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Original Article

Comparison of Radiological and Clinical Outcome of Unstable Intertrochanteric Fracture Treated with Dynamic Condylar Screw and Proximal Femoral Nail Antirotation: A Facility Based Retrospective Study

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Abstract

Introduction *Extra-medullary and intramedullary implants are options for treatment, although consensus is lacking concerning the outcomes. This study compared clinical and radiological results of unstable intertrochanteric fractures treated by either proximal femoral nail anti-rotation (PFNA) or dynamic condylar screw (DCS) system.*

Methods *This was an eighteen months retrospective comparative study (January 2022 to June 2023) where all the operated unstable intertrochanteric fractures from Tikur Anbessa Specialized Hospital (TASH) between January 2022 and June 2023 were reviewed. Data was analyzed with SPSS version 26 and results were summarized by text and table, with statistical significance set at p <0.05. Comparison of blood loss, duration of surgery, injury to the time of surgery, postoperative hospital stay, time of full weight bearing, radiologic union time, and quality of reduction, complications, and Harris hip score was between PFNA and DCS groups.*

Results: *A total of 51 patients were included in the study, 31 (60.8%) in PFNA and 20(39.2%) in DCS group. PFNA group had statically significant superior outcome difference for the amount of blood loss and Harris hip score with p-values of 0.017 and 0.001 respectively. While, age, sex, location, comorbidity, injury at the time of surgery, duration of hospital stay, duration of follow-up, radiologic union time, quality of reduction, and complications were not significantly different between the two groups.*

Conclusion *proximal femoral nail anti-rotation system has better functional outcomes and less intraoperative blood loss than dynamic condylar screws in the treatment of unstable intertrochanteric fractures.*

Keywords*: unstable intertrochanteric fracture, dynamic condylar screw, proximal femoral nail anti-rotation, varus collapse*

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Introduction

Unstable intertrochanteric fracture characterized by comminution of the posteromedial cortex, a thin lateral wall, displaced lesser trochanter fracture, sub-trochanteric extension, and reverse obliquity fractures (1).

Surgical management with stable fixation and early mobilization using extramedullary or intramedullary devices is the gold standard treatment of intertrochanteric fractures (2). However, controversy over the choice of various implants continues as intramedullary and extramedullary devices with significant price differences and conflicting outcome reports designed for the treatment of unstable intertrochanteric fractures (2–5). In developed countries, the intra-medullary device is the gold standard treatment choice (5, 6). However, in low-income countries using affordable extramedullary devices with comparable outcomes is an option (7, 8).

Several factors influence the outcome of intertrochanteric fracture treatment such as the age of the patient, the patient's general health, the time from fracture to treatment, and the stability of fixation (7). Regardless of treatment choice, there remains a 20% to 30% mortality risk in the first year following fracture, with males having a higher mortality rate compared to females (9, 10). Operative complications include varus collapse, implant failure, nonunion, and infection which leads to revision surgery (1, 2,10).

To our knowledge, there is no data showing treatment modality and outcome of unstable intertrochanteric fractures in sub-Saharan countries. The study aims to assess differences in Harris Hip Score, varus collapse, fixation failure, and blood loss, among patients with unstable inter-trochanteric fracture treated with Dynamic condylar screw (DCS) and proximal femoral nail anti-rotation (PFNA). Therefore, knowing the outcome of DCS and PFNA in the treatment of unstable fractures helps to choose the proper implant with a good outcome and a reasonable cost.

Material and Methods

Study setting, study design and study period

A retrospective study encompassed all patients aged 18 to 80 years who underwent PFNA and DCS fixation for unstable intertrochanteric fracture at a single tertiary institution in Addis Ababa, Tikur Anbessa Specialized Hospital (TASH) between January 2022 and June 2023 was conducted. TASH is the biggest referral hospital in the country, where orthopedic service has one of the highest volume. Orthopedic department has a separate trauma and pediatrics unit with sub-specialty training, where two-third of the admissions are trauma patients.

Source population

The source of population is all intertrochanteric patients who visited TASH during study period.

Study Participants

All patients who fulfilled the eligibility criteria within the study period were selected.

Dependent and Independent Variables: sociodemographic variables such as age, sex, clinical, radiologic characteristics, and type of implant used were independent variables, whereas varus collapse, amount of blood loss, fixation failure and Modified Harris Hip Score were dependent variables.

Eligibility Criteria

Inclusion criteria were the presence of completed patients' data, and a minimum of six-month follow-up. In contrast, patients with pathologic fractures, patients who didn't answer phone call complete data were excluded.

