

# Surgical Treatment of Femoral Neck Fractures in Young Adults

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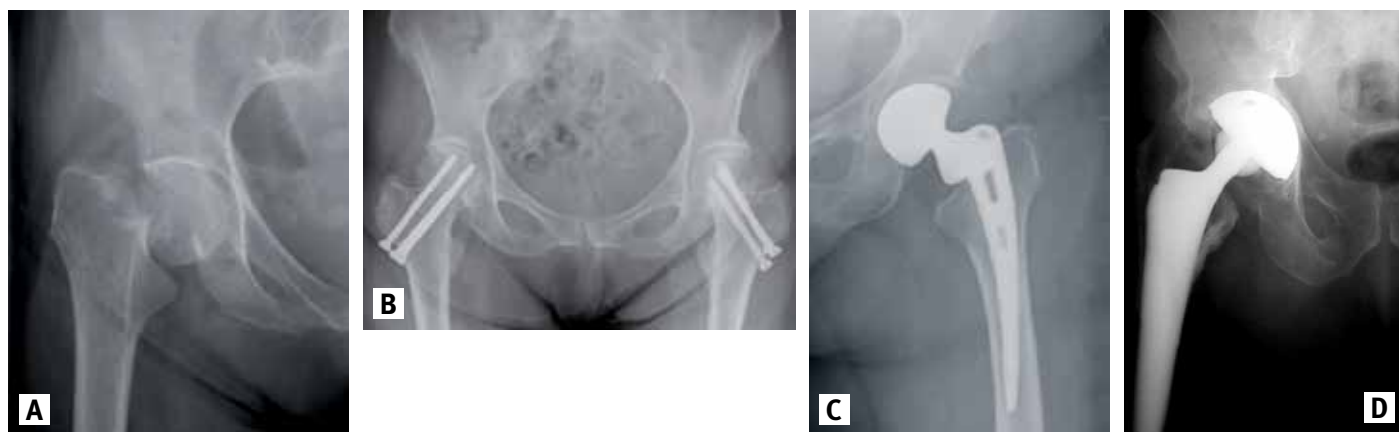
**F**emoral neck fractures are usually observed in the elderly population after a simple fall or minor trauma [1]. Most of these patients are over 65 years old with poor bone quality and progressive osteoporosis. The independence and quality of life in the aged individual is adversely affected following such fractures. In contrast, in young adults, femoral neck fractures are uncommon (about 2–3% of all femoral neck fractures) and are often due to high-energy trauma caused by road traffic injuries, work injuries, or fall from a height [2–4]. Patients often present with multiple

traumatic injuries, such as other fractures, or head, chest and abdominal trauma [5].

The classification of femoral neck fractures is based on the degree of displacement. Most are subcapital intra-articular fractures. The two main classification systems in use were devised by Pauwel in 1930 and Garden in 1961. Pauwel's classification is based on the angle of femoral neck fracture relative to the horizontal axis, as follows: type I < 30 degrees relatively horizontal, type II 30–50 degrees, type III > 50 degrees. A type I femoral neck fracture is more stable due to the compressive forces that predominate. Type II and mainly type III femoral neck fractures are more vertically oriented and more unstable, resulting in increased shear force, varus moment and instability. Type III fractures are seen more frequently in young adults; achieving fixation is more difficult and they have a higher risk of fixation failure, mal-union, non-union and osteonecrosis [3]. The Garden classification

is based on the degree of displacement of the femoral head (Garden I = incomplete fracture of the femoral head with valgus impaction, Garden II = non-displaced complete fracture of the femoral neck, Garden III = complete fracture with partial displacement of the femoral head, Garden IV = complete fracture with complete displacement of the femoral head). The unstable fractures – namely Pauwel type III or Garden types III and IV – are seen in young adults more frequently; achieving stable fixation is more difficult and they have a higher risk of fixation failure, mal-union, non-union and osteonecrosis [3,6,7].

The surgical management of femoral neck fractures comprises various options: a) closed or open reduction with internal fixation of the fracture, b) hemiarthroplasty by hip arthrotomy, c) removal of the fractured head and its replacement by an implant, or d) removal of the fractured head and total hip arthroplasty [Figure 1].



**Figure 1.** Optional treatments for subcapital hip fractures in young adults: **[A]** displaced subcapital fracture of the hip joint (Garden type IV), **[B]** anatomic reduction and fixation by cannulated hip screws, **[C]** bipolar hip replacement, **[D]** total hip arthroplasty

**Figure 2.** Anatomic closed reduction and percutaneous fixation of a subcapital hip fracture (Garden type II) with three cannulated screws in a 53 year old patient.

