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FRACTURE NECK OF FEMUR FIXED WITH CANCELLOUS SCREWS USING BIPLANE DOUBLE SUPPORTED SCREW FIXATION TECHNIQUE (BDSF) - OUTCOME ANALYSIS

Orthopaedics

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ABSTRACT

Background: Fracture neck of femur has always presented a great challenge to the Orthopaedic surgeons. Results depend upon adequacy of reduction and stable fixation. Fixation with cannulated cancellous screws is usually adequate for femoral neck fractures. The aim of the study was to analyse the results of treatment of fracture neck of femur with cannulated cancellous screw fixation using BDSF method.

Methods: 15 patients with intra capsular neck of femur fracture fixed by BDSF method were followed up for a period of two years post-surgery and their functional outcome was assessed based upon Harris hip scoring system.

Results: According to Harris hip scoring system, we had excellent results in 60% cases, good in 20% cases and poor in 20%.

Conclusions: Management of intracapsular fracture neck of femur with cannulated cancellous screw fixation using BDSF is a very good method of treatment being a surgically easy procedure. The position of the screws allow them to slide under stress with a minimal risk of displacement. The position of the distal most screw, Primary Trabecular Screw(PTS) is in line with the primary compressive trabeculae which allows the body weight to be transferred successfully from the head fragment onto the diaphysis. Compared with conventional cancellous screw fixation, the screws are purchased in the thick diaphyseal cortex and are placed in two different planes wide apart from each other which adds to the stability. This prevents screw loosening and varus collapse. The method was developed in search of a solution for those patients, for whom primary arthroplasty is contraindicated.

KEYWORDS

femoral neck fracture, intracapsular, BDSF, PTS, Harris hip score.

INTRODUCTION

Fracture neck of femur has always presented a great challenge to the treating Orthopaedic surgeon. The decision to fix a fracture neck of femur depends on the age, physiologic condition of the patient and quality of the bone. Results generally depend upon adequacy of reduction and stable fixation. The conventional screw fixation methods(both inverted triangle and four quadrant), however are associated with poor results in 20 to 42%. The high failure rate of traditional screw fixation has led to the development of this novel method of fracture fixation by Biplane Double-supported Screw Fixation(BDSF) by Orlin Filipov of Bulgaria[1].

The conventional method has serious complications such as screw loosening, back out and varus collapse of the fracture. *Instability of the construct can be explained based on their location* in the metaphyseal region of the greater trochanter. 1) All the screws are often placed closely in soft cancellous bone near the axis of the femoral neck, with less cortical support. This results in high failure rate in cases of osteoporosis where strength of the lateral cortex is poor. 2) *These screws* cannot effectively slide distally and laterally keeping unchanged their angle towards the axis of diaphysis, and rather have expressed tendency to displace in varus, with fixation failure.

The problems of varus collapse and lack of sliding are resolved by the use of Primary Trabecular Screw (PTS) through the concept of biplane positioning of the implants. This method is done with the three screws being laid in two planes, with the entry points of two of the implants placed much more distally, in the solid cortex of the proximal diaphysis. The PTS is placed in the same axis of the primary compressive trabeculae which allows effective transfer of body weight from the head fragment onto the diaphysis and prevents varus collapse.

MATERIALS AND METHODS

Prospective study was carried out at our Institute from May 2016 to December 2018. A series of 15 patients were included in this study with intracapsular fracture neck of femur.

Inclusion criteria

- Both male and female patients between ages of 20 to 60 years of age.
- All Garden stage I to IV fractures

Exclusion criteria

- All patients below 20 years and above 60 years of age
- Pathological fractures
- Concomitant shaft of femur fractures

The fractures were classified using Garden classification system.
On admission fracture was preliminarily immobilized in Thomas' Splint. In all the patients an AP and lateral X-rays of the hip joint were taken to assess the fracture pattern. The patients were then processed for surgery. The patients were informed and written consent obtained for their inclusion in the study for this new method of fixation. Ethical committee clearance was obtained.

Operative procedure

In the operation theatre the patient was given appropriate anaesthesia and taken on the fracture table. All the fractures were reduced by Leadbetter technique[2]. The reduction was confirmed with fluoroscopy, and if alignment was deemed satisfactory the operation was performed.

No more than two attempts were given. The goal of reduction was to obtain a position as close as possible to a garden alignment index of 160 to 180 in both anteroposterior and lateral radiographic views[3]. Anatomic reduction even with slight valgus displacement was accepted. Yet, varus displacement was strictly not accepted.

