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Effectiveness of Dynamic Condylar Screw (DCS) in Treating Unstable Proximal Femoral Fractures

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ABSTRACT

Despite the availability of various treatment modalities for proximal femoral fractures, there remains ongoing debate regarding the optimal fixation method especially those for unstable fractures, particularly in patients with resource-limited areas. **Objective:** To assess the effectiveness of dynamic condylar screw fixation in treating unstable proximal femoral fractures. **Methods:** A longitudinal prospective study was conducted from Nov 2021 to Dec 2022. 47 patients aged between 18 to 65 years with unstable proximal femoral fractures (intertrochanteric, sub-trochanteric, or complex fractures involving the femoral neck or shaft), were included in the study and followed up for 1 year. Patients with open fractures, poly-trauma, and ipsilateral hip surgery were excluded from the study. The effectiveness of the dynamic condylar screw in treating unstable proximal femoral fractures was measured through a structured clinical and radiographic follow-up process. Patients underwent open reduction and internal fixation using a 95° DCS to ensure optimal fracture stabilization. **Results:** The study involved 47 patients with intertrochanteric (42.6%), sub-trochanteric (31.9%), and complex fractures (25.5%). The effectiveness of treatment and postoperative outcomes was reported in 43 patients (91.5%), with unsuccessful outcomes in 4 (8.5%). The acceptable alignment as per the radiological evidence was seen in 38 patients (80.9%), mal-unions were observed in 5 (10.6%), and implant failure in 4 (8.5%). Functional outcomes showed 29.8% excellent, 44.7% good, 17.0% fair, and 8.5% poor results. **Conclusions:** it was concluded that the study demonstrated a high rate of successful treatment across different fracture types, with no significant differences in success rates.

INTRODUCTION

Unstable proximal femoral fractures are an important public health problem because of their high prevalence, particularly in the geriatric group of patients. These fractures contribute to about 45% of hip fractures and are common in the geriatric population especially individuals aged more than 60 years, by low energy mechanisms such as falls from standing height [1]. Due to the growing ageing populace, these fractures will also become more circulated and some studies project a 240 percent boost in hip fractures by 2050 [2]. A recent survey that was conducted in Qatar revealed that the incidence of a proximal femur fracture was 3. 12/100,000/year [3]. There are two basic classifications of proximal femoral fractures, stable and unstable proximal femoral fractures; unstable fractures are difficult to treat because of a high degree of displacement and comminution. There are three types of unstable fractures: the intertrochanteric fracture with reverse obliquity, the sub-trochanteric fracture and the fracture including the femoral shaft. Otherwise, these fractures cause serious problems like non-union, mal-union, avascular necrosis of the femoral head, and long-term functional loss [4]. Besides, it has been estimated that 30% of first-year mortality following hip fractures may occur, meaning that early and adequate treatment is

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crucial [5]. Current management of unstable proximal femoral fractures involves the use of intramedullary nails, dynamic hip screws (DHS) and dynamic condylar screws (DCS)[6]. Of these, the dynamic condylar screw is efficient and adopted, especially in the metaphysical femoral fracture and they provide axial stability[7]. The DCS system leverages both angular stability and slip-resistant compression in the fracture site that assists in bone healing with minimal probability of implant failure with lower incidence of nonunion and implant cut-out rates[8]. Nonetheless, the current treatment intervention offers several modalities, and a debate is still ongoing regarding the appropriate kind of fixation to be used in unstable fractures, especially in patients with poor bone quality.
This study aims to evaluate the outcome of the inter-trochanteric fracture fixation involving DCS.

