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Factors determining failure of intertrochanteric fracture fixation with a dynamic hip screw: a retrospective analysis

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ABSTRACT

Background: The intertrochanteric fractures are extra capsular fractures of proximal femur in the trochanteric region. Different fixation techniques were tried for intertrochanteric fractures, with variety of implants but the dynamic hip screw fixation is most widely accepted treatment. However, several authors have concluded that sliding compression screws may be associated with several complications such as perforation of the femoral head, loss of reduction caused by excessive sliding of the lag screw, non-union, shortening of the affected limb and pain. This study was carried out to ascertain the factors that contributed to mechanical failure at our institute.
Methods: We retrospectively reviewed 92 patients with unilateral intertrochanteric fracture treated with a sliding hip screw between July 2015 and April 2017. Postoperative radiographs were studied for any loss of reduction, which was defined as a varus deformity greater than 10°, perforation of the femoral head, extrusion of the lag screw of more than 20 mm, or metal failure. The Pearson chi-square test was used to assess the relationship between failure and osteoporosis. A p value of less than 0.05 was considered to be significant.
Results: Results revealed a significant relationship between failure and osteoporosis. A possible relationship between the stability of the fracture on Evans' classification and osteoporosis on Singh's index was investigated which revealed a high positive correlation between the failure rates of unstable fractures with osteoporosis.
Conclusions: An unstable fracture combined with osteoporosis, has higher percentage of fixation failure leading to other methods of treatment like hemiarthroplasty.

Keywords: Intertrochanteric fractures, Dynamic hip screw, Failure, Osteoporosis

INTRODUCTION

The intertrochanteric fractures are commonly referred to as extra capsular fractures of proximal femur in the trochanteric region. Among the hip injuries these fractures are the most common in elderly age group.[1] As compared to the femoral neck fractures these fractures are 4-5 times more common.[2] The average age in these patients is reported to be 66-76 years with female preponderance.[3] Female to male ratio ranges from 2:1 to 8:1. Decreasing bone density after menopause may be a contributory factor.[4] They are often associated with some degree of osteoporosis and the different treatment methods available emphasize the difficulties in managing these injuries.

The surgical treatment aims to achieve union in a good position with a low morbidity and to facilitate early return of the patient to his/her pre fracture activity. If prior to injury, patient was bedridden then goal of treatment is pain relief and better nursing care.[5] Due to low socioeconomic status and other co-morbidities such as severe anemia, poor pulmonary status etc. in

developing countries, many patients are not suitable for surgical intervention in which less invasive option i.e. external fixation may be a satisfactory option.[6]

Dynamic hip screw fixation is the most widely accepted treatment of fracture of the proximal femur among the various fixation techniques available for intertrochanteric fractures, with variety of implants.[7] The principle of the sliding hip screw is to provide a controlled collapse at the fracture site.[8] Previous studies have concluded that sliding compression screws may be associated with various complications such as perforation of the femoral head, loss of reduction caused by excessive sliding of the lag screw, non-union, shortening of the affected limb and pain.[9-11] The failure rate in unstable fractures is known to be 10–16% but the factors responsible for these complications still remain controversial and are not well understood.[9,12-14] Factors affecting mechanical failure are osteoporosis, fracture pattern stability, screw placement and distance of screw tip from subchondral bone.

We carried out this study to review the factors that contributed to mechanical failure at our institute. Through an analysis of the results of 'failed' DHS cases we aimed at developing a reliable method of classification which, using simple radiology, could both predict post-operative complications and also demonstrate the importance of osteoporosis in the management of these difficult fractures.

METHODS

This is a retrospective observational study in which we reviewed all the patients who underwent Dynamic Hip Screw fixation for unilateral intertrochanteric fracture at Sri Aurobindo Medical College and Post Graduate Institute, Indore between July 2015 and April 2017. We included the patients of age group 18-100 years, both male and female who had closed unilateral intertrochanteric fracture with no neurovascular injury and were treated with DHS. Patients with open fracture or any other associated fractures were excluded. Of the total 134 patients who had intertrochanteric fracture, 92 patents met our criteria and were included in the study. The operation was performed with the patient in supine position on a standard fracture table. Following closed reduction under flouroscopy control, a DHS was inserted through a standard lateral approach. After operation the patients were kept non weight bearing and were encouraged to start partial weight-bearing at the beginning of the third post-operative week. The Boyd-Griffin classification, Evans classification modified by Jensen, and the AO classification were used.[15-18] Singh's index was used to grade preoperative osteoporosis of the contralateral proximal femur.[19,20] Postoperative radiographs were studied for any loss of reduction, which was defined as a varus deformity greater than 10°, perforation of the femoral head, extrusion of the lag screw of more than 20 mm, or metal failure.[21-24]

Statistical analysis

Statistical analysis of the failures was performed using the Statistical Package for Social Sciences (SPSS) version 19.0 and Microsoft Excel. The Pearson chi-square test was used to assess the relationship between failure and osteoporosis. A p value of less than 0.05 was considered to be significant.

