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OUTCOME ANALYSIS OF DYNAMIC HIP SCREW FIXATION IN FEMORAL NECK FRACTURES

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Abstract:

Background: Fracture neck femur constitute nearly half of the fractures around hip with majority in elderly patients after simple fall. In elderly patients, replacement is the treatment of choice but in young patients hip preservation is advocated. Out of the various fixation options , Multiple cannulated screws and Dynamic hip screw is the preferred modality. DHS although involves more soft tissue dissection is a more stable construct and thus gives better anti-rotation stability and fixation in fracture neck femur. The purpose of this study was to assess functional outcomes after fixation of transcervical fracture neck femur using Dynamic Hip Screw.

Materials and Methods: A prospective study of transcervical neck femur fracture treated with DHS fixation at a tertiary level hospital between 2012-2014. Exclusion criteria included basicervical, subcapital fracture pattern, patients with pathologic fracture, with same side shaft femur fracture, and who were using walking aid before injury. Functional outcome was assessed using Harris Hip Score and radiologically, reduction was accepted as adequate if the distance between fragments is less than 3 mm and if the femoral neck angle was >150 valgus or <100 varus as compared to opposite hip.

Results: Out of 42 cases, 37 were available for final follow-up, 18 cases (48.6%) were of Garden type IV, 13 cases of (35.1%) of Garden type III, and 6 cases (16.3%) of Garden type II. Mean age at presentation was 37.5 years (range 20-65), with mean time lag before surgery was 4.6 days (1-18 days). Closed reduction was successful in achieving adequate reduction in all the cases. Fixation was done with 1350 DHS plate in 35 cases and 1400 DHS plate in 2 cases. Adequate fixation was achieved in 31 cases (83.8%) and inadequate in 6 cases (16.2%) as either the tip apex distance was >25 mm and/or the screw was placed in superior and/or anterior quadrant. Union was achieved in 33 cases (89.1%) at mean duration of 13.4 months. There was a significant difference in non-union rates if TAD was >25 mm and/or screw placed in superior/or anterior quadrant. Mean Harris hip score at 1 year follow-up was 84.6 (58-96).

Conclusion: DHS gives better functional outcome with less complication rates in transcervical fracture neck femur and the placement of the screw is the most important criteria other than reduction for better outcomes in such fractures.

Key-words: *Transcervical fracture neck femur, Dynamic Hip screw, Harris hip score, tip apex distance*

Introduction:

With increased life expectancy and more number of road traffic accidents, fractures around hip are on the rise, in which femoral neck fractures account for nearly half of the cases.[1] Majority of such cases are seen in elderly population after a simple fall[1]. Surgical management of neck femur fractures are very challenging where the management plan depends on various factors like age, activity level, type of fracture, bone density. Osteosynthesis either with multiple cannulated screws (MCS) or dynamic hip screw (DHS) ,hemiarthroplasty or total hip replacement are the surgical management options available.

Management protocol of femoral neck fractures has been debated over many years with the aim of either preserving the head or replacing it. In elderly patients replacement has been the preferred choice as compared to internal fixation as early mobilisation minimises morbidities associated with prolonged inactivity.[2-4] In young age patients, internal fixation is preferred as it preserves the natural hip anatomy and mechanics.[5,6] However, head preserving surgeries not only have the potential to give normal hip function after fracture consolidation but also present with two important challenges, first is the technical difficulty in achieving anatomic reduction and second being high failure rate, owing to vulnerability of femoral head blood supply, which leads to high incidence of avascular necrosis and non-union.[7-9]

Most surgeons either prefer dynamic hip screw (DHS) or multiple cannulated screws (MCS). Although MCS is less invasive with minimal soft tissue stripping and blood loss, but it is not biomechanically a very stable construct.[10-12] Various studies have been published focussing on the number of screws, position of screws but the use of three parallel screws, placed perpendicular to the fracture site in inverted triangle pattern with the most inferior screw placed on medial aspect of distal femoral neck and provision of fourth screw in cases of posterior comminution remains the most preferred biomechanically stable construct.[6,9] Bonnaire et al[13] has compared the four most commonly used constructs in his study in Pauwels type III fracture and has concluded that DHS with derotation screw is the most stable one, however in stable fracture patterns, addition of derotation screw is of little benefit. Various other studies have concluded that DHS is a more stable construct than MCS for high shear neck fractures.[11,13,14]

The purpose of this study was to assess functional outcomes after fixation of transcervical fracture neck femur using Dynamic Hip Screw and to correlate the outcomes with patient demographics, time elapsed from fracture to surgery, and tip apex distance.

