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Accuracy of valgus osteotomy using dynamic hip screw

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KEYWORDS

Intertrochanteric valgus osteotomy
Non-union femoral neck fraction
Union rates

ABSTRACT

Background: Non-union of neck femur is a common but difficult situation to manage especially in young adults. There are two main options of arthroplasty or osteotomy. The aim of this study was to assess the results of intertrochanteric valgus osteotomy in non-union femoral neck fractures.
Patients and Methods: We present a study of 44 cases of neck femur non-union including untreated fractures, late presentations (more than 3 weeks), treated with compression screw, DHS. From 2006-2016, 44 patients presented to our institute and we analyzed them prospectively on the following criteria: Pauwel's angle, Garden classification, union at fracture site, union at osteotomy site, osteoporosis and AVN changes. Inclusion criteria were age<65, neck not reabsorbed, no AVN. Powel's angle was calculated using the anatomic axis of femur. Wedge angle is equal to Powel's angle minus 30 degree. Entry point of DHS was at the base of greater trochanter and tip of the screw was in the inferior quadrant. Y osteotomy was done in the distal half of the lesser trochanter with a proximal straight cut.
Results: Complete union was noted in 93% of the cases. One patient with uncontrolled diabetes developed severe infection and was treated with excision arthoplasty. AVN occurred in 3 cases. The Powell's angle was reduced to mean 30 (22–39). The neck shaft angle was increased to mean 140 (130–150). Limp was noted in almost all patients but they were able to walk full weight bearing with or without the support of a stick.
Conclusion: Valgus intertrochanteric osteotomy achieved good union rates and good functional outcome with minimal complications.

Introduction

Hip fractures are devastating injuries that have a tremendous impact on both the health care system and society in general. Despite marked improvements in implant design, surgical technique, and patient care, neck of femur fractures and their complications of non-union continue to consume a substantial proportion of our health care resources [1].

Non-union of neck of femur is a common orthopaedic problem. Neglected neck of femur fracture is almost always a non-union. In India, a patient may come 3–4 months after injury, untreated or treated by a bone-setter. It may be a complication of internal fixation of fracture, even if the primary surgery of osteosynthesis is well-performed. In spite of recent advances in the management, the incidence of non-union in fracture neck of femur, is 15–30% [2].

Femoral neck fractures should unite by 6 months after osteosynthesis. If there is no evidence of healing, or the patient continued to have pain at 3 to 6 months after surgery, non-union should be suspected. The possibility of avascular necrosis (AVN) should be ruled out by MRI, CT scan, or bone scan. A CT scan is extremely helpful to diagnose a femoral neck non-union. Bone scan with colometer view has 85 to 90% sensitivity and is helpful to diagnose AVN [2].

Non-union is treated either by osteosynthesis or arthroplasty. Osteosynthesis is done in the younger patients less than 50 to 60 years of age. Arthroplasty is reserved for patients above the age of 60 years of age. Osteosynthesis is done by valgus osteotomy which is preferable to other methods such as by fibular graft or muscle pedicle graft.

Intertrochanteric valgus osteotomy has stood the test of time as a good tool for: head preserving procedures which act by altering the biomechanical environment of the fracture site [3], restoring limb length, making fracture bone more horizontal, buttressing the head from below to improve stability by internal fixation [4] and converting shearing forces into compressive forces. Preoperative determination of Powell's angle [5], reducing this shear angle to about 30 to horizontal so as to achieve compression and get union are key point of this procedure. Lateralisation of the distal shaft of femur restores the mechanical axis and the problem of future knee valgus. Fixation with Dynamic Hip Screw helps to achieve lateral translation.

Indications for valgus osteotomy include: non-union of neck of femur [6,7] and vertical shear fracture patterns and delayed presentation of fracture neck femur >7 days. Other indications are

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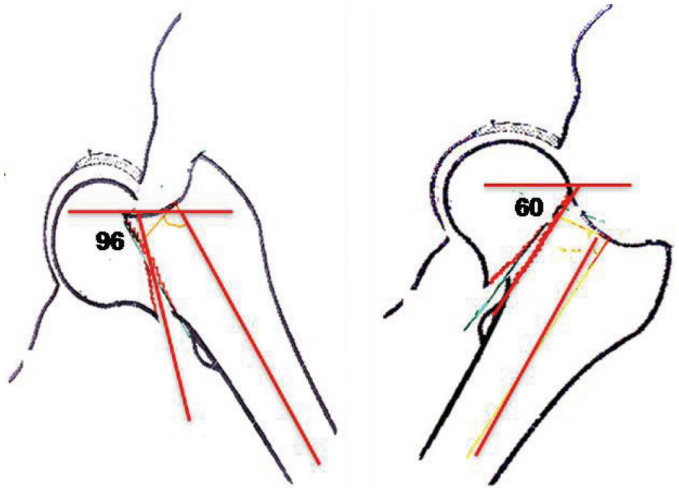

Fig. 1. While taking x-rays of hip for fracture neck femur, abduction of limb causes increased Pauwel's angle and adduction causes decreased angle because of movement of head. Fracture surface of shaft side and the midaxis of shaft femur is constant in abduction or adduction.

coxa vara in children (Figure 1), varus malunion of Intertrochanteric fracture and pathologic conditions such as fibrous dysplasia.

