Primary treatment of femoral neck fracture in young adults using valgus osteotomy and fixation by dynamic hip screw combined with cannulated screw

Ahmed El Naggar, Waleed Nafea, Mohsen Fawzy

Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Zagazig, Egypt

Correspondence to Waleed Nafea, MD, Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Zagazig, Egypt. Tel: +20 122 337 6967; e-mails: waleednafee1999@gmail.com, waleednafea345@yahoo.com

Received: 18 June 2017
Revised: 1 July 2017
Accepted: 20 July 2017
Published: 6 January 2022

The Egyptian Orthopaedic Journal 2021, 56:251–255

Background
For most femoral neck fractures in young adults, the recommended fixation technique is with multiple cancellous lag screws. The Pauwels types I and II fractures are the most amenable to this type of fixation. A Pauwels type III fracture is a vertically oriented fracture with more than 50° inclination angle from the horizontal line on an anteroposterior radiograph. This fracture is both axially and rotationally unstable and experiences increased shear forces leading to a higher rate of failure and nonunion. The treatment of this type of fracture remains controversial. Various treatment modalities have been proposed to improve the outcome of the treatment, such as treatment with valgus osteotomy and fixation with dynamic hip screw (DHS) and cannulated screws. The valgus osteotomy converts the shear force into compression increasing the stability of the implant.
Patient and methods
A total of 12 patients (10 males and two females) with acute Pauwels type III femoral neck fractures in the age group 22–48 years (mean, 28.5 years) were managed with valgus osteotomy and fixation with DHS and cannulated screws. The patients were followed up from 1 to 3 years (mean, 20 months).
Results
Clinically, the patients were evaluated according to the Harris Hip Score. Excellent results were achieved in eight patients, good in three, and fair in one. No evidence of infection occurred in any patient. Radiologically, the fracture united in all cases 6 months postoperatively. Avascular necrosis occurred in one case.
Conclusion
Vertical femoral neck fractures in young adults can be safely managed using valgus osteotomy and fixation with DHS augmented by cannulated screws.

Keywords:
cannulated screws, dynamic hip screw, femoral neck fractures, valgus osteotomy, young adults

Egypt Orthop J 56:251–255

1110-1148

Introduction

Femoral neck fractures account for nearly half of all hip fractures with the vast majority occurring in elderly patients after a simple fall [1]. Femoral neck fractures in adults younger than age 50 years are uncommon and often the result from high-energy trauma. They account for only 2–3% of all femoral neck fractures [2].

The Garden and Pauwels classification schemes are the most frequently used to describe fractures of the femoral neck. The Garden classification is often simplified to describe fractures as nondisplaced (types I and II) or displaced (III and IV) [3]. In elderly, treatment can be recommended based on the Garden classification [2]. The Pauwels classification may be more useful for femoral neck fractures in young adults by describing the orientation of the fracture line relative to the horizontal plane. Type I fracture has a fracture line less than 30° from the horizontal, type II fracture has a fracture line between 30 and 50°, and type III fracture is greater than 50° [4]. Type III fractures are observed more frequent in young adults because they are often associated with a high-energy mechanism of injury [5]. Type III fracture pattern is more vertically oriented, causing increased shear force, varus moment, and instability, thus, it is associated with higher risk of fixation failure, nonunion, and osteonecrosis [6].

In an unstable fracture pattern (displaced and/or vertical fracture line and/or comminuted), various treatment modalities have been proposed to improve the outcome. Osteosynthesis and primary valgus angulation osteotomy is one of them [7]. The valgus osteotomy converts the shear force to compressive force at the fracture site. This increases the stability of the implant and allows for faster healing [2].

Patients and methods

From February 2011 to August 2015, we had 12 patients (10 males, two females) who presented with femoral neck fractures (Pauwels type III) as a result of road traffic accident in eight patients and falling from height in four patients. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Zagazig university, Egypt. The mean age was 28.5 years (range, 22–48 years). The right side was affected in seven patients, whereas the left side was affected in five patients. All patients were managed within 3 days of injury (range, 8–72 h; average, 20.3 h) by valgus osteotomy and fixation with dynamic hip screw (DHS) and two cannulated screws. All patients were followed up for a minimum period of one year (range, 1–3 years; average, 20 months).

