



OBSERVATIONS ON THE USE OF NON VASCULARISED FIBULAR GRAFT AND ONE CANNULATED SCREW FOR FRACTURE NECK OF FEMUR

Orthopaedics

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ABSTRACT

Femoral neck fractures are associated with non union and avascular necrosis because of precarious blood supply. Treatment options are different for physiologically young and old patients. In young patients we usually do close reduction /open reduction and internal fixation but in old patients we prefer Hemiarthoplasty. Aim should be to get a stable, painless and mobile hip. By using fibular graft we tried to reconstruct the trabecular pattern; provide structural support and incorporation of fibular graft. Out of 32 patients 24 were females and 8 were males in the age group of 18 to 60 years with mean age of 52.3 years. All patients were operated within 1 to 7 days of injury. Fractures were classified according to the garden's classification as type 1 [5 patients] type 2 [10 patients] type 3 [10 patients] type 4 [7 patients]. All patients were evaluated according to Harris hip score as excellent, good, fair or poor. 56% patients had excellent results, 18% had good, 14% fair, 12% poor. Avascular necrosis was reported in one patient non-union in one patient and varus collapse in two patients.

KEYWORDS

INTRODUCTION

Hip fractures are among the most common fractures. Fractures of the neck of femur occur predominantly in the elderly, typically result from low-energy falls, and may be associated with osteoporosis. Life expectancy is increasing worldwide, and is expected to increase the number of hip fractures from 1.66 million in 1990 to 6.26 million in 2050.¹ The lifetime risk of sustaining a hip fracture is high and lies within the range of 40% to 50% in women and 13% to 22% in men. The estimated annual cost of treating these fractures is enormous and a significant burden to any healthcare system. These fractures have long been recognised as most difficult of femoral fractures in terms of treatment. The treatment of these fractures continues to present great challenges to orthopaedic surgeons worldwide and remain in many ways today "the unsolved fracture" (speed 1935).

The challenges mainly stem from a combination of biomechanical and anatomical reasons pertinent to this area;²

1. Precarious blood supply.
2. Absent cambium layer of periosteum.
3. Shear stress at fracture site.
4. Angiogenic inhibiting factors in synovial fluid.
5. Difficulty in reducing and maintaining reduction.
6. Small proximal fragment leading to less than optimal fixation.
7. Strong muscle forces.
8. Osteoporosis.

NECK OF FEMUR FRACTURE IN YOUNG PATIENTS

Intracapsular femoral neck fractures account for about 50% of all hip fractures. Fractures of the femoral neck in the young are a very different injury and are treated in different ways. Femoral neck fractures in young patients typically are result of a high-energy mechanism, and associated injuries are common. Protzman and Burkhalter³ emphasized three basic differences between these femoral neck fractures in young adults and those in elderly individuals:

1. They are distinctly uncommon.
2. The reported results of treatment are notably poorer than those in more elderly patients
3. There is a significant difference in the severity of trauma required to cause this fracture in young adults.

Some of these patients often have predisposing conditions that render them more liable to sustain a hip fracture. These factors include chronic diseases associated with osteoporosis, steroid treatment, and alcohol abuse. These fractures should be treated by reduction and fixation as soon as possible. The overall rate of non-union in younger patients after open reduction has been shown to be 11%, in comparison with 5% for closed reduction. A recent meta-analysis estimated the overall rates of non-union and avascular necrosis (AVN) to be 8.9%

and 23%, respectively.⁴ Although early reduction and fixation would seem advisable, there is no strong relationship between timing of surgery and non-union or AVN. In their series, Jain et al. reported no AVN in 15 patients fixed within 12 hours compared with 26% in patients with a delay to fixation. Nonetheless, in another large series and in a meta-analysis of the literature, there was no relationship between the timing of surgery and development of non-union or AVN. Varus reduction has been shown to be associated with a 13-fold increase in the likelihood of fixation failure.

According to Bray and Templeman⁵, there are three criteria for successful treatment of femoral neck fractures in young adults.

