ORIGINAL ARTICLE

Dynamic hip screw fixation for inter-trochanteric fractures: determinants of outcomes

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Abstract

Objective: To evaluate factors associated with revision of dynamic hip screw implant in patients undergoing the procedure for the fixation of intertrochanteric fractures.

Methods: The retrospective study was conducted at the Aga Khan University Hospital, Karachi, and comprised records of patients who had undergone dynamic hip screw fixation surgery between 2008 and 2012. Medical records and data for all patients were obtained from the medical records office. For all patients, the record files were systematically reviewed using a structured, pre-defined data extraction sheet. SPSS 20 was used statistical analysis.

Results: Out of 317 patients who had undergone the procedure, 8(2.5%) were excluded due to missing records. The study sample as such stood at 309(97.5%). Of them, 6(1.9%) required revision of the dynamic hip screw placed initially. High tip apex distance was found to be associated with the revision ($p<0.0001$).Demographic parameters and co-morbid conditions were not associated with a need for revision surgery ($p>0.05$).

Conclusion: Patients requiring dynamic hip screw implant revision had higher tip apex distance than the rest. A lower value is advisable during placement of the screw to reduce the need for subsequent revision.

Keywords: Intertrochanteric fracture, Femoral fracture, Dynamic hip screw, Complications, Revision.

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Introduction

Femoral fractures are one of the most common fractures encountered by orthopaedic surgeons across the globe.[1] Intertrochanteric (IT) fractures are a common subtype of these and occur mostly in elderly patients with multiple co-morbidities, including osteoporosis.[2] Even though many different management options are available for managing these fractures, the most commonly used approach involves fixation of the fracture with a dynamic hip screw (DHS) implant system.[3] In the United States alone, approximately 2 million patients undergo DHS placement annually.[4]

Despite being the treatment of choice for IT fractures, DHS placement is not devoid of complications. Although such untoward incidents are infrequent, their consequences are devastating when they do occur.[5] The most common types of complications reported are perforation of the femoral head, non-union, excessive sliding of the lag screw resulting in loss of reduction, screw breakage and infection.[6] Depending on whether the IT fracture is stable or unstable, the rate of revision ranges from 1% to 12% in most specialised centres across the globe.[7,8]

Complications occurring after the placement of DHS and the need for subsequent revision lead to significant morbidity in elderly patients. It is, therefore, important to understand the causes and factors which predispose patients to the development of such sequelae. A few studies have reported osteoporosis and unstable fractures as predictors of such complications.[9]

The present study as planned to provide a retrospective analysis of patients undergoing DHS placement over a five-year period. An attemptwas made to identify factors that predispose such patients to the development of subsequent complications.

Materials and Methods

The retrospective analytical study was performed at the Aga Khan University Hospital (AKUH), Karachi, and comprised patient data related to the period from January 1, 2008, to December 31, 2012. The institutional medical records database, coded using the International Classification of Diseases, 9th Revision-Clinical Modification (ICD-9-CM) system, was searched by specifying codes for "dynamic hip screw" as the procedure and "intertrochanteric fracture" as the diagnosis. The data was obtained from the medical records office. Ethical exemption was sought from the institutional ethics

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review committee.

All patients who had undergone DHS fixation for IT fractures during the study period were included. Patients with missing data were excluded. Medical records were deemed to be complete if in-patient progress notes, out-patient follow-up notes, intra-operative notes and reports of laboratory and radiological investigations were complete. A total of six different orthopaedic surgeons had performed DHS placement procedures in the patients included in the study.

For all patients, medical record files were systematically reviewed using a structured, pre-defined data extraction sheet. This ensured that data pertaining to demographics, co-morbidities, type of fracture as per the modified Evans' classification,[10] length of stay, type of anaesthesia, American Society of Anaesthesiologists' (ASA) physical classification level,[11] operative time, tip-to-apex distance (TAD), operative time, post-operative complications, if any, type of complication and subsequent revision were recorded. TAD was defined as the distance from the tip of the screw to the apex of the femoral head. TAD was measured in millimetres on ananterio-posterior (AP) radiograph of the pelvis as well as a lateral shoot-through film of the femur taking into account the level of magnification. Osteoporosis was diagnosed by identifying a T-score value that was 2.5 standard deviations below the mean T-score of an adult female as measured by dual energy X-ray absorptiometry (DEXA) scan of the neck of femur.[12]

Statistical analysis was performed using SPSS20. Frequencies and descriptive measures along with 95% confidence interval (CI) were calculated for qualitative and quantitative variables respectively. Patients were dichotomised into those who required revision of the DHS and those who did not require revision. Student's t-test and Mann-Whitney U-test were used to compare quantitative variables (including TAD) among the two groups. Likewise, Chi-square test and Fisher's exact test were used to compare all other qualitative variables between the two groups. For all comparisons, $p<0.05$ was considered statistically significant.

