

# Modified valgus osteotomy of the femoral neck for late presenting femoral neck stress fractures in military recruits

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## ABSTRACT

Neglected or late presenting femoral neck stress fractures are often associated with varus deformity, with potential risks of nonunion and osteonecrosis. We proposed a surgical technique whereby a wedge osteotomy was performed at the basal part of the neck, on the tensile surface, keeping the inferomedial femoral neck as a hinge. The femoral shaft was abducted to close the osteotomy site and it was fixed with three cannulated cancellous screws. Three military recruits who presented with neglected femoral neck stress fracture with varus deformity were operated on with the proposed modified femoral neck valgus osteotomy. All the fractures united without any complications and the patients resumed their professional activity.

**Key words:** Neglected, femoral neck fracture, stress fracture, valgus osteotomy

## INTRODUCTION

Femoral neck stress fractures account for only 5% of all the stress fractures.<sup>1-4</sup> Although these fractures are infrequent in daily clinical practice, a strong suspicion is needed, especially when treating appropriate risk populations like military recruits and athletes. Stress fractures in military recruits are seen with an incidence of about 4 to 5%.<sup>1-4</sup> There should be a high degree of suspicion for a fatigue fracture of the femoral neck in healthy young men reporting with hip and/or groin pain during physical activities. The tension stress fractures located in the superior portion of the neck of the femur are susceptible for displacement, as compared to compression stress fractures located in the inferior part of the neck, classically seen in insufficiency fractures. One should try to differentiate tension stress fractures occurring superiorly, which need

stabilization, as compared to compression stress fractures which can be treated conservatively.<sup>2,4</sup> The diagnosis is often missed or delayed due to the non-specific patterns of clinical presentation. Moreover, a simple radiograph performed during the initial onset of symptoms is usually non-contributory.<sup>5,6</sup> Hence, femoral neck stress fractures are one of the most difficult problems to diagnose, resulting in delayed presentation. This delay in the diagnosis might lead to displacement of the fracture site.<sup>7-9</sup> The most serious complication following treatment of a partial or completely displaced femoral neck stress fracture is osteonecrosis of the head of the femur. The incidence of osteonecrosis following a displaced fracture has been reported to be between 19 and 42%.<sup>10</sup> Delayed diagnosis and varus reduction are important contributory factors for osteonecrosis.<sup>10</sup>

We describe outcome of an osteotomy at the basal part of the neck to correct the varus deformity in such a displaced stress fracture of the neck of the femur; fixed with cancellous screws in three military cadets.

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## CASE REPORTS

### Case 1

A 26-year-old military man presented to us with a complaint of pain in the right hip and a limp for a duration of eight weeks. There was no history of trauma. He consulted a local clinic after one month of his field training when he had vague pain in the right hip. A radiograph was prescribed, which showed no abnormality. He was advised anti-inflammatory drugs. Despite relief in symptoms for a

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short period, with mechanical activity his pain and limp aggravated.

Clinical examination revealed tenderness in the right Scarpa's triangle, hip flexion of  $110^{\circ}$ , abduction of  $30^{\circ}$ , adduction of  $10^{\circ}$  and external rotation of  $15^{\circ}$  and no internal rotation. There was a shortening of 1.5 cm. Plain radiographs of the pelvis with both hips showed a partially displaced femoral neck fracture with a varus deformity [Figure 1a]. The fracture surfaces were smooth. Magnetic resonance imaging confirmed the viability of the femoral head [Figure 1b]. He was offered surgical treatment and he underwent realignment osteotomy at the basicervical area. After reduction fixation was done with three partially threaded cancellous screws. Active and passive physiotherapy was started as tolerated by the patient in the immediate postoperative period. Crutch walking with non-weight bearing on the affected limb was instructed for a period of six weeks. Subsequently gradual weight bearing was allowed, with full weight bearing achieved after two months. At the end of the four-year followup, there was no evidence of avascular necrosis of the head of the femur [Figure 1c] and the Harris hip score was 92, indicating excellent functionality [Figure 2].

