CLINICAL ARTICLE

Surgical Treatment of Basicervical Intertrochanteric Fractures of the Proximal Femur with Cephalomedullary Hip Nails

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Objective: To study the outcome of basicervical intertrochanteric fractures of the proximal femur treated with cephalomedullary hip nails.

Methods: The clinical outcomes of 32 cases of basicervical intertrochanteric fractures treated with cephalomedullary hip nails from January 2008 to June 2010 were retrospectively reviewed and the progress of fracture healing and occurrence of complications recorded. The function of the hip joints was evaluated by the Harris social index 2 years postoperatively.

Results: Thirty patients were followed up until fracture union for at least 24 months. Twenty-seven fractures had healed with no loss of position by 12 months postoperatively; the remaining three had mild varus deformity of the hip joint. No patient had evidence of avascular necrosis of the femoral head. No cut out of the helical blade was visible on radiographs. The mean Harris score was 86.5 (75–96) two years postoperatively, 11 patients having excellent scores, 15 good and 4 fair.

Conclusion: Closed reduction and proximal femur intramedullary nail fixation for basicervical intertrochanteric fractures provides stable fixation and allows early exercise. It appears to have excellent outcomes in the short and medium term.

Key words: Cephalomedullary hip nail; Fracture; Intertrochanteric; Outcome; Surgery

Introduction

Intertrochanteric femur fractures are one of the most serious causes of mortality and morbidity in the elderly^{1–3}. Because the burdens of injury, long-term immobilization and muscle atrophy compromise muscle strength and power in the fractured limb and can lead to serious complications such as deep vein thrombosis, thrombophlebitis, pulmonary embolism, urinary and pulmonary infection and ulcers, early surgical intervention is advocated in most of these patients^{4–7}.

Basicervical intertrochanteric fractures are a particular type of trochanteric fracture in which the fracture line can be seen radiologically to cross close to the base of the femoral neck and its junction with the intertrochanteric region. Bio-

mechanically, these are extracapsular fractures and usually treated by closed reduction and internal fixation. They are described as basicervical neck fractures or intertrochanteric fractures in published reports^{8–14}. Many earlier reports discuss the results of surgical management of intertrochanteric fractures; however, there was few published reports focusing on the result of surgical management of basicervical intertrochanteric fractures as a separate entity. It is unclear whether the incidence of nonunion and avascular necrosis (AVN) of the femoral head in this type of fracture is greater than for reported intertrochanteric fractures in general. These fractures do have different characteristics, compared with the intertrochanteric fractures described in earlier reports^{12,13}.

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Fig. 1 Radiograph of a typical basicervical intertrochanteric fracture.

This article presents our experience in a series of 32 basicervical intertrochanteric fractures treated by closed reduction and cephalomedullary hip nail fixation. The efficiency of this surgery was tested by assessing the maintenance of radiographic reduction and evaluating functional outcomes according to postoperative time-course measurements.

Patients and Methods

During a 2.5-year period from 1 January 2008 to 31 June 2010, 32 consecutive patients with basicervical intertrochanteric fractures were admitted and surgically treated in our department. With Institutional Review Board Approval and the patients' informed consent, these patients were enrolled in this prospective study. The patients' radiographs, injury mechanisms, fracture patterns and operative outcomes were recorded during follow-up.

The study included 25 men and 7 women of average age 47.8 years (range, 25–71 years). Thirteen fractures were caused by motor vehicle accidents, ten by falling from a height, five by strenuous exercise and four by simple falls at ground level. Comorbidities included cardiac disease in two patients, hypertension in five, diabetes in two and smoking in eight. In this group of patients, the fracture lines were close to the basicervical region (Fig. 1) Fifteen were single two part intertrochanteric fractures, eight fractures with a greater trochanter fragment, five fractures with a lesser trochanter fragment and four fractures with a comminuted basicervical region (both comminuted greater and lesser trochanter fragments). Accord-

ing to the modified Evans-Jensen classification¹⁵, there were fifteen type IB fractures, eight type IIA, five IIB and four of type III.

All patients underwent routine laboratory tests and organ function assessment after admission. In patients who were extremely weak or had cardiac or pulmonary disease, the baseline assessment included arterial blood gas analysis. Internal diseases were actively treated. During the perioperative period, i.v. fluids were infused according to physiological need and amount lost daily. Those with low blood volumes received i.v. infusions. Blood glucose concentrations and blood pressure were managed as required to achieve normal values. Tibial tuberosity or femoral supracondylar traction was used in all patients for at least three days after admission until the length of the fractured leg had been restored and the rotation significantly corrected on plain radiographs. All the patients underwent surgery as soon as their preoperative preparation was complete.

