



Original Article

Treatment of displaced femoral neck fractures in young patients with DHS and its association to osteonecrosis[☆]



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ABSTRACT

Objective: The purpose of this study is to evaluate the performance of dynamic hip screw for the treatment of dislocated femoral neck fractures in young patients, focusing on osteonecrosis.

Methods: A series of 53 patients with less than 55 years of age were retrospectively evaluated. All patients had dislocated femoral neck fractures (Garden III or IV) and were treated with DHS. Ficat's staging system was used to evaluate avascular necrosis.

Results: There were 38 (71.7%) males and 15 (28.3%) females, with an overall mean age at the onset of fracture of 41.9 years (± 12.8). According to Garden's classification, 21 (39.6%) fractures were classified as type III and 32 (60.4%) were considered totally dislocated, Garden IV. Fracture healing was achieved in 39 patients (73.6%). Thirteen cases of avascular necrosis were observed (24.6%).

Conclusions: The incidence of avascular necrosis in young patients with a displaced femoral neck fractures treated with DHS was 24.6%. No statistically significant association was found between times elapsed to surgery, fracture displacement, and presence of derotation screw with osteonecrosis. Level of evidence IV.

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Tratamento de fraturas deslocadas do colo femoral em pacientes jovens com DHS e associação com a osteonecrose

RESUMO

Objetivo: O objetivo deste estudo foi avaliar o desempenho do *dynamic hip screw* (DHS) no tratamento de fraturas do colo femoral deslocadas em pacientes jovens, com foco na osteonecrose.

Palavras-chave:

Fraturas do colo femoral/patologia

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Parafusos ósseos
Adulto jovem

Métodos: Uma série de 53 pacientes com menos de 55 anos de idade foram avaliados retrospectivamente. Todos os pacientes apresentaram fraturas do colo femoral deslocadas (Garden III ou IV) e foram tratados com DHS. O sistema de estadiamento de Ficat foi utilizado para avaliar a necrose avascular.

Resultados: Foram incluídos 38 (71,7%) pacientes do sexo masculino e 15 (28,3%) do sexo feminino, com idade média no momento da fratura de 41,9 anos ($\pm 12,8$). Segundo a classificação de Garden, 21 (39,6%) fraturas foram classificadas como tipo III e 32 (60,4%) foram consideradas totalmente deslocadas, Garden IV. A consolidação da fratura foi obtida em 39 pacientes (73,6%). Foram observados treze casos de necrose avascular (24,6%).

Conclusões: A incidência de necrose avascular em pacientes jovens com fraturas deslocadas do colo do fêmur tratados com DHS foi de 24,6%. Não houve associação estatisticamente significativa entre os intervalos até a cirurgia, o deslocamento da fratura e a presença de parafuso anti-rotacional com a osteonecrose. Nível de evidência IV.

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Introduction

The vast majority of femoral neck fractures occur in the elderly patients after simple falls.¹⁻⁶ Today, we have sufficient evidences to support the routine use of hip replacement surgery in these patients.⁷⁻¹¹ However, for the young patients, it is necessary some preservation surgery to maintain the natural hip anatomy, its physiology and biomechanics, because they need high functional demands.

Anatomic reduction and stable internal fixation are essential in achieving the goals of treatment in young adult population with good bone quality. Until now, there is a debate on the best method of fixation for promoting union and preventing osteonecrosis of the femoral head. Many authors advocated two or three cannulated screws, and others for a more stable fixation using the dynamic hip screw, with anti-rotational screw or not.¹²⁻¹⁷

The purpose of this study is to evaluate the performance of dynamic hip for the treatment of dislocated femoral neck fractures in young patients (less than fifty five years), focusing in the worst complication: osteonecrosis.

Methods

A series of 53 patients were retrospectively selected from the Hospital records. The inclusion criteria were less than 55 years old, and the patients should have a displaced femoral neck fracture (Garden III or IV) in the admittance to the hospital.¹⁸ The exclusion criteria were less than 18 years or more than 55 years, Garden I or II femoral neck fractures, more than one week since the fracture event, comminuted fracture, associated head or acetabulum fracture, rheumatoid, arthritis, and metabolic diseases.

