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RESEARCH ARTICLE

FIXATION OF BASICERVICAL AND RELATED FRACTURES USING DHS WITH DRS

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ABSTRACT
Background: Basicervical fracture is a fracture through the base of femoral neck at its junction with the intertrochanteric region. Due to this location, it represents an intermediate form between femoral neck, usually fixed with multiple cancellous screws, and the intertrochanteric fracture, fixed with a sliding screw device. Previous studies recommended treating basicervical fractures as intertrochanteric fractures with the dynamic hip screw (DHS). However, because basicervical fractures have greater instability than stable intertrochanteric fractures, poor functional outcome may be expected when the DHS used alone.
Aims & Objective: To evaluate the outcome of fixation of basicervical and related fractures using DHS with DRS.
Materials and Methods: We prospectively studied 42 patients in order to identify a group of proximal femoral fractures having liability for axial and rotational instability, and to present results of their fixation using the dynamic hip screw (DHS) with derotation screw (DRS).
Results: At 12 months postoperatively, patients were functionally evaluated and the radiological outcome was analysed. All fractures united within an average period of 11.5 weeks. The mean sliding distance was 5.5 mm and mean shortening of the limbs was 2 mm. According to the criteria of Kyle et al. (J Bone Joint Surg [Am] 61-A:216–221), 39 patients obtained excellent results, two good and one fair.
Conclusion: We conclude that the AO types B2.1, A1.1, A2.1, A2.2 and A2.3 have a common instability denominator and therefore should be treated alike. The sliding component of the DHS allows solid fixation of the two major fragments in two planes and the DRS in the third plane.
Key Words: DHS; DRS; Basicervical Fractures

Introduction

Basicervical fracture is a fracture through the base of femoral neck at its junction with the intertrochanteric region.[3] Due to this location, it represents an intermediate form between femoral neck, usually fixed with multiple cancellous screws, and the intertrochanteric fracture, fixed with a sliding screw device.[7,22] Previous studies recommended treating basicervical fractures as intertrochanteric fractures with the dynamic hip screw (DHS).[3.7,22] However, because basicervical fractures have greater instability than stable intertrochanteric fractures[3,9,14], poor functional outcome may be expected when the DHS is used alone[7,14,19]. Trochanteric fractures are not alike. Stable trochanteric fractures usually heal well, irrespective of the fixation device. Unstable trochanteric fractures are associated with complications.[16] Nevertheless, an accurate detection of the fracture stability is difficult.[6] We have confronted specific technical difficulties when dealing with certain types of trochanteric fractures, the same as those with basicervical fracture. Therefore, we supposed that some types of trochanteric fractures perhaps biomechanically simulate basicervical fracture. Thus, we postulated that for successful internal fixation of basicervical fractures and similar fractures, they should be treated according to considerations of both femoral neck osteosynthesis and trochanteric fractures. The DHS and derotation screw (DRS) combination comprises a multiplicity of the screws, usually required for rotational stability of the neck fractures and sliding capacity, which is required for controlled impaction of trochanteric fractures. The aims of this study were to identify a group of proximal femoral fractures having potential liability for axial and rotational instability. Also, we present results of their fixation using the DHS/DRS composite.

Materials and Methods

This was a prospective study, carried out between February 2010 and February 2013, where we treated 42 patients who agreed to participate in the study.

Inclusion Criteria: Criteria for inclusion required mobility with no or one walking aid, presenting with basicervical fracture or its equivalent; a basicervical fracture, defined as an extracapsular fracture, through the base of the femoral neck at its junction with the intertrochanteric region[3], corresponding to the AO type B2.1[18]; and simulators of the basicervical fracture, defined as a trochanteric fracture in which the head–neck fragment does not remain connected to the trochanters and its inferior cortical extension is not long enough to hinder its rotational movement. We considered the simulators are the AO types A1.1, A2.1, A2.2 and A2.3.[18]

Exclusion Criteria: Criteria for exclusion included intracapsular femoral neck fractures; intertrochanteric fractures in which the head-neck fragment has connection with the trochanter(s), or has inferior cortical extension which can tether it to a distal fragment and prevent its spinning around the lag screw; and patients with advanced arthritis or with a pathological fracture. The primary assessment included determination of the fracture type. Then, the patients were interviewed about their walking ability that was classified into two categories: able to walk independently without aids and walking independently with one cane.

