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Comparison of proximal femoral nail versus dynamic hip screw for intertrochanteric femoral fractures

İntertrokanterik femur kırıklarında proksimal femur çivisi ile dinamik kalça vidasının karşılaştırılması

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ABSTRACT

Objective: *This study aimed to compare the functional outcomes and complications of intertrochanteric fractures (ITF) treated either with proximal femoral nail (PFN) or dynamic hip screw (DHS).*

Methods: *Patients treated with PFN and DHS for ITF in our clinic between 2010-2013 were retrospectively screened. The demographic, clinical, and radiological data were obtained using the patient archive. Fractures were classified according to the AO/OTA classification. Functional status was assessed using the Harris Hip Score (HHS). All patients were followed for at least 12 months, and all complications were recorded.*

Results: *There were 64 patients (34 female, 28 male) with a mean age of 69.3±15.3 years (range, 34-93). The mean follow-up duration was 25.5±11.2 months (range, 12-59). Twenty-eight patients were treated with PFN, and 36 patients were treated with DHS. There were no significant differences between the two groups regarding age, sex, mechanism of injury, follow-up, time to surgery, fracture classification, ASA score, type of anesthesia, hemoglobin decline, and length of hospital stay (p>0.05 for all variables). HHS was similar between the groups (p:0.929). However, the HHS for unstable fractures was lower than stable fractures regardless of the fixation method (85.2±8.8 vs. 67.1±15.4, p:0.001). The infection and mechanical complication rate between groups was similar (p>0.05).*

Conclusions: *Both treatment methods had similar functional outcomes and complications. Surgeons should carefully follow patients with unstable fractures since the functional results might be poor.*

Keywords*: intertrochanteric fractures, hip fracture, dynamic hip screw, proximal femoral nail*

ÖZET

Amaç: *Bu çalışmada proksimal femoral çivi (PFN) veya dinamik kalça vidası (DHS) ile tedavi edilen intertrokanterik kırıkların (ITF) fonksiyonel sonuçları ve komplikasyonlarının karşılaştırılması amaçlandı.*

Yöntemler: *2010-2013 yılları arasında kliniğimizde İTF nedeniyle PFN ve DHS ile tedavi edilen hastalar retrospektif olarak tarandı. Demografik, klinik ve radyolojik veriler hasta arşivinden elde edildi. Kırıklar AO/OTA sınıflandırmasına göre sınıflandırıldı. Fonksiyonel durum Harris Kalça Skoru (HHS) kullanılarak değerlendirildi. Tüm hastalar en az 12 ay takip edildi ve tüm komplikasyonlar kaydedildi.*

Bulgular: *Yaş ortalaması 69.3±15.3 (dağılım, 34-93) olan 64 hasta (34 kadın, 28 erkek) vardı. Ortalama takip süresi 25,5±11,2 aydı (dağılım, 12-59). Yirmi sekiz hasta PFN ile tedavi edildi ve 36 hasta DHS ile tedavi edildi. İki grup arasında yaş, cinsiyet, yaralanma mekanizması, takip, cerrahiye kadar geçen süre, kırık sınıflandırması, ASA skoru, anestezi tipi, hemoglobin düşüşü ve hastanede kalış süresi açısından anlamlı fark yoktu (p> 0,05 tüm değişkenler için). HHS gruplar arasında benzerdi (p:0.929). Ancak stabil olmayan kırıklar için HHS, tespit yönteminden bağımsız olarak stabil kırıklardan daha düşüktü (85,2±8,8 ve 67,1±15,4, p:0,001). Gruplar arasında enfeksiyon ve mekanik komplikasyon oranları benzerdi (p>0,05).*

Çıkarımlar: *Her iki tedavi yöntemi de benzer fonksiyonel sonuçlara ve komplikasyonlara sahipti. Fonksiyonel sonuçlar kötü olabileceğinden, cerrahlar stabil olmayan kırıkları olan hastaları dikkatle takip etmelidir.Anahtar kelimeler: intertrokanterik kırıklar, kalça kırığı, dinamik kalça vidası, proksimal femoral çivi*

Anahtar Kelimeler: *intertrokanterik kırıklar, kalça kırığı, dinamik kalça vidası, proksimal femoral çivi*

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INTRODUCTION

Intertrochanteric femur fractures (ITF) are usually seen in elderly patients and are associated with osteoporosis. The progress in healthcare has led to a considerable increase in life expectancy, resulting in a rise in the elderly population. Consequently, there has been a parallel increase in the incidence of ITFs. In the United States alone, there are approximately 296,000 hip fractures annually, with ITF accounting for nearly half of these cases (1). In 2040, this number will increase to 500,000 (2). Although less common in younger patients, high-energy trauma, such as traffic accidents or falls from height, can also cause these fractures.