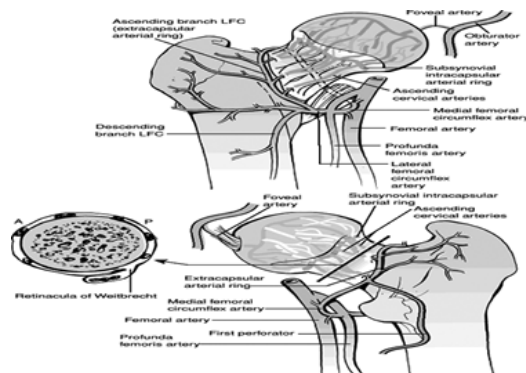
1. Fixation must be achieved within 12 hours of injury or as soon as possible.
2. Anatomic reduction must be obtained through closed manipulation or open reduction, if necessary; and
3. Fracture should be stabilized with some form of internal fixation.

The authors believed that circulation would improve after anatomic reduction and fixation. In addition, reconstructive procedures such as total hip replacements are more likely to fail in younger individuals.³

Currently the options available for management of femur neck fractures in young adults are

1. Cannulated cancellous screw fixation
2. Dynamic hip screw fixation
3. Internal fixation combined with vascularised or non-vascularised fibular graft.
4. Replacement arthroplasty (Hemiarthroplasty/ Total Hip Arthroplasty).

VASCULAR ANATOMY OF THE FEMORAL HEAD



The blood supply of the hip joint is of particular relevance when considering intracapsular hip fractures. The anatomy has been well described. There are three sources (Crock in 1980): capsular vessels, intramedullary vessels, and a contribution from the ligamentum teres.^{6,7} In adults the most important source of femoral head blood supply is derived from the capsular vessels arising from the medial and lateral circumflex femoral arteries, branches of the profunda femoris in 79% of patients. These form an extracapsular circular anastomosis at the base of the femoral neck, and the ascending cervical capsular vessels arise and penetrate the anterior capsule at the base of the neck at the level of intertrochanteric line. On the posterior aspect of the neck they pass beneath the orbicular fibers of the capsule to run up the neck under the synovial reflection to reach the articular surface. Within the capsule these are referred to as retinacular vessels. There are four main groups (anterior, medial, lateral, and posterior), of which the lateral group is the largest contributor to femoral head blood supply. The most important retinacular vessels arise from the deep branch of the medial femoral circumflex artery.⁸ These vessels supply the main weight-bearing area of the femoral head. The contributions of the lateral femoral circumflex artery and metaphyseal vessels are much less important by comparison. At the junction of the articular surface of the head with the femoral neck there is a second ring anastomosis termed the subsynovial intra-articular ring. The terminal branches of the deep branch of the medial femoral circumflex artery penetrate the femoral head 2 to 4 mm proximal to the articular surface on its posterosuperior aspect. These capsular vessels are vulnerable to damage in displaced subcapital fractures.⁹ They enter the femoral head just below the articular margin. Displacement of the femoral head because of a fracture in this area will damage these vessels, jeopardizing the blood supply to the femoral head and resulting in an increased risk of avascular necrosis if the head is retained. Claffey¹⁰ shown that the risk of avascular necrosis is greatly increased if the important lateral retinacular vessels are damaged. The artery of the ligamentum teres is a branch of the obturator or medial femoral circumflex artery. Some additional blood supply in the adult reaches the head via the medullary bone in the neck. Clearly these latter vessels will be as vulnerable to disruption in any displaced fractures as are the retinacular vessels. Although the vessels entering the head through the ligamentum teres contribute to femoral head blood supply, their contribution is generally not sufficient to maintain complete vascularity of the entire head. After a displaced fracture, revascularization of the femoral head occurs by revascularization from areas of the head with retained blood supply and ingrowth of vessels from the metaphysis. The portion of the femoral neck within the hip joint capsule has no cambial layer to participate in callus formation during fracture healing. Fracture union depends on endosteal healing alone, which is one of the reasons for delayed union and non-union in femoral neck fractures.