Through 8 cm lateral approach base of greater trochanter and proximal femur were exposed. First we insert the guide wire for the distal cannulated screw(figure 1). Its entry is placed at 5-7 cm distally from the base of the greater trochanter in the anterior one-third of the diaphysis. It is directed proximally at an angle of 150 – 165° to the diaphyseal axis, with inclination from anterodistally to

posteroproximally, so that after it touches tangentially on the curve of the distal femoral neck cortex, the wire goes into the posterior and superior third of the femoral head.

The middle guide wire is placed secondly. The entry point is at 2 to 4 cm proximally from the entry point of the distal wire, but in the posterior one-third of the diaphysis. This wire is placed at an angle of 135-140° to the diaphyseal axis and inclined from posterodistally to anteroproximally, so that after it touches tangentially on the curve of the distal femoral neck cortex, the wire goes into the anterior and inferior third of the femoral head.

Last to be laid is the proximal guide wire, with its entry point at 1-2 cm proximally from the entry point of the middle wire, in the posterior one-third of the diaphysis, close to the lower border of the greater trochanter. Placed parallel to the middle wire, the proximal wire goes into the anterior and superior third of the femoral head.

In the anteroposterior view the proximal and the distal guide wire tips lie in the proximal one third of the femoral head. The middle guide wire tip lies in the distal one third. In lateral view, the proximal and middle guide wires lie in the anterior part of femoral head and the distal lies in the posterior part of femoral head.

The middle and the proximal screws are placed first, because they are perpendicular to the fracture surface. This achieves interfragmentary compression of the fracture fragments. Finally the distal screw (PTS) is placed. The PTS allows weight to be transferred from the head to the larger surface area of lateral cortical diaphyseal mass effectively without varus collapse.

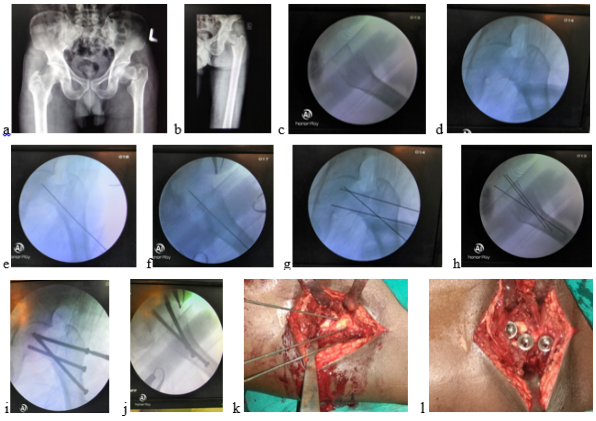

FIGURE 1: A 43 year old male patient with fracture neck of femur(Garden's type 4) on left side. Preoperative Xray (a,b). Intra operative C arm pictures showing fracture reduction (c,d). C arm pictures showing guide wires position (e,f,g,h) and C arm pictures showing screw position (i,j). Intra operative picture showing position of guide wire and cancellous screws (k,l).

RESULTS

A total of 15 patients were included in the study. Of the 15 studied patients, 9 were men and 6 were women. The average age is 45.6 (with the youngest patient aged 30 and the oldest aged 53). Follow up was done every month. During follow up, radiological examination was done to assess fracture union and clinical examination done to assess the functional outcome (figure 2). The average follow-up period was 12 months.

In our series of 15 patients 2(13%) were between 21 and 30 years, 3(20%) between 31 and 40 years, 7(47%) between 41 and 50 years and 3(20%) between 51 and 60 years. In our study we had 9(60%) males and 6(40%) females. 10(67%) had right sided fracture and 5(33%) had left sided fracture. In our series 8(54%) of the cases were operated less than 24 hours from injury, 5(32%) operated between 24 and 72 hours and 2(14%) operated after 72 hours.

Garden staging

Staging	No of cases (%)
I	0(0)
II	6(40)
III	3(20)
IV	6(40)

Outcome

Harris hip score	No of cases (%)
Poor	3(20)
Fair	0(0)
Good	5(33)
Excellent	7(47)

In this study of 15 patients, one patient(7%) developed non union fracture neck of femur and two patients(14%) developed avascular necrosis of the femoral head.

