IJMA

International Journal of Medical Arts

Volume 6, Issue 9, September 2024

P- ISSN: 2636-4174
E- ISSN: 2682-3780

Available online at Journal Website
https://ijma.journals.ekb.eg/
Main Subject [Orthopedic Surgery]

Original Article

Dynamic Hip Screw with Trochanteric Stabilization Plate Fixation of Unstable Intertrochanteric Fractures

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Article information

Received: 31-12-2023

Accepted: 03-07-2024

DOI: 10.21608/ijma.2024.259699.1903.

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Citation: Elsawy AA, Elmenawy MM, Goda SA. Dynamic Hip Screw with Trochanteric Stabilization Plate Fixation of Unstable Intertrochanteric Fractures. IJMA 2024; September; 6 [9]: 4910-4914. doi: 10.21608/ijma.2024.259699.1903.

ABSTRACT

Background: Unstable trochanteric fractures have a higher risk of implant failure and complications and are extremely challenging to treat. The intramedullary nail and dynamic sliding hip screw were the preferred implants for many years. However, these techniques were related with high failure rates.

The aim of the work: This study aimed to assess the efficacy and safety of dynamic hip screw [DHS] with trochanteric stabilizing plate [TSP] in the fixation of unstable trochanteric fractures.

Patients and Methods: A prospective study was conducted on 20 patients with an unstable trochanteric fracture. The fractures was fixated using a DHS with TSP. All patient were followed up for 6 months for evaluated of union time, weight bearing ability, Parker Mobility Score [PMS], muscle power grade [ASIA] and incidence of complications. Radiological evaluation was performed preoperative and during follow-up.

Results: The age of included patients was 62.5±4.5 years. Most of the included patients have an osteoporotic bone. Time to full bone union was 15.1±3.8 weeks. The time to partial weight bearing was after 6.9±1.5 weeks. Parker's score was 7.85±1.089. The ASIA score was 4.10±0.788. Most of cases [55%] had tip-apex distance [TAD] less than 25 mm and [45%] cases had TAD more than 25. All patients with TAD less than 25 mm had early weight bearing and showed full union within three months.

Conclusion: For unstable intertrochanteric femur fractures, the use of DHS with TSP fixation is a successful method that offers good functional and radiological outcomes with few comorbidities and early rehabilitation rates.

Keywords: Unstable intertrochanteric fractures; Dynamic hip screw; Trochanteric stabilizing plate; Elderly.

INTRODUCTION

Extracapsular proximal femur fractures between the greater and lesser trochanters are referred to as intratrochanteric fractures. These fractures, which can be categorized as stable or unstable, typically occur from ground-level falls in the senior population. Intra-capsular fractures are more common in younger adults than intertrochanteric fractures. These fractures typically worsen with age because of the longer lifespans of the elderly and the proportionate loss of bone density [1].

Unstable trochanteric fractures have a higher risk of implant failure and sequelae and are extremely challenging to treat [2, 3]. The most frequent side effects are medialization of the femoral shaft, varus collapse, and lateral wall fracture [4].

Nonoperative care is rarely necessary and should only be taken into account for patients who are mobile, have a high risk of dying after surgery, or are seeking comfort care. This therapeutic approach has poor results because of the increased risk of deep vein thrombosis, pneumonia and urinary tract infections [5,6].

Because the choice of implant and fracture pattern have a strong correlation with failure rate, the type of surgical therapy is determined by the fracture pattern and its intrinsic stability. Hip screws that slide are not recommended for treating fractures that involve the lateral femoral wall. Instead, intramedullary nailing is the recommended course of action. Intramedullary nailing is also indicated in unstable fracture patterns such as reverse obliquity fractures, fractures with comminution of the posteromedial cortex, fractures with a thin lateral wall, displaced lesser trochanter fractures, and subtrochanteric extension of the fracture [7].

For the treatment of such fractures, extramedullary fixation and intramedullary fixation are often the two main alternatives. For the treatment of these fractures, the dynamic hip screw [DHS], which is frequently utilized in extramedullary fixation, was the conventional implant. But it was linked to significant failure rates, particularly when treating unstable per-trochanteric fractures. The Trochanter Stabilizing Plate [TSP] is a modular expansion of the Dynamic Hip Screw [DHS] that stabilizes the lateral wall and the greater trochanter. It has been observed that using a TSP to fix unstable intertrochanteric fractures reduces the risk of femoral medialization and improves the functional outcome [2,6].

Dynamic hip screw systems have been the standard means of fixation of peri-trochanteric fractures in the last few decades, and using of Trochanter Stabilizing Plate [TSP] they have been associated with decreasing failure rates in unstable fractures that may reach [8].

