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Functional Outcome of Intertrochanteric Fracture (Kyle's Type 1 and 2) Treated with Dynamic Hip Screw

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ABSTRACT

Background: Intertrochanteric fractures are common in elderly and surgical treatment like Dynamic Hip Screw (DHS) fixation is often used for early mobilization and to reduce the risks associated with prolonged immobilization. However, the outcomes may vary based on the different fracture patterns and conditions of the bone. **Aim of the study:** To evaluate the functional outcome and radiological evaluation of intertrochanteric fracture (Kyle's type 1 and 2) treated with Dynamic Hip Screw (DHS). ***Methods:*** This quasi-experimental study was conducted in the Department of Orthopedic Surgery, BSMMU, Dhaka, from Sept 2022 to Sept 2024. Within this period, 26 patients were selected after fulfilling the selection criteria, and they had undergone DHS fixation. Assessment was done preoperatively and postoperatively on the 1st, 3rd, 6th, and 9th months. Pain status was assessed using the Visual Analog Scale (VAS) Score. Functional outcomes were measured by the Harris Hip Score, perioperative events, and the radiological union was noted postoperatively. Standard statistical analysis was used to process and analyze the data using the software 'Statistical Package for Social Science' (SPSS) version 25, IBM®, Armonk, USA. For all analyses, a p-value <0.05 was considered statistically significant. ***Result:*** The average age of patients was 67.73±10.26 years, with 77% of the study population > 60 years. Females accounted for 61.5% of cases. 76.9% of the patients had at least one major comorbidity. 50% were osteoporotic. 84.6% of cases occurred due to simple falls. 53.8% of cases had type 1 and 46.2% were type 2 fracture patterns. 57.7% had involvement of the left limb. The mean operative time was 66.81 ± 8.11 minutes. 80.8% of patients had a Tip Apex Distance (TAD) of <25mm. The fracture union was achieved at an average of 16.62 ± 2.38 weeks. The VAS and HHS scores improved significantly from 7.8±0.95 to 1.04±0.92 and 87.12±5.92, respectively. 42.3% had excellent, 42.3% had good,

and 15.4% had fair outcomes. Improved HHS scores were observed more in male patients, Kyle's type 1, and with a <25mm. ***Conclusion:*** Dynamic Hip Screw fixation for intertrochanteric fracture is an effective and safe procedure with significantly improved functional outcomes. Kyle's type 1 showed relatively better functional outcomes with a lower rate of postoperative complications than Kyle's type 2. Also, Better outcomes were observed in male patients and TAD <25mm.

Keywords: Dynamic Hip Screw, Intertrochanteric Fracture, Kyle's Classification.

INTRODUCTION

Forty percent of orthopaedic trauma involves hip fractures, making it a significant part of orthopaedic practice and surgery (Chehade et al., 2015). Intertrochanteric fractures, which account for 45% of all hip fractures, are defined as extracapsular fractures of the proximal femur occurring between the greater and lesser trochanter (Grimsurd et al., 2005). Due to the increasing life expectancy, the incidence of fragility fractures like intertrochanteric fractures is on the rise, and it is anticipated that by 2050, more than 50% of hip fractures will occur in Asian countries (Dhanwal et al., 2011). However, non-surgical treatment is seldom recommended due to poor outcomes, including an increased risk of pneumonia, urinary tract infection, bedsores, and deep vein thrombosis, which contribute to a high mortality rate (Kumar et 2 al., 2012). Non-surgical treatment should only be considered for non-ambulatory patients and patients with a high risk of perioperative mortality (Loggers et al., 2022). The surgical intervention includes extramedullary and intramedullary devices. Extramedullary devices include the Dynamic Hip Screw (DHS) and, Dynamic Condylar Screw (DCS), where the intramedullary device includes Proximal Femoral Nailing and, Gamma Nail. There has been a recent increase in the trend towards the new intramedullary devices, especially for unstable fractures, because it is a load-sharing devices, biomechanically stronger, and a minimally invasive procedure. So, the patients can be mobilized early, and the risk of complications related to immobilization is reduced. However, these devices are costly, have a steep learning curve, and also increase unnecessary hardware-related bone damage, whereas the DHS is cost-effective, more accessible in all parts of the world, technically less challenging, and also the device is familiar to most surgeons. So, in many parts of the world, the DHS is still the first choice for the management of intertrochanteric fracture (Chowdhury et al., 2022). DHS fixations have been widely used to treat hip fractures outside the joint capsule, such as intertrochanteric fractures (Fernandez et al., 2015). In 1951, Ernst Pohl, in collaboration with Gerhard Küntscher obtained the first patent for a sliding screw in Germany. This implant consisted of a two-hole side plate with a *plate*-barrel angle of 3 135 degrees (Bartonicek et al., 2014). Later, Schumpelick and Jantzen documented their initial experience with this implant in 1953 in German literature and then in 1955 in English literature (Schumpelick et al., 1995). The design of DHS allows the sliding of the screw within a barrel connected to the side plate, accommodating the inevitable collapse of fracture ends during the healing process (Whittle, 2021). Thus, dynamic hip screw fixation works by above mentioned principles in which the screw experiences sliding and the bone at the fracture site experiences compression, which causes micromotion at the fracture site. It is crucial to assess the long-term outcome of surgical procedures like DHS to understand how enduring they are. The Harris Hip Score (HHS) is the