Preoperative evaluation

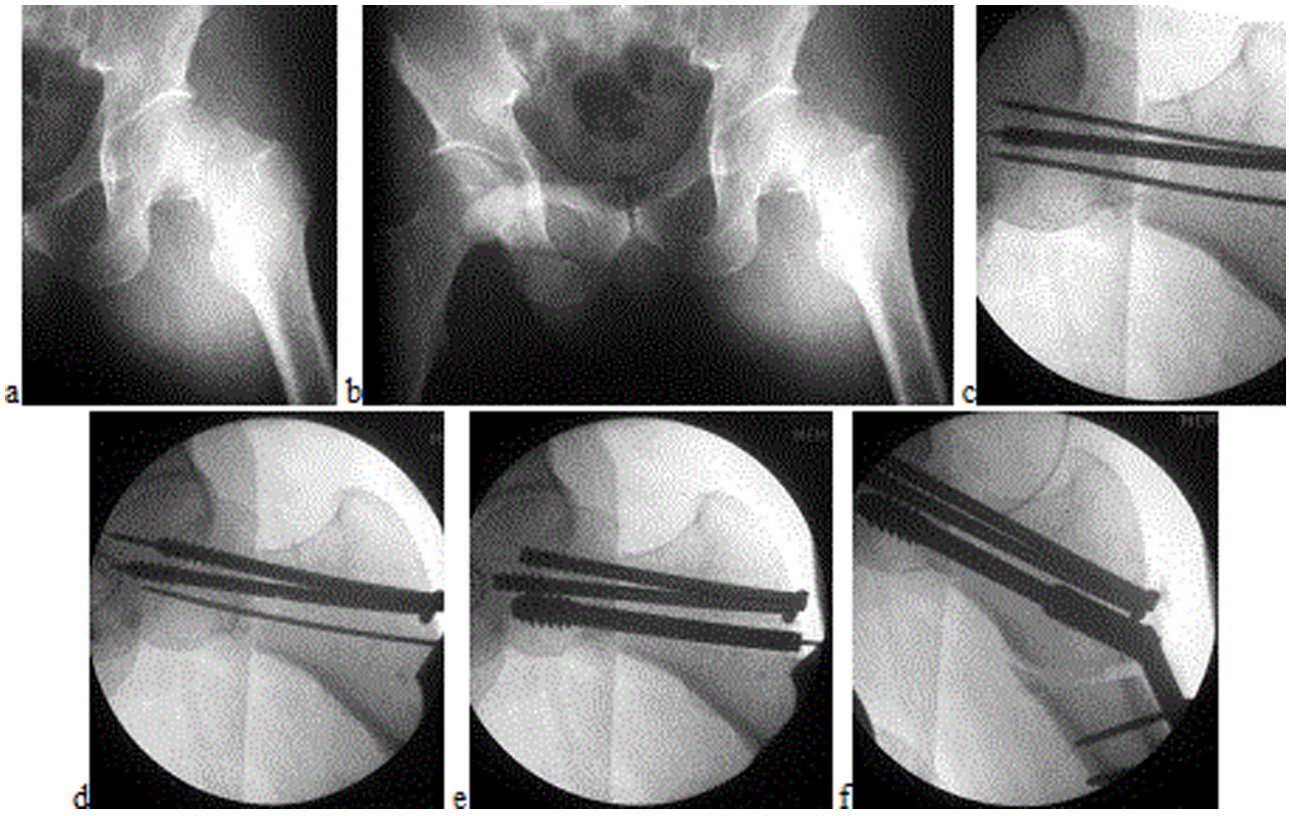
A good quality anteroposterior radiograph of the affected hip was taken. Preoperatively one should calculate the following:

(1) Pauwels angle: it was more than 50° in all cases.
(2) Wedge angle: Pauwels angle −30°.

Operative technique

All patients were operated under spinal anesthesia. The patients were taken on the fracture table. Closed reduction was achieved in 11 cases, whereas open reduction via Watson–Jones approach was required in one case. Garden's alignment index was used for assessment of adequacy of reduction. After achieving the reduction, a direct lateral incision used for a conventional DHS fixation was done. The 2.5-mm guide wire of the DHS lag screw was inserted in the lower half of the femoral neck in the anteroposterior view and in the center of the femoral neck in the lateral view (the position was confirmed by fluoroscopy). Then, another two 2.5-mm guide wires were inserted superiorly to the first wire. After that, two 6.5-mm cannulated screws with washers were inserted. Then, the tract for the DHS lag screw was performed with a triple reamer, and an appropriately sized lag screw was inserted. A lateral closing wedge osteotomy was done at the level of lesser trochanter or just below it. The angle of the osteotomy was determined intraoperatively by using two guide wires inserted at an angle equal to that of the osteotomy (Fig. 1). The wedge of the bone was removed, and the limb distal to the osteotomy site was abducted, and a DHS plate with

Figure 1



(a, b) Preoperative radiograph of Pauwels type III femoral neck fracture (c, d, and e) after closed reduction of fracture and insertion of guide wires of lag screw and cannulated screws. (f) Fluoroscopic image showing osteotomy and application of the side plate of DHS. DHS, dynamic hip screw.

sufficient number of screw holes was applied. Then, the plate was fixed to the bone using 4.5-mm cortical screws. Bone grafts of the wedge were applied at the osteotomy site. The wound was closed in layers over a section drain.