This study sought to investigate the complication rate following the use of a dynamic hip screw and trochanteric stabilizing plate in the treatment of unstable trochanteric fractures, as well as the radiological results and functional outcomes as measured by the Parker mobility score of the patients.

PATIENTS AND METHODS

This study included 20 patients with an unstable trochanteric fracture who were admitted to Al-Azhar University Hospital in Damietta between the beginning of March [2023] and the end of August [2023]. They were treated with a DHS plus TSP.

Inclusion criteria was adult patients with unstable trochanteric fracture [AO/OTA type 31.A2-2 and 31.A2-3 subtypes and 31.A3 fracture group]. Exclusion criteria were stable trochanteric fracture, open fractures, trochanteric with subtrochanteric extension and pathological fractures

Preoperative management protocol

On admission, socio-demographic parameters were collected. All patients were underwent clinical examination, radiological assessment. Before operation, all patients administrated analgesic, antibiotic and prophylaxis drug against deep vein thrombosis [DVT] and pulmonary embolism. Blood sugar in diabetic patients and any other comorbidities were properly controlled. All patients were consented about the surgery, possible risks, complication and follow up protocol.

Operative technique: With induction of anesthesia, Patient in the supine position on a traction table; closed reduction was done under the control of an image intensifier on both views and maintained by traction. A straight lateral incision was made two finger breadths below the vastus ridge to a point 7 - 9 cm distally then deep dissection was performed. The posterior portion of the vastus lateralis was elevated off to expose bone.

The DHS guide pin was placed anteriorly along the femoral neck with the use of the appropriate DHS angle guide. The pin was gently hammer into the femoral head. The appropriate DHS angle guide was aligned along the axis of the femoral shaft. The reaming was performed followed by insertion of lag screw and DHS plate. The spoon Shaped end of the trochanteric stabilizing plate was contoured to fit the bone if necessary. The trochanteric stabilizing plate was positioned over the DHS followed by insertion of screws [figure 1].

Postoperative evaluation:

After the operation was finished, all patients were administrated Intra venous broad spectrum antibiotic, Low molecular weight heparin. Patients began actively moving their hips and knees one to three days following surgery, and they were mobilized as soon as it was safe to do so.

Follow-up protocol:

All patient were followed up for 6 months for evaluated of union time, weight bearing ability and incidence of complications. Radiological evaluation was conducted using X-ray [anteroposterior view of pelvis and lateral view of the operated hip].

Clinical evaluation: Walking, pain and hip function were evaluated using Parker Mobility Score [PMS] [9]. The muscle power was evaluated according to the muscle power grade [ASIA], with comparing to the other normal side [10].

Statistical analysis: All statistical analysis was performed using SPSS version 27. The normality was evaluated using Shapiro-wilk test. Normally distributed continuous data were represented as mean and standard deviation. Categorical data were represented as event and percentage. Chi square test was using between categorical variables.

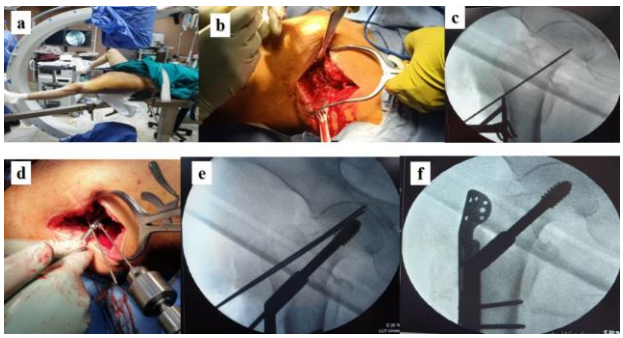

Figure [1]: operation procedures: [a] Patient Position, b] Bone Exposure by Homan's Elevators, c] Placement of Anteversion Wire, d] DHS Angle Guide Alignment, e] DHS Impaction by Impactor, f] Securing of the Trochanteric Stabilizing Plate.

RESULTS

The age of included patients was 62.5 ± 4.5 years. The majority of included patients [60 %] were females. 40% had a diabetes mellitus and hypertension each and 5 [25%] had an HCV infection. 11 [55%] of the fractures were on the right side and 9 [45%] were on the left side. Most of the included patients have an osteoporotic bone. 65% of the fractures were due to fall to the ground and 35% of the fractures were due to road traffic accidents. 17 [85%] of the patients had multiple fractures [Table 1].

The time to full bone union was 15.1±3.8 weeks. The time to partial weight bearing was after 6.9 ± 1.5 weeks. Parker's score was 7.85 ± 1.089. The ASIA score was 4.10 ± 0.788. Regarding the tip-apex distance [TAD], most of cases [55%] had TAD less than 25 mm and [45%] cases had TAD more than 25 [Table 2].