Operative technique: Preoperatively, patients underwent anteroposterior and lateral hip X-rays, deep venous thrombosis screened, and received prophylaxis. Surgeries were performed by orthopedic trauma specialists or fellows. Patients were positioned supine on a traction or standard table, closed reduction was tried; open approaches were used if needed. Intraoperative fluoroscopy verified reduction, PFNA is preferably used**.** The quality of reduction was evaluated using the Baumgartner reduction quality criteria in immediate postoperative x-rays.

Good reduction: when alignment is normal or slightly valgus neck shaft angle and less than 20º angulation on lateral view and displacement less than 4mm on both views.

Acceptable reduction: is when only one criterion is met

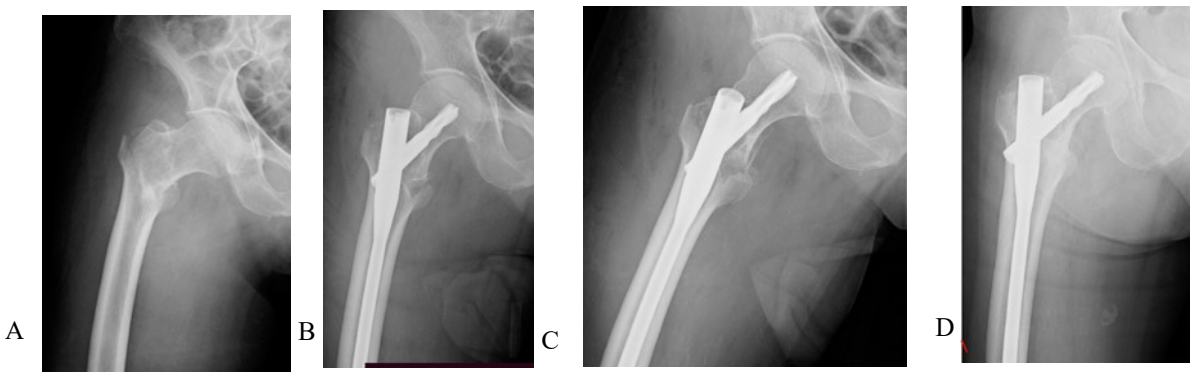

Figure 1: A) 68-year old female patient with a right unstable intertrochanteric fracture B, C) immediate postoperative AP/Lateral x-rays show good reduction. D) At 8-month follow-up

Postoperative clinical and radiological assessment at 2, 6, and 12 weeks, six months and one year were collected. Full weight-bearing was allowed upon evidence of clinical and radiological union. Complications were treated accordingly upon presentation

Fixation failure was defined as a helical blade and screw pull-out, cut through or out, and nail or plate breakage.

Varus collapse change in neck-shaft angle at six months >10° from immediate post-operative radiography. In this study, a complication is defined as varus collapse, fixation failure, or non-union within 18 months of postoperative follow-up evidenced by radiography.

Modified Harris hip score is a functional assessment tool consisting of eight questions categorized into three: pain, function, and level of activity. Scores are added together to make a maximum possible score of 91, which is multiplied by a factor of 1.1 to derive a final Harris hip score (HSS) out of 100 (12).

Data Collection and Analysis

Data were collected by trained resident and cross checked by the principal investigator with Excel sheet, which was exported into a statistical package for the social sciences (SPSS) version 26 for data cleaning and analysis. The result was summarized by using texts, tables, and figures. The data was presented with mean and median for continuous and percentage for categorical variables. Age, amount of blood loss, duration of surgery, injury to the time of surgery, postoperative hospital stay, time of full weight bearing, and radiologic union time were tested using student's t-tests to compare the PFNA and DCS groups. To compare the groups with categorical data Chi-square tests were performed and statistically significant was declared when the P-value was <0.05.

Ethical Consideration: The study was conducted after getting ethical approval from Addis Ababa University College of Health Sciences with institutional review board number 004/24/Ortho.

Result:

A total of sixty-nine patients with unstable intertrochanteric fracture fixed with either PFNA or DCS were selected the study period. Among these, 51 patients who fulfill the inclusion criteria were included in the analysis. Thirty-one patients treated with PFNA for the remaining 20 DCS were used. Eleven patients with incomplete data, six patients who died, and one pathologic fracture were excluded.

The distribution of age, sex, location, comorbidity, injury to time of surgery, duration of hospital stay, and duration of follow-up was not significantly different between the two groups**.** Fall from standing height is the commonest mechanism of injury for both groups. There are a total of 18(35.3%) complications where varus collapse was found the highest 14(77.7%) in both groups (Figure. 2, *Table 1)*.