Operative Technique: A closed reduction was obtained under spinal or general anaesthesia and conformed using an image intensifier. A straight lateral incision was made from the greater trochanter and extended distally along the thigh. Using a guide, a threaded guide pin was inserted at the subcapital level of the femoral head. A second guide pin was placed parallel and superior to the main guide pin at a distance of about 13 mm. This provided temporary rotational stability for the fracture and prevented spinning of the head–neck fragment during reaming or screw insertion. After screw insertion, the plate was fixed to the shaft. Then, a cannulated cancellous screw, of suitable length, with washer was inserted onto the second guide pin to act as a DRS. A suction drainage system was inserted and the wound was closed.

Follow-Up: Postoperative management was individualised based on the quality of reduction obtained. Patients were allowed to walk using crutches and toe touching until the absence of pain and a good callus had been observed on radiographs. Then, progressive weight bearing was started. However, if the reduction was considered as not good, partial weight bearing was allowed only when the callus bridged the fracture gap. Patients received low molecular-weight heparin and prophylactic doses of antibiotic. Patients were discharged when primary complications had been excluded. Follow-up reviews were undertaken at 6, 9, 12 and 15 weeks, then at 6, 9 and 12 months. The outcome was assessed with data at 12 months postoperatively.

Radiological Assessment: Reduction was categorised as good if the femoral neck angle was <10° of varus or <15° of valgus compared to the contralateral hip[16] and the displacement between the fragments was <3 mm on both AP and lateral radiographs. Adequacy of the fixation was judged through assessment of the screws position within the femoral head by two independent techniques. First, the femoral head was divided into nine zones.[13] Fixation was deemed adequate if the screw was placed central/central, inferior/central, or inferior/ posterior (in AP/lateral views). Placement in the superior and/or anterior third of the femoral head was considered inadequate.[16] Second, a tip apex distance (TAD) of less than 20 mm was considered adequate.[2] Parallelism between the lag screw and DRS, if obtained, is deemed good and used as an indicator for maintenance of reduction. In the subsequent radiographs, lost parallelism in any view indicated lost reduction. Convergent placement of the DHS/DRS composite is deemed inadequate but was not considered a technical failure.[10] Technical failures were defined as lag screw penetration or cut-out of the femoral head, excessive displacement, e.g. femoral shaft medialisation, implant breakage or loosening, intra or postoperative femoral shaft fracture or non-union. Lag screw migration without femoral head penetration or cut-out was not regarded as a technical failure.[17] Downward displacement of the proximal fragment without cut-outs (Figure 2b) or DRS (alone) penetration of the femoral head (Figure 2c) were not considered technical failures. The fracture was defined as healed if there were visible trabeculae across the fracture line.[17] Time to union was calculated from the surgery date to the healing date. Nonunion was defined as the absence of bridging bone at the fracture line by follow-up at six months, including progressive displacements.[16,17] Fracture collapse was defined as the length of protrusion of the compression screw from the lateral edge of the barrel relative to entire length of the lag screw. Percentage collapse was calculated at six months postoperative and a categorisation system was developed a priori: mild collapse was defined as <10% shortening, while severe collapse was defined as >10% shortening.[16,24]

Clinical Assessment: Hip joint motion was measured using a goniometer and compared to the healthy side. Leg length was assessed by measuring the distance between the anterior superior iliac spine and the tip of medial malleolus. Lengths of the lower extremities were compared. At final follow-up, patients were evaluated according to the modified criteria of Kyle et al.[13] Patients who had a normal range of motion, minimum limp and no pain, and who rarely used a cane (provided that they had not used a cane in the prefracture period) were graded as having excellent results. Patients who had a normal range of motion but a noticeable limp and occasional mild pain and who use a cane (provided that they had not used a cane in the prefracture period) were graded as having good results. Patients who had a limited range of motion, a noticeable limp, and moderate pain, and who used two canes or a walker, were graded as having fair results. Patients who had pain on any motion and who were in a wheelchair or were non-ambulatory were graded as having poor results.

