

Original Research Article

# Role of Valgus Osteotomy and fixation with Double Angle Blade Plate in the management of Neglected and Ununited femoral neck fracture in young patients

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**Abstract:**

**Background:**

Non-union of femoral neck fracture in young patients is still a problem as they are too young to have hip replacement and other salvage procedures are usually unsatisfactory. Pauwels described valgus osteotomy for nonunion of femoral neck which was used by later surgeons also.

**Methods:**

We report a series of 20 patients of nonunion of femoral neck fracture which were taken up for valgus osteotomy and fixed with 120° double angled blade plate. Average age of patients was 35 years. Delay in presentation ranged from 8 weeks-58 weeks (mean 24 weeks). Average follow up was 18 months (12 months to 36 months).

**Results:**

Femoral neck fractures united in 18 patients (90%). Excellent to good results were seen in 70% patients.

**Conclusion:**

120° double angled blade plate provides rigid internal fixation after valgus osteotomy and being a more familiar fixation device simplifies the procedure and gives good results.

**Key Words:**

Non-union Neck of Femur; Valgus Osteotomy; 120° Double angled Blade Plate

## Introduction

Intra-capsular fracture neck of femur is one of the commonly encountered injuries in Orthopaedics. It is more common in elderly individuals. Only 2–3% of these occur in patients younger than 50 years.<sup>1</sup> However, the increase in high-energy trauma has contributed to the increased incidence of fracture neck of femur in younger patients. Despite improvements in the techniques of surgery and internal fixation devices, non-union (Figure 1) is still reported in one-third of cases of femoral neck fracture with displacement.<sup>2</sup> In young patients with femoral neck non-union, it is desirable to preserve the femoral head. Various treatment modalities have been described to preserve the head e.g. vascularized bone grafts<sup>3,4</sup>, muscle pedicle grafts<sup>5,6</sup>, fibular grafts with or without osteotomy<sup>7</sup> but still the best form of

treatment remains inconclusive as these procedures are technically demanding and have not given consistently reproducible results. Pauwel<sup>8</sup> postulated that in non-union of femoral neck, the problem is both biological and mechanical. He suggested that by changing the fracture inclination, the fracture site can be brought under compression, thereby resulting in union of fracture. These principles still hold true, most authors have used blade plate for fixation after osteotomy.<sup>7,8</sup> Valgus intertrochanteric osteotomy alters the biomechanical environment of the fracture site and restores limb length. We conducted a prospective study at our institution to evaluate the clinical and radiographical results of valgus intertrochanteric osteotomy and fixation by 120° double angle blade plate in the treatment of neglected and ununited femoral neck fractures in patients less

than 60 years old. Knee and ankle physiotherapy were started next day and the patients were mobilized with crutches non-weight-bearing from third postoperative day. The patients were evaluated radiographically in an outpatient clinic at 8 weeks postoperatively and further at 6-week intervals until union was achieved, after which full weight-bearing was started. Radiographic union was defined by absence of a fracture line and appearance of trabeculae across the fracture site (Figure 2). Average follow up was 18 months (12-36 months). All osteotomy sites healed in an average of 14 weeks (8-20 weeks).



Figure 1



Figure 2

### Material and Methods:

Between January 2014 and July, 2017, we performed valgus intertrochanteric osteotomies for neglected and ununited femoral neck fractures in 20 consecutive patients with mean age of 35 years (range 18–58 years). There were 14 males and 6 females with right hip affected in 12 cases and left hip affected in 8 cases. Delay in presentation ranged from 8 to 58 weeks (mean 24 weeks). The mechanism of injury was road-traffic accident in 15 patients, fall from height in four and slipping onto ground in one. All patients were in good health before the fracture and walking with/without aid. All fractures were displaced (Garden grade 3 and 4). 16 patients had undergone previous surgery. All these cases had fixation with cannulated cancellous screws except one with DHS and one case had fibular strut autografting also with varus collapse at fracture site.

Preoperatively, all patients complained of pain and limitation of hip motion and were unable to walk without support. Prior to osteotomy, average neck-shaft angle was  $95^{\circ}$  ( $80^{\circ}$ – $105^{\circ}$ ), with average limb shortening of 2.0 cm (1.5–4.5 cm). No patient was known to be diabetic. All the osteotomies were fixed by  $120^{\circ}$  double angle blade plate. The patients had minimum follow-up of 12 months and a maximum of 36 months (mean 18 months).