GARDENS CLASSIFICATION

Garden classification was described in 1961.¹¹ It divides femoral neck fractures into four groups. The divisions are based on the degree of displacement, which is judged on the anteroposterior radiograph by determining the relationship of the trabecular lines in the femoral head to those in the acetabulum. In the non-fractured hip, the trabecular lines in the femoral head are in the same orientation as those of the acetabulum.

Garden I: Valgus impacted subcapital fracture, incomplete

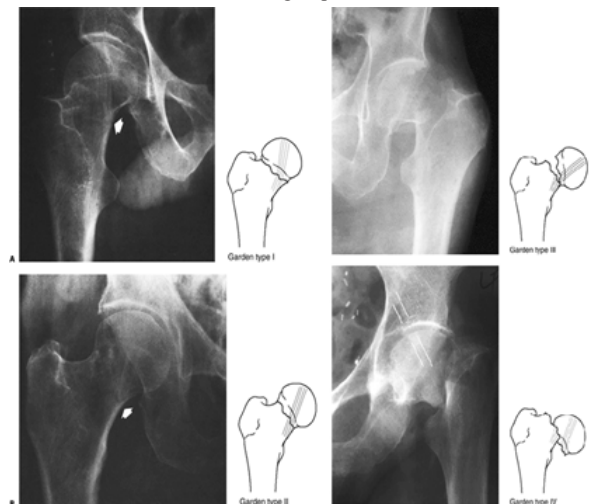
Garden II: Complete fracture but undisplaced

Garden III: Subcapital incompletely displaced fractures. The femoral head has lost contact with the femoral neck, but the head is varus and extended, resulting in angulation of the trabecular lines. The angulation is in the opposite direction to that described for Garden I fractures.

Garden IV: Completely displaced, and the trabecular lines line up as the femoral head returns to a neutral position within the acetabulum. The femoral neck has lost contact with the head and rotates externally, so the trabecular lines in the neck are not colinear with those in the head.

The Garden classification has been widely used and is probably the most frequently utilized classification system in the orthopaedic literature pertaining to femoral neck fractures.¹² Unfortunately, like many other orthopaedic radiologic classifications, interobserver and intraobserver level of agreement are not ideal. Frandsen et al.

evaluated the classification and found that the level of interobserver agreement was only 22% across all four grades. Surgeons demonstrated high levels of agreement in determining whether fractures were undisplaced (Garden I or II) or displaced (Garden III or IV), but the level of agreement was much poorer when they were asked to subdivide cases across all four groups.



BONE GRAFTING

Internal fixation has been supplemented with bone grafting procedures in cases where the treatment was delayed due to some reason or the patients presented with united fractures.^{13,14,15,16,17} However Primary autologous fibular grafting along with cancellous screw fixation has been done in fresh cases and good results have been reported by various workers^{16,17,18}.

Choice of graft

Various types of bone grafting procedures ranging from phemister graft, nonvascularised (iliac crest graft, fibular graft), vascularized Gluteus medius based grafts have been used in the treatment of femoral neck fractures but no single technique has shown superiority over other techniques in a randomized controlled trials. Muscle pedicle bone grafting and vascularized fibular grafting are probably superior technique but are skill dependent, time, expensive and require microsurgical sophisticated equipments which are not readily available at most of the tertiary level hospitals in India. We chose autologous ipsilateral fibular graft as the procedure can be easily done at simpler setups across the developing world. Moreover, it being cortical and tubular would not only provide mechanical strength like a screw in maintaining the reduction but also provide osteogenic stimulus across the fracture site. Multiple drill holes in the grafts also encourage the in growth of the creeping substitution.

