

Osteonecrosis of the Femoral Head in Garden 1 Femoral Neck Fractures

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Abstract

Introduction: Femoral neck fractures are a common public health problem and femoral head osteonecrosis represents the ultimate complication of this disease.

Methods: We conducted a retrospective study of 102 Garden 1 femoral neck fractures managed by a conservative surgical treatment. We studied the occurrence of femoral head osteonecrosis and its risk factors.

Results: The mean age was 63 years. On radiographs, Pauwels type III fractures accounted for 50% of fractures and a posterior femoral head tilt more than 10° was found in 75% of cases. The average preoperative delay was 7.18 days, 43.75% of patients were operated between the 3rd and the 7th day. Full weight bearing delay was less than 3 months in 78.12% of cases. Osteonecrosis occurred in 31.4% of cases in an average delay of 11.37 months. Risk factors with a statistically significant correlation with the occurrence of osteonecrosis were a preoperative delay between the 3rd and 7th day ($p=0.006$), Pauwels type III fractures ($p<0.001$), a femoral head tilt $>10^\circ$ ($p<0.001$) and a full weight bearing delay <3 months ($p=0.02$).

Conclusions: Femoral head osteonecrosis is a serious complication in undisplaced femoral neck fractures. The understanding of its occurrence risk factors is the key in avoiding it.

Keywords: Femoral neck fractures; Osteonecrosis; Risk factors

Introduction

Femoral neck fractures (FNF) are the prerogative of older people particularly females in whom osteoporosis is more important [1]. Impacted coxa valga fractures classified stage I according to Garden classification, represent 5% to 15% of FNF. They have a special status compared to other fractures of the proximal femur, as they are considered, wrongly, as benign and stable.

Nevertheless, several authors estimate that approximately 20% to 30% of these fractures were secondarily complicated by the occurrence of osteonecrosis which represents the ultimate complication of this disease [2,3].

It's a primary public health problem, with a heavy human and socio-economic cost. Knowledge of this common disease is a national priority.

We tried through this retrospective study of 102 patients with Garden 1 femoral neck fracture to list the risk factors for the onset of osteonecrosis in these fractures and to highlight some recommendations.

Methods

This was a retrospective study of 102 medical records of patients who had a Garden 1 femoral neck fracture (Figure 1), managed by a conservative surgical treatment, in the period between January 2003 and December 2010, with a minimum follow-up of 4 years. We studied the epidemiology of our patients, the type of fracture and

displacement. In the treatment, we studied the delay of surgery, the type of osteosynthesis and the surgical techniques. After which we studied the occurrence of the femoral head osteonecrosis, as well as its risk factors.

Results

Epidemiology

The mean age was 63 years. The sex ratio was 1.04. The study of patient history showed that conditions were dominated by hypertension (39.2%) followed by diabetes (25.5%) and cardiovascular diseases (21.5%). The majority of our patients had a domestic accident (76.5%). Road traffic accidents and workplace accidents accounted for 13.7% and 9.8% of etiologies.

Fracture

Left side fractures were slightly predominant (56.9%). On AP pelvis radiographs, we used the Pauwels classification to study the orientation of the fracture line. Pauwels type III fractures accounted for 50% of cases.

On lateral view radiographs, the majority of our patients (75%) had a femoral head tilt more than 10°.

Treatment

The average preoperative delay was 7.18 days. Only 9.8% of patients were operated before the 48th hour and 43.75% between the 3rd and the 7th day, with extremes ranging from few hours to 58 days.



Figure 1: Garden 1 femoral neck fracture.

In this study, 8 patients were operated beyond the 14th day post traumatic. This delay was due to the negligence of symptoms by the patient, after a low energy hip trauma.

Eighty patients were operated under spinal anesthesia and only 14 patients under general anesthesia. Ninety-two of our patients were operated in the lateral position (90.19%). The type of osteosynthesis was dominated by the dynamic hip screw (DHS) in 50% of cases, followed by cancellous parallel screws in 47% of cases, 70% of them by two parallel screws. Finally, 3 patients were treated by a proximal femur nail (PFN). The average full weight-bearing delay was 2 months; in our study 78.12% of patients had an inadequate early total weight-bearing (Less than 3 months).

