

Relationship of Avascular Necrosis of Femoral Head and Accuracy of Reduction in Garden Type III and IV Femoral Neck Fracture following Osteosynthesis

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Abstract

Introduction: The most incriminating cause of avascular necrosis following osteosynthesis of femoral neck fracture is still unknown. We investigate its relationship with accuracy of reduction in garden type III and IV femoral neck fracture.

Materials and methods: Thirty patients (M=26) of average age 39.5 years (range 15 to 59) with displaced Garden type III and IV fresh femoral neck fractures are included in this prospective study. Reduction was achieved by closed manipulation in 27 case and 3 had open reduction. Eleven had sliding hip screw and nineteen had cannulated hip screws as internal fixation. Anatomic reduction was obtained in 18 hip (group I) and 12 hips did not have anatomic reduction (group II). All are operated within 7 days (range 1-7).

Results: Patients were followed up for average of 2.5 years (range 1 – 4 years). Avascular necrosis developed in 2 (11.1%) and 5 (41.7%) cases in group I and group II respectively.

Conclusion: Good quality of reduction and stable internal fixation in displaced fracture Garden type III & IV reduce the incidence of avascular necrosis of femoral head.

Keywords: Garden index; Fracture; Femoral neck; AVN;

Introduction

Most common age group in which fracture neck femur occur is elderly after fall from standing height [1], but femoral neck fractures in adults before 50 years are infrequent and usually follow high-energy trauma like road accident [2]. The incidence of this group is 2-3% of all femoral neck fractures [3]. Selection of the suitable method of treatment for femoral neck fractures in younger adults before 50 years it is important to understand how they differ in patho-anatomy and physiology with that of elderly. Significant differences are observed in respect to the vascular orientation, the mechanism and characteristics of associated injuries, orientation of fracture fragments and the outcome of

treatment [1-3]. Since bed ridden condition is poorly tolerated by the elderly patient early mobility in bed as well as early weight bearing minimize medical complications [4], but those problems are rarely seen in younger patients. Moreover replacement arthroplasty in them invites more revisions after 10 years particularly of the acetabular component. Thus close or open reduction and internal fixation is better suited in younger patients. Femoral head avascular necrosis (AVN) is persistent problem following osteosynthesis amounting 10-30% [6, 7]. Considering all these facts close or open reduction and internal fixation of the femoral neck fracture is method of choice in the

Younger patients. While doing so means to be adopted to reduce the incidences of AVN and non-union as head preservation is an important need. There are number of variables affecting avascular necrosis of femoral head in femoral neck fracture in young adults like amount of displacement, interval between injury and surgery, fixation with or without capsulotomy, open reduction or close reduction, and quality of

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Figure 1: Clinical details of the patients in the two groups

reduction [8]. In this study, we investigate the relationship of AVN with quality of reduction of Garden type III and IV femoral neck fractures in young adults when the variables are constant.

Materials and Methods:

This study was conducted in department of Orthopaedics, R.G.Kar Medical College and Hospital during January 2013 to December 2016. Ethical committee approval and written consent of the participants are obtained. Inclusion criteria are age group between 15 years to less than 60 years with isolated femoral neck fractures of Garden type III and IV. Considerable medical comorbidities, multiple injuries, previously injured ipsilateral proximal femur, heavy smokers and otherwise osteoporotic individuals are excluded from this study. Thus fulfilling these criteria 30 patients (Male=26, Female=4) are included in this prospective cohort study. Left side affected in 16 patients. Road accident is the most common mechanism found in 21 patients and other mechanisms include fall from height in 5 and contact sports injury in 4. Apart from X-ray antero-posterior and lateral views of both sides are done. Bone mineral density (BMD) is estimated. All included patients show BMD T score more than minus 1.5. Patients were operated within 7 days (1 – 7 days) and pre operatively hips were kept in flexion with a pillow behind knee. None was administered no steroidal anti-inflammatory agents. Two light smokers stopped smoking at least 5 days prior to operation. The whole patient population are then grouped in two during operation.

Group I includes 18 patients where anatomical reduction could be achieved. Whereas 12 patients who do not have anatomical reduction are placed in group II.

Technique: All patients are operated under spinal anaesthesia under C-Arm image control in fracture table. Reduction is achieved by longitudinal pull in closed method and fixed in 10° internal rotation. Through longitudinal incision of skin vastus lateralis is split and guide wires are put after checking satisfactory reduction. Three patients had open reduction after failing to achieve correct reduction with two close attempts. Short plate sliding hip screw (SHS) was applied in 11 patients and three 6.5 mm cannulated hip screw (CHS) with washer were put in 19 patients. Implants are inserted in usual way in inverted triangular fashion in CHS group and in SHS group two guide wires are used before reaming. Stitches were removed after two weeks and kept non weight bearing for 1 month, but hip movements in bed were permitted in second post-operative days. Implant was removed after 1 to 1½ years with union.