Patient's clinical conditions were evaluated using the ASA score.¹⁹ All surgeries were performed with a standard fracture table and fluoroscopy assessment. Fractures were fixed with 135 degrees dynamic hip screws. An anatomic reduction was the goal to archive. Reduction was judged on both anterior posterior and lateral view.

Table 1 – Demographics.

Age (years \pm SD)	41.9 \pm 12.8 (18–55)
Sex	
Female	15 (28.3%)
Male	38 (71.7%)
Side	
Right	28 (54.3%)
Left	25 (45.7%)
Garden	
III	21 (39.6%)
IV	32 (60.4%)
TAD	9.62 \pm 3.70
Anti rotational screws	
Yes	11 (20.8%)
No	42 (79.2%)
Time	
<72 h	30 (56.6%)
>72 h	23 (43.4%)

Avascular necrosis of the femoral head was diagnosed by clinical evaluation and x-rays alterations, as classic mottled appearance, increasing radio density, segmental collapse and degenerative changes. The Ficat's staging system was used to evaluate avascular necrosis.²⁰ The tip-apex distance (TAD) was measured as described by Baumgartner et al.²¹

Casuistic

There were 38 (71.7%) males and 15 (28.3%) females with an overall mean age at the onset of fracture of 41.9 years (± 12.8). The youngest patient had 18 years old and the oldest 55 years old. The mean follow-up period was 2.6 years. The minimal follow-up time was 23 months.

Twenty-eight patients (54.3%) had the fractures on the right hip, and 25 (45.7%) on the left side. According to Garden's classification, 21 (39.6%) fractures were classified as type III and 32 (60.4%) were considered totally dislocated, Garden IV (Table 1).

Thirteen (24.5%) patients had associated injuries: three had knee ligament rupture, three had arm fractures, two ankle

Table 2 – Association between consolidation, AVN and nonunion.

	Consolidation		AVN		Nonunion		Total	p
<i>Time to surgery</i>								
<72 h	22	56.4%	7	53.8%	1	100.00%	53	0.87
>72 h	17	43.6%	6	46.2%	0	0.00%		
Total	39		13		1			
<i>Sex</i>								
Female	10	25.6%	5	38.5%	0	0.00%	53	0.37
Male	29	74.4%	8	61.5%	1	100.00%		
Total	39		13		1			
<i>Garden</i>								
III	18	46.2%	3	23.1%	0	0.00%	53	0.34
IV	21	53.8%	10	76.9%	1	100.00%		
Total	39		13		1			
<i>Anti rotational screws</i>								
Yes	7	17.9%	4	30.8%	0	0.00%	53	0.87
No	32	82.1%	9	69.2%	1	100.00%		
Total			13		1			

fractures, three rib fractures, one proximal humeral fracture and one tibial shaft fracture. When considering clinical conditions, 51 patients (96.3%) were considered as ASA I (normal healthy), and 2 (3.7%) were ASA II (mild systemic disease).

Thirty patients (56.6%) were operated on first 72 h after the fracture. Twenty-three (43.4%) were operated after 72 h of admittance. The average hospital discharge was 5 days (± 2.3).

The length of the lag screw was 90 mm in 32 times, 85 mm in 14 times, and 100 mm in 7 times. The mean tip-apex distance (TAD) was 9.62 (± 3.70). No cut out was observed. The DHS plate was fixed with two screws in 6 times, 3 screws in 40 times, and with 4 screws in 7 times. Eleven fractures were fixed with anti-rotational screws, placed superiorly.

Fracture healing was achieved in 39 patients (73.6%). Because of nonunion, in one case we performed a valgus intertrochanteric osteotomy to achieve the healing (1.8%). In twelve patients a total hip replacement was considered the necessary solution.