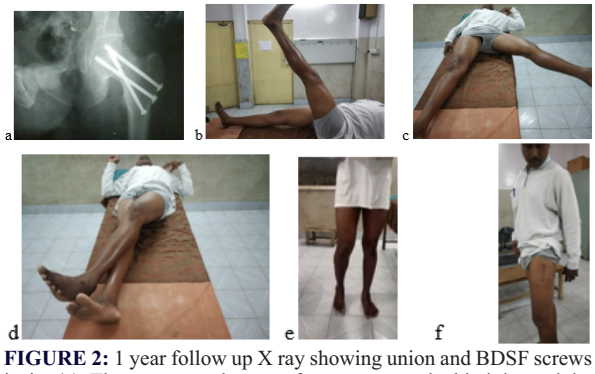

FIGURE 2: 1 year follow up X ray showing union and BDSF screws insitu (a). There was good range of movement at the hip joint and the patient walking comfortably (b,c,d,e,f).

DISCUSSION

The most important objective in the treatment of displaced intracapsular fracture of the hip is to obtain good reduction and stable internal fixation. The fixation is used to increase stability by compressing the fracture and then maintaining the reduction by neutralizing forces acting on the hip.

The advantages of using Primary Trabecular Screw in this new technique is

1) It acts as a simple beam with an overhanging head. Thus the load on the head is effectively transferred on to the strong distal diaphyseal cortex enabling early weight bearing.
2) The PTS is parallel to the axis of the Primary Compressive Trabeculae which is the axis of weight bearing and thus ensures better load transmission and prevents varus collapse.
3) The screws are purchased on the thick diaphyseal cortex distal to the greater trochanter especially the PTS and the middle screw which adds stability to the construct preventing screw loosening.
4) Biomechanically the area covered by conventional method of cancellous screws can be converted to a rectangle and can be calculated as shown (figure 3a)

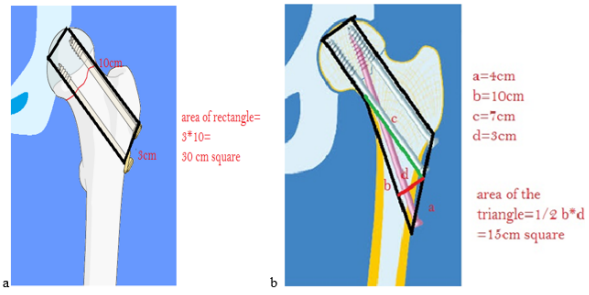

FIGURE 3.
Area of the rectangle is calculated by the formula A=length * breadth(10*3=30)

The area covered by cancellous screws using BDSF forms a pentagon as shown (figure 3b). Compared to the conventional method PTS covers an additional triangular area in the distal diaphyseal cortex which adds to the overall area covered by the screws. The 15cm^2 formed by this triangle described above is the area added to the conventional method of screw fixation.

From the above description it is clear that by using this method more area is covered in the proximal femur which allows the use of the third screw in an effective manner avoiding crowding. This enhances fracture fixation and improves healing. The values are obtained as the average for the cases (conventional and BDSF) done during this study period.

Orlin Filipov in his original study of 88 patients, registered fracture union in 87 patients (98.86%) and failure in 1 patient (1.13%). In our study we had an union of 93%. Assessment according to the Harris hip score[6] (modified): poor results in 10 patients (11.36%), fair results in 20 patients (22.72%), good results in 21 patients (23.86%) and excellent results in 37 patients (42.04%)[1]. In our study we had poor results in 20%, good in 33% and excellent in 47% of patients. The average Harris hip score was 84.26 points in his study. It is 82.50 in our study. Thus the results we achieved with this novel method in our institution is comparable to the original study.

Osteonecrosis remains the main complication following internal fixation of intracapsular fractures. In many of the studies on intracapsular fractures, the rates of osteonecrosis were based on the assumption that if segmental collapse were to occur, it would be evident within two years[4,5]. In our series two patients (14%) had definitive evidence of osteonecrosis within 24 months of fracture. Both these patients had displaced fractures i.e.: Garden stage III and IV. Thus out of 14 displaced fractures, we had 2 patients who developed osteonecrosis. Therefore the rate of osteonecrosis in displaced fractures was 14% in our series. There was one case (7%) of non-union in our series. Thus we had a 93% rate of union. In our series we had no case of infection.

CONCLUSION:

Positioning of Primary Trabecular Screw (PTS) along the primary compressive trabeculae allows transfer of body weight from femoral head to the femoral diaphysis and prevents varus collapse. Biplane positioning of cancellous screws in a wider area prevents torsional forces from displacing the fracture. This enhances fracture healing with lesser complications than other methods of fracture fixation.

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