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Outcome of valgus osteotomy in recent fracture of neck of femur with powels angle more than 50 degree: A prospective study

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> **Abstract**---Background: Vertical femur neck fractures are prone to nonunion due to shear forces. This mechanical component that causes nonunion is corrected with intertrochanteric valgus osteotomy. Osteotomy has historically been reserved for fractures that have been neglected for more than three weeks or for nonunion following screw fixation failure. In the primary therapy of a fracture neck of the femur, valgus repositioning osteotomy is not a conventional method. In this study, we assess this management strategy as an alternate treatment for specific conditions. Patients and Methods: This study comprised 12 adult patients with recent vertical femoral neck fractures. The age ranged from 20 to 48 years old. Ten guys and two ladies were present. There were seven mid-cervical fractures and five subcapital fractures. Vertical fractures were treated with valgus osteotomy (angle more than 50 degrees). Due to renal insufficiency, three individuals developed osteoporotic fractures. The intertrochanteric osteotomy was performed to transform shear pressures into compression forces with the goal of reducing the fracture angle to 25 degrees. The average follow-up time was 45 months. Results: The average postoperative angle was 28 degrees. The average neck-shaft angle after surgery was 142 degrees. With complete weight bearing, all fractures healed in an average of 17 weeks. The Harris hip score was 88 on average, with ten individuals receiving excellent or good performance. Three individuals had 1-1.5 cm of limb lengthening. Avascular necrosis was not reported in any of the patients during the follow-up period. Conclusion: Primary valgus

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repositioning osteotomy is an important treatment in the primary therapy of the fracture neck of the femur in vertical fractures to prevent nonunion and in fractures with bone softening to prevent early displacement and metal failure.

Keywords---valgus intertrochanteric, repositioning osteotomy, femoral neck fracture.

Introduction

Because of the large joint response force exerting to move the fracture, the fracture neck of the femur is inherently unstable [1]. Secondary displacement and nonunion are prevalent even in well-reduced and repaired fractures [2,3]. Valgus reduction alone may not be enough to improve mechanics, as shear forces continue to act, resulting in reduction loss and nonunion [1]. Intertrochanteric valgus repositioning osteotomy tries to address this mechanical aspect by shifting the vertical fracture's inclination to a more horizontal one, resulting in fracture compression [1,4]. Osteotomy has long been suggested for fractures that have been neglected for more than three weeks or for nonunion following screw fixation failure [4,5]. The use of valgus repositioning osteotomy in the primary therapy of femur fracture neck fractures is not common. The purpose of this study is to see how effective valgus intertrochanteric osteotomy is for treating recent femoral neck fractures.

Materials and Methods

For one year, twelve adult patients with recent intra-capsular femoral neck fractures were studied in a hospital setting. Their average age was 32 (range 20-48 years). Ten guys and two ladies were present. All of these symptoms appeared the day after the event. In nine cases, the mechanism of injury was high-velocity trauma (road traffic collision and fall from a height) and low-energy trauma (fall) (osteoporotic fractures). Antero-posterior (AP) radiographs were taken, including hips and lateral (frog leg) views. The limb was internally rotated 15 degrees in the AP radiograph to adjust for the typical anteversion of the femoral neck. The fracture angle was determined as the angle between the fracture line and the perpendicular to the femoral axis. Fractures were classified according to anatomical type (subcapital or midcervical) and then classified according to displacement (Garden) [6]. Singh's Index [7] was used to grade the severity of osteoporosis. Seven fractures were mid-cervical and five were subcapital in site, according to anatomical type. Eight people were affected on the right side, while four were affected on the left. In a renally compromised patient with coxa vara, nine fractures were entirely displaced (Garden IV), two fractures were partially displaced (Garden III), and one fracture was in place (Garden II). All of the fractures were vertical, with a fracture angle more than 50 degrees. Following preoperative evaluation, all patients had valgus osteotomies performed. Three of the individuals developed osteoporosis (grade I Singh). Two of the patients had renal osteodystrophy and needed dialysis, while the third had renal impairment. By tracing the radiographs on paper, the fracture angle was measured and preoperative planning for the needed angle correction was determined (Fig.1-A).