## Case 2

A 32-year-old military recruit presented with a complaint of pain in the right hip and inability to walk for the past seven days. There was no history of trauma. His past history revealed that he had undergone a rigorous training program of two months duration. At the end of seven weeks into training, the patient started experiencing vague pain in the right groin area. He went to a primary hospital for military recruits where he underwent a radiograph that came out to be normal. He was given a course of anti-inflammatory agents.

The patient went onto to his job as a soldier after a period of two weeks. After a period of two months, he had aggravation of pain and became completely non-ambulatory at the time of his presentation to our hospital. Clinical examination revealed tenderness in the mid-inguinal region. Examination revealed a flexion of  $90^{\circ}$ , extension of  $10^{\circ}$ , abduction of  $20^{\circ}$  and adduction of  $10^{\circ}$ , with an external and internal rotation of  $20^{\circ}$  and  $10^{\circ}$ , respectively. He underwent a plain radiograph, which showed a displaced stress fracture of the femoral neck with varus deformity [Figure 3a]. He underwent modified osteotomy of the femoral neck and the fracture site was reduced and fixed with three partially threaded cancellous screws. The postoperative protocol was



**Figure 1:** (a) X-ray anteroposterior view showing femoral neck stress fracture in a 26-year-old military personnel, (b) Magnetic resonance imaging shows viability of the femur head. (c) Radiograph after four years of femoral neck basal neck osteotomy and partially threaded cancellous screw fixation shows complete fracture union



**Figure 2:** Clinical photographs (a,b,c) showing functional outcome of the patient (case 1) at four years followup

similar to that in case 1. Complete radiographic union was noted after a period of 10 weeks. He returned to his work after a period of five months. At five years, there was no evidence of avascular necrosis of the femoral head [Figure 3b] and the Harris hip score was 94, with an excellent functional outcome [Figure 4].

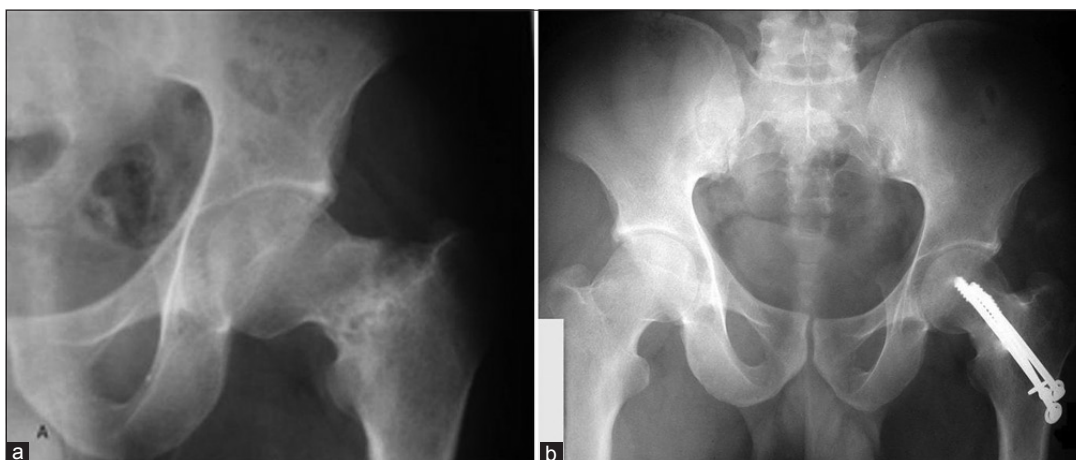
### Case 3

A 34-year-old military recruit presented to us with a complaint of vague pain in the right hip and a limp for the past six weeks. There was no history of trauma. He had gone through a fitness program for the past four weeks, which included long distance jogging, jumping and cycling for long distances. Initially the pain started within two weeks of the training program when he went to a local orthopedic clinic where his plain radiographic study showed a stress fracture of the femur neck. He was treated with a dynamic hip screw. After three months of the fixation, his pain and limp aggravated. A radiograph showed that the dynamic hip screw had cut through the neck and a tensile surface fracture of the neck of the femur, with varus deformity,

was noticed. He underwent the osteotomy procedure and fixation with cancellous screws. Fracture union was uneventful and rehabilitation was done in a similar manner as in the above-mentioned two cases. He returned to his routine activity and at the three-year followup he had a viable femoral head on the plain radiograph and an excellent functional outcome, with a Harris hip score of 92.

