HOW EFFECTIVE ARE OSTEOTOMIES FOR UNSTABLE INTERTROCHANTERIC FRACTURES?

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Osteotomy has been used in the treatment of unstable intertrochanteric hip fractures in an attempt to increase the stability of the fracture fragments. We have assessed this stability in a randomised prospective trial on 100 consecutive patients, all having fixation by an AO dynamic hip screw, comparing anatomical reduction with two types of osteotomy.

The groups were similar in terms of age, gender, mental test score, and fracture configuration. There were more failures of fixation in the osteotomy groups, and the operations took longer. We found no clear benefit from osteotomy and therefore recommend anatomical reduction and fixation by a sliding hip screw in most cases. Rarely, a fracture configuration which does not allow load-sharing between the fracture fragments and the device may benefit from an osteotomy or the use of an alternative implant.

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Sliding hip screws have been shown to give better results than fixed devices for the treatment of trochanteric fractures of the femur (Bannister and Gibson 1983; Heyse-Moore, MacEachern and Jameson Evans 1983; Esser, Kassab and Jones 1986). Before these screws were introduced some surgeons used either a medial displacement osteotomy (Dimon and Hughston 1967; Wolfgang, Bryant and O'Neill 1982) or a valgus osteotomy (Sarmiento and Williams 1970) for unstable fractures to convert them to more stable configurations. There are opposing views on the need for osteotomy, especially with the use of sliding devices. Den Hartog, Bartal and Cooke (1991), in a cadaver study, found that a valgus osteotomy increased the mean load to failure, but Chang et al (1987), also using cadavers, reported that anatomical reduction increased the transmission of medial cortical

load and lowered the tensile strain on the plate, compared with medial displacement osteotomy. Rao et al (1983) also found no benefit from medial displacement osteotomy in a retrospective study of 39 patients, but Harrington and Johnston (1973), in another retrospective study, supported the use of medial displacement osteotomy with a sliding hip screw. Clark and Ribbans (1990), after a prospective study, suggested that anatomical reduction was the treatment of choice, although they had more failures of fixation in this group.

Our study examines first whether osteotomies achieve their objective of a more stable configuration and secondly, by a prospective randomised trial, assesses the need for osteotomies in the treatment of unstable intertrochanteric fractures.

PATIENTS AND METHODS

A consecutive series of 100 patients with unstable intertrochanteric fractures of the femur was treated with AO dynamic hip screws (DHS) at the John Radcliffe Hospital, Oxford, over a two-year period. After excluding those with multiple injuries, pathological fractures or severely arthritic hips, patients were randomly allocated to receive either anatomical reduction and fixation or an osteotomy and then fixation. Both groups were followed prospectively. The study was approved by the Central Oxford Research Ethics Committee.

Fractures were defined as unstable by the presence of one or more of the following:

- 1) four parts (Dimon and Hughston 1967),
- 2) medial cortical comminution (Evans 1949),
- 3) reverse obliquity of the main fracture line (Evans 1949),
- 4) a large and separate posterior trochanteric fragment (Dimon and Hughston 1967), and
- 5) subtrochanteric extension (Sarmiento and Williams 1970).

The home circumstances, level of mobility, medical history and Abbreviated Mental Test Score (Hodkinson 1972) of all the patients were recorded before and after the operation, and all were followed up until union of the fracture or failure of the fixation. Randomisation was achieved by means of sealed envelopes held in the operating theatre, the type of operation to be performed being determined from a table of random numbers. The

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surgeon performed a valgus or medial displacement osteotomy according to personal preference; there was no difference in the proportions of different fracture patterns in the two osteotomy groups. The grade of the surgeon, the operating time and the amount of blood transfused were recorded. Patients were mobilised weight-bearing as soon as possible, usually on the second or third postoperative day.

Radiographs were taken preoperatively, on the first postoperative day, at six weeks and at subsequent reviews. The pattern of the fracture and the Singh osteoporosis grade (1 to 3 or 4 to 6) were recorded (Singh, Nagrath and Maini 1970). Postoperative radiographs were measured to determine the sliding distance available in each fixation, by subtracting the known length of the threaded part of the screw with its accompanying shoulder from the length of screw protruding from the barrel. On postoperative and review films the length of screw protruding from the barrel and the distance of the tip of the screw to the joint line were compared to determine the actual distance of screw slide and the amount by which the screw had cut into the head. Magnification and rotational errors were corrected by a factor obtained by measuring the apparent length of the plate and barrel of the fixation device and comparing it with the known dimensions of the implant.

During most of the study period, standard devices were used, but late in the series a short-barrelled device (25 mm barrel) became available and was used when the screw length required was less than 85 mm. In the last 20 cases two of these were used in anatomical fixations and nine after osteotomies.