METHODS

A longitudinal prospective study was conducted from Nov 2021 to Dec 2022. 47 patients were chosen via purposive sampling with unstable proximal femoral fractures under the age of 65 years, intertrochanteric, sub-trochanteric or combined femoral neck/shaft fractures were enrolled in the study, with 1-year follow-up.The AO/OTA (ArbeitsgemeinschaftfürOsteosynthesefragen/Orthopedic Trauma Association) classification was used to classify the fractures into Intertrochanteric, Sub-trochanteric, and Complex fractures. A2 and A3 unstable intertrochanteric fractures were included in the study. Open fractures, Polytrauma, and ipsilateral hip surgery were considered as contraindications to the study and hence were excluded. A sample size of 47 patients was calculated with an 80% confidence level, 9% absolute precision and by taking an expected percentage of excellent outcomes assessed with Hip Harris score with Dynamic Condylar Screw (DCS) in the Treatment of Unstable Proximal Femoral Fractures as 46.94% [9]. The study was approved from IRB vide letter no. NO.LUMHS/REC/-187). Informed written consent was taken from the participants, enrolled in the study. The functional outcome of the DCS for the management of proximal femur unstable fractures was assessed using common clinical and x-ray evaluation protocols. Patients underwent open reduction and internal fixation using a 95° DCS to ensure optimal fracture stabilization. The patients were supplemented postoperatively with anticoagulant prophylaxis for deep vein thrombosis and the patients were encouraged for early mobilization to prevent complications related to immobility. Progressive weight-bearing was initiated eight weeks' post-surgery or after radiographic confirmation of bony union, which was determined by the presence of a bridging callus. Follow-up assessments were conducted at six weeks, three months, six months, and one-year post-surgery or till the complete recovery (defined as pain free walking). Patients who were unable to walk pain free or patients with implant failure were followed up to 12-month post-surgery. Clinical outcomes were measured in terms of clinical union, defined as pain-free walking, and radiographic union, determined by the presence of bridging callus at three out of four cortices on orthogonal views. The postoperative acceptable alignment was set at ≤10° Varus-valgus angulation and external rotational deviation at ≤15°. Malunions were considered functionally acceptable only if there was no significant impact on mobility, meaning patients could perform daily activities without substantial difficulty. If self-reported mobility issues were present, the malunion was classified as unacceptable. Implant failure was regarded as an unsuccessful treatment. Additionally, the Harris Hip Score, a widely recognized measure of hip function, was used to evaluate the patient's recovery. It is a comprehensive tool used to assess hip function, particularly after surgeries like hip replacement or fracture fixation. It evaluates pain (0–44 points), function (0–47 points), absence of deformity (0–4 points), and range of motion (0–5 points). The total score ranges from 0 to 100, with higher scores indicating better outcomes: 90–100 (excellent), 80–89 (good), 70–79 (fair), and <70 (poor) [10]. The time taken to achieve full weight-bearing was also recorded as a key outcome to assess the success of the surgical intervention and overall rehabilitation process. Quantitative variables like age, units of packed red blood cells (RBCS) transfused, operative time, length of hospital stay, follow-up period and time to full weight-bearing were calculated in mean + SD. Qualitative variables like gender, mechanism of injury, type of fracture, functional outcomes, postoperative alignment and complications and effectiveness of treatment were measured via frequency and percentages. The association between the effectiveness of treatment and postoperative alignment/complications with the type of fracture was determined via the Chi-Square test. The data were analyzed using Statistic Package for Social Sciences (SPSS) version 25.0.

RESULTS

Out of the 47 patients, 34% were female while 66 % were male with a mean age of 49.2 ± 12.7 years. Fracture types were more frequent in the inter-trochanteric region (42.6%), followed by the sub-trochanteric region (31.9%) and the remaining 25.5% were complex fractures. Fall from ground level was the leading cause of injury occurrence accounting for 63.8% of the injuries, followed by road traffic accidents 25.5% and osteoporotic collapse 10.7%. The other parameters which are also required are written in table 1.

Table 1: Demographics and Clinical Characteristics of study participants

Characteristic	Value
Male	31(66%)

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Female	16 (34%)
Mean age (years)	49.2 ± 12.7
Mechanism of Injury	
Ground-level falls	30 (63.8%)
Road traffic accidents (RTA)	12 (25.5%)
Osteoporotic Collapse	5 (10.7%)
Type of Fracture	
Inter-trochanteric	20 (42.6%)
Sub-trochanteric	15 (31.9%)
Complex Fractures	12 (25.5%)
Mean time from injury to surgery	2.6 ± 1.1 days
Mean intraoperative blood loss	243.5 ± 102.6 ml
Mean units of packed RBCs transfused	2.12 ± 1.7 units
Mean operative time	131.7 ± 52.4 minutes
Mean length of hospital stay	4.8 ± 3.3 days
Maximum follow-up period	12 months
Mean follow-up period	9.1 ± 2.5 months
Average time to full weight-bearing	3.6 months (Range: 3-6)

Among the Postoperative Outcomes, treatment was successful in 43 (91.5%) patients and remained unsuccessful in 4 (8.5%). Of total 47 patients, 38 (80.9%) had an acceptable alignment, 5 (10.6%) had malunions, and 4 (8.5%) had implant failure. The post-operative outcomes were assessed at different points of time (at six weeks, three months, six months, and one-year post-surgery) and last obtained post-surgery status are reported in Table 2 & 3. unctional outcomes showed 29.8% excellent, 44.7% good, 17.0% fair, and 8.5% poor results as shown in table 2.

Table 2: Effectiveness of Treatment and Postoperative Outcomes

Category	Frequency (%)
Effectiveness of Treatment	
Successful Treatment	43 (91.5%)
Unsuccessful Treatment	4 (8.5%)
Postoperative Alignment and Complications	
Acceptable alignment (Varus-Valgusangulation ≤10°, external rotational deviation ≤15°)	38 (80.9%)
Malunions (Functionally acceptable)	5 (10.6%)
Implant Failure	4 (8.5%)
Functional Outcomes (Harris Hips Score)	
Excellent	14 (29.8%)
Good	21 (44.7%)
Fair	8 (17.0%)
Poor	4 (8.5%)

Among 43 patients, successful treatment rates were 90% for intertrochanteric, 93.3% for sub-trochanteric, and 91.7% for complex fractures (p=0.32). Acceptable alignment was achieved in 90% of intertrochanteric, 80% of sub-trochanteric, and 66.7% of complex fractures (p=0.45). Functionally acceptable malunions were 5% for intertrochanteric and 13.3% and 16.7% for sub-trochanteric and complex fractures, respectively. Implant failure occurred in 4 cases, mostly in complex fractures (16.7%). The relationship between treatment effectiveness and postoperative alignment and complication with the type of fracture is represented in table 3.