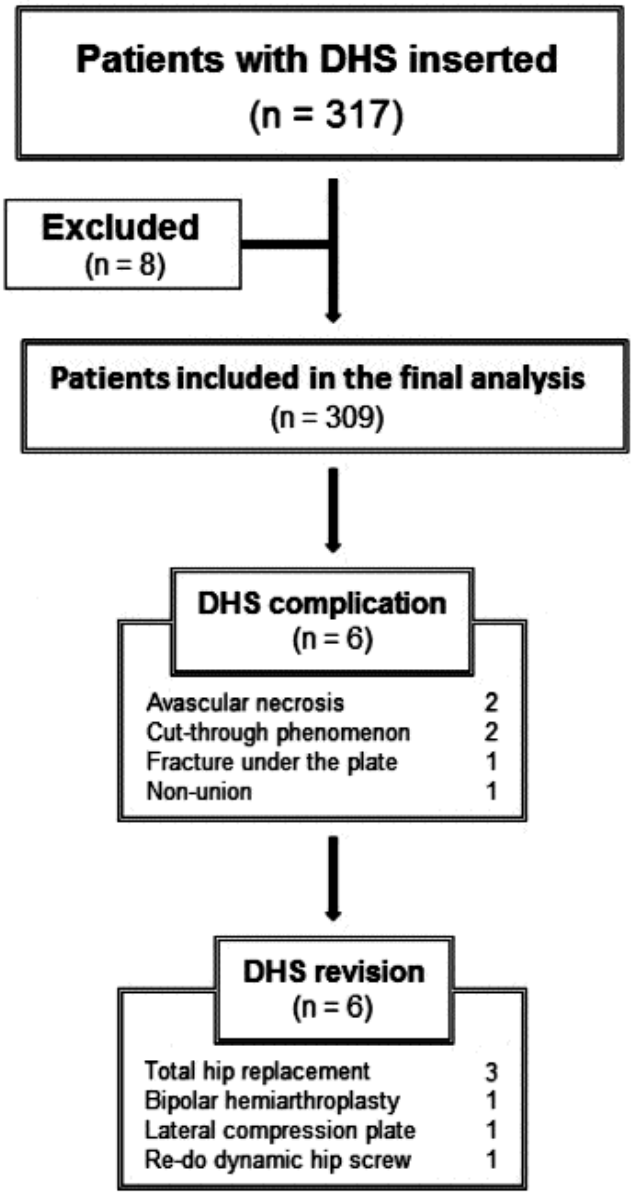

Figure-1: A flow-diagram depicting the inclusion and exclusion of patients in our study.

Results

Out of 317 patients who had undergone the procedure, 8(2.5%) were excluded due to missing records. The study sample as such stood at 309(97.5%) (Figure 1).The overall mean age was 70.5±12.705 SD years (range: 69.1-71.9 years) and 191(61.8%) patients were female. Overall body mass index (BMI)was 23kg/m2 or higher with a mean of 28±2.914 SD kg/m2 (range: 27.7- 28.3kg/m2). Hypertensionin 179(57.9%) and diabetes mellitus in 66(21.4%) were the most common co-morbid conditions. Besides, 95(30.7%) patients had osteoporosis.

There were 126(40.8%) fractures of Evans type 3and 108(35%) of type 4. General anaesthesia was administered to 221(71.5%) patients, while spinal anaesthesia was administered to 88(28.5%). A total of 147(47.6%) patients were ASA II and 155(50.2%) were ASA III. Overall median TAD was 19.3 (IQR 18-20) mm, while 294(95.1%) had a TAD of less than 25mm. The overall median length of hospital stay was 12.5 (IQR 10-15) days.

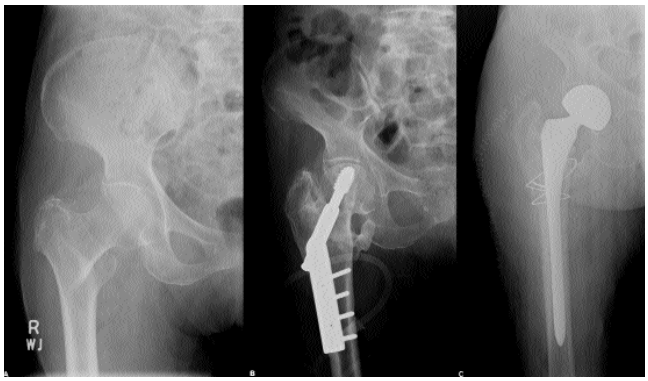

Figure-2: A. Plain radiograph of a 75-year-old lady showing an Evans type 3 intertrochanteric fracture of right femur. B. Plain radiograph of the same patient taken 28 months post-surgery showing avascular necrosis of the head of right femur. C. A plain radiograph obtained after total hip replacement procedure shows appropriate alignment.

