

The Management of the Displaced Fracture Neck Femur by Dynamic Compression Hip Screw with Derotation Screw

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Abstract

Introduction: The aim of the present study was to evaluate the outcomes of displaced intracapsular fracture neck femur managed by dynamic hip screw (DHS) with derotation screw treated within ten days of injury in patients younger than 60 years.

Materials and methods: This was a prospective study, carried out between December 2010 to December 2016. A total of 42 patients younger than 60 yrs of age with displaced intracapsular fracture neck femur (Garden III and IV, Pauwels III, with the comminution) presenting to the hospital within 2-10 days were included in the study. Data analysis and statistical analysis was done by using SPSS using appropriate tests.

Results: There were 27 males and 15 females, age ranging from 21 to 60 years (mean 42.4±10.2 years). There were twenty seven Garden III while fifteen fractures were Garden IV. In forty fractures (95.2%) average time to union was 3.7 months [3-5 months]. Radiographic evidence of avascular necrosis was seen in four cases (9.5%) and two patients (4.7%) developed non-union of the fracture. There were no cut-outs and breakage of implant. Two patients developed isolated coxa vara (120-124°) with backing of screws. Mean shortening of the injured limb was 2-4 mm in twenty four patients without any functional impairment. Functional results were evaluated by Harris Hip Score. Excellent results were achieved in thirty four (81%), good/fair in six (14.2%) and poor in two (4.8%) patients.

Conclusion: Dynamic Hip Screw (DHS) with derotation screw is a good implant for the fixation of the displaced fracture neck femur with excellent to good radiological and functional outcome.

Keywords: Fracture neck femur, transcervical/ subcapital fracture, cannulated cancellous screw, dynamic hip screw, avascular necrosis, nonunion.

Introduction

Introduction

The goals of treatment in an unstable femoral neck fracture are preservation of femoral head and minimize the rate of complications. Anatomic reduction and stable internal fixation are essential for achieving union. Osteosynthesis has the potential to offer normal hip function after consolidation of the fracture. Most common fixation options include sliding hip screws and multiple cannulated screws. In a bio-mechanical study, comparing the four commonly used constructs for Pauwels

type III, Garden III-IV and basicervical fractures, DHS is found to be a more stable implant.²

Osteosynthesis with the multiple cannulated screws is less invasive technique with negligible blood loss and soft tissue stripping. Wei et al³ retrospectively analyzed 222 femoral neck fractures and reported an AVN rate of 38.8% in displaced fractures after use of cannulated screws. The insertion of DHS has some potential to create rotational malalignment of femoral head at the time of screw insertion.

Therefore besides sliding hip screw, some

surgeons consider an additional anti-rotation screw placed in the cranial part of femoral neck to prevent spinning of head to increase the stability of the construct. 4, 5, Bonnaire et al⁵ found the DHS with derotational screw to be more load stable than compressive screws, a fixed-angle plate or a simple DHS construct. There are a very few reports on DHS with derotation screw fixation and its effect on fracture union and avascular necrosis.

The aim of our study is to assess the functional outcome and incidence of avascular necrosis and non-union following

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Table 1: Distribution of incidence of the fractures according to the age group.

Age group	Incidence of fractures	Percentage
21-30	6	14.28%
31-40	11	26.20%
41-50	16	26.20%
51-60	9	21.42%

treatment of displaced femoral neck fractures with DHS and additional screw in young patients presenting within ten days of injury.

Material & Methods:

After obtaining institutional review board approval, a prospective non randomized study of patients with displaced intracapsular femoral neck fracture was carried out between December 2010 to December 2016. [Table 1].