There were relationship between weight bearing and TAD. All patients with TAD less than 25 mm had early weight bearing. Patients with TAD from 25 to 30 had late weight bearing [p value 0.001]. Unlike cases with a TAD ranged from 25 to 30, the majority of cases with TAD less than 25 mm had been showed full union within three months [p value 0.001] [Table 3].

Table [1]: Socio-Demographic parameters of the included patients

Age	**Mean ± SD [range]**
	62.5 ± 4.5 [51-70]
	N [%]
Gender	
Male	8 [40%]
Female	12[60%]
DM	8[40%]
HTN	8[40%]
DM & HTN	5[25%]
HCV	5[25%]
Fracture patterns	
Side	
Right	11 [55.0]
Left	9 [45.0]
Bone Quality	
Good	8 [40.0]
Osteoporotic	12 [60.0]
Mechanism of injury	
RTA	7 [35.0]
FTG	13 [65.0]
Associated Fractures	17 [85.0]

Table [2]: Radiological and functional outcome

	Mean ± SD
Bone union [weeks]	15.1 ± 3.8
Partial weight bearing [weeks]	6.9 ± 1.5
Parker Mobility Score [PMS]	7.85±1.089
ASIA	4.10±0.788
TAD	**N [%]**
less than 25	11[55%]
25 to 30	9[45%]

Table [3]: The relationship between weight bearing and TAD

		Total	**TAD**		**P value**
			less than 25	25 to 30	
Weight bearing	Early	12	11	1	0.001*
	Late	8	0	8	
Full motion	Yes	15	11	4	0.008*
	No	5	0	5	

Regarding complications, Intraoperative complication were observed in 2 patients with inadequate reduction. Regarding post-operative complications, superficial wound infection was in two cases and was treated by repeated dressing and broad spectrum antibiotics administration. Implant failure in one case after1.5 months because of non-anatomical reduction which put the implant under continuous loaded by its failure. It was treated by removal of the implant and non-weight bearing until the union is achieved then starting weight bearing. Screw extrusion in one case at 3 months without an obvious cause. The fractures were healed and the patient can walk with only pain from extruded lag so they were treated by removal of implant after complete fracture union at 6 months and one year

DISCUSSION

The intramedullary nail and dynamic sliding hip screw were the preferred implants for many years. However, these techniques were associated with high failure rates mainly in unstable per-trochanteric fractures treatment with a significant loss of medial buttress and complications due to the greater surgical trauma. failure rates and complications as limb shortening, varus collapse, cut-out through the head and neck and lateral pulling out of the side plate were documented and reported [11,12].

Therefore, we conducted this study to evaluate the efficacy of dynamic hip screw combined with TSP in fixation of unstable intertrochanteric fractures. The age of included patients was 64.20 ± 6.338 years. The majority of included patients [60 %] were females. Five individuals, or 25%, had an HCV infection, and 40% had both diabetes mellitus and hypertension.

Elderly people frequently sustain intertrochanteric femur fractures. The percentage in females is twice that of males [1]. These were in accordance with studies performed by **Yu *et al.*** [12] and Zhang ***et al.*** [13]. The mean age of included patients in these studies were more than 60 years old.

Regarding fractures' pattern, most of the included patients had osteoporosis and with multiple fractures. The mechanisms of fracture were low energy in majority of patients. Owing to low energy mechanism, these fractures are more common in the older population with osteoporosis [1].

Our results revealed that, the time to full-bone union was 15.1 weeks ± 3.8 weeks. Partial weight bearing start was after 6.9 ± 1.5 weeks. In **Saif *et al.*** [14] study, with a median of 16 weeks, the period to complete bony union varied from 11 to 22 weeks. The mean was 16.38 weeks, plus or minus 3.01 weeks. Partial weight bearing could begin as soon as two to ten weeks from now. The average was 6.44 ± 1.66 weeks.

According to **Selim *et al.*** [15], the DHS and TSP groups took 14.47 ± 5.37 weeks to reach bony union. According to **Patil and Srinivas** [16], the TSP group's average bony union lasted 14 weeks. According to Kim et al. [17], the average time to union was 15.23 weeks. Compared to our study, the period to bony union in these investigations was shorter.

Kim et al. [18] conducted a retrospective comparison of 151 patients with unstable trochanteric fractures treated with gamma nail [31 instances, group I], DHS with TSP [43 cases, group III], helical blade type LCP-DHS with TSP [24 cases, group IV], and PFNA [53 cases, group I]. In the TSP group, the average time to union was 18.21 [SD 1.2] weeks. **Raman et al.** [19] revealed that 15.8 weeks were taken for radiological consolidation of fracture.