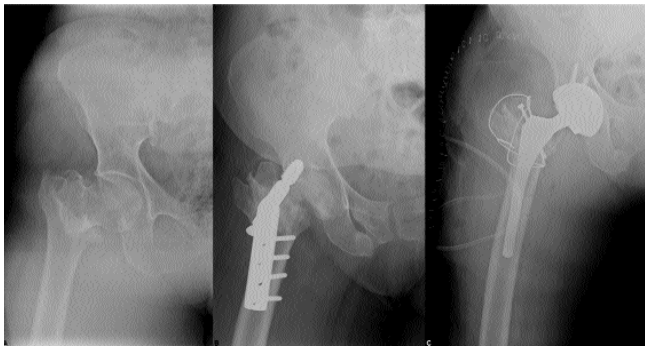

Figure-3: A. Plain radiograph of a 61-year-old woman showing an Evans type 4 intertrochanteric fracture of left femur. B. Another radiograph taken 12 months post-surgery shows the screw cutting through right femur. C. Appropriate alignment is seen on this radiograph obtained after total hip replacement.

Of the 309 patients who underwent DHS insertion, only 6(1.94%) required revision at a median follow-up of 12 (IQR 8-16 months) months. The causes of revision in these cases were avascular necrosis of head of femur in 2(33.3%), screw cutting through bone in 2(33.3%), non-union in 1(16.7%) and fracture of femur under the plate in 1(16.7%)). Radiographs demonstrating these complications were analysed (Figures-2-4). The age of these patients ranged from 35 years to 77 years with a median of 71.5 (IQR 54.5-74.5) years. Five (83%) of these 6 patients were female; 4(66.7%) had hypertension, and 2(33.3%) had diabetes mellitus. All patients, who required DHS revision were either overweight or obese as per the Asian cut-off values for BMI.[13] All patients had a TAD greater than 25mm with a median TAD of 26mm (IQR 24.25-26.25). Only 2(33.3%) of the 6 patients had osteoporosis on DEXA scans. These patients were

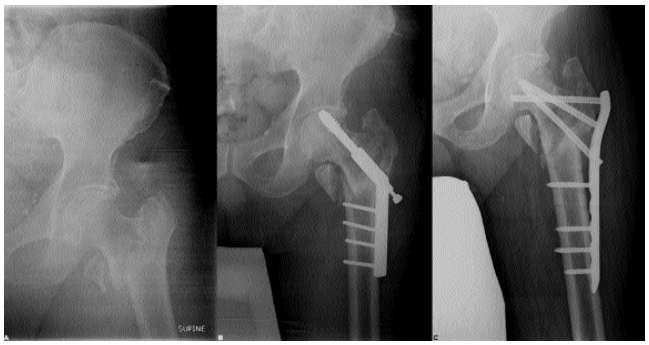

Figure-4: A. Plain radiograph of a 77-year-old man showing an Evans type 5 intertrochanteric fracture of the left femur. B. Plain radiograph of the same patient taken 6 months post-surgery revealed non-union. C. A locking compression plate fixation performed in this patient provided good approximation as seen in this plain radiograph.

followed up for a mean period of 15.5±5.2 SD months (median: 12 months).Revision procedures performed in these patients were total hip replacement in 3)50%), bipolar hemiarthroplasty, locking compression plate fixation and a repeat DHS placement in 1(16.67%) each.

The mean difference in TAD among patients who had DHS revision versus the rest was significant ($p<0.0001$). As TAD had a skewed distribution among the sample, a non-parametric test was performed to further validate the difference, and it also revealed a statistically significant difference between the median TAD values ($p<0.0001$).