Surgical technique

All procedures were performed in a supine posture on a radiolucent operating table with an image intensifier. To enable for hip mobilisation, the lower limb was cleaned and draped loose. Before the osteotomy, the lateral approach was used, and the fracture was closed by manipulation and temporary fixation with several guide wires. The osteotomy necessary was calculated during preoperative planning. This angle is meant to modify the fracture (shear) angle to the ideal (optimal) 25 degree angle (Fig.1-A). The fracture will be under pure compression at this ideal angle (as stated by Pauwel [1]). The guide wire's point of entrance was determined (slightly above the blade's targeted entry site), and the wire was inserted into the femur's neck and head (Fig.1-B). The angle between the wire and the femoral shaft was verified to ensure it was equal to the angle calculated during planning. The difference between the implant angle and the osteotomy angle is equivalent to this angle. If a 30 degree osteotomy correction is needed and the implant angle is 120, the guide wire (and blade) should be 90 degrees from the femoral shaft. The wire was directed at the femoral head's inferior half. After that, the sitting chisel was used to prepare the blade of the plate. The requisite intertrochanteric osteotomy was achieved by cutting the proximal limb parallel to the blade and the distal limb with a metal triangle cut at the same angle. The plate was attached to the femur after the limb was abducted. In five patients (Fig. 2), a double-angled 120° blade plate was utilised for fixation of the femoral neck fracture and the intertrochanteric osteotomy, and a 130° singleangled plate was employed in seven fractures (Fig. 3). A suction drain was used to seal the incision in layers.



Fig. 1A. Preoperative planning is done by tracing of the upper femur on a transparent paper. The fracture angle (F) is the angle between the fracture line and the vertical line to the anatomical axis (A). The osteotomy angle is calculated by subtraction of 25 degrees (the optimal angle) from the fracture angle. The

proximal cut of the osteotomy is at the upper part of the lesser trochanter (L). The

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point of entry (P) is at least 2 cm above this line with an angle to the anatomical axis that equals the instrument angle (120) minus the osteotomy angle.



Fig.1B. Intra-operative screen shot of the guide wire aiming to the inferior half of the head with the preplanned angle (in this case 90 degrees).



Fig. 2-A. Following high-velocity trauma, a 26-year-old man suffered a totally displaced vertical fracture neck of the right femur. The angle of fracture was 86 degrees. Fig. 2-B. After first valgus osteotomy and blade plate fixation, postoperative radiograph. With a fracture angle of 36 degrees, a 50-degree osteotomy correction is demonstrated. Fig. 2-C. The fracture and osteotomy have healed one year after surgery, according to an AP radiograph. The patient got a positive outcome.



Fig. 3-A. AP radiograph of a 33 old man with vertical fracture neck of left femur above previous healed femoral fracture fixed by plating. The fracture followed a motor vehicle accident. Fig. 3-B. Postoperative radiograph after primary valgus osteotomy and 130° blade plate fixation. The fracture angle is horizontal (25 degrees) and the neck shaft angle measures 140 degrees. At the final follow-up, the score was excellent.

After 6 weeks of nonweight bearing mobilisation with two crutches, partial weight bearing was allowed until full weight bearing was allowed after complete healing. Following stitch removal, outpatient clinic visits began 6 weeks after surgery and continued every 6 weeks thereafter, with clinical and radiological evaluation. The Harris hip score (HHS) [8] was used to record the functional evaluation. Measurement of pre- and post-operative fracture angles, neck shaft angle, and limb length discrepancy (LLD), as well as fracture healing, were all part of the radiographic evaluation. The lack of the fracture line and the presence of bridging trabeculae across the fracture site were used to define radiographic union. The distance between the lowest point on both lesser trochanters and the horizontal line of the pelvis was used to calculate LLD. The average follow-up time was 45 months (range 36-53 months).

Results

Table 1 shows a summary of the clinical and radiological findings. One patient suffered intra-articular penetration of the implant blade, resulting in a painful hip after the implant was removed, while two patients had superficial wound infections. These infections occurred in renal failing patients and were treated with wound debridement and antibiotics with no long-term consequences.

Clinical results

At the final assessment, all patients were examined. The clinical evaluation was completed, and the HHS's functional evaluation was documented. Seven patients had an exceptional result, three had a good result, and two had a fair result at the final follow-up. The HHS scored 88 points on average (range 71-96). Five of the patients had a little limp. The fair result in two patients was owing to a sore hip in one patient (complicated by blade penetration) and renal failure and a low activity level in another patient (Fig. 4).

Radiographic results

The average fracture angle before surgery was 65 degrees (range 52-88). The average fracture angle after surgery was 28 degrees (range 22-36 degrees). The average neck-shaft angle after surgery was 142 degrees. With an average time of 17 weeks, all fractures were joined with full weight bearing (range 12-24 weeks). Three individuals had 1-1.5 cm of limb lengthening. The LLD was on average 6 mm. Avascular necrosis (AVN) was not found in any of the patients until the end of the follow-up period (averaged 45 months).



