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# Fixation of displaced femoral neck fractures in young adults: Fixed-angle devices or Pauwel screws?

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ABSTRACT

*Background:* We sought to compare the incidence of complications after fixation of displaced femoral neck fractures in young adults treated with fixed-angle devices versus multiple cancellous screws and a trochanteric lag screw (Pauwel screw).
*Methods:* We conducted a retrospective cohort study at a level I trauma centre. Sixty-two skeletally mature patients (age range, 16–60 years) with displaced femoral neck fractures were included in the study. Forty-seven were treated with a fixed-angle device (sliding hip plate with screw or helical blade) and 15 with multiple cancellous screws placed in a Pauwel configuration. The main outcome measure was postoperative complication of osteonecrosis or nonunion treated with a surgical procedure.
*Results:* Significantly fewer failures occurred in the fixed-angle group (21%) than in the screws group (60%) ($p = 0.008$). Osteonecrosis was rare in the fixed-angle group, occurring in 2% of cases versus 33% of cases in the screws group ($p = 0.002$). Consistent with previous studies, good to excellent reductions were associated with a failure rate of 25% and fair to poor reductions were associated with a failure rate of 55% ($p = 0.07$). The best-case scenario of a good to excellent reduction stabilised with a fixed-angle device yielded a success rate of 85%.
*Conclusion:* In young patients with displaced high-energy femoral neck fractures, fixed-angle devices resulted in fewer treatment failures than did Pauwel screws.



## Introduction

In the young patient with a displaced femoral neck fracture, the goals of treatment are to achieve fracture union in the absence of osteonecrosis while preserving hip anatomy. In contrast to the elderly patient who might benefit from prosthetic replacement, in young patients, these goals are best met with internal fixation. Anatomic reduction is critical to promote and maintain femoral head vascularity and to achieve osseous union [1,2]. However, after reduction of the fracture is achieved, the best implant with which to stabilise the femoral neck is unknown.

Fixed-angle devices and multiple cancellous screws have proponents. Advantages to fixed-angle devices include increased stability under physiological loading [3–6] and a trend towards improved performance in clinical studies [7–9]. However, fixed-angle devices are technically more difficult to implant. Alternatively, multiple cancellous screws are familiar to most surgeons, preserve bone stock, and are more stable in torsion [1,10]. It is widely known that the majority of clinical and biomechanical studies use screws placed at the periphery of the femoral neck in an inverted triangle configuration.

At our institution and other North American trauma centres, when screws are used to treat a displaced femoral neck fracture, a Pauwel screw configuration is preferred. The Pauwel screw configuration features a lag screw directed from the greater trochanter into the inferior neck and multiple cancellous screws placed parallel to the femoral neck. A recent biomechanical study showed 70% increased stiffness provided by the Pauwel configuration compared with parallel screws [11]. We theorised that the Pauwel screw construct would outperform parallel screws and perhaps achieve results equal to those of fixed-angle devices.

The goal of this study was to compare fixed-angled devices with a Pauwel screw configuration for fixation of displaced femoral neck fractures in young adults. Our hypothesis was that there would be no difference between fixed-angle implants and multiple cancellous screws in the Pauwel configuration regarding postoperative complications and radiographic outcomes.

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## Patients and methods

### *Study population*

After institutional review board approval, a retrospective review of our prospectively maintained orthopaedic trauma database was conducted. We identified consecutive femoral neck fractures in skeletally mature young adults (age range, 16–60 years) who presented to our Level I trauma centre from January 1, 2001, to June 1, 2012. Each patient who underwent internal fixation of a displaced (Garden stage III and IV) (Orthopaedic Trauma Association types 31-B2 and 31-B3) [12] femoral neck fracture with a side plate and screw and blade device or with Pauwel screws was included. Patients with nondisplaced fractures; those treated with parallel screw configurations, proximal femoral locking plates, or cephalomedullary nails; and those with less than 6 months of follow-up were excluded. Patients who were shown to have clinical and radiographic union and those who suffered complications before 6 months were included.

### *Surgical procedures*

Surgery typically was performed with the patient in the lateral decubitus position. An anterolateral approach to the hip allowed both open reduction (>95% of cases) and implant placement through the same incision. Surgeon preference dictated whether a Watson-Jones or modified Hardinge approach was used to manage the abductor muscles. When the Hardinge approach was used, the abductor tendon was repaired with heavy suture at the conclusion of surgery. Regardless of the approach used, a T-shaped capsulotomy was performed to allow for hematoma decompression and direct manipulation of fracture fragments. Reduction tenacula and Steinman pin joysticks were used to reduce the fracture.