Inclusion criteria

1. Displaced femoral neck fracture
2. Presentation within 10 days of injury
3. Young patients less than 60 years age

Exclusion criteria:

1. Fractures in elderly
2. Pathological fracture
3. Revision surgery

A total of 42 patients with 27 males and 15 females, age ranging from 21 to 60 years (mean 42.4 ± 10.2 years) were studied. Diagnosis was made by using patient's history, clinical examination, and plain radiographs in two planes. Once the diagnosis of an intracapsular femoral neck fracture was confirmed an antero-posterior radiograph of the pelvis with traction and 20° internal rotation at hip was taken to calculate the Pauwel's angle and comparison of neck shaft angle with other hip. Lateral view of the involved hip was taken to assess angulation, and to note the presence of posterior comminution. Pre-operative radiographic evaluation revealed 25 (59.5%) cases of Pauwel's type III, and 17 (40.4%) cases of Pauwel's type II with posterior comminution of varying extent found in majority of the cases. The twelve cases demonstrated osteoporosis. Fall from height was the commonest mode of injury ($n=19$), followed by road traffic accident ($n=18$) and slip while walking ($n=5$). The Left side was involved in 19 patients and

the right side in 23. Considering anatomical location 22 (52.4%) cases in our series were trans-cervical, while 20 (47.6%) cases were sub-capital. Mean time from injury to surgery, was 3.8 days (range 2-10 days). All patients were given perioperative antibiotic prophylaxis, and encouraged to mobilize as early as possible. Patients were followed up for eighteen months to twenty eight months (twenty two months). Details collected included Pauwel's angle, operative details, perioperative orthopedic complications, re-operations, follow-up details and radiographic findings.

Surgical Procedure

Under an appropriate anesthesia, the patient was taken on the fracture table for the closed reduction with appropriate traction and dialing the rotation to match the cortical continuity on anteroposterior and lateral views. Garden's alignment index was used for the assessment of an adequacy of reduction. The angle of the compression trabeculae on AP view relative to the longitudinal axis of the femoral shaft and the angle of the compression trabeculae on the lateral view relative to the femoral shaft, this angle should be on the AP 160 deg vs 180 deg on the lateral view. Desired length (approximately 5 cm) of the lateral cortex of the femur was exposed through lateral approach and two parallel guide wires at appropriate neck shaft angle were passed under image intensifier control. The inferior guide wire [2.5 mm] directed towards lower quadrant of the femoral head in AP view and center or slightly posterior in a lateral view for DHS screw and superior one [1.8mm] for the derotation screw. The superior guide wire entry was then enlarged to accommodate 6.5 mm cannulated cancellous screw to stabilize the fracture. The inferior guide wire hole was enlarged by DHS triple reamer. After tapping, appropriate sized Richard screw

Table 2: Nonunion and AV rates at follow up

Outcome	Number	Nonunion (%)	AVN (%)
Sex	42	2 (4.8)	6 (14.28)
Male	27	1 (2.38)	3 (7.14)
Female	15	1 (2.38)	1 (2.38)

was passed over the guide wire and attached to two hole side plate in the desired angle of valgus. The fixation was deemed adequate if the screw was placed central/central, inferior/central, or inferior/posterior (in AP/lateral views). The placement in the superior and/or anterior third of the femoral head was considered inadequate [7]. A tip apex distance (TAD) of less than 20 mm was considered adequate [8]. -[Figure 1ABCDEF].

Postoperatively as soon as the patient was free from pain, non-weight-bearing two-crutch walking was allowed. Partial weight-bearing with crutches was permitted after six weeks. Full weight-bearing was allowed once the fracture seemed consolidated. All patients were followed up at four weeks, eight weeks, three months, six months and then yearly.

The assessment of functional and the radiological outcome was done after minimum follow up of two years. Radiological assessment was done considering, the quality of fracture reduction, adequacy of fixation, union of fracture, avascular necrosis of femoral head, coxavara, and implant failure. Though a lot of assessment systems are available, we adopted modified Harris Hip Score for assessing our results.