Dynamic Hip Screw (DHS) has been successfully used in treating ITF for the past 30 years (3). DHS has been advocated for stable ITFs. (3,4). While there is no proven superiority, proximal femoral nail (PFN) has been increasingly utilized in recent years for these fractures (3-5). However, there is still a debate on which implant is the most appropriate or superior to one other (6).

The functional outcomes and complications might be superior concerning the biomechanical advantages and less invasive surgical technique with PFN fixation. Thus, we hypothesized that PFN would result in better functional outcomes and a low complication rate compared to DHS fixation in treating ITFs. This study aimed to present patients' clinical and demographic characteristics in our clinic with ITFs treated with either DHS or PFN and compare the clinical outcomes and complications.

MATERIALS AND METHODS

Patients and study design

A retrospective review was performed on all patients with ITFs treated with either DHS or PFN in our clinic between January 2010 and June 2013. One hundred four patients were identified during the study period, but 27 died, and 13 were excluded from the study due to irregular follow-up visits. Therefore, a total of 64 patients who survived and had a follow-up of at least 12 months were included in the study. The choice of the implant was left to the discretion of the surgeon operating. Of the 64 patients in the study, 28 (44%) underwent PFN fixation, and 36 (56%) underwent DHS fixation. This retrospective study was conducted following the declaration of Helsinki and its later amendments. The education committee approved the study protocol as the thesis of the senior author.

Data collection

Plain anteroposterior (AP) and lateral radiographs were obtained on admission, and all fractures were categorized according to the AO/OTA classification. 31-A1 fractures were classified as stable, while 31-A2 and 31-A3 fractures were classified as unstable (7,8). The mechanism of injury was classified into two groups: low-energy trauma, such as simple fall from standing height, and high-energy trauma, including fall from height or traffic accident. In addition, accompanying injuries were recorded. An anesthetic risk assessment was carried out risk according to the American Society of Anesthesiologists (ASA) classification, and the type of anesthesia (spinal or general) received was recorded. The waiting time for surgery and length of hospital stay was recorded. The operation time and the amount of blood loss during surgery were extracted from the operation notes and medical files.

Surgical technique and implants

All patients received a prophylactic dose of an i.v. antibiotic and were also treated with low-molecular-weight heparin during their stay in the hospital. For PFN patients, closed reduction was performed under fluoroscopy on a traction table in the supine position, followed by surgical procedures. Veronail (Orthofix Medical Inc., USA) was used as an implant, and proximal screws were sent in a convergent or parallel manner, depending on the surgeon's preference. For DHS patients, surgery was performed by making a lateral incision over the greater trochanter under fluoroscopy on a traction table in the supine position. Implantation was performed using a 2-4 holed plate and lag screws, with particular attention to the tip apex distance, according to the surgeon's choice.

Postoperative follow-up and rehabilitation

Patients in both groups were called for physical examination and radiological control at postoperative

1, 3, 6, 12 months, and then once a year. The functional results of the patients were evaluated with the Harris Hip Score (HHS) at their final postoperative control. All complications during the follow-up were recorded.

Statistical analysis

All data were presented as mean, standard deviation, range, frequency, and percentage. The normality of continuous variables was tested using the Kolmogorov-Smirnov test. Student's t-test and Mann-Whitney U test were used for comparing continuous variables between independent groups. The chi-square test was used for comparing categorical variables. For comparing dependent variables, paired sample t-test and Wilcoxon signed-rank test were used for dependent groups. A p-value less than 0.05 was considered statistically significant.

RESULTS

There were 64 patients (34 female, 28 male) with a mean age of 69.3±15.3 years (range 34-93). The mean follow-up duration was 25.5±11.2 months (range, 12-59). The two groups had no significant differences regarding preoperative demographic and clinical characteristics (Table 1).