Discussion

Unstable IT fractures pose a challenge for even the most experienced orthopaedic surgeons. While the revision rate of prostheses placed for stable IT fractures may be lower than 1%,[7] this rises to as high as 16% for unstable IT fractures.[8] In the present study, we treated a cohort of 309 patients with DHS insertion and the revision rate was noted to be 1.9%. Of note, the prevalence of Evans type 4 and 5 fractures among our study subjects was 35% and 12.9% respectively, while 30.7% patients had osteoporosis. The revision rate was similar to that reported for other experienced orthopaedic centres across the globe.[14-18]

IT fractures typically occur in elderly patients.[2] Surgical procedures performed in this population of patients are often complicated by multiple factors, including reduced functional reserve, depressed immune system, presence of multiple co-morbid conditions, and increased risk of anaesthesia-related complications.[19] In our study, we did not find a significant association between age and the need for DHS revision. Interestingly, one young patient (aged 35 years) developed avascular necrosis, which

suggests that age alone is not a reliable predictor of DHS complications. A meta-analysis of 17 randomised controlled trials involving DHS did not find any direct influence of age on the rate of complications.[20]

Co-morbid conditions including hypertension, diabetes mellitus and ischemic heart disease can theoretically increase the risk of developing DHS complications. Patients with these co-morbid conditions have accelerated atherosclerosis, which can predispose them to the subsequent development of avascular necrosis.[21] Similarly, by impairing bone-healing, the risk of non-union may also be elevated.[22] However, we did not observe any adverse influence of co-morbid conditions on the development of DHS complications. As most elderly patients have multiple co-morbidities, the presence of these in a patient does not reliably predict the need for subsequent revision of DHS.[14-18]

The rate of DHS complications in patients with osteoporosis, in contrast with other co-morbidities, has been reported to be significantly higher.[9,14-18,20] Osteoporosis results in decreased bone mass and results in more brittle bones, which are highly prone to fractures.[23] Moreover, patients with osteoporosis tend to have comminuted and unstable IT fractures, which further increases the risk of complications.[24] Our study did not observe a significant association between the presence of osteoporosis and the development of DHS complications. This may be a consequence of the fact that only six patients required DHS revision and amongst these, only two had osteoporosis. Furthermore, the prevalence of osteoporosis in our study sample was not as high as that reported in some other studies.[9]

Obesity would intuitively seem to increase the risk of both IT fractures and subsequent DHS complications. However, a recent large systematic review of 15 prospective cohort studies (3,126,313 subjects) showed that obesity is actually a protective factor against hip fracture.[25] In our study, we could not find a significant association between obesity and the risk of DHS complications. Nevertheless, it should be noted that in our study sample, all patients were either overweight or obese; none of our patients had a normal BMI. Theoretically, in obese patients, artificial prostheses would be subjected to substantially higher amounts of mechanical stress, which may result in a higher rate of screw cut-through, especially in osteoporotic patients.[26] But, as of now, there is no high-quality evidence available to validate these theoretical hypotheses.

Evans first proposed a classification scheme of IT fractures in 1949 in an attempt to identify unstable fractures, which are prone to complications.[27] This was then modified by Jensen and Michaelsen in 1975[10] and this modified system was utilised in our study. Although, we were unable to identify any association between the type of fracture and the development of DHS complications, but this association is well-recognised in previously published literature.[28] The likely reason for a failure to note such an association in our study is the small number of patients who required DHS revision (n=6).

Among 309 patients who underwent DHS fixation at our institution, only 6 required subsequent DHS insertion. Previously published literature has shown an association of the surgical technique on the subsequent outcome.[14-18,20,28] Meticulous surgical technique, method of insertion of screws, fixation and angulation of screws and post-operative weight-bearing status may account for discrepancies in the rate of DHS complications.

With respect to surgical technique, TAD was noted to be a significant and reliable predictor of subsequent need for DHS revision. TAD is an indicator of position and depth of the lag screw inside the femoral head. A recently published systematic review concluded that a TAD of more than 25mm increases the risk of lag screw cut-through by more than 10times.[29] Our study further substantiates these observations as all six patients who required DHS revisions had a TAD of more than 25mm. A TAD of more than 25mm suggests that a lag screw is not centrally placed within the femoral head and, therefore, it is more likely to erode through the bone over time.

Our study comes with a small array of caveats that need further mention. We performed a retrospective analysis of a hospital-based sample of patients and, therefore, the prevalence of obesity and osteoporosis in our sample was not representative of that in the general population. Even though we included 309 patients who underwent DHS placement at our institution, the overall number of patients who required revision was small (only 6). This relatively small proportion of patients who experienced DHS complications renders it difficult to ascertain with certainty all factors affecting the need for DHS revision.

Conclusion

DHS insertion is the most commonly performed procedure for IT fractures. Unstable IT fractures are prone to the development of complications and subsequent DHS revision. Surgical technique, presence of osteoporosis and type of fracture are already known to influence the need for DHS revision. A lower TAD, preferably less than 25mm, is advisable during DHS insertion to reduce the development of complications and the subsequent need for revision.

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