Results

In our series of 42 femoral neck fractures, closed reduction of the fracture could be achieved in all patients except two, where an open reduction was required to achieve anatomical reduction. Excellent reduction could be achieved in 35 patients and good in 7. The 1350 side plate was used in twenty four cases and 1300 side plate in eighteen. The mean preoperative Pauwel's angle was $60 \pm 6.4^\circ$. Forty fractures (95.2%) united within an average time of 3.7 months [3months -5 months]

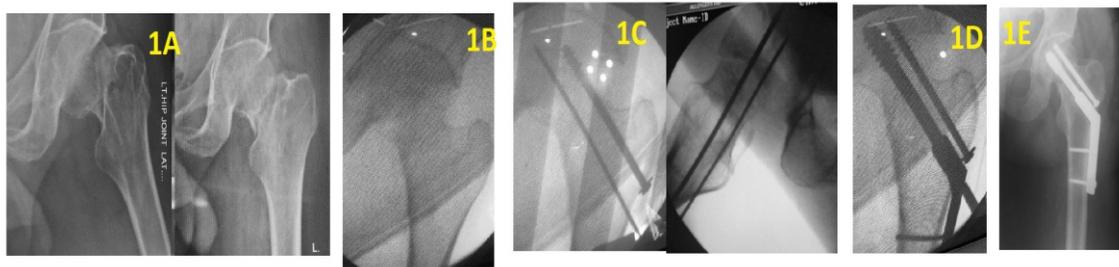


Fig1: A] Garden III fracture with type III Pawel's angle in a 45 year old male. B] Reduction of the fracture on table. C] Passage of guide wire and derotation screw. D] Introduction of DHS Screw. E] Fixation by DHS and derotation screw

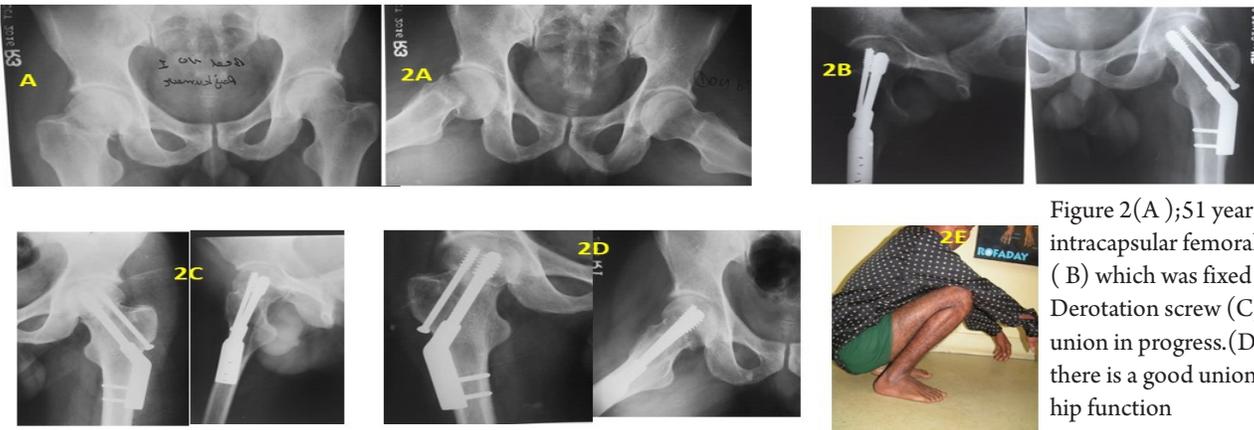


Figure 2(A); 51 year male sustained displaced intracapsular femoral neck fracture 8 days old (B) which was fixed internally by DHS with Derotation screw (C). At 12 weeks follow up union in progress. (D) At 24 weeks follow up there is a good union (E) with the excellent hip function

Accepted definition of union was the development of the established trabecular pattern across the fracture site within 6 months following the date of injury. [Figure2].ABCD; [Figure3].ABCD [Figure4; ABCD]. Two patients (4.7%) developed non-union of the fracture which were successfully converted to arthroplasty. Radiographic evidence of avascular necrosis was seen in four cases (9.5%), which was diagnosed based on the mild pain in the groin with the classic mottled appearance, increase in the radio-density, segmental collapse, and degenerative changes after the follow up of two years. However the patients were relatively asymptomatic and had good functional hip scores. There were no cut-outs or breakage of implant but two patients developed isolated coxa vara (120-124°) with backing of the screws. These fractures drifted into coxa vara due to the poor fixation in the osteoporotic bone. The patients reported mild pain at the extremes of abduction/external rotation movements. Superficial wound infection was noticed in the first postoperative week in three patients which was managed with dressing and antibiotics. Some amount of shortening was noticed in twenty seven patients, with 2-4 mm in twenty four patients and 5 to 10 mm in three patients. Functional results are evaluated by modified Harris Hip Score. Excellent results were achieved in thirty four (81%), the good/fair in six (14.2%)

and poor in two (4.8%) patients. [Functional outcome Table2]