Closed reduction was rarely performed (<5% of cases). To perform closed reduction of the femoral neck, traction and internal rotation were used. When closed reduction was used, percutaneous capsulotomy was not performed.

Surgeon preference guided the choice of fixed-angle device versus Pauwel screws for fracture fixation. In general, Pauwel screws were used in fracture patterns without substantial comminution so that a true lag screw technique could be used.

### *Fixed-angle device technique*

Patients who received a fixed-angle device (fixed-angle group) had the implant placed via the same incision created for the open reduction. Multiple guidewires were placed to maintain the reduction during implant placement. Two similar implants were used in the fixed-angle group: the dynamic hip screw (DHS) and the dynamic helical hip system (DHHS) (DePuy Synthes, Inc., West Chester, PA) (Fig. 1). The DHS is placed across the fracture into the femoral head, and the DHHS has a helical blade that performs a similar function. A side plate slides over the screw and blade and is fixed to the femoral shaft, typically with two nonlocking screws, resulting in a fixed-angle device. In the majority of cases, a single 7.3-mm cannulated derotational screw was placed before implant placement. Before placing the DHS, a tap was used to avoid rotational malreduction during screw placement in hard bone. Likewise, during impaction of the DHHS blade, care was taken not to distract the fracture.

### *Pauwel screw technique*

In patients who received Pauwel screws (screws group), after reduction was achieved, either a solid 4.5-mm or cannulated 7.3-mm lag screw was placed from the greater trochanter into the nonarticular portion of the inferior femoral neck. This was followed by multiple (typically two to three) 7.3-mm cannulated screws placed parallel to the femoral neck (Fig. 2).

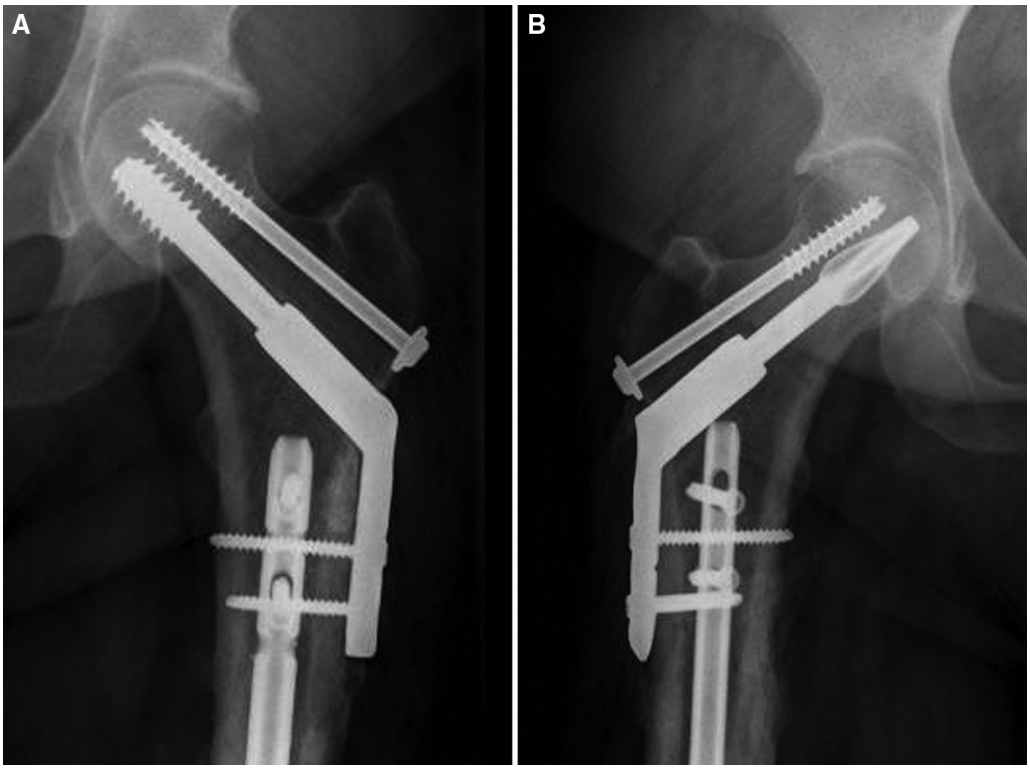


**Fig. 1.** (A) Patient treated with a DHS and derotational screw. (B) Patient treated with the DHHS and derotational screw.