RESULTS

This study includes a total of 92 patients with intertrochanteric fracture who were admitted to the Orthopaedics Department of SAMC and PGI, Indore through accident, emergency and outpatient department. There were 40 (43.4%) male patients and 52 (56.5%) female patients. Male to female ratio was 1:1.3 (Table 1).

Table 1: Distribution of patients according to sex.

Sex	Number	Percentage (%)
Male	40	43.4
Female	52	56.5

Table 2: Distribution of patients according to age.

Age group (in years)	Number	Percentage (%)
51-60	23	25.00
61-70	31	33.69
71-80	29	31.53
81-90	9	9.78
Total	92	100.0

The patients were divided into four age groups (Table 2). There were 23 (25%) patients in the first age group aged 51-60 years, 31 (33.6%) patients in second age group aged 61-70 years, 29 (31.5%) patients in the third age group aged 71-80 years and 9 (9.7%) patients in the fourth age group aged 81-90 years. The mean age of the patients was 71.91 yrs.

Table 3: Distribution of patients according to type of admission.

Type of admission	Number	Percentage (%)
Emergency	72	78.26
OPD	20	21.74
Total	92	100.0

72 patients (78.2%) were admitted through emergency and 20 patients (21.7%) through outpatient department (Table 3).

85 patients had fractures caused by falls when standing and were considered relatively low energy injuries. The remaining 7 fractures were caused by road traffic accidents.

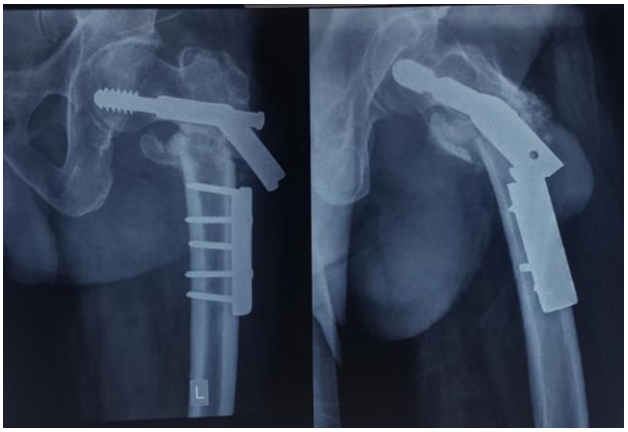

Figure 1: Broken dynamic hip screw.

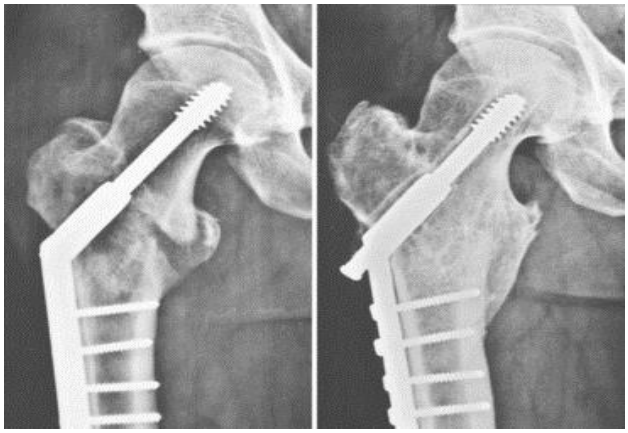

Figure 2: Screw pull out.

Table 4: Distribution according to failure based on radiological findings.

Failure (based on radiological findings)	Number	Percentage (%)
Pull out of leg screw (>20 mm)	11	11.9
Malunion including varus deformity	4	4.3
Perforation of femoral head	1	1.0
Broken plate	3	3.2
Total	19	20.6

Table 5: Distribution according to failure based on Evan's classification.

	Failure (Evan's classification)	Total number	Failure	Failure (%)	Overall (%)
Stable fractures	Type I and Type II	27	1/27	3.70	3.70%
Unstable fractures	Type III	14	4/14	28.57	18/65 = 27.69%
	Type IV	18	5/18	27.77	
	Type IV	33	9/33	27.27	

Table 6: Distribution according to failure based on Singh's classification.

Failure (based on Singh's Classification)	Total number	Number	Percentage (%)
Osteoporotic (Grade I, II, III)	43	11	25.58
Non-osteoporotic (Grade IV, V, VI)	49	8	16.32

Table 7: Distribution according to Singh's Classification in relation to Evan's classification.