Osteonecrosis

The femoral head osteonecrosis was the most common complication in our study (Figure 2). It was observed in 32 of our patients (31.4%). It occurred in an average delay of 11.37 months ranging from 3 to 40

months. 43.8% of patients had this complication beyond two years. In 25% of cases, it was present in less than 6 months (Table 1).

Delay	Number	Percentage
<6 months	8	25
<12 months	10	31.3
>24 months	14	43.8
Total	32	100

Table 1: Delay between surgery and osteonecrosis development.



Figure 2: Femoral head osteonecrosis.

Several factors have been studied, but only some of them would impact significantly on the development of femoral head osteonecrosis (Table 2).

Factors	Op delay			Pauwels			Head tilt		Weight-bearing		Osteosynthesis	
	<3	3-7	>7	I	II	III	<10°	>10°	<3 m	>3 m	DHS	VIS
Number/32	3	14	15	10	6	16	8	24	25	7	18	14
P	0.000			0.006			0.000		0.029		0.515	

Table 2: Summary of risk factors tested for femoral head osteonecrosis.

Preoperative delay: Osteonecrosis was significantly more frequent in the group of patients operated between the 3rd and 7th day ($X^2=22.245$, $p<0.001$) (Figure 3). This implies that this period is of higher risk of osteonecrosis onset.

Fracture type: In our study, 50% of detected osteonecrosis were associated with Pauwels type III fracture with a statistically significant

difference ($X^2=10.145$, $p=0.006$). Therefore, fracture Pauwels type III appears to be a risk factor for femoral head osteonecrosis.

Femoral head tilt: In our study, 75% of osteonecrosis were associated with a femoral head tilt of more than 10° on lateral view radiographs with a statistically significant difference ($X^2=25.046$, $p<0.001$).

Full weight-bearing delay: Early full weight-bearing (<3 mois) significantly influenced the risk of developing osteonecrosis ($X^2=4.716$, $p=0.029$).

Osteosynthesis: The type of osteosynthesis had no influence on the subsequent development of femoral head osteonecrosis ($X^2=0.422$, $p=0.515$).

In summary, this bivariate analysis allowed to retain four variables that had statistically significant correlations with the occurrence of osteonecrosis, which were:

- Preoperative delay between the 3rd and 7th day
- Pauwels type III fracture
- Femoral head tilt > 10°
- A full weight-bearing before 3 months postoperatively

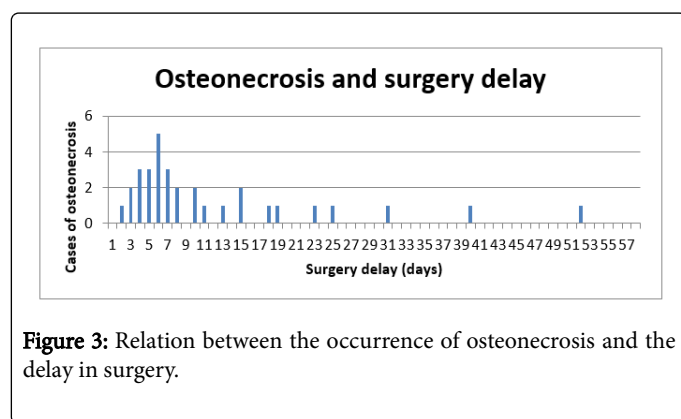


Figure 3: Relation between the occurrence of osteonecrosis and the delay in surgery.

Discussion

In our epidemiological analysis, as in literature, Garden 1 femoral neck fracture, is most common in the elderly woman, osteoporotic and suffering from one or more chronic diseases and resulting mostly of a domestic accident. Systematic osteosynthesis of coxa valga impacted Garden 1 fractures, especially in the elderly and in poor general condition, was recommended by several authors [4,5], because the increased risk of secondary displacement and the long immobilization period of the functional treatment with the risk of associated complications. Preoperative delay was an average of 7.8 days in our study. It seems much longer than those reported by Brechet et al. [2] and Conn et al. [5] which had respectively delays of 1.5 and 2.25 days. This delay is due to a number of medical reasons can, such as investigation of fall reasons (myocardial infarction, arrhythmia, stroke ...). Non-medical reasons are possible too, especially, operating program problems and availability of surgical teams or operating theaters [6]. In some cases there was no functional impairment after a mild hip trauma and patients came to consult for residual post-traumatic hip pain [2]. In the literature, longer preoperative delay, apart from the fact of increasing the rate of osteonecrosis, increased linearly mortality beyond the fourth day [7]. This leads us to conclude that the initial management and the operative program are to improve in our health system. Femoral head osteonecrosis remains the ultimate major complication of femoral neck fractures. In our study, it was observed in 31.4% of cases. Several studies [2,6,8] including ours, showed that a significant percentage of these fractures were complicated by osteonecrosis.