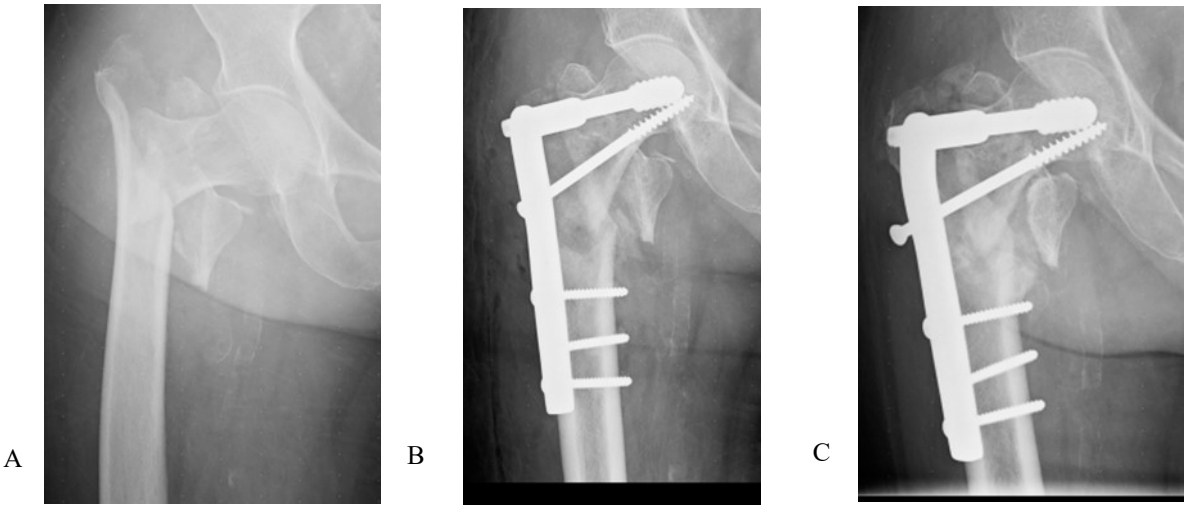

Figure 2: A) 74-year old female patient with a right unstable intertrochanteric fracture B) immediate post-operative x-rays show poor reduction, C) Varus collapse at 3-month follow-up

Table 1: Sociodemographic, clinical and radiologic distribution, TASH, 2022-23

Variables		No. (%)		
		PFNA group	DCS group	Total
Age(years)	≤50	15(48.4)	10(50)	25(49)
	>50	16(51.6)	10(50)	26(51)
Sex	Male	20(64.5)	11(55)	31(60.8)
	Female	11 (35.5)	9(45)	20(39.2)
Location	Addis Ababa	15(48.4)	7(35)	22(43.1)
	outside Addis Ababa	16(51.6)	13(65)	29(56.9)
Comorbidity	None	23(74.2)	15(75)	38(74.5)
	Had comorbidity	8(25.8)	5(25)	13(25.5)
Mechanism of injury	RTA	4(12.9)	3(15)	7(13.7)
	Fall-height	7(22.6)	0	7(13.7)
	Fall-standing height	13(41.9)	13(60)	26(51)
	Bullet	7(22.6)	4(25)	11(21.6)
Injury to surgery (days)	Mean, Median	19.2, 19	22.5, 23	
Need of transfusion		3(9.7)	5(25)	8(15.7)
Post-operative hospital stay (day)	Mean	10.2	4	
	Median	3	3	
Average duration of follow up (month)	Min. 6 to max. 18	12	7.7	
Types of complications	Varus collapse	6(33.3)	8(44.4)	14(77.7)
	Fixation failure	2(11.1)	0	2(11.1)
	Infection	1(5.6)	0	1(5.6)
	Non union	0	1(5.6)	1(5.6)

In regard to duration of surgery, and time of full weight bearing, the PFNA group was seen to have better values but not statically significant. The amount of blood loss was found statically significant in PFNA group (P=0.01), Table 2.

Table 2 : Comparison of the groups of intra-operative variables, radiologic and clinical variables, TASH, 2022-23

Variables	PFNA	DCS	P value
Age (year)	52.4	50.8	0.62
Duration of surgery(in minutes)	79.8	110.8	0.08
Amount of blood loss(ml)	378.1	665.6	0.01
Injury time to surgery(day)	19.2	22.5	0.18
Post-operative hospital stay(day)	10.2	4.0	0.97
Time of full weight bearing	3.0	3.7	0.69
HHS	84.9	70.9	0.73
Radiologic union time	3.0	3.4	0.42

Concerning Harris hip score, we found a statically significant relationship (p=0.001) with the PFNA group, accounting for 20 (64.5%) excellent scores (table 3).