Table 3: Treatment Effectiveness and Postoperative Alignment According to Type of Fracture

Characteristic	Inter-Trochanteric	Sub-Trochanteric	Complex Fractures	p-value
Successful Treatment (n=43)	18 (90%)	14 (93.3%)	11 (91.7%)	0.32
Unsuccessful Treatment (n=4)	2 (10%)	1 (6.7%)	1 (8.3%)	
Acceptable Alignment (n=38)	18 (90%)	12 (80%)	8 (66.7%)	0.45
Mal-unions (Functionally Acceptable) (n=5)	1 (5%)	2 (13.3%)	2 (16.7%)	
Implant Failure (n=4)	1 (5%)	1 (6.7%)	2 (16.7%)	

DISCUSSION

The present study was designed to analyze the outcome of the management of unstable proximal femoral fracture by DCS fixation; the study included 47 patients being a mean age of 49 years. 2 ± 12. 7 years. Such demographic characteristics can be expected as a common patient group for these kinds of fractures that usually occur due to falls or, in general, traumatic events. Our cohort included 42.6% intertrochanteric fractures, 31. Sub-trochanteric fractures accounted for 9%, while 25% of the patients suffered from any of the trochanteric fractures. 5% complex fractures. These proportions are in parallel with the literature where inter-trochanteric fractures are common because of the link between falls and osteoporotic bone status [11]. Self-reported ground-level falls comprised 63 percent. 10% of the injuries estimated that falls are the major factors contributing to proximal femoral fractures, particularly in older people [12]. The secondary mechanisms, road traffic accidents (25. 5%) and osteoporotic collapse (10.7%), were confirmed by other studies dealing with the same issue as well [13, 14]. The success rate of 91.5% for DCS fixation in this study is comparable to other studies evaluating DCS for proximal femoral fractures. DCS for proximal femoral fractures have produced similar findings. For example, Abdullah *et al.*, have mentioned a 90% success rate applicable to DCS with which we concur [15]. This is identified as a principle strength of DCS leading to improved stability hence early mobilizations of the patient with minimal complications. The criteria for acceptable alignment and successful treatment for intra trochanteric fracture was as ≤10° of Varus-Valgus angulation with external rotational deviation ≤15° to which 80.9% of patients met. This was quite in

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agreement with that of Ashraf *et al.* The problems with the alignment, however, most noticeably in comminuted fractures demonstrate the problems inherent in achieving satisfactory outcomes in such situations. The overall complication rate of malunion, 10.6%, and implant failure, 8.5% are higher in complex fracture patients compared with patients with simple fractures because of the difficulties inherent in managing patients with such fractures, findings consistent with other studies. The lucidity of these findings is confirmed by another study, where similar rates of malunion and implant failure were also revealed; still, DCS should be recognized as effective; however, it might be insufficient for the treatment of complex fractures [16]. Functional outcomes in this study, with 29.8% of patients achieving excellent results and 44.7% good results based on the Harris Hip Score, are comparable to other reports. The distribution of the Harris Hip Score of patients who had 7% good results out of all patients is equally supported by other reports [17]. Together these results indicate that DCS is useful for the return of function however if the results of DCS are so disparate then different treatment and management plans should be used, as well as meticulous postoperative care. Although this study identified a relatively smaller number of patients, the average time to full weight-bearing was found was 3. 6 months; which is in contrast to an earlier study by Aggarwal *et al.*, [18] and Bouaicha *et al.*, [19] on weight-bearing where they obtained similar period. Participants' mean follow-up period was 9. 1 ± 2. 5 months' follow-up is in concordance with the other similar studies, where follow-up is conducted from 6 to 12 months after the intervention to evaluate the long-term outcomes [20]. This study had several limitations, particularly the small sample size of 47 patients, which may limit the generalizability of the findings. Additionally, the follow-up duration, while one year, may not fully capture long-term outcomes or complications. Further studies with larger sample sizes and longer follow-up periods are needed to validate the results.

CONCLUSIONS

It was concluded that the study demonstrated a high rate of successful treatment (91.5%) across different fracture types, with no significant differences in success rates (p=0.32). Alignment outcomes as per radiological assessment were generally acceptable, with 80.9% of patients achieving good alignment, though the rates varied slightly by fracture type (p=0.45). Mal-unions and implant failures were less common but also varied by fracture type.

Authors Contribution

Conceptualization: MA
Methodology: MA, SAM, MFJ, AMH, RAB
Formal analysis: IB
Writing review and editing: SAM, MFJ, AMH

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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