**Inclusion criteria-** (i) Patients less than 60 years of age with fracture neck of femur of more than or equal to 3 weeks since injury. (ii) Patients less than 60 years of age with failed primary fixation (non-union with varus collapse).

**Exclusion criteria-** Elderly patients ( $>60$  years of age) and patients who had significant changes of avascular necrosis (AVN) on plain radiography and significant resorption of femoral neck with proximal fragment less than 2.5 cm were excluded from the study.

### Surgical Technique:

From January, 2014 to July, 2017, 20 cases of non-union of femoral neck fractures in young patients (less than 60 years old) were taken up for valgus osteotomy and fixed using  $120^{\circ}$  double angled condylar blade plate. Anteroposterior radiographs of both hips in internal rotation were taken to assess for neck length and classify fracture according to Pauwel's criteria. The goal of osteotomy was to achieve a Pauwel's angle of  $30^{\circ}$  or less and hence to bring fracture site under compression. The inclination of fracture line to horizontal was measured. We planned a wedge of  $30^{\circ}$  in all cases as it is difficult to precisely measure the size of wedge. The osteotomy was planned at the level of lesser trochanter as described by Pauwel<sup>8</sup> and later modified by Muller<sup>9</sup>. The entry point of blade of condylar plate was 2 cm above the osteotomy site. The procedure was performed with patient on fracture table under Epidural block with spinal anaesthesia and under C-arm image intensifier. The skin incision was directly lateral and straight over greater trochanter and proximal femur. Vastus lateralis was cut in L-shaped manner and elevated subperiosteally. All previous internal fixation devices were removed. The fracture site was not exposed in any patient. One guide wire was placed in the

superior part of neck of femur under image intensifier control, for putting cannulated partially threaded (16 mm) cancellous screw. This screw acts as derotation screw as well as brings both fracture fragments in approximation and it avoids undue displacement of the nonunion during introduction of the seating chisel. One k-wire was introduced, parallel in the lateral plane to the guidewire in respecting the calculated valgization. The seating chisel is introduced exactly parallel to the k-wire and as caudally in the femoral head as possible under Image intensifier control in both directions and osteotomy is marked. At the level of osteotomy, proximal transverse cut and distal angled cut were made and predetermined sized wedge (usually 30°) was removed. The lower limb was swung into abduction to align the femur to plate and reduction clamps were applied. Valgus Osteotomy was closed with well seated 120° angle blade plate. The plate was fixed to femur using 4.5 mm cortical screws. The removed bone wedge was used as bone graft at osteotomy site.

Postoperatively, active exercises of hip and knee were started and non-weight bearing crutch walking began after 2-3 days. Weight bearing was delayed till healing was seen at osteotomy site on radiographs and then progressed gradually to full weight bearing.

### Results:

Average age of patients was 35 years (range 18 years to 58 years). Right side was involved in 12 cases and left side in 8 cases. There were 14 males and 6 females. There were 11 Pauwel's type 2 and 9 Pauwel's type 3 fractures in our series. Assessment of union was done by both clinical and radiological criteria. Clinically, healing was defined as pain free full weight bearing without assistance. Radiographically, healing was determined by presence of bridging trabeculae of bone crossing the non-union site on plain radiographs (Figure 2). Average follow up was 18 months (12 months-36 months). All osteotomy sites healed in an average of 12 weeks (8 weeks- 18 weeks). In 18 of the 20 patients, the fracture went on to satisfactory union after an average of 18 weeks (12–32 weeks). No patient was lost to follow-up. The average preoperative neck shaft angle of 95° (range 80–100°) increased to 130° (range 120–140°) after surgery. The average limb length discrepancy postoperatively

was 1.0 cm (range 0–1.8cm). In all patients, there was improvement in leg length discrepancy (average 1.5 cm) after osteotomy. No patient had any serious immediate postoperative complication such as deep infection or deep vein thrombosis. No patient had coxa vara, defined as neck shaft angle less than 120°.

Functional outcome was judged according to Askin&Bryan<sup>11</sup> criteria

Excellent - Full range of movements and strength, little or no pain and essentially normal appearing radiographs.

Good: Some limitation of motion, mild discomfort and mild joint space narrowing.

Fair: Some limitation of motion and moderate pain with degenerative changes or aseptic necrosis.

Poor: Severe restriction of function and pain requiring salvage procedure.