Fig. 4-A. A 36-year-old lady with chronic renal failure and a vertical osteoporotic fracture neck of the left femur on an AP radiograph. She had shattered her right hip a year ago and was fitted with a cemented Thompson prosthesis. Fig.4-B. A close-up of the fracture reveals an 88-degree fracture angle, coxa vara, and

osteoporosis, as well as the possibility of nonunion. The femoral heal's trabecular pattern is lost. (grade I Singh). Fig.4-C. Six months after surgery, the fracture and osteotomy have healed, and the neck-shaft angle has returned to normal. Due to

the low amount of activity, the ultimate result was assessed as fair.

Discussion

Healing problems are common in femur neck fractures [9]. About one-third of patients experience nonunion [2]. Femoral neck fractures in young individuals differ from those in elderly patients. They usually affect healthy individuals with normal bones who have been exposed to high-energy trauma [10-13]. The nonunion rate was reported to be as high as 59 percent in one study of patients

aged 20 to 40 who had received high-energy trauma [11]. Young people are more likely to have vertical shear fractures, which are more difficult to minimise and hold with internal treatment than oblique fractures [10]. In these patients, primary valgus osteotomy has two advantages over the standard therapy of numerous lag screws. It does two things: first, it converts shearing forces into compression forces by putting the fracture site perpendicular to the resultant of body weight forces; and second, it buttresses the head of the femur from below to promote internal fixation stability [4]. Osteoporotic femoral neck fractures, particularly those that are vertical and displaced, are another rationale for this surgery. The blade plate provides a more secure fastening than purchasing screws. There may be coxa vara from long-term bone softening illness in these osteoporotic fractures, and the valgus osteotomy will actually restore the architecture of the upper femur (Fig. 4). Primary valgus osteotomy was proven to be beneficial for these two purposes in this investigation. All fractures and osteotomy sites showed signs of this. In 10 of the 12 patients, the results were satisfactory.

In a few series, primary intertrochanteric valgus osteotomy has been described with union rates ranging from 94 to 100 percent [14-16]. This treatment has only been used in one set of osteoporotic fractures [15]. The rate of AVN in these series ranged from 8 to 14 percent, which is lower than the 16 percent reported in a meta-analysis of 106 published studies [2]. This benefit of primary osteotomy can be linked to adequate stable fixation and the possibility that the osteotomy has a biological role in revascularizing an ischemic femoral head [15]. A neck fracture is thought to mend and a necrotic head can be vascularized, albeit this requires long-term appropriate fixation [17].

The technical challenges of this operation can be handled with meticulous preoperative planning and the selection of the appropriate implant. Blade plates, whether single-angled 130° or double-angled 120°, provide advantages over the dynamic hip screw that has been employed in some research [18-20]. These benefits include reducing the incidence of AVN by preventing femoral head reaming [21] and providing adequate osteoporotic bone purchase. Hammering helps to compress the fracture via impaction of the plate. Said et al favoured the use of a 130° blade-plate since the doubly angled 120° blade-plate causes medialization of the proximal femoral shaft. If this occurs, it can be harmful, creating strain on the knee's medial ligament, genu valgum, and eventually knee osteoarthritis [16]. As a result, if practical, we prefer to use the single-angled 130° blade-plate. The use of a 120° blade-plate, on the other hand, should be reserved for severe vertical fractures (angles more than 70) requiring high degrees of correction. If the 130 plate is utilised, this will lessen the wedge required (given the same angle of blade entry).

Mechanical drawbacks of the procedure include valgus orientation of the proximal femur which decreases the abductor lever arm and therefore increases contact pressure on the head [20]. Another drawback of valgus osteotomy is limb lengthening. In nonunion, there is shortening due to collapse of the femoral neck and lengthening is advantageous. In recent fractures, lengthening can be a problem. Lengthening produced by the valgus osteotomy can be controlled by the angle of the wedge, its size (full, two-third), and the lateral displacement of the femoral shaft [22]. All osteotomies in this study were performed with a full-size wedge to limit the effect of the osteotomy on limb lengthening. Primary intertrochanteric valgus osteotomy can be a successful alternative to other fixation procedures if proper preoperative planning and technical measures are followed. The study's shortcomings include the small number of instances (only 12), the retrospective character of the study, and the possibility of selection bias. This is a preliminary study to see how primary intertrochanteric valgus osteotomy affects the outcome of femoral neck fractures. These limits do not negate the technique's benefits, but they do urge more research into the challenging questions of the technique's proper indications, restrictions, and long-term outcomes.

Conclusion

Although valgus repositioning osteotomy was first published in the treatment of femoral neck fracture nonunion, its use as a primary therapeutic technique for femoral neck fractures is warranted in this study. It can be an effective therapeutic option for nonunion-prone fractures such as vertical neck fractures in young people and individuals with low bone quality.

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