Evan's Classification	Singh's classification	Total number	Failure	Failure (%)
Stable fracture (n=27)	Osteoporotic	7	1	14.29
	Non-osteoporotic	20	0	0.0
Unstable fracture (n=65)	Osteoporotic	36	10	27.78
	Non-osteoporotic	29	8	27.59

19 (20.6%) of 92 patients 'Failed' according to our strict radiographic criteria. 11 (11.9%) fractures had greater than 20-mm pull out of the lag screw. 4 (4.3%) fractures displayed mal-union including varus deformity, 1 (1%) fractures had perforation of the femoral head and 3 (3.2%) fractures presented with broken plate as shown in table 4. Using Evans' classification there was 1 failed fractures among 27 in type I and type II which are stable fractures, 4 of 14 in type III (29%), 5 of 18 in type IV (28%), and 9 of 33 in type V (27%) which are all unstable fractures (Table 5). These results reveal a significant correlation between failure and stability of the fractures. With Singh's classification using the trabecular bone structure in the proximal part of the contralateral femur as a measure of osteoporosis, there were 11 (26%) failed fractures in 43 osteoporotic patients (grades I, II and III) and 8 (16%) failed fractures of 49 non-osteoporotic patients (grades IV, V and VI) as depicted in

Table 6. Thus these results reveal a significant relationship between failure and osteoporosis. A possible relationship between the stability of the fracture on Evans' classification and osteoporosis on Singh's index was investigated. As shown in Table 7 Stable fractures with no osteoporosis accounted for 20 fractures with no failure. Stable fractures with osteoporosis numbered 7, and one failed. There were 29 unstable fractures with no osteoporosis of which 8 failed. 10 of 36 unstable fractures with osteoporosis failed. These results reveal a high positive correlation between the failure rates of unstable fractures with osteoporosis.

Figure 3: Screw perforating the head.

DISCUSSION

Intertrochanteric fracture of femur are primarily common in elderly1. The mean age reported in these patients is around 73 to 76 years.[25,26] Our study showed a mean age of incidence to be 71 years. We have observed there is a higher incidence of intertrochanteric fracture among female patient with ratio of 1.3 to 1. This finding is similar to Gallanger et al report in which female to male ratio of 1.7 to 1 to 8 to 1 in Dahl series.[27,28] We have noticed that there were 27 stable fractures (29%) comparable to reports by Simon et al in 1989 (30%) and Leung in 1992 (26.7%).[29,30]

In around 1980 many authors reported excellent results of treatment for femoral intertrochanteric fractures with the use of a dynamic hip screw.[31,32] Although a sliding screw device having several advantages such as controlled impaction of the fracture site, a short operation time, unstable fractures which are comminuted at the posteromedial cortex often displace because of excessive sliding and extrusion of the lag screw.[31,33] Steinberg et al reported that the failure rate was increased when this excessive sliding was more than 15 mm.[33] We noted shortening of the affected limb and hip pain to be associated with sliding of more than 20 mm. Common causes of failure of fixation are instability of the fracture (most important), osteoporosis, lack of anatomic reduction, failure of the fixation device, and the location of the screw in the femoral head.[9,17,19,21,22,24,34-36] However, the most important cause of fixation failure is believed to be instability of the fracture. Evans' classification was compared with the other methods, it was found to be the most accurate for predicting a failure of fixation. Osteoporotic and unstable fractures using Singh's and Evans' classification had a high rate of collapse (27.7%). Chan and Gill reported that patients with femoral intertrochanteric fractures treated with a hemiarthroplasty had substantially more weight bearing on the injured limb in the immediate post-operative period when compared with patients in whom a stable or unstable fracture was treated with internal fixation.[37] In elderly patients a good pre-operative assessment of both osteoporosis and of the instability of their fracture using Singh's and Evans' classifications, can predict post-operative collapse, or failure.

CONCLUSION

Fractures of intertrochanteric region of the femur are challenging to treat. The present study showed various causes and their frequency leading to failure of dynamic hip screw fixation of Intertrochanteric fracture. We found that most common cause of DHS failure was unstability followed by osteoporotic nature of bone. Optimal reduction of the fracture and compression screw positioning in femoral head remain of crucial importance and should be obtained all the times. The results of our study suggest that the use of Evans' classification and Singh's classification for femoral intertrochanteric fractures on the basis of a pre-operative radiograph allows for an accurate prediction of any post-operative failure of fixation and maintenance of reduction. An unstable fracture according to Evans' classification is combined with osteoporosis, has higher percentage of fixation failure leading to other methods of treatment like hemiarthroplasty. Although our results were comparable with other national and international studies of operatively treated intertrochanteric fractures with dynamic hip screw but we still believe that even better results can be achieved with more precise operative technique and enthusiastic rehabilitation program.

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