most utilized system for evaluating hip function. So, this current quasi-experimental study was undertaken to evaluate the postoperative outcome of Dynamic Hip Screw fixation for the treatment of Kyle's type 1 & 2 intertrochanteric fractures.

METHODOLOGY & MATERIALS

This prospective quasi-experimental study was conducted at the Department of Orthopedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbagh, Dhaka, Bangladesh, a tertiary care center specializing in orthopedic surgery. The study was carried out over a period of two years, from September 2022 to September 2024. The study protocol was developed and ethically approved before data collection. Patients with radiologically confirmed intertrochanteric fractures (Kyle's types 1 and 2) were enrolled during the study period. A purposive sampling method was applied to select available cases. Data were collected, analyzed, and compiled upon completion of the study. The study aimed to evaluate the postoperative outcomes of Dynamic Hip Screw fixation in intertrochanteric fractures (Kyle's type 1 & 2).

Inclusion Criteria:

- Age: 31 years to 80 years (Hakim et al., 2019)
- Both genders
- Both right and left-sided fractures included (Bilateral)
- Kyle's Type 1 and 2 intertrochanteric fracture of the femur
- Able to walk with his affected limb before injury
- Osteoporosis
- Timing of surgery within 3 weeks.

Exclusion Criteria:

- Pathological fracture except osteoporosis
- Kyle's Type 3 and 4 intertrochanteric fracture of the femur
- Open fracture
- Previous hip surgeries
- Associated femoral neck fracture
- Polytrauma
- Patients who cannot follow up for at least 9 months.
- Unable to use his affected limb before fractures due to lack of power or muscle spasticity
- Timing of surgery after 3 weeks
- Who is not able to give consent.

Ethical Consideration

In this study, keeping in compliance with the Helsinki Declaration for Medical Research Involving Human Subjects 1964, the nature and purpose of the study was informed in detail to

all patients. Voluntary participation was encouraged. There were physical and psychological risks to the patients. Informed and understood written consent was taken from every patient before enrollment. The study didn't include any additional investigation and economic burden to the patients. Privacy, anonymity and confidentiality of data information identifying any patient was maintained strictly. Each patient enjoyed every right to participate or refuse or even withdraw from the study at any point of time. With the approval of the study from the academic committee of Department of Orthopedics, BSMMU, the research work was started before the approval from the Institutional Review Board (IRB) of BSMMU, later the clearance was obtained from IRB. Data taken from the participants was regarded as confidential and kept locked under myself, the investigator, for purposeful use only. Due respect was given to all the patients.

Data Collection

Data were collected using a pretested structured questionnaire (Appendix VI) and a study-specific data sheet. Information on demographic variables (age, sex, occupation), clinical variables (mechanism of injury, side involved, duration of injury, comorbidities), radiological variables (X-ray findings, Singh Index, fracture classification Kyle's type, radiological outcome), peri-operative variables (duration of surgery, blood loss, complications, hospital stay), and outcome variables (functional outcomes assessed by Visual Analog Score and Harris Hip Score) was systematically recorded. Patients were evaluated preoperatively and followed up postoperatively at 1, 3, 6, and 9 months. Accuracy and completeness of data were ensured throughout the study to assess the postoperative outcomes of Dynamic Hip Screw fixation.

Statistical Analysis

The analyses of different variables were done according to standard statistical analysis. Qualitative data were expressed as frequency & percentage and were analyzed by chi chi-square test. Quantitative data were expressed as mean & standard deviation and analyzed by Student's t-test (parametric) & Mann-Whitney U test (non-parametric). Data were processed and analyzed using software 'Statistical Package for Social Science' (SPSS) version 25, IBM®, Armonk, USA. For all analyses, statistical significance was set at $p < 0.05$, and the confidence interval set at a 95% level.