### Operative procedure

All the three patients were operated under regional anesthesia in a supine position, with a sand bag underneath the involved hip. The femur neck on the affected side was exposed using the Watson Jones approach.<sup>11</sup> The anterosuperior aspect of the capsule was incised in an 'L-shaped' manner and the fracture site was exposed. There was no frank mobility at the fracture site. The fibrous tissue at the tensile surface of the neck was gently nibbled out using the spinal disk forceps [Figure 5a]. Four-to-five drill holes were made over the intact inferomedial cortex of the femur neck. Then a

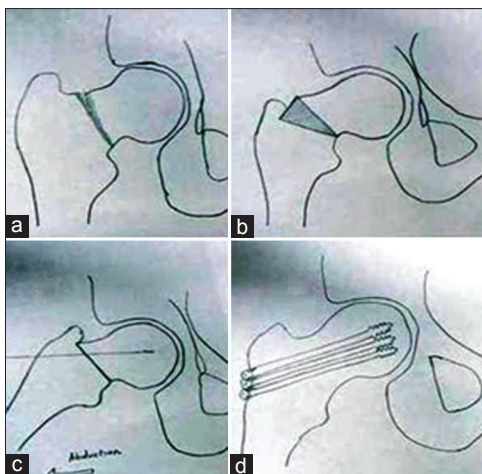


**Figure 3:** (a) X-ray anteroposterior view showing stress fracture of the femur neck in 32-year-old military recruit, (b) Five years after femoral neck osteotomy and cancellous screw fixation, the fracture has completely united



**Figure 4:** Clinical photographs (a,b,c) showing functional outcome (case 2) at five years followup





**Figure 5:** A line diagram showing (a) Stress fracture of the neck femur with varus angulation, (b) The fibrous tissue from the opened up tensile surface is nibbled out and an inverted triangular wedge of bone is resected till fresh bleeding cancellous bone is exposed, (c) By abduction of the limb, the fracture site is closed, (d) The fracture is stabilized with three cancellous screws

triangular wedge-shaped osteotomy, with the apex at the inferior surface, was made on the trochanteric side [Figure 5b]. The fracture site toward the inferior aspect of the neck was minimally disturbed. Keeping the inferior cortex of the femoral neck as a hinge point, the tensile surface was closed by abduction of the limb. The osteotomy was performed in such a manner that the neck-shaft angle of  $120^{\circ}$  to  $130^{\circ}$  was restored on abduction of the limb [Figure 5c]. After achieving this reduction, stabilization was done using three cancellous screws [Figure 5d]. The exact size of the wedge to be taken on the trochanteric side was calculated by preoperative templating, using paper tracings. The capsule was resutured using 00 Mersilene sutures. The wound was closed in layers with a negative suction drain.

## DISCUSSION

Later presentation of femoral neck stress fractures are very rare.<sup>12</sup> Although there is a recent increase in the reporting of this entity, there is little mention about any specialized surgical technique to avoid or reduce the occurrence of complications.<sup>13,14</sup> Use of planar scintigraphy performed along with single photon emission computed tomography (SPECT) and magnetic resonance imaging at an early stage avoids the delay in diagnosis leading to prompt management of these fractures.<sup>15,16</sup>

Fullerton and Snowdy<sup>3</sup> in their study of 54 femoral neck stress fractures classified them into tension side, compression side and displaced fractures. Lee *et al.*<sup>10</sup> in their study of 71 patients with stress fractures of the femoral neck classified them into five types based on the

progression of the fracture site displacement with dynamic mechanical loading, stage 1 being the occult fracture, stage 2a and 2b being the tension side and compression side fractures, respectively, while stage 3 was the partially displaced and stage 4 constituted the completely displaced fractures.