Discussion

In young adults, a displaced vertical shear femoral neck fracture is a problematic orthopedic injury predisposed to non-union or loss of fixation. In these patients, aim is to preserve the femoral head which requires acceptable closed reduction and stable fixation with compression across the fracture fragments for direct bone healing process 9,10. Garden believes that an alignment index after reduction within range of 155° to 180° on both the frontal and lateral views is an acceptable reduction resulting in a higher percentage of union and a low rate of late segmental collapse 11. Multiple cannulated screws and DHS are commonly used for the fixation of displaced femoral neck fracture. Multiple cannulated screws have been advocated in a more stable fracture and the dynamic compression screw for high shear angle neck fractures (Pauwels type III) 4,12. In a bio-mechanical study comparing commonly used constructs for Pauwels type III fractures, DHS with Derotational screw to be more load stable than compressive screws, a fixed-angle plate or a simple DHS construct, 13,3. There is no standard protocol with regards to closed or open reduction of displaced femoral neck fractures in the young adults as long as an

anatomic reduction is achieved. 14. In our study, closed anatomic reduction is achieved with intra-operative fluoroscopy in the majority of the patients. This approach of closed reduction decreases cost, is less invasive and saves operating time. Only two patients required open reduction, hence we consider open reduction, an option only when closed reduction is not satisfactory. Some studies conclude that there was a difference in functional outcome between early and delayed fixation. In contrast, other studies have found no difference in the osteonecrosis rates between early and delayed time to fixation 10, 15. Costas Papakostidis et al carried out, a systematic review and meta-analysis of the final outcome which failed to prove any essential association between timing of internal fixation and the incidence of AVN. However the delay of an internal fixation of more than 24 hours could increase, substantially the odds of non-union by some authors. 16. In the series of Razik et al the delay in treatment was not reflected in results regarding non-union and avascular necrosis [17]. In our series all the patients are operated between 2nd and 10th day as we work in the rural area with the population being less aware about the condition. There was no correlation in the occurrence of avascular necrosis and time of injury in our series. We

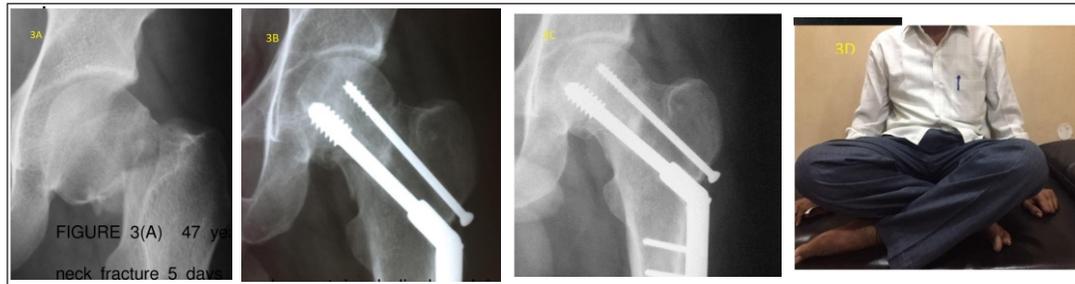


Figure 3(A) 47 year female sustained displaced intracapsular femoral neck fracture 5 days old which was fixed internally by DHS with Derotation screw (B). At 12 weeks follow up (C) with union in progress. At 24 weeks follow up there is a good union (D) with the excellent hip function