RESULT

The study included 26 patients with a mean age of 67.73 ± 10.26 years, most of whom were aged 71–80 years (46.15%). Females comprised 61.54% of the cohort, and the majority were retired (53.85%). The most frequent comorbidities were hypertension (65.38%) and diabetes mellitus (46.15%). A fall from standing height (84.62%) was the predominant injury mechanism, with the left limb affected in 57.69% of cases. Figure 1 depicts that the Singh's Index, most patients were categorized as Grade III (34.62%), followed by Grade IV (26.92%), while Grades II and V each accounted for 15.38%, and Grade VI for 7.69%. Based on Kyle's Classification, Type I fractures were slightly more common (53.85%) compared to Type II fractures (46.15%) (Figure 2). As shown in Table 2, the average time to surgery was 4.96 ± 1.76 days, with 42.31% undergoing surgery within 5 days. The mean duration of surgery was 66.81 ± 8.11 minutes, and the average hospital stay was 5.42±1.63 days. Most patients

(80.77%) had a Tip Apex Distance (TAD) ≤25 mm (mean 22.12 ± 4.47 mm). The radiological outcomes, where the mean fracture union time was 16.62 ± 2.38 weeks. Half of the patients (50%) achieved union by the 16th week, while delayed union (≥20 weeks) occurred in only a few cases (Table 3). Table 4 demonstrates progressive improvement in VAS pain scores and Harris Hip Scores (HHS) over time. The mean VAS decreased significantly from 7.88 preoperatively to 1.04 at nine months (p=0.001), while the mean HHS improved from 45.81 at 1 month to 87.12 at 9 months (p=0.001). Minor complications occurred in 15.38% of patients, comprising superficial wound infections (7.69%) and screw cut-outs (7.69%). No cases of non-union or malunion were observed. Based on the final HHS assessment, 84.62% of patients achieved excellent or good results, while 15.38% were rated as fair; none had poor outcomes (Table 5). Table 6 compares subgroup outcomes. Although gender and fracture type showed no significant difference, patients with a TAD ≤ 25 mm achieved significantly higher HHS (p = 0.003).

Table 1: Baseline characteristics of the study population (n=26)

Parameter	Frequency (n)	Percentage (%)
Age (years)		
31–40	1	3.85
41–50	1	3.85
51–60	4	15.38
61–70	8	30.77
71–80	12	46.15
Mean ± SD	67.73 ± 10.26	
Gender		
Female	16	61.54
Male	10	38.46
Occupation		
Retired	14	53.85
Housewife	5	19.23
Business	4	15.38
Office worker	3	11.54
Comorbidity		
Hypertension	17	65.38
Diabetes Mellitus	12	46.15
Coronary Artery Disease	5	19.23
Respiratory Disease	5	19.23
Kidney Disease	3	11.54
Mechanism of Injury		
Fall from standing height	22	84.62
Road traffic accident	2	7.69

Fall from height	2	7.69
Limb Involvement		
Left	15	57.69
Right	11	42.31

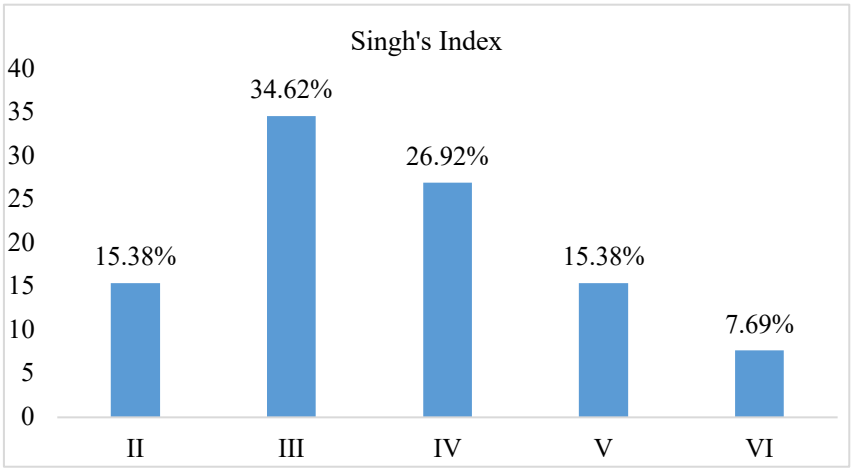

Figure 1: Distribution of patients according to Singh's Index (n=26)