**[A]** Subcapital hip fracture (type II), **[B]** anatomic reduction and fixation by three screws (AP and axial views)



Selection of the mode of treatment depends on the patient's age, level of activity, medical co-morbidities, degree of bone density, and degree of displacement of the femoral head. Most surgeons prefer to treat non-displaced fractures (Garden types I and II) in both young and elderly patients by internal fixation but prefer arthroplasty for displaced fractures (Garden types I and II) in patients above 80 years [8]. For young adults with good bone quality and high functional demands, it is important to preserve the natural hip anatomy and mechanics. However, there is a relatively high incidence of loss of fixation, non-union and avascular necrosis of the femoral head after internal fixation of displaced femoral neck fractures [9-11]. Patients with types I and II femoral neck fractures are at low risk for osteonecrosis. However, it is accepted that a femoral neck fracture in a young patient should be considered an orthopedic emergency, the preferred treatment for young patients being anatomic reduction of the fracture and stable fixation.

Various authors claim that anatomic reduction and accurate implant placement will assure a good outcome after closed reduction and internal fixation of intra-articular hip fractures. However, the question remains: what is the best method of fixation of subcapital femoral fractures in young adults, and how should it be implemented. Many authors are of the opinion that best results will be achieved with fixation using cancellous screws, as demonstrated in Figure 2. Pal et al. [12] noted that fixation with cancellous screws and fibular

strut grafts for neglected femoral neck fractures in young patients, 17–50 years old, was associated with good outcomes [12]. There is still controversy regarding which method of screw fixation of intra-articular hip fracture is optimal. Mei and co-authors [13] found the inverted isosceles triangle to be the best screw configuration for femoral neck fracture fixation. Dewei and Xiaobing [14] demonstrated the successful use of cannulated compression screws and a vascularized iliac bone graft in the treatment of displaced fracture of the femoral neck in patients aged < 50 years [14]. Similar results were observed by Stein and Volpin [15] in comparable patients who developed osteonecrosis of the femoral head. Schwartzmann and team [16] observed non-union in 3% of their patients treated successfully with valgus intertrochanteric osteotomy and avascular necrosis (AVN) in 16% of the patients. The incidence of necrosis in patients under age 50 treated with dynamic hip screw fixation (DHS) was twice as high as in older patients. Displacement is a predictive factor of osteonecrosis and is associated with a high and anterior position of the screw in the femoral head [16]. Bonnaire and Weber [17] examined four different fixation methods of Pauwel type III fractures (sliding hip screw with additional derotational screw, sliding hip screw without additional derotational screw, cancellous screws, and a 130° angled blade plate) for cadaveric femoral neck fractures. They found the sliding hip screw with the derotational screw to be the best implant for this fracture pattern

**Figure 3.** A 59 year old patient with degenerative changes and avascular necrosis of the femoral head following open reduction and fixation of subcapital fracture (type III) by sliding hip nail and derotational hip screw. **[A]** Degenerative changes and avascular necrosis of the femoral neck following open reduction and fixation by sliding hip nail and derotational hip screw. **[B]** The patient was treated with a non-cemented total hip arthroplasty



[17]. Figure 3 illustrates the development of degenerative changes and avascular necrosis of the femoral head with shortening of the femoral neck following open reduction and fixation by sliding hip nail with additional derotational hip screw. Various authors hold that anatomic reduction and accurate implant placement promises a good outcome after closed reduction and internal fixation of intra-articular hip fractures. Most authors recommend that surgical intervention be performed as early as possible, most suggesting 6–12 hours after injury [2,18,19].

In this issue of *IMAJ* Kenan and co-authors [20] describe their experience of a long follow-up, 8–17 years, of 27 young patients under age 60 (mean age at the time of initial fracture 44 years, range 23–59) after reduction and fixation of displaced subcapital hip fractures using cannulated screws. Four of the 27 (14.8%) developed

non-union or femoral head avascular necrosis and had therefore undergone a hip arthroplasty. All reoperations were performed within the first year after fracture fixation; all these patients were in the 50–60 year age group. Based on their findings, the authors concluded that internal fixation using fracture reduction and cannulated screw fixation is a successful treatment modality for displaced subcapital hip fractures in patients under age 50.

According to the literature, anatomic reduction and accurate implant placement seem to be the key to a successful outcome of intra-articular hip fractures in young adults. This can be achieved in most cases by cannulated screws or dynamic hip screw with the addition of a derotational screw. Most authors recommend that surgical intervention be performed as early as possible. Osteonecrosis of the femoral head and non-union are the two most common and challenging complications of such fractures, observed in about 15–30% in most series, and may be treated with hip subtrochanteric valgus osteotomy or by hip arthroplasty.

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