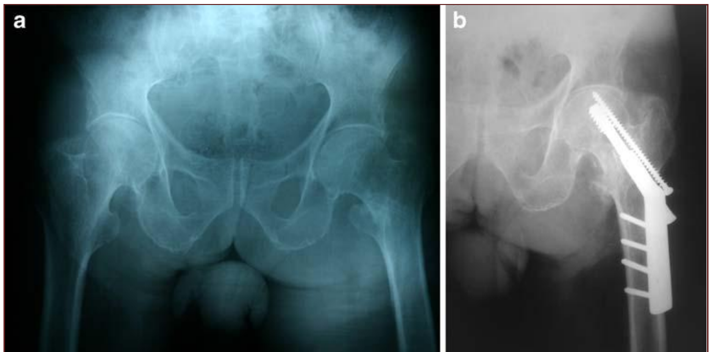

Figure-1: Heterotopic ossification corresponding to Brooker's classes II and III

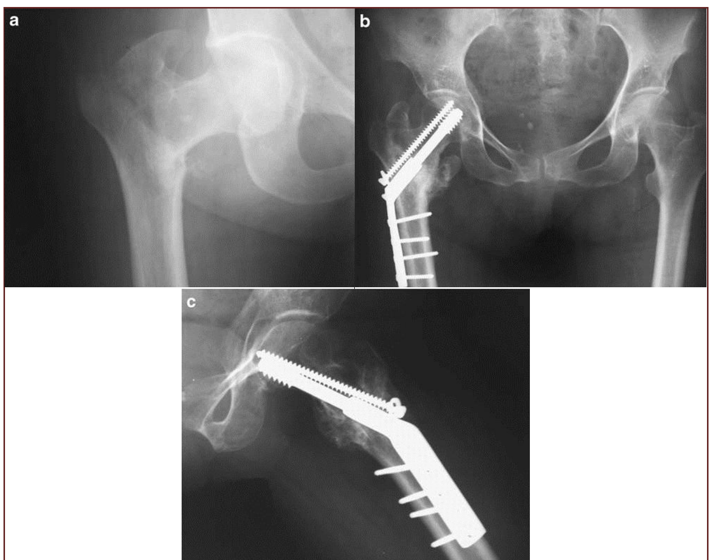

Figure-2: Fixation of DHS/DRS combination

Results

The baseline data of the 42 patients included in the study. The mean time lag before sugary was 3.9 days (range 1–14 days). Reduction was considered adequate in 39 patients (92.86%); in three patients (7.14%), reduction was considered inadequate. Reasons for inadequate reduction were that the shaft–neck angle exceeded the contralateral by 18° in one patient (2.38%) and displacement between the fragments was >3 mm in two patients (4.76%). Adequate fixation was reported in 39 patients (92.86%) and inadequate in three hips (7.14%). Reasons for inadequate fixation were the TAD exceeded 20 mm and superior placement of the DHS/DRS composite. Placement of the DRS was considered adequate in 40 patients (95.24%) and inadequate in two patients (4.76%) . There was no major displacement of the fractures during the study. All fractures united within an average period of 11.5 weeks (9–15 weeks). The sliding distance of the lag screw was <10% in 39 patients (92.86%) and >10% in three patients (7.14%). The mean sliding distance was 5.5 mm (0–12 mm). The femoral shaft–neck angle was measured at the final assessment. In 41 patients (97.62%), the differences between both sides did not exceeded 10° varus or 15° valgus. In one patient (2.38%), the angle exceeded the contralateral by 18°.

Complications

There were no cut-outs, breakage or pull-out of screws. There were no re-operations, general complications or death during the follow-up period. Superficial wound infection was noticed in the second postoperative week in one patient (2.38%). The infection was controlled within five days with daily wound dressing and antibiotics. Penetration of the femoral head by the DRS was reported in one patient (2.38%). The DHS/DRS combination was placed posterior in the lateral view (Figure 2c). The patient reported no limitation of hip motion, but reported mild pain at extremes of abduction/external rotation movements; she refused extraction of the DRS. Heterotopic ossification corresponding to Brooker's[4] classes II and III was observed in two patients (Figs. 1b and 2b). However, walking ability was regained at five months. Functional outcome Patients who used one cane increased from six (14.29 %) in the prefracture period to eight patients (19.05%) at final. Mean shortening of the injured limb was 2 mm (range 0–15 mm). In 41 patients (97.62%), there were no differences between motions at both hip joints. One patient reported flexion arc (0–90°), abduction (0–20°) and external rotation in extension (0–10°). According to the modified criteria of Kyle et al.[13], 39 patients (92.86%) obtained excellent results, two (4.76%) obtained good results, one (2.38%) obtained fair results and no poor results were reported.