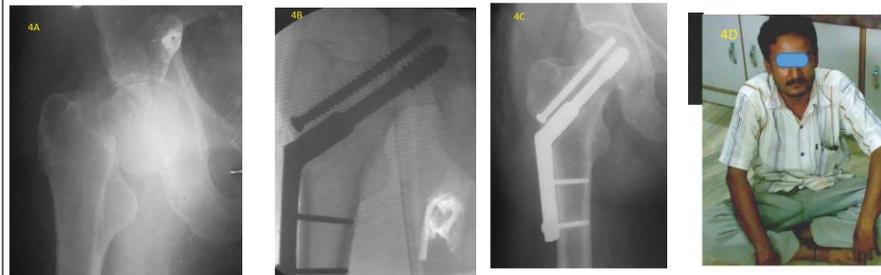


Figure 4(A) 56 year male sustained displaced intracapsular femoral neck fracture 10 days old which was fixed internally by DHS with Derotation screw (B). At 14 weeks follow up mild varus collapse with union. (C) At 24 weeks follow up there is a good union with the excellent hip function [D]

believe that when surgery is delayed for more than 72 hrs there is resorption at fracture ends, for which compression is required which can very well be achieved by DHS with an additional screw. In our series only 04 patients (9.5%) of avascular necrosis even though reduction and fixation was good..and two cases (4.8%) of nonunion were reported out of 42 patients after minimum follow up of eighteen months . These patients with non union had garden stage IV fracture with Pauwels angle more than 70° . However our sample size is too small and follow-up is short to make definitive conclusions about true incidence of avascular necrosis.

A reduction in Pauwel's angle from a preoperative mean of 60° to a postoperative mean of 42° was observed in 10 cases which occurred because of 135° barrel plate applied after the fixation of derotation screw. This changed the angle of inclination and gave favorable outcome. We have found that placement of DHS lag screw in the center or inferior quadrant along the calcar and use of long barrel plate increases the stability of fixation and hence we strongly recommended it. The disadvantages of sliding hip screw for femoral neck fracture stabilization includes a larger surgical exposure and a potential to create rotational malalignment of the femoral head at the time of screw insertion.

Comminution of the posterior wall of the femoral neck has a negative influence on the security of fixation due to persistence of posterior gap after reduction . All redisplacements occurred in cases of

unsuccessful reduction, indicating that quality of reduction is the prime determinant with regard to redisplacement. [18, 19]. Despite the presence of the posterior comminution in our study, primary dhs with derotation screw fixation was an effective answer to an adverse biomechanical factors.

Capsulotomy was not performed in any of the cases as we believe that reaming for the lag screw placement decompresses the femoral head [20,21]. In an extensive meta-analysis by Lu-Yao et al. [22] from the 41 studies and 1558 fractures were re-operation following internal fixation of isolated femoral neck fractures ,occurred in nearly 18% of cases. Avascular necrosis (14.3%) and non-union (9.3%) were the most common complications that likely contributed to repeat surgeries. Blomfeldt et al. [23] recorded 19% of cases with necrosis after 48 months.

In our study the relation of DHS screw in the femoral head was in the limits of standard TAD distance proposed by Baumgaertner et al [8]. In displaced femoral neck fractures, age, sex, fracture level and bone density were not significant factors for non-union in young patients, including our study. The DHS with additional screw screws provide stable fixation even in osteoporotic bones . We had 12 cases which demonstrated osteoporosis. Out of these patients, mild screw back out was seen in only two patients.

Barnes et al, [24] described long term results after follow up of 1503 fractures no significant difference was found in necrosis

delaying the operation up to one week. After analyzing the results in our series we could not identify the significant difference before and after 72 hours of surgical intervention. The patients who developed AVN, which was diagnosed on clinical and radiological assessment, the none of the patients required further surgical management in the form of hip replacement till follow-up. On assessment of patients on final follow up with Harris hip score, excellent results were achieved in thirty four (81%), the good/fair in six (14.2%) and poor in two (4.8%) patients. There are a few shortcomings in our study as it is not a comparative study between two or three implants and has a limited period of follow up and MRI scanning was not done in a patients at final follow up to rule out incipient AVN.

Conclusion

Owing to absence of implant failure and breakage of any implant with high rate of union in our series, we conclude that Dynamic hip screw with derotation screw can be safely used for the management of unstable displaced femoral neck fracture in patients less than 60 years of age.

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