Result: Patients were followed up for average of 2.5 years (range 1 – 4 years). Results are analysed using SSP software. Pearson Chi square test and Fisher's exact test are used. One (5.6%) from group I and two (16.7%) from group II had non-union. All three were fixed with CHS. Avascular necrosis was assessed radiologically. In group I patients with anatomical reduction 2 of 18 (11.1%) had AVN, and in group II the number was 5 of 12 (41.7%) [Table 1]. Apparently there seems to be large difference among these two groups, however p values are 0.053 (Pearson Chi square test) and 0.084 (Fisher's Exact test).

Table 1: Table shows group distribution, technique distribution and rate of non-union and AVN in each group and technique.

Groups	Patients (Nb &%)	CHS (Nb&%)	SHS (Nb&%)	Non -union (Nb &%)	AVN (Nb&%)
Group I	18(60)	11(61.1)	7(38.9)	1(5.6)	2(11.1)
Group II	12(40)	8(66.7)	4(33.3)	2(16.7)	5(41.7)

(Abbreviations: No = Number; CHS= cannulated hip screw; SHS = sliding hip screw; AVN = avascular necrosis)

Since the P value is >0.05, thus, although there seems to be a large difference between these two groups, however this difference was statistically not significant.

Discussion

Tao Wang et al. (2014) in their study of 146 patients with mean age of 47.5 years found incidence of femoral head necrosis was 14.4% [8]. Garden classification grading, quality of reduction, implant selection, and pre-operative traction were significantly associated with femoral head osteonecrosis. In the present study it is observed that quality of reduction is an important factor to minimize incidence of non-union and AVN.

Min BW, Kim SJ (2011) in their study observed that the quality of fracture reduction, adequacy of fixation, degree of displacement, and comminution of the posterior cortex were significantly associated with avascular necrosis of femoral head [9]. In this study comminuted femoral neck fractures are excluded. Other findings are agreeable with their observations. Inadequate reduction makes shifting of anteversion and change of the relationship between the femoral head and acetabulum, thus altered load transfer results in stress concentration on the surface of the femoral head and deranging the internal ultrastructure of the trabecular bone. If this alteration results in failure of trabecular bone to accommodate the stress of the acetabulum demand, there is degeneration of trabecular bone, absorbs, collapses, and causes femoral head necrosis [10]. This study finds Garden classification, reduction quality, and preoperative traction were the most important risk factors influencing the development of femoral head necrosis. Displaced fracture, reduction quality C, and preoperative traction also increased the occurrence of femoral head necrosis. Possible explanation, though controversial, is that,

during fracture neck femur intra-osseous cervical vessels are disrupted. Consequently femoral head nutrition is dependent on remaining retinacular vessels and those functioning vessels in the ligamentum teres. Valgus and rotatory malposition are known to affect foveal blood supply. So, achieving anatomical reduction of femoral neck results in

straightening of the vessels which were kinked due to displacement. Straightening of these vessels re-establishes the femoral blood flow and thus it reduces the chances of avascular necrosis of femoral head [8].

CCH Khoo et al. (2014) observed incidence of avascular necrosis in patients with adequate fracture reduction was 15.79%, comparable to 20% for those with inadequate fracture reduction which is statistically insignificant [11]. They also substantiated that no significant difference between displaced and undisplaced fracture with regard to future risk of avascular necrosis in their study. They believe that the initial force sustained at the proximal femur during the causal injury is directly related to the fate of the head of femur in terms of future avascular necrosis. The vascularity of the head could have been disrupted from the initial trauma; therefore, the adequacy of reduction did not influence the rate of avascular necrosis. In present study we have included only displaced fractures (Garden III & IV). In this study incidence of AVN are at statistically significant level. Moreover it is unusual that an initial impact causing fracture displacement sufficient to damage feeding vessels and springing back to remain undisplaced femoral neck fracture.

Lakhani, Mahajan, Sonawane (2014) in their article said that anatomical reduction is of prime importance for any fracture neck femur to unite [12] the factors that have been most consistently found to be predictive of nonunion after fixation of intracapsular femoral neck fractures were poor reduction and fracture displacement. We have similar observation in this study. The strong limitation of this study is small sample size. Thus, by percentage though the difference is large, in statistical analysis it is not significant.

Conclusion: To conclude, good quality of reduction and stable internal fixation in displaced fracture Garden

type III & IV reduce the incidence of avascular necrosis of femoral head and non-union of femoral neck. Large sample size is necessary to substantiate its statistical significance.

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