Fate of fibular graft

The fate of the graft has not been studied and reported as yet, but it is believed that it gets incorporated with the host bone rather than getting resolved. The fibular graft starts fusing with the host bone and is seen as gradual decrease in the density of the graft and loss of cortical details of the graft. Over a sufficiently long period, the fibula is replaced by trabecular pattern of cancellous bone. The exact time frame of the graft incorporation has not been studied by any worker. It is believed that autologous fibular strut graft should be used as an adjuvant to anatomic reduction and internal fixation in all fresh femoral neck fractures primarily, especially in younger adults, as this provides a more osteogenic environment for fracture healing without jeopardizing the already precarious blood supply to the femoral head.¹⁹

MATERIALS AND METHODS

Study was conducted in the Postgraduate Department of Orthopaedics, Government Hospital for Bone and Joint Surgery, Government Medical College (GMC) Srinagar. thirty two patients were taken up for the study aged between 18 years to 60 years with mean age of 52.3 years and include 24 females and 8 males, both displaced and undisplaced fractures were included. All fractures were less than 1 week old. Eighteen hips were right sided and Fourteen hips were left sided. Five patients of gardens type 1, ten patients of type 2, ten patients of type 3 and seven patients of type 4. All fractures were fixed by one cannulated screw and one fibular graft. All patients were

operated under spinal anaesthesia on a traction table. Closed reduction was achieved by leadbetter and Whitman technique under image intensifier. Gardens Alignment Index was used for proper reduction. About 90% of patients had satisfactory reduction. Mid line lateral incision was given and trochanter and proximal femur exposed subperiosteally. One cannulated screw of 6.5mm was introduced. DHS triple reamer used to make bed for fibular graft just below the introduced screw. Fibular graft of appropriate length was obtained from ipsilateral leg via Henrys approach. Graft was tapped in the graft bed and wound was closed in layers. Intravascular antibiotics were given for 3 days followed by oral antibiotics. Cefuroxime 1.5 g was used in most of the patients. Most of the patients were discharged within 3rd postoperative day. ROM knee started on 2nd postoperative day. Patients were followed at 2nd week, 4th week, 3 months, 6 months, 1 year, 2 year, 3 year intervals. Patients were put on non weight bearing for 6 weeks followed by partial weight bearing for next 6 weeks. Full weight bearing was advised only after evidence of radiographic union. Final outcome was assessed by Harris hip score, 56% of the patients had excellent score, 18% had good, 14% had fair and 12% had poor score.



HARRIS HIP SCORE

Grade	Pain	LLD cm	Hip Movement	Walking	Non Union	AVN	Varus collapse	no of pts
Excellent	Nil	<1	Full	Good	nil	Nil	nil	18
Good	Nil	1 to 2	upto 15 restriction	Good	nil	Nil	nil	6
FAIR	intermittant	2 to 3	<50 degree	1 km	nil	Nil	nil	4
POOR	continuous	>3	full restriction	with aids	present	Present	present	4

RESULTS OF 32 PATIENTS

AGE years	MALES	FEMALES	LEFT	RIGHT	Time to union	Non union	AVN	Varus coll.	Screw per	Graft fracture
18 to 30	2	2	2	2	2 8 weeks	0	0	0	0	0
31 to 40	2	5	3	4	4 10 weeks	0	0	0	0	0
41 to 50	1	7	4	4	4 11 weeks	0	0	0	0	0
51 to 60	3	10	5	8	14 weeks	1	1	2	0	0
TOTAL	8	24	14	18						

DISCUSSION

Femoral neck fracture is very common in countries like India. Various methods are used in preservation of femoral head in young patients such as multiple cannulated cancellous screws, fibula graft with screw, vascularised fibular grafts, iliac grafts, muscle pedicle graft. In our study closed reduction and internal fixation with cannulated cancellous screw and fibular graft was done and we have achieved good outcomes. The screw provide rigid fixation where as fibular graft provide additional stability and facilitate bone regeneration owing to its osteoinductive potential. Additional rotational stability provided by its trephine shape. Drill hole helps in revascularisation at the fracture site.

CONCLUSION

Fresh femoral fractures can be treated by cannulated screw and non vascularised fibular graft. proper Reduction at fracture site is most important step, moreover strict post-operative rehabilitation programme should be followed.

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