Table 3 : Comparison of categorical variables and groups, TASH, 2022-23

Variables		PFNA n (%)	DCS n (%)	Chi-square	P-value
Quality of reduction	Good	18(58.1)	10(50	0.54	0.764
	Acceptable	9(29.0)	6(30)		
	Poor	4(12.9)	4(20)		
Complications	Yes	9(29.0)	9(45.0)	1.36	0.244
	No	22(71.0)	11(55.0)		
HHS	Excellent(90-100)	20(64.5)	1(5.0)	20.32	0.001
	Good(80-89)	5(16.1)	6(30.0)		
	Fair(70-79)	1(3.2)	4(20.0)		
	Poor(60-69)	2(6.5)	6(30.0)		
	Under poor(<60)	3(9.7)	3(15.0)		

Discussion

Due to improvements in life expectancy and population size, the number of hip fractures has been projected to rise from 1.7 million in 1990 to 6.26 million by the year 2050(13). DHS is considered the gold standard option of treatment for stable-type fractures. The optimal internal fixation device for the repair of unstable intertrochanteric fractures remains a matter of controversy (8, 14–16).

In our study, the amount of blood loss in PFNA group is significantly lower than DCS group. However, this is due to all DCS fixations being done open while the majority of PFNA groups are reduced closed. This result is consistent with a retrospective comparison study done in 91 patients to determine the clinical and radiological results who are treated with PFN, DHS, or proximal femoral locking compression plate (PF-LCP) for unstable intertrochanteric femoral fracture. This study shows perioperative operating time, blood replacement amounts and hospitalization period is statically significant in PFN group than DHS and PF-LCP group (5). Similarly, a randomized control trial done by Baumgartner comparing extramedullary and intramedullary devices on 131 patient's shows 44% less blood loss in the intramedullary device group (17). However, a prospective randomized controlled trial done by Leyi to compare perioperative blood loss between extramedullary and intramedullary devices found a significantly lower blood loss in the extramedullary group (18).

We found HHS in the PFNA group is higher than DCS group which was supported by a meta-analysis of 18 randomized controlled trials (RCTs), 2414 patients, conducted to evaluate functional scores, surgical outcomes, and adverse events in adult patients receiving intramedullary fixation more effective and safer in terms of blood loss, operative time, length of incision, hospital stay, and implant failure than extramedullary fixation (2). However, another meta-analysis done on 8 randomized controlled trials comparing PFN and DHS in the treatment of trochanteric fractures showed no significant difference in blood loss, blood transfusion, mortality, and reoperation between the two implants even though the cost of intramedullary is higher than DHS(19). Similarly, a randomized prospective study comparing fixation using a DHS (343 patients) or intramedullary nail (341 patients) for all intertrochanteric and subtrochanteric fractures showed no long-term differences in outcome at three and 12-month follow-up, with improved early pain on mobilization scores in the intramedullary group. Maintenance of a good reduction and prevention of collapse offers optimum function (20).

Contrary to our finding, a prospective randomized multicenter study compared the clinical and radiographic outcomes of 204 patients treated with extramedullary hip screw and intramedullary device for unstable intertrochanteric hip fracture, radiographic parameters favored the intramedullary treatment arm, which had less femoral neck shortening (21). This is in line with a randomized clinical trial study by Ali Andalib (22) and a meta-analysis comparing the relative advantages of intramedullary nail and extramedullary fixation in unstable intertrochanteric fractures which shows PFNA group had a better union time (23). However, a comparison of the dynamic hip screw and proximal femoral nailing techniques in stable intertrochanteric fractures (24) and systematic review and meta-analysis compared extramedullary fixation and intramedullary fixation for intertrochan-

teric fracture showed no difference in union time (25).

Our study had certain limitations: being a retrospective study in nature, a relatively small number of patients, a single-center study, and a short follow-up period. The strength of the study is to our knowledge it is the first study in Africa to compare the outcome of DCS and PFNA fixation for unstable intertrochanteric fractures and the result is practice changing.

Conclusion

This study supports proximal femoral nail anti-rotation system (PFNA) has a superior outcome than the dynamic condylar screw concerning HHS and the amount of blood loss. DCS should not be the first choice of treatment because of the high rates of varus collapse.

Recommendations

Further randomized control trials on the outcome of PFNA and DCS fixations is recommended.
Consider manufacturing orthopedic implants locally to reduce the cost and improve the availability.

Abbreviations and Acronym

AAU Addis Ababa University
DCS Dynamic Condylar screw
DHS Dynamic hip screw
HHS Harris Hip Score
PFNA Proximal Femoral Nail Antirotation
TASH Tikur Anbessa Specialized Hospital

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