Thirteen cases of avascular necrosis were observed (24.6%) (Table 2). In one case (Ficat III), we performed decompression with the use of bone grafting, with good result. When correlated necrosis and time elapsed to surgery, seven cases were observed before 72 h (7/23 – 30.4%), and six cases (6/30 – 20.0%) after this period.

When considering the association between Garden's classification and necrosis, it occurs in three patients with Garden III (3/21) 14.2%. When a completed dislocated Garden IV occurs, we observed necrosis in 10 patients (10/32) (31.2%). Osteonecrosis were found in 4 patients when we use anti-rotational screws (4/11) (36.3%), and 9/42 (21.4%) without using the screw.

Discussion

Acute femoral neck fractures have been described as the "Unsolved fracture" and continues to be a challenging issue. The vast majority occurs in elderly patients after simple fall.

At first analysis, it is necessary to distinct two completely different patient's categories. The common and most frequented is the old patient with his own characteristics: fewer

functional demands, poor bone quality, low energy trauma, isolate fracture, multiple comorbidities and arthroplasty. In the other side are the young patient: high physiological reserves, good bone quality, high energy trauma, associated traumatic injuries, no medical comorbidities and the goal treatment is the joint preservation.

Today there may be sufficient evidence to support routine use of hip replacement surgery for low demand elderly patients. Many randomized trial shows better long-term hip function and lower re-operation rates when compared with internal fixation.^{7-11,22-29}

For the non-elderly patient, with good bone quality, preservation of the natural hip anatomy and biomechanics is the goal to be archived. Anatomic reduction and stable internal fixation are essential to avoid non-union and osteonecrosis. The first step to management this fracture is establishing patient's physiologic age. Chronologic age is less important. Several variables have been used to make a patient profile physiologic age: medical condition, cognitive status, co morbidities, pre injury activities and quality of bone stock. In this study we accept like "young" patients less than 55 years.

Fifty-one patients (96.3%) were normal healthy (ASA 1) and thirteen (24.5%) had associated injuries. Goals of the surgical management of femoral dislocated neck femur fracture in young patients are three fold: (1) achieve an anatomic reduction to preserve blood supply and prevent osteonecrosis; (2) provide stable fixation to achieve bone union; (3) return to pre injury level of function.

For internal fixation most orthopedic surgeons choose either a dynamic hip screw (DHS) or multiple cannulated screws (MCS). Tronzo³⁰ identified more than 100 different available implants for fix this fracture but nowadays we must decide between one of these consecrated techniques. Osteosynthesis with MCS fixation is a less invasive technique and reduces blood loss and soft tissue stripping.^{12,13} With the use of DHS the screw plate system achieves a more stable condition. Deneka et al.³¹ and Baitner et al.³² published a biomechanical comparison of internal fixation techniques for the treatment of unstable basocervical femoral neck fractures. The results support the use of DHS. Its disadvantages are large

skin incisions, more extensive soft tissue dissection, a greater need for blood transfusion and a longer stay in hospital.^{12,13}

Bonnaire et al.¹⁵ also advocated DHS against MCS in high shear angle neck fractures. Siavashi et al.,³³ Razik et al.,³⁴ and Gardner et al.³⁵ also agree that DHS is a better option compared with cannulated screws. Addition of a derotational screw placed in the cranial part of the femoral neck superior to the dynamic hip screw can improve the rotational stability of the construct.

Makki et al.¹⁶ showed no benefit in union rate or osteonecrosis in fractures treated with DHS alone or with DHS with a derotational screw. Furthermore, Razik et al.³⁴ studying 92 young patients found that DHS supplemented with derotational screw had significantly less osteonecrosis for Garden III and IV fractures than MCS. In our study, only 11 fractures were fixed with derotational screw. Four patients developed osteonecrosis (4/11 – 36.3%) of the hip.