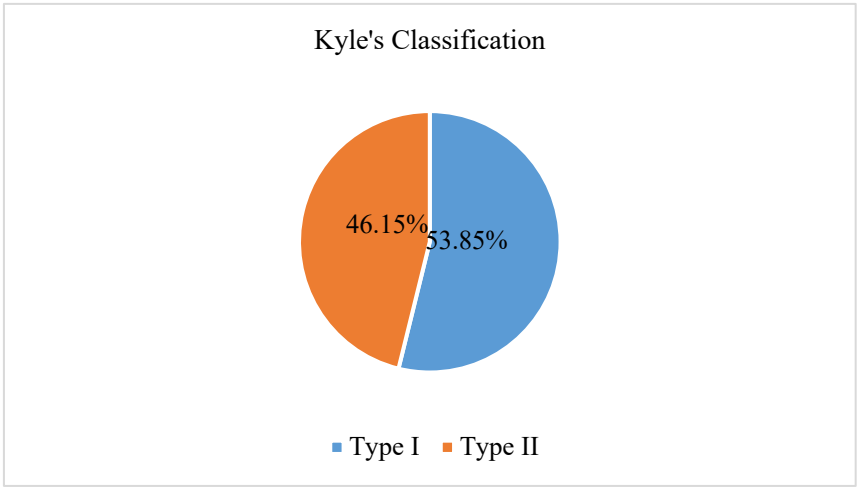

Figure 2: Distribution of patients according to Kyle's classification (n=26)

Table 2: Operative and hospital parameters among participants (n=26)

Parameter	Frequency (n)	Percentage (%)
Timing of Surgery (days)		
≤ 5	11	42.31
> 5	15	57.69
Mean ± SD (days)	4.96 ± 1.76	
Duration of Surgery (minutes), Mean ± SD	66.81 ± 8.11	
Length of Hospital Stay (days), Mean ± SD	5.42 ± 1.63	
Tip Apex Distance (mm)		
≤ 25	21	80.77

> 25	5	19.23
Mean ± SD (mm)	22.12 ± 4.47	

Table 3: Radiological Outcome: Fracture Union (n=26)

Fracture Union Time (weeks)	Frequency (n)	Percentage (%)
14	5	19.23
16	13	50.00
18	4	15.38
20	3	11.54
24	1	3.85
Mean ± SD (weeks)	16.62 ± 2.38	

Table 4: Functional outcomes: pain and Hip Function Scores (n=26)

Parameter	Mean ± SD	P-value
VAS Score		
Pre-operative	7.88 ± 0.95	0.001
1st month	4.50 ± 0.76	
3rd month	2.62 ± 0.80	
6th month	1.73 ± 0.79	
9th month	1.04 ± 0.92	
Harris Hip Score (HHS)		
1st month	45.81 ± 5.42	0.001
3rd month	60.27 ± 5.69	
6th month	79.04 ± 5.09	
9th month	87.12 ± 5.92	

Table 5: Overall outcome of the study (n=26)

Parameter	Frequency (n)	Percentage (%)
Complications		
Superficial wound infection	2	7.69
Screw cut-out	2	7.69
Non-union	0	0
Malunion	0	0
None	22	84.62
Final Outcome (HHS-based)		
Excellent (90–100)	11	42.31
Good (80–89)	11	42.31
Fair (70–79)	4	15.38
Poor (<70)	0	0

Table 6: Comparative functional outcome by subgroups

Comparison	Mean HHS ± SD	P-value
Gender		
Female (n=16)	85.63 ± 6.03	0.087
Male (n=10)	89.50 ± 5.15	
Fracture Type		
Type I (n=14)	88.64 ± 5.36	0.176
Type II (n=12)	85.33 ± 6.27	
Tip Apex Distance (TAD)		
≤25 mm (n=21)	88.90 ± 4.53	0.003
>25 mm (n=5)	79.60 ± 5.41	