Excellent results were seen in 10 patients, good in 4 patients and fair results in 4 patients. Poor outcome was seen in two patients. One patient with poor result had avascular necrosis with collapse of head after union of fracture 12 months postoperatively. In second case, the position of blade was not central; this led to cut through of blade, out of the head after 12 weeks of surgery. Both the patients with poor results were taken up for bipolar arthroplasty. All the patients with united fractures were able to sit cross-legged, squat and do one-leg stance. Pain and limitation of motion improved remarkably, so that the majority of the patients did not have to use crutches at 6 months after operation.

### Discussion

Femoral neck fractures in young active adult patients should be treated by early closed reduction and stable internal fixation. Despite improvement in results of internal fixation due to better understanding of reduction of fracture and positioning of implants and improvement in radiography, non-union results in 4%-30% cases<sup>10, 11</sup>. Treatment options for femoral neck non-union with preservation of the femoral head include re-fixation of the fracture, re-fixation and bone grafting, a pedicle graft to provide blood supply, or a valgus osteotomy with fixation. Reports in literature suggest that if neck fracture is more than 2-3 weeks old then primary osteosynthesis with cancellous screw alone does not give good results<sup>12</sup>. Considering the fact that the

majority of patients with femoral neck fracture are over 60 years of age, have extreme osteoporosis and are poor surgical candidates, it is better to replace the femoral neck with a femoral prosthesis or a total joint replacement. In patients younger than 55 years who are in good general medical condition, with no osteoporosis and with a reasonable size of femoral neck and normal joint space, it is desirable to preserve the femoral head<sup>13</sup>. Pauwels recognized that non-union of femoral neck fracture would consolidate within few months if shearing force acting on non-union fracture site were transformed into compression forces<sup>14</sup>.

Pauwel<sup>8</sup> showed that placing the non-union of fracture neck under compression by resecting a laterally based wedge resulted in union of fracture. Pauwels carried out a simple lateral closing valgus osteotomy for non-union. For post-operative immobilization patients were placed in hip spica. This type of osteotomy resulted in shortening and marked medialization of femoral shaft which usually led to genu valgus. To overcome these problems, Muller suggested condylar blade plate for fixation after valgus osteotomy. Angelen<sup>15</sup> reported 13 patients with failed internal fixation of femoral neck treated with valgus osteotomy achieving a union rate of 100%. Wu et al<sup>16</sup> used a sliding hip screw to compress the nonunion and to realign the proximal femur. Avascular necrosis without head collapse has not been considered to be a contraindication for valgus osteotomy.

In most of case series reported in literature on valgus osteotomy<sup>17,18</sup>, blade plate fixation has been used, that's why, we have also used blade plate for fixation in our study. This technique resulted in union in 18 of 20 patients in our study. We believe that valgus osteotomy acts as a biological stimulus for healing of these fractures, promoting osteogenesis as a result of conversion of shearing forces to compressive forces across the fracture site. The osteotomy is relatively easy to perform, cost effective, provides stability and often is definitive one-time surgery. Valgus osteotomy and internal fixation with 120° double angle blade plate plays a twofold role: it converts the shearing forces into the compression forces by placing the fracture site perpendicular to the resultant of body weight forces; and it buttresses the head of femur from below to improve stability provided by the internal fixation<sup>19,20</sup>. Osteosynthesis

with blade plate in its optimum position in the femoral head, supplemented by the buttressing effect of the distal osteotomy fragment, maintains coaptation and immobilization of the fragments and provides a high degree of stability.

In our present study, because of the delay in intervention and the young age of patients, Pauwels' osteotomy was performed as the head-salvaging procedure. Union was achieved in 90% of our patients, which is quite good for any surgical intervention. Excellent results were seen in 10 patients, good in 4 patients and fair results in 4 patients. Poor outcome was seen only in two patients. One patient had avascular necrosis with collapse of head after union of fracture 12 months postoperatively and second case had implant cut out. Both the patients with poor results were taken up for bipolar arthroplasty. All the patients with united fractures were able to sit cross-legged, squat and stand on affected leg, which are needed in day-to-day life. Pain and limitation of motion improved remarkably.

We conclude by stating that valgus osteotomy and fixation with 120° double angle blade plate has high success rate in young patients with neglected and ununited intracapsular fracture neck of femur as far as the union of fracture is concerned, and internal fixation with 120° double angle blade plate is technically simple.

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