In 42 fractures without screw, 9 developed necrosis (9/42), 21.4%. This difference does not have statistical significance ($p=0.87$). Avascular necrosis of the femoral head remains one of the greatest concerns in the young patient with femoral neck fractures. The incidence has been documented and ranges from 12% until 86%.^{35-37,13,38-45} In worst series published, Protzmann et al.,³⁶ analyzing 22 fractures under 40 years, related 86% of necrosis. In our study, 13 fractures developed osteonecrosis (13/53) 24.6%. In 12 patients, the final solution was total hip replacement. In one case, in early post collapse, the used treated was the removal of hardware, core decompression and bone grafting. After 12 years, the patient was doing well.

Another controversial issue is the timing of surgery. Some authors advocates the early surgery and suggest that prompt reduction can produce an “unlinking” of the proximal femoral vessels, thus leading to intra-capsular decompression, restoring the blood flow to the femoral head and minimizing the risk of necrosis.⁴⁶⁻⁵² Other studies confirm that early surgery may decrease the rate of femoral head osteonecrosis.^{35,39,42} On the contrary, several studies reported no difference in the rate of osteonecrosis with more than a 24-h delay or even more than one week.^{1,3,12,43,47,53,54}

Barnes et al.,¹ in their historical paper, describes long-term follow up of 1503 fractures. No significant difference was found in necrosis delaying the operation up to one week. Analyzing the avascular necrosis in our 53 patients, we could not identify statistical significant differences for surgical intervention before and after 72h. In 30 cases, when surgery occurs before 3 days, the rate of osteonecrosis was 20.0% (6/30). When compare it to the delayed fixation group, the rate increase to 30.4% (7/23). The consensus for time surgery is still matter of debate. Probably early fixation decreases osteonecrosis. Razik et al.,³⁴ retrospectively, analyzed 92 fractures and found no difference in rates of osteonecrosis when comparing treatment within 6 h post-injury and delayed treatment of 48 h post injury. They concluded that the rate of osteonecrosis was related to the type of fixation. The conflicting results in the literature are indicative of the wide amount of variance in these studies.

Another topic of discussion is how the initial fracture displacement can induce a necrosis. The most useful classification was proposed by Garden.¹⁸ Basically, the author divided the fracture into not displaced (Garden I and II) or displaced

(Garden III and IV). In our study, all 53 fractures were considered displaced. When we consider the femoral fracture like Garden III, we found (14.2%) of avascular necrosis (3/21). When we consider a complete dislocated fracture, the rate rise doubled (31.2%) (10/32), but not with statically significance ($p > 0.05$).

Conn and Parker,⁵⁵ when evaluating 375 non-displaced fractured, observed necrosis in 4% (15/375). Yih-Shiunn et al.⁵⁶ reviewed 84 cases of non-displaced fractures and found an incidence of about 10% (8/84). Haidukewych et al.¹³ found 14% (3/22). When only displaced fractures are taken into consideration, this complication is more frequent. In an extensive meta-analysis, Lu-Yao et al.¹² found a 16% rate of osteonecrosis, and Blomfeldt et al.⁹ record 19% of cases with necrosis after 48 months. Majernicek et al.⁵⁷ observed 13.4% (9/64) after a minimum of 5 years of follow-up. Haidukewych et al.¹³ found 27% (14/51), and Nikopoulos et al.⁵⁸ found 39.4% (15/38) after a mean follow up of 4.7 years. Kaplan et al.⁵⁹ described 30.3% (10/33) and Schwartzmann et al.⁴⁷ presented 19% (16/83) using DHS. Razik et al.³⁴ described 16.2% (11/92) of avascular necrosis in displaced fracture, but in cannulated group find 29.4% compared to 4% using the DHS.

Conclusions

The incidence of avascular necrosis in young patients, with less than 55 years, with a displaced femoral neck fractures treated with DHS was 24.6%. No statistically significant association was found between times elapsed to surgery, fracture displacement and presence of de-rotational screw with osteonecrosis.

Conflicts of interest

The authors declare no conflict of interest.

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