The surgical procedure used cephalomedullary hip nails and was similar to that used for most intertrochanteric fractures. Under spinal (8 patients) or general (24 patients) anesthesia, surgery was performed with the patient lying supine on a fracture table in traction. Closed fracture reduction was performed before surgery under the guidance of C-arm fluoroscopy anteroposterior and lateral/axial views and subsequently secured in traction. The affected leg was abducted, adducted and rotated to reduce the fracture. Achieving proper rotation of the femur with the patella in a horizontal position was crucial.

The operative technique followed the manufacturer's instructions, the implant used being the Proximal Femoral Nail Antirotation System (PFNA, Synthes, Solothurn, Switzerland). The PFNA includes a cannulated intramedullary nail with a reduced angle of mediolateral bending (6°) to allow insertion into the greater trochanter, a helical blade and an interlocking screw. After insertion of the nail, the helical blade was inserted into the femoral head. The blade was placed in the middle-inferior 1/3 of femoral neck on the anteroposterior view and in the middle 1/2 on the lateral view. Distal locking screws prevent rotation of the nail within the femur. The three lengths of PFNA usually used were 240 mm, 200 mm and 170 mm; it is also available with a long stem (300 cm, 340 cm, 400 cm and 420 cm).

No patients had closed suction drainage of the wound and all received antibiotic prophylaxis with i.v. injection of 1.5 g of cefuroxime before induction of anesthesia. The patients were permitted to get out of bed and sit in a wheelchair on the third postoperative day. Partial weight-bearing started about 8 weeks postoperatively. The actual time was determined by the extent of fracture healing. Weight-bearing was gradually increased as tolerated. The patients were evaluated at 6 weeks, 3 months, 6 months 1 year and 2 years postoperatively with clinical and radiographic assessment of the progress of healing and assessment of complications. The function of the hip joints was evaluated by the Harris social index score 2 years postoperatively.

Results

Of the 32 patients studied, two were lost to follow-up and the rest followed up for an average of 28.3 months (range, 24–40 months). Thirty-one of 32 incisions healed primarily with one skin slough. Clinical fracture union, which was implied by the absence of local tenderness on palpation or motion of the injured hip joint, occurred at an average of 11.6 weeks (range, 8–16 weeks). Radiographic union, as evidenced by bony trabeculae crossing the fracture interspace, occurred at an average of 14.7 weeks (range, 8–24 weeks). Of the 30 cases followed up, 27 fractures (90%) had healed with no loss of position by the 6-month check-up, and all fractures had healed with no loss of position by the 12-month check-up. The remaining three had mild varus deformity of the hip joint. No patients had any evidence of AVN of the femoral head according to clinical assessment and radiographs two years postoperatively. No cut out of the helical blade was visible on radiographs. Of the 30 patients, 22 had returned to their pre-injury level of occupation or daily activities; 6 had mild discomfort on prolonged walking and mildly restricted motion of the hip joints and 2 had pain and reduced mobility subjectively.

The Harris social index was used to evaluate the outcome of surgery. The mean Harris social index score was 86.5 (range, 75–96) 2 years postoperatively, including 11 cases rated as excellent, 15 as good and 4 as fair. With regard to their subjective perception of the outcome of surgery, 16 patients stated they were highly satisfied, 10 satisfied, and 3 moderately satisfied. Only one patient stated poorly satisfied and this was because of pneumonia and congestive heart failure, which was unrelated to the surgical intervention or implant. Images of a typical case are shown in Fig. 2.

Discussion

Basicervical intertrochanteric fractures are a particular type of trochanteric fracture that has rarely been reported as a separate entity^{4–7}. We define this fracture as a trochanteric fracture in which the fracture line crosses close to the base of the femoral neck and its junction with the intertrochanteric region on radiographs and there is only partial connection with the cortical bone of the superior edge of the greater or lesser trochanter.