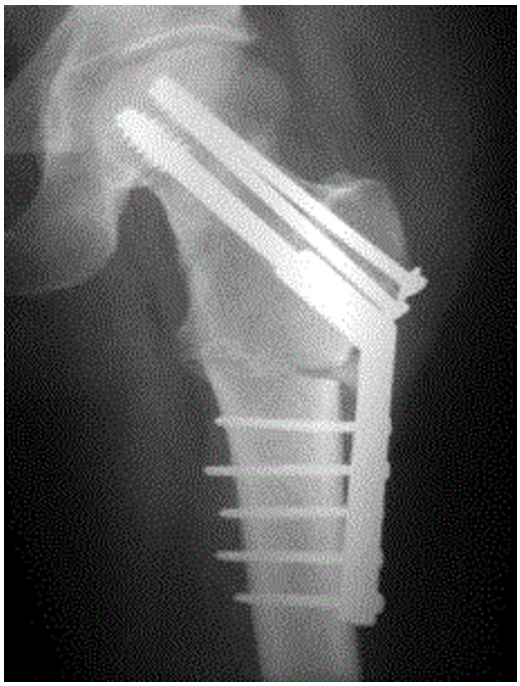
Postoperative care

No extraimmobilization was required postoperatively. Intravenous antibiotics and analgesics were given for 3 days, and then, oral antibiotics were given for another 5 days. The suction drain was removed within 24–48 h. Isometric quadriceps exercise and knee bending was encouraged on the third day and nonweight-bearing mobilization with crutches started at 3 weeks. Full weight bearing was permitted only after union. Radiological evaluation was performed every 6 weeks till bone union (Fig. 2).

Results

The preoperative mean Pauwels angle of 65±10° was converted to a mean of 31±6° after valgus osteotomy. The average follow-up period was 20 months (range, 1–3 years). Clinically, the patients were evaluated according to the Harris Hip Score [8]. The Harris Hip Score gives a maximum of 100 points. Pain receives 44 points, function 47 points, range of motion 5 points, and deformity 4 points. Function is subdivided into activities of daily living (14 points) and gait (33 points is considered fair, 80–90 is good, and 90–100 is an excellent result). Excellent results were achieved in eight patients, good in three, and fair in one. No evidence of infection occurred in any patient. Radiologically, the fracture united in all cases 6 months postoperatively (Fig. 3). Avascular necrosis occurred in one case and was managed conservatively. No implant-related complications like cutout of screws or breakage of plate occurred in any patient.

Figure 2



Immediate postoperative AP radiograph. AP, anteroposterior.

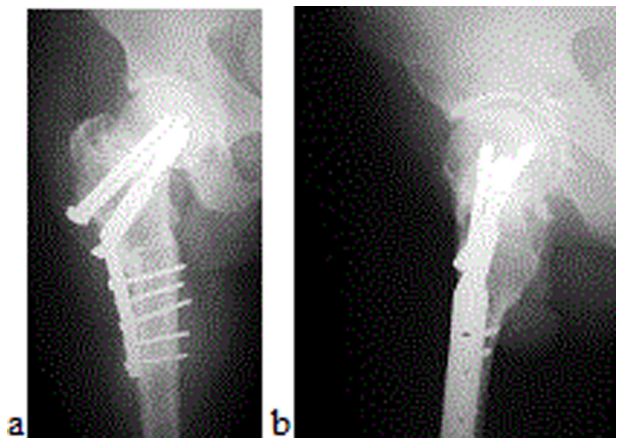
Discussion

Femoral neck fractures are commonly seen in the elderly population after a trivial fall. However, femoral neck fractures in adults younger than the age of 50 years are uncommon and often the result from high-energy trauma [2]. Although the anatomical fracture zone is similar, intracapsular hip fractures in physiologically young patients vary from those in older or clinically frail patients by the mechanism of injury, fracture pattern, surgical timing and intervention, the goals of treatment, and clinical outcome [3]. Currently, there may be sufficient evidence to support the routine use of hip replacement surgery for low-demand elderly patients in all but nondisplaced and valgus-impacted femoral neck fractures [9]. Arthroplasty procedures for young adults with displaced fractures are not ideal because of the patients 'young age and high level of activity [10].