RESULTS

Of the 100 patients, 55 had an anatomical reduction and DHS fixation. The other 45 had an osteotomy followed by DHS fixation; 25 valgus and 20 medial displacement osteotomies were performed. The mean age of the patients was 82 years (60 to 100); there were 15 men and 85 women. There was no significant difference between the groups treated by osteotomy or by anatomical fixation in terms of age, gender, degree of independence, mental test score and medical or drug history. There were 91 four-part fractures, and nine three-part; 86 showed medial cortical comminution, 34 had a large separate posterior trochanteric fragment and 15 had subtrochanteric extension. Only one showed reverse obliquity of the fracture line. Singh osteoporosis grades were 1 to 3 in 77. There were no significant differences between the two groups in pattern of fracture or osteoporosis grading.

In all the anatomical fixations 135° DHS plates were used; five of the osteotomies were secured with 150° plates and 40 with 135° plates. The mean screw length in the anatomical group was 90 mm and in the osteotomy group 68 mm ($p < 0.001$). The mean operating time was 0.78 hours in the anatomical group and 1.16 hours in the

osteotomy group ($p < 0.001$). Mean blood transfusions were 1.59 units in the anatomical group and 2.03 units in the osteotomy group (NS). Senior registrars performed 36% of the osteotomies and 24% of the anatomical fixations; the remaining operations were done by registrars.

Nine patients died in hospital, four in the anatomical group and five in the valgus osteotomy group. Two other patients in the anatomical group died at home before union. This left 89 surviving patients for full analysis of the results. Twelve of these patients (13.5%) had failure of the fixation before union, four out of 49 in the anatomical group and eight out of 40 in the osteotomy group. The odds ratio for failure of fixation in the anatomical group compared with the osteotomy group is 0.36 (95% confidence interval 0.08 to 1.46). In nine cases the screw had penetrated the joint, in two it had cut out of the neck, and in one case the plate had pulled off the femoral shaft. Other postoperative complications were similarly frequent in the two groups.

At review we found no difference in pain, mobility, limping or walking distance between the two groups. Radiographs, however, showed differences in the amount of sliding within the implant during union, and in the amount by which the screws had cut into the femoral heads. The sum of sliding and cutting-in was recorded as 'settling' (Fig. 1). This differed in the operation groups (Fig. 2). Settling of over 10 mm was seen in 50% of the anatomical group, 35% of the valgus osteotomy group and 10% of the medial displacement osteotomy group. This may suggest that greater stability was achieved after medial displacement osteotomy.

In both osteotomy groups, all the failures occurred after a fixation in which the amount of slide available was less than 10 mm, due to effective shortening of the femoral neck. Figure 3 shows the distribution of slide available by operation type and shows the large percentage of osteotomy patients whose fracture fixation allowed less than 10 mm of slide. After a short-barrel device became available a subgroup of 20 patients was treated. Nine of 11 patients treated by osteotomy needed this short barrel to allow sufficient slide since the screw length selected was less than 85 mm, but the short barrel was needed in only two of nine treated without osteotomy. There was only one failure of fixation in this subgroup; this was after osteotomy.

There were seven failures in the 34 patients who had an osteotomy before the introduction of the short-barrel device but only one failure in 11 treated after this. The use of a shorter barrel, when screws less than 85 mm are selected, increases the slide available and may reduce the failure rate.

DISCUSSION

The groups were generally well matched, their fracture configurations were similar, and the functional and

Fig. 1

The settling (sum of sliding and cutting-in) in mm (mean $\pm$ SEM) for each type of operation.

medical outcome was also similar. Technical failure of the fixation is a serious problem in these frail elderly people, and almost always necessitates further surgery and prolonged rehabilitation with less chance of regaining an independent existence. Osteotomy did not appear to reduce this.

The aim of an osteotomy is to obtain a more stable configuration, which will allow less movement of the fracture fragments under physiological load. Our results show that many osteotomies did not achieve this objective (Fig. 2). Failures in the osteotomy group were attributable to the reduction of the amount of sliding available, because of the shortening effect of the osteotomy on the femoral neck. The use of a shorter barrel, later in the series, increased the sliding potential and appeared to reduce the failure rate. The addition of an osteotomy increased the operating time, the technique is more difficult and there is a longer learning curve.

Successful fixation requires sharing of the load between the fracture fragments and the implant. All four failures in the anatomical group had an identifiable cause: two had subtrochanteric extensions, one had reverse obliquity of the fracture line and in one the screw was too high in the head. Thus there may be some fractures, such as those with reverse obliquity, which cannot be made

Fig. 2

Distribution of settling in each type of operation.

Fig. 3

Distribution of slide available for each type of operation.

stable by an anatomical DHS. For this small group an osteotomy or the use of a different implant may be appropriate.

We conclude that many osteotomies do not achieve their objective of putting the fracture into a more stable configuration. We found no clear benefit from osteotomy

when the AO dynamic hip screw was used and therefore recommend anatomical reduction and fixation by a sliding hip screw in most cases, taking care to choose an implant which will allow sufficient slide.

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