Materials and methods:

This is a prospective study of 42 cases of transcervical femoral neck fractures operated at a tertiary level hospital, between 2012 - 2014. Exclusion criteria included basicervical, subcapital fracture pattern, patients with pathologic fracture, with same side shaft femur fracture, and who were using walking aid before injury. All fractures were classified as per Garden classification.[15]

Surgical technique:

All surgeries were performed under image guidance and on fracture table. Closed reduction was successful in all cases and achieved with varying amounts of rotation and traction. Reduction was assessed on anteroposterior and lateral views with femoral head and neck should produce a S shaped curvature.[16] Also alignment index as defined by Garden was used to assess reduction.[17] Valgus reduction is preferably accepted as compared to varus reduction.[18] A straight lateral incision was made from base of greater trochanter along the shaft of femur. Using angle guide system, a threaded guide pin was inserted which should be central in both AP view and lateral view. Another guide pin was inserted superior and parallel to main guide pin to give rotational stability while reaming and screw insertion. Lag screw was inserted after reaming with tip-apex distance less than 25 mm and plate was applied and fixed with cortical screws. Second guide pin was removed.

Postoperative protocol:

Three doses of intravenous first generation cephalosporin was given with first dose preoperatively and other two doses post-operatively. All patients were allowed to do passive and active hip exercises and were allowed to walk with crutches and toe-touch weight bearing on first post-operative day until the evidence of union on radiographs. Then gradual and full weight bearing was started on evidence of union. Follow-up was done at 2, 6, 12 weeks and at 6 monthly interval thereafter.

Clinical and Radiological assessment:

Functional outcome was assessed using Harris hip score at 1 year and was graded as excellent (90-100), good (80-89), fair (70-79), and poor (less than 70). Radiologically, reduction was considered as good if the distance between two fragments was less than 3

mm and if the femoral neck angle was $<15^0$ valgus or $<10^0$ of varus compared to opposite hip.[16] Fracture fixation was judged adequate if the lag screw was placed central/central, inferior/central or inferior/posterior (in AP/lateral views) and if tip apex distance is < 25 mm[20]. Lag screw placement in superior and/or anterior quadrant is considered inadequate.[19-21]

Fracture union was defined when traversing trabeculae was seen across the fracture site. Time to union was the time from fracture to union. Failures were defined as lag screw penetration or cut-out of femoral head, varus collapse of the femoral head, implant breakage and non-union. Non-union was defined as the absence of bridging trabeculae seen at 6 month follow-up including progressive displacement.

Results:

Out of 42 cases enrolled in the study, total 37 cases were available at final follow-up. There were 24 males (64.9%) and 13 females (35.1%) with mean age at presentation was 37.5 years (range 20-65), with mean time lag before surgery was 4.6 days (0-18 days). 4 cases (10.8%) were due to simple mechanical fall, 11 cases (29.8%) due to fall from height and 22 cases (59.4%) due to road traffic accidents. Mean time to follow-up was 18.1 months (12-36 months). As per Garden classification, there were 18 cases (48.6%) of Garden type IV, 13 cases (35.1%) of Garden type III, and 6 cases (16.3%) of Garden type II. 135^0 DHS plate was used in majority of cases with 2 cases in which 140^0 plate was used. DHS plate was fixed with two screws in 33 cases (89.1%), while four screws were used in 4 cases (10.9%). Good reduction was obtained in all the cases. Adequate fixation was achieved in 31 cases (83.8%) and inadequate in 6 cases (16.2%) as either the tip apex distance was >25 mm or the screws were placed in superior and/or anterior quadrant. Mean tip-apex distance was 20 mm (10-32mm). Out of those 6 cases of inadequate fixation, non-union was seen in 2 cases with screw cut-out in one of the case ($p<0.05$)

Union was achieved in 33 cases (89.1%) at mean duration of 13.4 months (10-18 months). In 31 cases with TAD<25 mm and screws placed in central/central, inferior/central, inferior/posterior, 1 non-union was seen ($p>0.05$) and out of the 6 cases with TAD>25 mm or screw in superior and/or anterior quadrant, 3 cases of non-union was seen ($p<0.05$). There was a statistically significant difference in these two groups. All 4 cases of non-union were treated with valgus intertrochanteric osteotomy, which later achieved union. In one of the non-union case, screw cut-out was also seen. Two cases of superficial wound infection was seen which was controlled with antibiotics and wound dressing. The femoral neck shaft angle difference between normal side and fractured side did not exceed 10^0 of varus or 15^0 of valgus in 31 cases (83.8%).There was a mean difference of 21^0 between normal and affected side in 6 cases.

Mean Harris hip score at 1 year follow-up was 84.6 (58-96) with 12 cases (32.4%) graded as excellent, 22 cases (59.5%) as good, 2 cases (5.4%) as fair and 1 case (2.7%) as poor.

Discussion:

Nonsurgical treatment of fracture neck femur is not recommended now and surgical treatment is the only line of treatment even in non-displaced neck femur fracture.[22-24] Surgical treatment protocol which is recommended is internal fixation in young patients and replacement arthroplasty in elderly patients.[2-6] Goals of management in young age patients are (i) return to preinjury functional level (ii) achieving anatomic reduction to preserve blood supply and prevent avascular necrosis of femoral head and (iii) to provide a stable fixation construct which will prevent redisplacement and will help in achieving union by preserving bone stock and providing compression at fracture site.