The DHS combined with TSP allows early postoperative weight bearing despite the fracture pattern whether stable or non-stable. Another privilege is that the DHS with TSP is a fast and easy operation and lower cost than intramedullary devices, the good to excellent scoring of Parker mobility score with the short time of union. Early active hip and knee exercises, early partial weight bearing, and early union are the three main benefits in DHS and TSP [20].

The TAD and Parker's ratio approach, which may both be determined from plain AP and Lateral radiographs, are the most often used techniques for assessing the appropriateness of lag screw placement. However, as the TAD has been shown to be a reliable indicator of lag screw cut-out, it is advised that the TAD be smaller than 25 mm in order to prevent screw cut-out. Neck shaft angle has been shown in DHS to have no bearing on TAD [21].

Regarding functional outcome, most of cases [55%] had TAD less than 25 mm and [45%] cases had TAD more than 25. Parker Mobility Score [PMS] was 7.85 ± 1.089. The ASIA score was 4.1 [0.78]. Patients without intraoperative complications and with good bone quality had better AISA scores.

At a one-year follow-up, all patients were walking without assistance, and 50% of them had outstanding or exceptional Harris Hip Scores [22].

A DHS has the benefit of a steep learning curve and improved exposure of the fracture site; nevertheless, unstable intertrochanteric fractures, which are mainly caused by posterolateral wall fractures, have been known to fail. According to a biomechanical investigation, the TSP's resistance to femoral medialization was on par with that of the intramedullary devices [23].

Additional stability was supplied by the TSP's insertion to the DHS construct, which prevented the head-neck component from rotating. The greater trochanter cannot lateralize because to the increased buttressing effect. For the stabilization of these unstable intertrochanteric fractures, TSP offered a sensible approach. By using the TSP, the distal fracture's medialization and the possibility of femur shaft fractures during the implantation of the Gamma nail were prevented [24].

The combination of DHS and TSP in the treatment of unstable trochanteric fractures was backed by several research. **El-Banna *et al.*** [25] came to the conclusion that treating unstable fractures with DHS and TSP is a good idea. Because TSP provides great functional outcomes, **Agrawal *et al.*** [22] propose using it in cases of unstable fracture type in conjunction with DHS. According to **Fu *et al.*** [26] while treating unstable intertrochanteric fractures, DHS and TSP had the best surgical results and were comparable to PFNA.

For the repair of unstable trochanteric fractures, DHS with TSP is a dependable technique that produces positive results and low rates of complications. TSP combined with DHS performs better than PFLP when treating unstable trochanteric fractures [15].

This study demonstrated that patients with TAD < 25 mm had early weight bearing. The majority of cases with TAD less than 25 mm had been showed full union within three months. **Khairy *et al.*** [24] reported that, TAD of less 25 mm is considered safe. TAD greater than 25 mm may cause implant penetration, non-union, cut through, and other issues. TAD is therefore a valuable and dependable aspect in DHS operations.

Regarding complications, Intraoperative complication were observed in 2 patients with inadequate reduction. Post-operative complications included superficial wound-infection in 2 cases, screw extrusion in one patient and implant failure in one patient. A series of problems, beginning with the lag screw's erroneous placement in the femoral head and ending with the mechanical failure of the internal fixation, could be brought on by insufficient reduction [26].

In **Saif *et al.*** [14] study, there were 8 [20%] patients in all who experienced problems. In two cases [5%], superficial infection happened. A lag screw cut through was one of the implant-related problems that two patients [5%] experienced. Three individuals [7.5%] had a deep infection. Deep vein thrombosis was observed in one patient.

Four [20%] of the cases reported by **El-Banna *et al.*** [25] had post-operative problems. These included [two cases of superficial wound infection, one case of implant failure at 1.5 months, one case of screw extrusion at 3 months, and one case of secondary varus at 3 months as a result of severe fracture collapse]. Our rate of complications was the same as this one, however the kinds were different.

Patil [27] stated that the TSP group had a mere 9% complication rate. There was one instance of superficial infection and one instance of revision surgery. Technically speaking, PFN is a more demanding procedure than DHS with TSP, and PFN has a greater rate of complications than DHS with TSP. There was no intraoperative or late diaphyseal femoral fractures associated with the DHS with TSP [28].

It is concluded that for unstable intertrochanteric femur fractures, the use of DHS with TSP fixation is a successful method that offers good functional and radiological outcomes with few comorbidities and early rehabilitation rates.

Conflict of interest and financial disclosure: none

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IJMA

International Journal of Medical Arts

Volume 6, Issue 9, September 2024

P- ISSN: 2636-4174
E- ISSN: 2682-3780