ORIGINAL PAPER

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Failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to pre-operative fracture stability and osteoporosis

Abstract We have reviewed 178 intertrochanteric fractures treated by dynamic hip screw (DHS) fixation between March 1995 and December 1999 and followed for a minimum of 1 year. We used Singh's classification of the trabecular bone structure in the proximal femur as a measure of osteoporosis and also classified the fractures according to three different systems (Boyd-Griffin, Evans, AO). The postoperative radiographs were examined for loss of reduction, i.e. varus angulation >100, perforation of the femoral head, more than 20-mm extrusion of a lag screw or metal failure. We found 49 cases which showed radiographic failures. Two were stable fractures and 47 unstable fractures (Evans' classification). Unstable fractures with osteoporosis had a failure rate of more than 50%. In such cases DHS should not be the first choice for treatment.

Résumé Nous avons examiné 178 cas de fractures intertrochanterienne unilatérales traités par vis cervicale dynamique (DHS) entre mars 1995 et décembre 1999 et a suivi pour un minimum d'une année. Nous avons utilisé la classification de Singh de la structure de l'os trabeculaire fémorale proximale comme une mesure d'ostéoporose et aussi avons classé les fractures d'après trois systèmes différents (Boyd-Griffin, Evans, AO). Les radiographies postopératoires ont été examinées pour perte de réduction c.-à-d. difformité en varus >100, perforation de la tête fémorale, plus grand que 20 mm qui se retirent de la vis cervicale ou échec métallique. Nous avons trouvé 49 cas qui ont montré des échecs radiographique de que deux étaient fractures stables et 47 fractures instables (classification Evans'). Les fractures instables avec ostéoporose avaient un taux de l'échec de plus que 50%. Dans tel emballe DHS doit être le deuxième choix pour traitement.

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Introduction

Femoral intertrochanteric fractures occur in elderly patients. They are often combined with some degree of osteoporosis and the wide variety of treatment methods available emphasises the inherent difficulties in managing these injuries. A sliding screw device is currently the implant of choice as it encourages impaction of the fracture [5, 16]. However, several authors have concluded that sliding compression screws may be associated with serious complications such as perforation of the femoral head, loss of reduction caused by excessive sliding of the lag screw, non-union, shortening of the affected limb and pain [3, 8, 12]. In unstable fractures this failure rate is 10–16% [3] but the factors responsible for these complications are not well understood and remain controversial [3, 5, 15, 22]. The purpose of our study was to produce through an analysis of the results of 'failed' DHS cases a reliable method of classification which, using simple radiology, could both predict post-operative complications and also demonstrate the importance of osteoporosis in the management of these difficult fractures.

Materials and methods

We retrospectively reviewed 178 consecutive patients with unilateral intertrochanteric fracture treated with a sliding hip screw between March 1995 and December 1999. The minimum follow-up was 1 year and the average age of the 92 men and 86 women was 71 years (range: 45–92 years). One-hundred and seventy-three of the fractures were caused by falls when standing and were considered relatively low energy injuries. The remaining five fractures were caused by crushing or car accidents. The operation was performed with the patient on a standard fracture table and in the supine position. Following closed reduction under image intensifier control, a DHS was inserted through a standard lateral approach. In those cases with severe comminution allogenous bone chip grafts were placed around the fracture (n=5). After operation the patients used a wheelchair when pain had settled and were encouraged to start partial weight-bearing at the beginning of the third post-operative week. The Boyd-Griffin classification [1], Evans classification [4] modified by Jensen [7], and the AO classification [13] were used. Singh's index [9, 20] was used to grade pre-

operative osteoporosis of the contralateral proximal femur. Post-operative radiographs were examined for any loss of reduction, which was defined as a varus deformity greater than 10°, perforation of the femoral head, extrusion of the lag screw of more than 20 mm, or metal failure [12, 14, 18, 22]. Statistical analysis of the failures was performed with the SAS software (Statistical Analysis System, Cary, N.C., USA). The Pearson chi-square test was used to assess the relationship between failure and osteoporosis. A *P*-value of less than 0.05 was considered to be significant.

Results

Forty-nine of 178 patients (28%) 'failed' according to our strict radiographic criteria. Thirty-eight fractures had greater than 20-mm extrusion of the lag screw (21%), seven fractures displayed mal-union including varus deformity (4%), two fractures had perforation of the femoral head (1%) and two fractures were infected (1%).