Timing of surgery is always a topic of debate with various studies published supporting urgent fixation which will produce "unkinking" of blood vessel, will provide intracapsular decompression and will help in restoring blood supply to femoral head.[25,26] But many studies states that there is no role of timing of fixation on rate of osteonecrosis.[22,27] In our study we have found no difference in the outcome when surgery was performed within 24 hour and after 3 days which is similar to the study conducted by Razik et al[28] who has found no difference in outcome score as well as osteonecrosis rate in 92 patients treated either within 6 hr post-injury and after 48 hr post-injury. They found that the rate of osteonecrosis was related to the quality of reduction achieved

Method of reduction is another topic of concern with many studies supporting the fact that closed reduction and internal fixation should be performed in undisplaced fracture neck femur (Garden type I-II) as there is low rate of osteonecrosis and non-union.[22,29] In displaced fracture neck femur (Garden type III-IV), there is still no consensus between the two methods of reduction. Achieving anatomic reduction is the goal as poorly reduced fracture is associated with high rate of

ONFH and non-union.[23,30,31] Closed reduction can achieve anatomic reduction but multiple attempts should not be tried as it increases ONFH risk.[32] Theoretically open reduction will drain the hematoma which was causing tamponade and thus will increase femoral blood supply. But studies done by Upadhyay et al[23] and Haidukewych et al[22] has shown no difference in outcome score and in osteonecrosis rate in capsulotomy group. Similarly in our study closed reduction was performed in all the cases and we were able to achieve anatomic reduction and good outcome. So we also support the fact that anatomic reduction is more important than the method of reduction and multiple attempts should be avoided.

Advantage of Dynamic Hip Screw (DHS) over Multiple Cannulated Screws (MCS) is that it is biomechanically more stable construct and provides better compression at fracture site.[11,13,14] But reaming or screw insertion may rotate the head fragment and may lead to loss of reduction as was reported by Jensen et al.[33] Therefore insertion of another guide pin superior and parallel to main guide pin will prevent rotation of the proximal fragment and will maintain reduction.[34]

Watson et al[35] has conducted a prospective randomised trial of nondisplaced or minimally displaced fracture in which cases were allocated to MCS or DHS group and he has found no difference in outcome between the two groups in terms of functional score, osteonecrosis rate or non-union rate. But Lee et al[12] after a study of 90 cases of non-displaced femoral neck fracture has associated DHS with better outcome. Although Makki et al[36] has found no benefit of DHS alone or in combination with derotation screw in Garden type I-II fractures.

Deneka et al[11] has conducted a study comparing internal fixation methods in unstable basicervical neck fractures and has favoured DHS. Similarly, in their retrospective study of 92 cases of unstable fracture neck femur, better outcome and decreased osteonecrosis rate was reported either with DHS alone or in combination with derotation screw by Raziket al.[37] Our results were comparable with other studies showing better outcome as most of our cases were displaced neck femur pattern (83.8%).

Overall complication rate was 16.2% with four cases of non-union , two cases of wound infection and 1 case of screw cut-out which was comparable to other studies. We have reported four cases of non-union (10.8%) which is less than the reported rate of non-union after femoral neck fracture fixation (10-33%).

Conclusion:

We conclude that DHS gives better functional outcome with less complication rate in transcervical fracture neck femur especially in displaced fracture pattern. Anatomic reduction and the placement of screw with tip apex distance less than 25mm is the most important criteria for better outcome in fracture neck femur.

Table/Figure 1

Characteristic	Number
Gender	
Male	24(64.9%)
Female	13(35.1%)
Nature of injury	
Simple Mechanical Fall	4(10.8%)
Fall from Height	11(29.8%)
Road traffic accident	22(59.4%)
Garden grade	
Type II	6(16.3%)
Type III	13(35.1%)
Type IV	18(48.6%)
Timing of surgery	
<24 hour	8(21.6%)
24-72 hour	6(16.3%)
>71 hour	23(62.1%)
Tip Apex distance	
<25mm	31(83.8%)
>25 mm	6(16.2%)
Lag screw placement	
Central/central	22(59.5%)
Inferior/central	8(21.6%)
Inferior/posterior	4(10.8%)
Superior and/or anterior	3(8.1%)
Harris Hip Score	
Excellent(90-100)	12(32.4%)
Good(80-89)	22(59.5%)
Fair(70-79)	2(5.4%)
Poor(<70)	1(2.7%)

Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

Table/Figure 1- Demographics and characteristics of cases

Table/Figure 2- Preoperative radiograph of pelvis showing transcervical fracture neck femur

Table/Figure 3, 4 - Immediate postoperative Antero-posterior and lateral radiographs of pelvis after fixation with DHS

Table/Figure 5,6- AP and lateral radiographs at 18 monthsfollow-up showing good fracture union.

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