Care should be taken while taking x-rays of the hip for fracture neck femur to keep the limb in neutral and slight internal rotation because any adduction or abduction will change Powel's angle.

The aim of this study was to assess the results of intertrochanteric valgus osteotomy in non-union femoral neck fractures.

Materials and methods

From 2006–2016, 44 patients presented to our institute and we analyzed them prospectively on the following criteria: Pauwell's angle [5], Garden classification, union at fracture site, union at osteotomy site, osteoporosis and avascular necrosis changes.

Radiographs were taken as AP and Lateral view, traction view to rule out neck reabsortion and MRI to rule out AVN changes. Inclusion criteria were age <65, neck not reabsorbed femoral neck and no AVN.

Preoperative planning

Preoperative planning and drawing is crucial and should include the following: 1) Pauwel's angle; 2) position and type of implant, entry point on the lateral cortex and the end point of the screw or blade in the head of femur; 3) calculations of wedge angle; 4) site and type of wedge (closing or open wedge, half closed and half open is called as neutral wedge); and 5) lateral translation of the distal femur.

It is important to plan to prevent limb length discrepancy. After valgus osteotomy, the limb lengthens (1 to 3 cm) [8].

X-ray are traced on a trace paper. Surgery is done on paper. The line from the centre of the head of the femur to the tip of greater trochanter is the horizontal line. The mechanical axis of the femur (a line drawn from the centre of the head of the femur to the centre of the knee.) makes an angle of 90° to the horizontal line. As the mechanical axis makes an angle of 6° with the anatomic axis, the anatomic axis makes an angle of 84° with the horizontal line (Figure 2). Therefore, the Pauwel's angle is formed by a line at 84° to the anatomic axis and the fracture line of the femoral side (not that of head fragment).

Step 1: Determination of Pauwel's angle

Step 1 is to determine the Pauwel's or shear angle or verticality of the fracture line. Pauwel's angle is the angle made by fracture line with the horizontal line. As the head is mobile, the fracture line changes with the position of the lower limb, while taking the x-ray. With adduction, the fracture line is more horizontal and with abduction more vertical. Therefore, it is preferred to measure the angle using the anatomic axis or the mid line of the shaft of femur (as shown in the Figure 2) and the fracture line of the distal femoral fragment.

The shaft of femur, and the fracture line of the distal portion of the neck have a fixed position. The head fragment is mobile.

To determine the Pauwel's angle the mid axial line or the anatomic axis is drawn (see Figure 3). A line is drawn passing through the proximal end of the fracture line of the distal femur, making an angle of 84° with the anatomic axis. In Figure 2 the line EC is passing through the proximal end H of the fracture line (HI). The angle ECD is 84°. EC is the horizontal line and the angle EHI is the Pauwel's angle which is 85°.

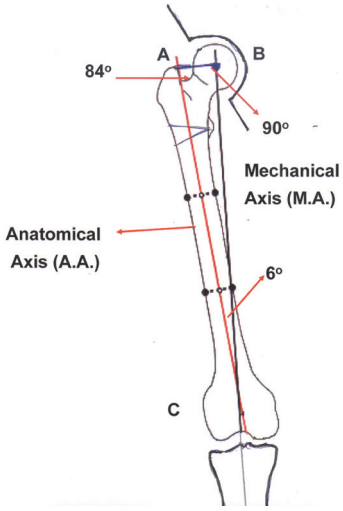

Fig. 2. The mechanical axis from the center of the head of the femur passes through the center of the knee joint. The line joining the tip of the greater trochanter to the center of the head of the femur is a horizontal line. The mechanical axis makes an angle of 90° with the horizontal line. The mid axial line or the anatomic axis is of the shaft of femur makes an angle of 6° with the mechanical axis and with the horizontal line 84°.

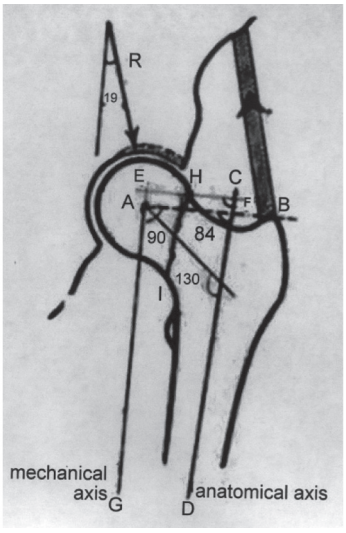

Fig. 3. Weight bearing line, passing from centre of vertebra to centre of head makes an angle of 19° to vertical line. CD is the anatomical axis or mid-axial line of shaft of femur. AB line from tip of greater trochanter to center of head of femur represents the horizontal line, the mechanical axis AG is at right angle to the horizontal line AB. Anatomical axis CD makes an angle of 6° with mechanical axis AG. R is the weight bearing line. Anatomical axis CD makes an angle of 84° with the horizontal line AB. A line EF parallel to AB passing through proximal end of fracture line H also makes an angle of 84° with CD.