All 'radiological failed' patients complained of various degrees of hip joint pain, leg length discrepancy, limping and limitation of joint motion. Two perforated femoral heads required replacement with a bipolar hemiarthroplasty and two infected cases were managed with a Girdlestone resection followed by a bipolar hemiarthroplasty. However, no revision surgery for mal-union was performed. The differences in the failure rates according to each individual classification were variable. With the Boyd-Griffin classification there were two failed fractures among the 45 in type I (4%), 44 of the 119 fractures in type II (37%), none of four fractures in type III (0%) and three of ten fractures in type IV (30%). It is interesting that these results did not reveal any relationship between failure and type of classification. Using Evans' classification there were two failed fractures among 48 in type I and type II which are stable fractures, and seven of 28 in type III (26%), nine of 37 in type IV (24%), and 31 of 66 in type V (47%) which are all unstable fractures. These results reveal a significant correlation between failure and stable/unstable fractures. With the AO classification failed fractures were 19 of 87 in A1.1, A1.2, A1.3 (22%), 15 of 65 in A2.1, A2.2, A2.3 (23%) and 15 among 26 in A3.1, A3.2, A3.3 (58%). These results did not reveal any relationship between failure and the AO classification. With Singh's classification using the trabecular bone structure in the proximal part of the contralateral femur as a measure of osteoporosis, there were 33 failed fractures in 85 osteoporotic patients (grades I, II and III; 39%), and 16 failed fractures of 93 non-osteoporotic patients (grades IV, V and VI; 17%). Thus these results reveal a significant relationship between failure and osteoporosis. A possible relationship between the stability of the fracture on Evans' classification and osteoporosis on Singh's index was investigated. Stable fractures with no osteoporosis accounted for 36 fractures, but one of these did in fact displace. Stable fractures with osteoporosis numbered 12, and one failed. There were 57 unstable fractures with no osteoporosis of which eight failed. Thirty-nine of 73 unstable fractur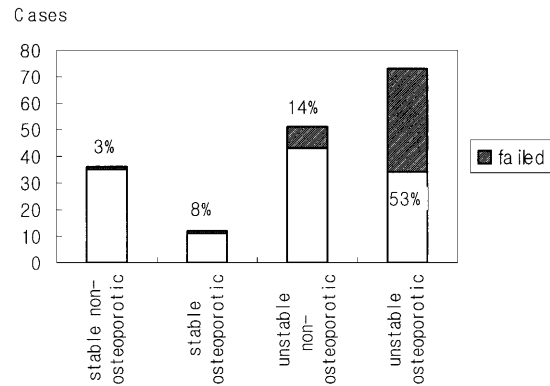es with osteoporosis failed. These results reveal a high positive correlation between the failure rate of unstable fractures with osteoporosis (Fig. 1).

Fig. 1 Unstable fractures combined with osteoporosis show a markedly high failure rate

Discussion

In the late 1970s and early 1980s many authors reported excellent results of treatment for femoral intertrochanteric fractures with the use of a dynamic hip screw [10, 17]. Although a sliding screw device has many advantages such as controlled impaction of the fracture site, a short operation time and no need for osteotomy, unstable fractures which are comminuted at the posteromedial cortex often displace because of excessive sliding and extrusion of the lag screw [10, 21]. Steinberg and associates reported that the failure rate was increased when this excessive sliding was more than 15 mm [21]. We noted shortening of the affected limb and hip pain to be associated with sliding of more than 20 mm. Common causes of failure of fixation are instability of the fracture (most important), osteoporosis [6, 9, 11, 19], lack of anatomic reduction [14], failure of the fixation device [7], and the location of the screw in the femoral head [3, 12, 22]. However, we believe that the most important cause of fixation failure is the instability of the fracture.

We applied each classification method to a pre-operative film and then calculated the relationship between the instability using each classification method and the failure rate. When Evans' classification was compared with the other methods, it was found to be the most accurate for predicting a failure of fixation. Osteoporotic and unstable fractures using Singh's and Evans' classification had a high rate of collapse (53%). Although Singh's classification for osteoporosis has a greater observer variation and less diagnostic accuracy than dual energy X-ray absorptiometry [9], it seems to be valuable in diagnosing extreme osteoporosis. Chan and Gill [2] reported that patients with femoral intertrochanteric fractures treated with a hemiarthroplasty bore substantially more weight on the injured limb in the immediate post-operative period when compared with patients in whom a stable or unstable fracture had been treated with internal fixation. In

Fig. 2 Pre- and post-operative radiographs show a well-reduced fracture and an implanted bipolar hemiarthroplasty for an unstable osteoporotic intertrochanteric fracture

elderly patients an accurate pre-operative assessment of both osteoporosis and of the instability of their fracture using Singh's and Evans' classifications, can predict post-operative collapse, or failure. The results of our study suggest that the use of Evans' classification and Singh's classification for femoral intertrochanteric fractures on the basis of a pre-operative radiograph allows for an accurate prediction of any post-operative failure of fixation and maintenance of reduction. If an unstable fracture according to Evans' classification is combined with osteoporosis, then treatment with a bipolar hemiarthroplasty should be preferred to the use of fixation by a dynamic hip screw (Fig. 2).

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