would have classified as subtrochanteric, and he also supplemented the nailing in a significant proportion of the patients with the use of cerclage and screws.

Many studies [1, 7, 9] favour the use of sliding hip screws instead of intramedullary nails in the treatment of extracapsular femoral fractures due to fewer peri-operative complications while others have reported intramedullary nails to be useful in the treatment of reverse oblique trochanteric fractures [6, 10, 12]. Prospective functional outcome studies of elderly patients with unstable intertrochanteric fractures are needed to determine if the theoretical advantages of these intramedullary implants warrant their routine clinical use. One notable exception as stated by Lorich et al. [8] is the reverse oblique intertrochanteric fracture for which he considers the intramedullary nail has a clear advantage.

In spite of the limitations imposed by a retrospective study, we found the GN a good treatment for these complex fractures, and all the different types of GN used gave similar results. The only technical difference was the absolute need to distally lock the two shortest nails, i.e. the trochanteric and the standard GN. Our preference for the use of intramedullary fixation devices in all reverse oblique trochanteric fractures is encouraged by their technical simplicity. Some studies [5] argue that once the technical learning curve has passed, the likelihood of mechanical complications is greatly reduced and that the GN is a valid alternative to the sliding hip screw and plate fixation. However, it seems somewhat contradictory that intramedullary devices have been recommended for the treatment of the most complicated and unstable fractures and yet not considered for the less-comminuted and more stable fractures.

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