Several theories tried to explain the occurrence of this complication. According to Jain et al. [9], the delay in surgery could be a lost

opportunity by settling irreversible lesions of the femoral head, for that, he strongly recommended rapid decompression of the hip joint. The literature does not allow to set a deadline beyond which necrosis was inevitable [10], although the study of Jain et al. [9] was in favor of a maximum delay of 12 hours. For some authors, the existence of a hemarthrosis result in an increase in intra-articular pressure and therefore a tamponade, that interrupts the blood supply to the femoral head [3]. This hypothesis was confirmed in animals [11], but it was never formally demonstrated in humans, although many publications have reported osteonecrosis or ischemia of the femoral head may occur after a traumatic hemarthrosis [12].

Brechet et al. [2] in a study of 33 cases of femoral neck fractures, found an osteonecrosis frequency of 6%, much lower than the majority of studies. This was probably due to the systematic evacuation of hemarthrosis before osteosynthesis. Crawford et al. [13] stated that in Garden 1 fractures, there is a risk of osteonecrosis by tamponade and recommended a systematic and urgent evacuation of hemarthrosis, particularly as it was a simple procedure. Strömquist et al. [14] showed that the decrease in intra-articular pressure improves femoral head isotopic fixation during a scintigraphy.

He also showed that, ischemia of the femoral head may be reversible after a simple joint aspiration. He argues that there is no volume nor pressure threshold at which the risk of osteonecrosis is effective, because the hip joint capsule is very variable in the elderly. In medial rotation of the hip, intra-articular pressure is maximum and therefore he advised to systematically evacuate the hemarthrosis, nursing of fractured hip in semi-flexion, lateral rotation position in which intra-articular pressure is minimal and the proscriptio of traction during procedure (as it is done in medial rotation).

More recently, Hernigou et al. [15] believed that the high rate of osteonecrosis after coxa valga fractures could be explained by an iatrogenic hemarthrosis related to a breach in femoral head cartilage by guiding pins or the cervical screw itself due to excessive retroversion associated with this type of injury. For this author, in addition to the hemarthrosis, reaching subchondral bone could also interfere with the further vitality of the femoral head. Similarly, Ben Alaya et al. [16] found in his work that when the distance between the implant end and the femoral head articular cartilage was between 0.5 cm and 1 cm, consolidation without complications was significantly higher. However, if the distance was less than 0.5 cm or the material was intra-articular, osteonecrosis was significantly more frequent. Calandruccio et al. [3] showed that the improvement of the fixation stability reduces the frequency of non-union but it could have no influence on the phenomenon of osteonecrosis.

Therefore, there isn't a significant difference between cancellous screws and fixed angle screw-plate devices, in matter of osteonecrosis development. Liporace et al. [17] says that the femoral neck fractures with a vertical fracture line >50°, classified Pauwels type III, had a significantly increased risk of transition to nonunion and osteonecrosis compared to more horizontal line fractures, despite a good fracture reduction and perfect fixation. The parallel screw fixation seems not recommended in this kind of fractures and a stronger fixation is mandatory, as confirmed by Noda et al. [18] in a biomechanical study on internal fixation of femoral neck fractures Pauwels III. Finally, Tsai et al. [19] considered that the intraoperative position could influence this complication, because it had no cases of osteonecrosis in Garden 1 fractures installed in a supine position.

Conclusion

Osteonecrosis is a serious complication that could be associated with a joint tamponade, which is still not well understood. In our study, the profile of a patient likely to develop a femoral head osteonecrosis after a Garden 1 femoral neck fracture treated conservatively may include the following risk factors: A preoperative delay between the 3rd and 7th day, a Pauwels type III fracture, a head tilt on lateral view radiograph of more than 10° and full weight-bearing before the 3rd postoperative month. So, we recommend to operate this patients before 72 hours, and to prohibit weight bearing till after the third month.

Competing Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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