A displaced femoral neck stress fracture is a dreaded problem, as it is difficult to treat and also due to the increased rate of complications, many studies report a high incidence of delayed union, nonunion, malunion, avascular necrosis and heterotopic ossification.<sup>3,8,9</sup> The higher the displacement and varus angulation of the fracture fragments, the more adverse is the prognosis.<sup>10,17</sup> All the patients in our series had varus angulation and were partially displaced.

The surgical options with regard to the management of these fractures include internal fixation after open reduction and in addition to the above, the use of a muscle pedicle graft, fibular grafting and bone grafts have also been described.<sup>10,13-16</sup> Some authors have reported Pauwel's abduction osteotomy for femoral neck nonunion with varus deformity; however, this alters the proximal femur anatomy and may pose a challenge in the subsequent prosthesis replacement.<sup>17</sup>

In a study by Pihlaimaki *et al.*,<sup>12</sup> out of the 19 patients with displaced femoral neck fractures in military recruits, 14 were treated with a sliding hip screw after open reduction, similarly an angle blade plate was used for four patients and one patient was treated with tibial traction. They reported osteonecrosis in six, delayed or nonunion in six and severe osteoarthritis in eight patients. Lee *et al.*<sup>10</sup> in their report of surgical treatment for displaced femoral neck fractures in 42 patients, found that 10 patients ultimately required a second surgery for avascular necrosis of the femoral head. They fixed 25 fractures with multiple cancellous screws and 17 with dynamic compression screws. Of the 10 patients with osteonecrosis, eight patients required prosthetic replacement and two patients underwent core decompression and bone grafting. They further observed that among the 35 patients with valgus alignment of the femoral neck only five had avascular necrosis of the femoral head.

In elderly patients with stress fractures of the femoral neck, prosthetic replacement can be a viable option. Even though it may offer an excellent short-term outcome, in young patients there is a need for a more suitable surgical approach to preserve the head of the femur. In a report of two cases, Diwanji *et al.*<sup>13</sup> recommended valgus subtrochanteric osteotomy for stress fractures with gross displacement and varus angulation. Although realignment subtrochanteric osteotomy preserves the vascular supply to the femoral

head, it may predispose to early degenerative arthritis, ligamentous strain in the knee joint and genu valgum.<sup>18</sup> Furthermore, since the osteotomy alters the proximal femoral anatomy by medialization of the distal fragment, subsequent prosthetic replacement might be difficult in these patients.

To the best of our knowledge a comparable technique described was on malunion of cervicotrochanteric fractures, but there is no mention of any osteotomy procedure on the trochanteric side.<sup>19</sup> The technique described is based on sound principles of the above studies, hence, the vascularity of the femoral head is minimally disturbed as there is no insult to the posterior capsule. In the procedure that we offer, there is no insult to the medial circumflex artery, which lies on the posterior aspect of the capsule, as only the anterosuperior aspect of capsule is opened. Furthermore, after nibbling out the fibrous callus, the inferomedial osteoperiosteal hinge is left intact to maintain the continuity of the bony trabeculae, which is very important to decrease the risk of nonunion or delayed union. Also, as the removal of the bone wedge is from the trochanteric side, the cancellous surface of the bone is exposed, which can further augment the healing process. In addition, the end result is conversion of shear forces to compressive forces by a valgus realignment. As an end result, our procedure offers the benefit of achieving a union and avoiding avascular necrosis, without any anatomical alteration in the proximal femur and biomechanical stress over the ipsilateral knee joint. However, the indications of this technique are restricted to tensile surface femur neck stress fractures with mild displacement and varus angulation.

We conclude that the modified femoral neck valgus osteotomy performed at the fracture site (basal part of the neck) might provide an effective method of treatment for late presenting femoral neck stress fractures. As it preserves the posterior capsule and realigns the neck-shaft angle by keeping the inferomedial aspect of the femoral neck as a hinge, complications like osteonecrosis and nonunion are avoided.

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