For most femoral neck fractures, the recommended fixation technique is with multiple cancellous lag screws. The Pauwels types I and II are the most amenable to this type of fixation [11].

A Pauwels type III fracture is a vertically oriented fracture with more than 50° inclination angle from the horizontal line on an anteroposterior radiograph. These fractures with a vertical orientation are fractures

Figure 3



Six-month postoperative AP and lateral images showing healing of fracture and osteotomy site. AP, anteroposterior.

with special characteristics and whose optimal treatment remains controversial. They are both axial and rotationally unstable and experience increased shear forces compared with the conventional and more horizontally oriented femoral neck fractures [12]. The dominant shear force that is seen with this high-angle fracture pattern leads itself to a higher rate of failure and nonunion [13].

Several implants and principles have been used to treat vertical femoral neck fractures over the years. Several biomechanical studies have evaluated different implants for managing vertical femoral neck fractures. Baitner *et al.* [14] compared cannulated screws with the DHS for the management of vertical femoral neck fractures. They found that the DHS had less inferior femoral head displacement, less shearing displacement, and a greater resistance to failure when compared with the three cannulated screws. Bonnaire and Weber [15] compared different methods of fixation (DHS with antirotation screw, DHS without antirotation screw, cannulated screws, and a 130° angled blade plate) for vertical cadaveric femoral neck fractures. They concluded that the DHS with antirotation screw is the best implant for this pattern of fracture. The role of using valgus osteotomy and internal fixation for treatment of acute femoral neck fractures has been reported in the literature [16–20]. The valgus osteotomy converts the shearing forces into compression, increasing the stability of the implant. The osteotomy can be fixed with either angled blade plate or DHS. Fixation with an angled blade plate is technically more demanding and has some disadvantages. The blade plate hammer can displace the fracture, perforation and splitting of the femoral head by chisel and blade are possible risks, and compression across the fracture cannot be achieved with an angled blade plate, but is possible with the DHS [21].

In our study, there were 12 patients with Pauwels type III femoral neck fractures managed by valgus osteotomy fixed by DHS and two cannulated screws. Excellent results were achieved in eight patients, good in three, and fair in one. Union was achieved in all patients. Avascular necrosis occurred in one patient.

Compared with other related studies, in the study by Gill *et al.* [22], there were 44 patients with femoral neck fractures managed by osteosynthesis using primary double-angle barrel plate combined with valgus intertrochanteric osteotomy. Of 44 cases operated, 42 cases were followed up for an average duration of 48 months. Excellent results were achieved in 20 patients, good in 18, and fair in four. In the study by Said *et al.* [23], there were 19 cases with recent vertical femoral neck fractures managed with valgus intertrochanteric osteotomy. Union was achieved in 18 cases. Magu *et al.* [24] reported their outcome on 50 adult patients with osteoporosis who underwent a primary valgus intertrochanteric osteotomy for displaced femoral neck fracture. The interval between injury and surgery ranged from 3 to 30 days. They concluded that this is a dependable procedure for fresh fractures of femoral neck with osteoporosis. Different authors in different studies showed 70–100% union rates. Fontanesi *et al.* [25] reported 71% excellent to good results in a study of 24 patients with one nonunion and four avascular necrosis. Studies of Huang [26] and Rinaldi *et al.* [27] reported 81–89% excellent to good results.

Conclusion

Vertical femoral neck fractures in young adults can be safely managed using valgus osteotomy and fixation with DHS augmented by cannulated screws.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Pauyo T, Drager J, Albers A, Harvey EJ. Management of femoral neck fractures in the young patient: a critical analysis review. World J Orthop 2014; 5:204–217.

2 Ly TV, Swiontkowski MF. Management of femoral neck fractures in young adults. Indian J Orthop 2008; 42:3–12.

3 Scolaro J, Mehta S, Chip Routt MI. Femoral neck fracture in the physiologically young. Univ Pennsylvania Orthop J 2010; 20:5–10.

4 Bartoicek J. Pauwels' classification of femoral neck fractures: correct interpretation of the original. J Orthop Trauma 2001; 15:358–360.

5 Swiontkowski MF. Intracapsular fractures of the hip. J Bone Joint Surg Am 1994; 76:129–138.

6 Broos PL, Vercruysse R, Fourneau I, Driesen R, Stappaerts KH. Unstable femoral neck fractures in young adults: treatment with the AO 130-degree blade plate. J Orthop Trauma 1998; 12:235–239.

7 Dwarkadas TG, Sandesh TS, Gajanan DK. Primary management of fracture of femoral neck in young adults using valgus osteotomy and fixation with dynamic hip screw and plate: a case series. IOSR J Dent Med Sci 2014; 13:13–19.