Discussion

Basicervical and some fractures in the trochanteric region are biomechanically related. Definition of these fractures determines the proper fixation mode. However, management of these fractures is a continuing challenge because of difficulty in achieving stable fixation with conventional metal implants. Improvement of the biomechanical capacity of the implant through addition of a simple device therefore seems to be an attractive option. Because basicervical fracture occurs at an area of differentiation of the femoral neck to the trochanteric region, it lacks an exact definition and appropriate place within the most commonly used classification systems.[7,22] Nevertheless, it has been characterised by an extracapsular location of its fracture line.[6,18,22], high fracture angle.[3,14] and absence of muscular attachment to its proximal fragment[6]. These characteristics are applicable to the AO type B2.1[18] (Figure 1a). Based on those characteristics, we observed a similarity in between the head–neck fragment of the basicervical fracture and that of AO type A2.1, A2.2 and A2.3[18], which are equivalent to unstable Jensen types 3, 4 and 5.[21] Jensen related fracture instability to separation of the head–neck fragment from the trochanters.[11] Yet, the rotational instability of trochanteric fractures had not been frankly reported. But, all movements of a ball-and-socket joint are rotational[23] and the studies that were concerned with neck fracture reported rotational instability for the proximal fragment.[14,23,25] Therefore, trochanteric fractures in which the proximal fragment is separated from the trochanters are considered equivalent to that of the neck fractures in terms of instability.

However, AO type A1.1, which is equivalent to Jensen type 2[21] fracture, can be added to the simulators, provided that the head–neck fragment has no long inferior cortical extension. The proper AP and lateral radiograph was sufficient for detection of the relation between the head–neck fragment and trochanters.[22] In brief, the common denominator of basicervical fracture and its simulators is an axial and rotary instability. Therefore, we grouped these fractures to be managed alike. The DHS had been a conventional implant for fixation of the extracapsular femoral neck fractures.[6,16] Nevertheless, the lag screw has potential to rotate the rotationally unstable femoral head during its insertion[14,25], a factor that may increase the incidence of aseptic necrosis and nonunion[23]. Therefore, during surgery we inserted a second pin superior to the main guide pin. Postoperatively, the compression screw of DHS does not control rotation of the separated femoral head–neck fragment as well as multiple screws or pins do[19,25], particularly in elderly patients[6,8]. Therefore, placement of the DRS is deemed necessary.[7,18,19,25] However, when Jensen used the sliding screw plate (alone) in the fixation of types 2, 3, 4 and 5 fractures, the reduction could not be maintained in 11%, 56%, 61% and 78% of cases, respectively.[11] The use of a DHS has been supported by biomechanical properties, which are assumed to improve the healing of fractures.[12]

Nevertheless, some authors suggest that with use of the DHS restoration of the hip joint function may be compromised.[20] One explanation might be shortening of the femoral neck as a result of substantial compression of the fracture.[16,20] Likewise, excessive shortening of a limb is a common problem in unstable trochanteric fractures because of pronounced impaction of the fracture.[16] Some authors have addressed this problem, and different solutions have been described, such as the use of a trochanteric stabilizing plate[15], valgus osteotomy[5] and augmentation of the fracture by use of the cement[1,16]. Excessive shortening of the femoral neck was not a common problem in this study. This assertion is supported by the fact that the mean sliding distance was 5.5 mm. Mattsson et al. reported that a sliding distance of less than 6.7 mm did not affect level of the mobility.[16] However, the high fracture angle generated shear force[14], but inferior translation of the proximal fragment was not excessive in this study (Figure 2b). The mean shortening of the injured limb was 2 mm (range 0–15 mm). Pajarinen et al. reported an average 4.7 mm (range 0–25 mm) shortening of the femoral shaft in a group of patients (n=41) treated with DHS.[20] Theoretically, the DRS, which is fixed between the intact lateral femoral cortex and subchondral bone of the femoral head, can increase the axial stability of the fracture. Hence, we feel that the DRS can control inferior translation of the proximal fragment. Penetration of the femoral head was observed when a fully-threaded DRS was placed posterior in the femoral head (Figure 2c). This complication can be minimised by placement of the DHS and a partially threaded DRS centrally in the femoral head.

Conclusion

We conclude that the grouped fractures have a common instability denominator and should therefore be treated a like. The sliding components of the DHS allow solid of the two major fragments in two planes with the DRS rather than the controlled impaction in the third plane. Besides the familiarity with the DHS, low cost of the DHS/ DRS combination compared to nails render this technique beneficial for patients in developing countries.

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