DISCUSSION

Intertrochanteric hip fracture has been reported to be a common type of hip fracture, which is known to be associated with older age and multiple comorbidities, suggesting substantial direct health-care costs [11]. Worldwide, it is predicted that there will be over 4.5 million hip fractures per annum by 2050 [12]. Lee et al showed the mean age of 71.3 years. The mean age of the study population in the study was 67.73±10.26 years, with a range of 35-80 years, which is comparable to other previous studies mentioned here [13]. Wong et al. showed 68.18% of females. Females were predominant, accounting for 61.5% cases in the current study, which was similar to above mentioned study results [14]. Asad et al. reported 77.1% of cases had at least one major comorbidity, and the majority were either hypertension (65.7%). In the current study, 76.9% of the patients had at least one major comorbidity, with 65.4% suffering from hypertension, and 46.2% having diabetes. One of the crucial ways of determining osteoporosis in radiology is with the help of Singh's Index, which looks at the trabecular pattern of the proximal femoral neck and head. Singh's Index of ≤ III is considered as osteoporosis [15]. Laohapoonrungsee et al. assessed that 66.25% of the patients had Singh's Index of ≤ III. In this current study, 50% cases had Singh's Index of ≤ III, results were comparable to the studies mentioned above [16]. Lee et al. reported 85% of cases fracture caused by ground-level fall. Here in the study, the most common cause of injury was falling from a standing height, which accounted for 84.6% of cases [13]. Kumar et al. reported 58% of the cases in study had involvement of the left side. In this current study, 53.8% of the study population had Kyle's type 1 fracture pattern, whereas 46.2% had a type 2 fracture pattern [4]. Here in the study, the mean interval from injury to surgery was 4.96±1.76 days with a range from 1 to 7 days. 42.3% of the patients had surgery within 5 days of injury. Previous studies' results are more or less similar to the current study. Debnath et al. studied the duration of surgery was 72.3 minutes [17]. The average length of hospital stay was 5.42±1.63 days with a range of 3-9 days, where Lee et al. reported that the average length of hospital stay was 8.8 days [13]. Asad et al., where TAD was 21.7mm. In this study, the mean Tip Apex Distance was 22.12±4.47 (15-30) mm [15]. Yu et al. reported radiological union at 15.08 weeks. In the study here, 5 patients had union at 14 weeks, most of the patients had union at 16 weeks (13 patients), 4 had union at 18 weeks, 3 had union at 20 weeks, and 1 case had union at 20 weeks [18]. Gill et al. showed a mean VAS

score of 2.5 at the final follow-up. In our study, the mean preoperative VAS score was 7.88±0.95 with a range of 7-10. The VAS Score improved significantly to 1.04±0.92 with a range of 0-3 postoperatively at 9-month follow-up (p value 0.001) [19]. Gurung et al. reported an average HHS of 86.35±6.61. In the current study, the mean Harris Hip Score improved significantly to 87.12±5.92 with a range of 75-96 postoperatively at 9-month follow-up [20].

Prakash et al. showed excellent scores in 34.78% cases, good in 43.48% cases, fair in 17.39% cases, and poor scores in 4.35% cases at final follow-up [21]. Overall, this study showed similar results to above mentioned literature where 42.3% had an excellent and good outcome, 15.4% had a fair outcome, and none of the cases had a poor outcome. At the final follow-up, the HHS scores were relatively better in males than in females (89.50±5.15 vs 85.63±6.03, respectively). Several factors might influence the improved scores in males than in females. As males have higher bone density, their bones are generally stronger and larger than those of women. Also, males tend to have greater muscle mass and strength, which can help to improve rehabilitation goals. At the final follow-up, the HHS scores were relatively better in Kyle's type 1 fracture than in Kyle's type 2 fracture (88.64±5.36 vs 85.33±6.27, respectively). As a result, they are often associated with a greater risk of perioperative and postoperative complications such as hardware failure or nonunion, which can have a detrimental impact on the functional outcome. HHS was significantly better in cases with TAD ≤25mm than in cases with TAD >25mm (88.90±4.53 vs 79.60± 5.41, respectively). When TAD is <25mm, the DHS fixation device is ideally placed in the denser central bone of the femoral head, improving fixation stability and decreasing the chances of implant failure, screw cutout, and varus collapse. Additionally, this placement encourages improved bone healing and quicker recovery, enabling patients to bear weight earlier and participate in physical therapy more efficiently, which is essential for restoring mobility and function [22].

Limitations of the study: Every research has its limitations despite the researcher's best efforts. There were still constraints that couldn't be addressed. This study was conducted at a single facility-based hospital, so the study population may not represent the whole community, which is needed for the study. There were no comparison groups to compare the outcome with different extramedullary operative techniques.

CONCLUSION

Treatment of intertrochanteric fracture by Dynamic Hip Screw showed significantly improved patients' functional outcome with adequate radiological union and fewer surgery-related complications, ensuring early mobilization with low cost and less technical support. Although insignificant, outcomes were relatively better in patients with Kyle's type 1 fracture pattern than Kyle's type 2 fracture pattern. Also, Improved outcomes were seen in males and patients with intraoperative parameters of Tip Apex Distance of less than 25mm.

RECOMMENDATIONS

The following recommendations are suggested:

- Multicentric study.
- There should be a comparative group to compare the outcome.

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Ethical approval: *The study was approved by the Institutional Ethics Committee.*

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