8 Nilsdotter A, Bremander A. Measures of hip function and symptoms Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), Lequesne Index of Severity for Osteoarthritis of the Hip (LISOH), and American Academy of Orthopedic Surgeons (AAOS) Hip and Knee Questionnaire. Arthritis Care Res 2011; 63(S 11): S200–S207.

9 Blomfeldt R, Törnkvist H, Ponzer S, Söderqvist A, Tidermark J. Comparison of internal fixation with total hip replacement for displaced femoral neck fractures. Randomized, controlled trial performed at four years. J Bone Joint Surg Am 2005; 87:1680–1688.

10 Huang HK, Su YP, Chen CM, Chiu FY, Liu CL. Displaced femoral neck fractures in young adults treated with closed reduction and internal fixation. Orthopedics 2010; 33:12.

11 Kauffman JI, Simon JA, Kummer FJ, Pearlman CJ, Zuckerman JD, Koval KJ. Internal fixation of femoral neck fractures with posterior comminution: a biomechanical study. J Orthop Trauma 1999; 13:155–159.

12 Enocso A, Lapidus LJ. The vertical hip fracture – a treatment challenge. A cohort study with an up to 9 year follow-up of 137 consecutive hips treated with sliding hip screw and antirotation screw. BMC Musculoskelet Disord 2012; 13:171.

13 Weinrobe M, Stankewich CJ, Mueller B, Tencer AF. Predicting the mechanical outcome of femoral neck fractures fixed with cancellous screws: an in vivo study. J Orthop Trauma 1998; 12:27–37.

14 Baitner AC, Maurer SG, Hickey DG, Jazrawi LM, Kummer FJ, Jamal J, *et al.* Vertical shear fractures of the femoral neck. Clin Orthop Relat Res 1999; 367:300–305.

15 Bonnaire FA, Weber AT. Analysis of fracture gap changes, dynamic and static stability of different osteosynthetic procedures in the femoral neck. Injury 2002; 33:C24–C32.

16 Gautam VK, Anand S, Dhaon BK. Management of displaced femoral neck fractures in young adults (a group at risk) Injury 1998; 29:215–218.

17 Chandler HP, Reineck FT, Wixson RL, McCarthy JC. Total hip replacement in patients younger than thirty years old. J Bone Joint Surg Am. 1981; 63:1426–1434.

18 Claffey TJ. Avascular necrosis of the femoral head: an anatomical study. J Bone Joint Surg Br 1960; 42:802–809.

19 Howe WW Jr, Lacey T 2nd, Schwartz RP. A study of the gross anatomy of the arteries supplying the proximal portion of the femur and the acetabulum. J Bone Joint Surg Am. 1950; 32:856–866.

20 Sevitt S. Avascular necrosis and revascularisation of the femoral head after intracapsular fractures: a combined arteriographic and histological necropsy study. J Bone Joint Surg Br 1964; 46:270–296.

21 Gupta S, Kukreja S, Singh V. Valgus osteotomy and repositioning andfixation with a dynamic hip screw and a 135 single-angled barrel plate for un-united and neglected femoral neck fractures. J Orthop Surg 2014; 22:13–17.

22 Gill S, Kumar D, Raj M, Singh P, Singh J, Vishwakarma R. Femoral neck fracture in young patients, managed by osteosynthesis using primary double angle barrel plate combined with valgus inter trochanteric osteotomy – long term result. Indian J Orthop Surg 2015; 1:265–272.

23 Said GZ, Farouk O, Said HG. Valgus intertrochanteric osteotomy with single-angled 130° plate fixation for fractures and non-unions of the femoral neck. Int Orthop 2010; 34:1291–1295.

24 Magu NK, Singh R, Mittal R, Garg R, Wokhlu A, Sharma AK. Osteosynthesis and primary valgus intertrochanteric osteotomy in displaced intracapsular fracture neck of femur with osteoporosis in adults. Injury 2005; 36:110–122.

25 Fontanesi G, Costa P, Giancecchi F, Tartaglia I. Intertrochanteric valgus osteotomy and sliding compression hip screw in fractures of the femoral neck. Italy J Orthop Traumatol 1991; 17:293–304.

26 Huang CH. Treatment of neglected femoral neck fractures in young adults. Clin Orthop 1986; 206:117–126.

27 Rinaldi E, Marenghi P, Negri V. Osteosynthesis with valgus osteotomy in the primary treatment of subcapital fractures of the neck of the femur. Italy J Orthop Traumatol 1984; 10:313–320.