Table 1. Comparison of demographic and clinical characteristics of patients

Variables		PFN Group (n:28)	DHS Group (n:36)	p-value
Age (years±SD)		70.5±16.0	68.3±14.9	0.573
Sex (n, %)				
	Male	11 (39.3%)	19 (52.8%)	0.283
	Female	17 (60.7%)	17 (47.2%)	
Mechanism of injury (n, %)				
	Low-energy	22 (78.5%)	26 (72.2%)	0.508
	High-energy	6 (21.5%)	10 (27.8%)	
Waiting time (days±SD)		5.6±3.9	4.7±2.7	0.303
Anesthesia type (n, %)				
	Regional	23 (82.1%)	31 (86.1%)	0.737
	General	5 (17.9%)	5 (13.9%)	
ASA score (n, %)				
	ASA I	4 (14.3%)	4 (11.1%)	
	ASA II	12 (42.9%)	17 (47.2%)	0.406
	ASA III	12 (42.9%)	12 (33.3%)	
	ASA IV	0	3 (8.3%)	
Fracture type (n, %)				
	Stable	10 (35.7%)	19 (52.7%)	0.224
	Unstable	18 (64.3%)	17 (47.3%)	
Fracture classification (n, %)				
	A1.1	7 (25.0%)	11 (30.6%)	
	A1.2	2 (7.1%)	7 (19.4%)	
	A1.3	1 (3.6%)	1(2.8%)	
	A2.1	7 (25.0%)	7 (19.4%)	0.224
	A2.2	3 (10.7%)	7 (19.4%)	
	A2.3	3 (10.7%)	3 (8.3%)	
	A3.1	0	0	
	A3.2	3 (10.7%)	0	
	A3.3	2 (7.1%)	0	

Table 2. Comparison of functional outcomes and complications

Variables	PFN Group (n:28)	DHS Group (n:36)	p-value
HHS (score±SD)	75.1±15.5	75.0±16.0	0.929
Length of stay (days±SD)	10.1±3.8	9.3±3.2	0.346
Follow-up (months±SD)	27.7±9.7	23.9±12.1	0.179
Hgb decline (gr/dL±SD)	1.6±0.8	2.0±0.8	0.060
Infection (n, %)	3 (10.7%)	2 (5.5%)	0.380
Cut-out (n, %)	2 (7.1%)	2 (5.5%)	0.593
Lag Screw pull-out (n, %)	1 (3.5%)	2 (5.5%)	0.595

The length of hospital stay (p:0.346), hemoglobin decline (p:0.060), and follow-up (0.179) were similar between the groups. At the final follow-up, the HHS was statistically similar between the groups (p:0.929) (Table 2). However, the HHS for unstable fractures was statistically lower than stable fractures regardless of the fixation method (85.2±8.8 vs. 67.1±15.4, p:0.001).

In the PFN group, three patients, and in the DHS group, two patients had infections, and there was no significant difference in the infection rate between the groups (p: 0.380). None of the patients required implant removal, and they were treated with debridement and antibiotic therapy. In both groups, two patients had cut-out complications (p:0.593), and these patients underwent revision surgery. In the PFN group, one patient and two in the DHS group had lateral migration of the proximal screws (p:0.595). The screw of the patient in the PFN group was removed, while the patient in the DHS group was monitored, and the other patient underwent implant removal and received a partial hip prosthesis.

DISCUSSION

Over the last thirty years, there has been a great debate regarding the optimum treatment of ITFs. The current study aimed to compare the clinical outcomes and complications of patients with ITFs who were treated operatively with either a DHS or PFN. In our series, several patients' preoperative clinical and demographic characteristics in both groups were similar. Thus, we assumed that both groups were appropriate to compare the treatment methods. Our study's findings revealed that the fixation method has similar functional scores and complication rates. It can be concluded that both surgical techniques are equally effective in treating ITFs. Interestingly, functional outcomes were poorer in unstable fractures regardless of the fixation method.

Intertrochanteric hip fractures usually occur in individuals over 65 due to low-energy trauma, such as a simple fall (9-11). The results of our study have shown that the vast majority of the IF was due to low-energy trauma (48 of 64 patients), and the mean age of the patients was 69 years, which is consistent with the literature (11). In a Cochrane review from 2022, seventy-six studies with 10,979 patients with 10-988 extracapsular hip fractures were analyzed (12). That study demonstrated no evidence of a difference between the two groups about the length of hospital stay. However, in a study with 4432 patients, the mean postoperative length of stay was significantly shorter for the PFN group than the DHS group (5.4 and 6.5 days, respectively. p<0.001) (13). The results of our study have shown that patients in group PFN were hospitalized for a longer duration than group DHS (10,1 days vs. 9,3 days), while no statistical significance was detected (P 0,346).