These fractures have different characteristics, compared with the trochanteric fractures reported in earlier series. In our case series, 78.1% of patients (25/32) were aged less than 65 years and the mean age was 47.8 years, whereas the mean age in previous reported series of trochanteric fractures may as old as 75 years. There were more men than women in our series, the number of men being three times that of women (23 vs 9). High energy force was the main cause of these fractures. In our series, 13 fractures (40.6%) were caused by motor vehicle accidents and 10 (31.3%) by falling from a height. Low-energy falls at ground level accounted for only 12.5% of all patients (4/32), whereas they are the main cause of the peritrochanteric fractures in previous series. The main mechanism for these fractures seems to be a shearing force along the longitudinal axial

combined with a lateral rotational force with or without direct impact on the trochanteric region. Patients with these fractures have significant symptoms with a shortened and extremely externally rotated lower limb. Lateral X-ray films can help to assess superior–inferior separation and severe fractures may have comminution of the trochanteric region. Most of these fractures cannot be reduced by regular traction and rotation of the extremity, surgical intervention is therefore advocated to achieve an ideal alignment.

A variety of fixation devices are currently available for intertrochanteric fractures, including dynamic hip screws (DHS), percutaneous compression plating (PCCP), intramedullary nails and external fixators^{2,3,16–19}. However, the clinical outcomes of each of these devices is controversial, different studies reporting varying results. Treating intertrochanteric fractures with DHS reportedly has various complications, such as screw cutout of the femoral head, loss of reduction, non-union and malunion with hip varus deformity or marked shortening of the injured limb^{20–23}. Intramedullary nails are advocated for unstable peritrochanteric fractures and reverse trochanteric fractures, in which they generally have satisfactory outcomes; however, the failure rates reported by some studies are still very high^{17,20,24–28}.

In our study, we found that treating basicervical intertrochanteric fractures by closed reduction and PFNA internal fixation has good outcome, including low re-operation rates, in the intermediate term, which is in accordance with some published reports^{24,26}. Nonunion and AVN are the main complications after internal fixation of intracapsular femoral neck fractures¹². In our group, there was no evidence of AVN of the femoral head on radiographs two years postoperatively. There are two possible explanations for the absence of AVN. First, basicervical intertrochanteric fractures are extracapsular fractures. Second, because closed reduction with PFNA fixation is a minimally invasive technique, it is associated with very little intraoperative blood loss. However, more cases and longer follow-up are needed to reach definite conclusions about the incidence of AVN in basicervical intertrochanteric fractures. The PFNA procedure has the following advantages: (i) it is minimally invasive and causes little damage to the blood supply of the femoral neck; (ii) it can be performed quickly and easily and guarantees stability even in inherently unstable fractures; and (iii) being an intramedullary fixation device, it theoretically provides more efficient load transfer than does a sliding hip screw. It has the further advantage of reduced likelihood of infection. With unstable fracture patterns, intramedullary nails reportedly provide greater rigidity for maintaining fragment stability than does DHS^{25,27}.

Based on our experience, we offer the following treatment recommendations which are crucial for the intermediate and long term outcome of basicervical intertrochanteric fractures.

1. Use presurgical tibial tuberosity or femoral supracondylar traction to achieve primary reduction and muscle relaxation; this may prevent contracture of soft tissue and iatrogenic damage to the blood supply. This step should last

Fig. 2 Radiographs of a basicervical intertrochanteric fracture in a 67-year-old male treated with closed reduction and PFNA fixation. (a) Preoperative X-ray film. (b) X-ray film 3 weeks postoperatively. (c, d) X-ray films 18 months postoperatively showed fracture had healed with no loss of position.

Fig. 3 A Diagrams illustrating the distraction effect (V effect) on trochanteric fragments on insertion of the intramedullary nail.

for at least three days. However, a long duration is not necessary, because traction only provides limited reduction.

2. In cases where the fracture is hard to reduce, a debonder can be used to distract the fracture slightly under traction and rotation in order to facilitate reduction. The debonder holds the fracture position until the blade is inserted into the femoral head.
3. During insertion of an intramedullary nail's massive empennage, there is a distraction effect (V effect) on the trochanteric fragments, which increases the incidence of hip varus deformity or nonunion (Fig. 3). With the assistant holding the greater trochanter in position, a reamer with high rotation speed can be used to enlarge the proximal femur; this diminishes the V effect.

4. Accurate positioning of the helical blade is necessary. It is hard to extract the helical blade after positioning and repeated manipulation causes bone loss, which may induce loosening of the implant.

5. Just as the tip apex distance (TAD) might be a useful predictor of lag screw cut-out in DHS fixation of intertrochanteric fractures²⁹, positioning of the blade in the femoral head is also believed to be a determining factor for cut-out. We try to position the blade with a TAD of less than 25 mm.

In conclusion, we have shown that surgical treatment of basicervical intertrochanteric fractures of the femur by closed reduction and cephalomedullary hip nails is very effective. Presurgical traction, anatomic reduction and rigid fixation with intramedullary nails are the keys to achieving a good outcome.

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