In a study of 1333 patients by Stuchliffe et al. regarding the anesthesia method to be used in hip fracture, the hospital stay of patients who received general and spinal anesthesia was evaluated, and no significant difference was found. (14). The distribution of ASA scores and types of anesthesia (regional vs. general) were similar between the two groups in our study. Bohl et al. reported a randomized trial with a large sample size (4432 patients) and found no difference in the distribution of ASA scores (13). Additionally, recent large prospective randomized trials by Barton et al.(3) and Matre et al.(15) support this finding (3).

The recent literature failed to show any significant difference between the two groups concerning blood loss (16-21), consistent with our findings, while some other studies detected that the PFN group has less blood loss (6,22-24). However, Ahrengart et al. reported a randomized study of 426 intertrochanteric fractures to treatment with either the Gamma nail or a compression hip screw (25), and they found that the compression hip screw group experienced less blood loss (P<0,05).

The current study found results consistent with recent literature, indicating that the functional outcomes achieved with extramedullary devices are comparable to those achieved with cephalomedullary devices (12,26-28). Moreover, in a study assessing the Veronail (Orthofix) (The intramedullary device that we used), patients had the same function as those managed with an extramedullary device (29).

Since the most commonly used classification for femoral trochanteric fractures in the literature (30,31) is the AO/OTA classification, which allows for a more objective evaluation of stability, we also used it in our study. Twenty-nine patients had stable fractures, while 35 patients had unstable fractures. The type of fixation method used did not differ between the stable and unstable groups. While sliding hip screws remain the preferred choice for stable hip fractures, the choice of implant for unstable fractures is controversial (9, 32). Although both the PFN and DHS methods have been reported to be successful in stable fractures, there are theoretical biomechanical advantages to using the PFN in unstable fractures, although there is no evidence-based superiority in the literature (16,22,33-39). Studies on this subject have reported that postoperative functional outcomes worsen due to mechanical problems that develop postoperatively in patients with unstable fracture types (40-42). In the current study, we also found that functional outcomes worsened as fracture types worsened and that there was a significant difference in functional outcomes between the stable and unstable groups regardless of the type of fixation.

According to a Cochrane review from 2022, there is a reduced risk of wound infection with cephalomedullary nails, and the authors stated that using a cephalomedullary nail in the treatment of these fractures in preference to an extramedullary device prevents one infection per 303 patients (12). Nonetheless, in earlier systematic reviews conducted by Kaplan et al. (33) and Parker et al. (26), comparing extramedullary and intramedullary devices, no significant difference was reported between groups concerning infection, compatible with our findings. In the PFN group, three patients, and in the DHS group, two patients were found to have a wound infection in our study. None of the patients required implant removal, and they were treated with debridement and antibiotic therapy, resulting in their recovery. There was no significant difference in infection rates between the two groups(p=0,380).

Concerning adverse effects related to implants (screw cut-out, lateral migration of the lag screw), this study's findings are generally consistent with the 2010 Cochrane Review (26), which found no significant differences between implant types. In the PFN group, screw cut-out was observed in 2 patients and lateral migration of the screw in 1 patient, while in the DHS group, screw cut-out was observed in 2 patients and lateral migration of the screw in 2 patients." in the current study and revision surgeries was necessary to be performed. However, A meta-analysis published in 2014 identified an insignificantly higher rate of screw cut-outs in the DHS group (43). Additionally, a Cochrane review from 2022 favors cephalomedullary implants in terms of mechanical complications (12).

The current study has several limitations that should be considered when interpreting the results. Firstly, the study was conducted at a single center, which may limit the generalizability of the findings to other settings. Additionally, the study was retrospective, meaning that some data may be missing or incomplete, and there is a potential for selection bias. The sample size was also relatively small, which may limit the study's statistical power, and the follow-up period was relatively short, which may not have allowed for the detection of some long-term complications or outcomes. Despite these limitations, the study also has several strengths. The study compared two commonly used surgical techniques for intertrochanteric hip fractures, which is a clinically relevant and important topic. The study included detailed demographic and clinical data, which allowed for a

thorough analysis of potential confounding factors. Additionally, the study used a standardized outcome measure (Harris Hip score) to assess functional outcomes, a widely accepted and validated tool. Finally, the study identified no significant differences between the surgical techniques regarding clinical outcomes and complications, which may help guide clinical decision-making. Overall, while there are limitations to the current study, its strengths contribute to the growing body of literature on this topic.

In conclusion, both DHS and PFN might be selected for ITF fixation. Both have similar functional outcomes and complications. However, surgeons should be careful while treating unstable fractures since the functional results might be poor compared to stable fractures.

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