The use of Dynamic hip screw with trochanteric stabilization plate in the management of unstable trochanteric fractures (31A2-31A3)

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The Egyptian Orthopedic Journal; 2021 supplement (1), June, 56: 40-45

Abstract

Introduction
Inter-trochanteric fractures of the femur are one of the most common fractures of the lower limb. Closed reduction or open reduction and internal fixation with DHS have evolved as one of the standard treatment options in the elderly, to achieve rigid stabilization and early mobilization. On the other hand, complications as massive collapse at the fracture site, medialization of the shaft of the femur, and lag screw cut off out of the femoral head may occur with DHS fixation in case of unstable trochanteric fractures with a thin lateral wall. So, (DHS) together with an angular stable trochanter-stabilizing plate (TSP) can offer better fixation for the unstable trochanteric fracture type with comparable results to the proximal femoral nail. This study aimed to evaluate the radiological and the functional outcome of using Trochanteric stabilization plate (TSP) along with Dynamic Hip Screw (DHS) in unstable types of trochanteric fractures and evaluate its ability to minimize complications eg. massive collapse and medialization of the femoral shaft.

Patients and Methods
40 patients with unstable intertrochanteric fractures AO/OTA classification 31-A2 and 31-A3 were treated with TSP superimposed on the regular DHS at Kasr Alainy hospital between June 2018 to June 2019 with a mean follow-up of 18 months. The functional outcome was assessed using patients' Harris His every 3 months.

Results
All cases were united at the last follow up visit where the time to full bony union ranged from 11 to 22 weeks (mean 16.38 weeks). No nonunion, malunion, reduction loss, or implant failure was encountered. Functional results were excellent in 22(68.8%) patients and good in 9 (23.1%), and poor in one (3.1%) patients.

Conclusion
In unstable intertrochanteric fractures with a thin lateral wall, the use of TSP along with DHS helps in achieving a stable fixation and is considered an effective method .it has excellent functional and radiological outcomes with minimal complication and early rehabilitation rates that prevents complications such as excessive collapse and femoral medialization. TSP is easily available and is a cost-effective alternative for intramedullary fixation

Keywords
dynamic hip screw, trochanteric stabilization plate, unstable trochanteric fractures.

Introduction

The incidence of Proximal femur fractures has increased due to the increase in the mean age of the population. There is no consensus on whether extramedullary or intramedullary (IM) fixation is the best treatment for extracapsular fractures [1].

Sliding hip screw devices were developed in the middle of the 20th century and gained popularity for the fixation of trochanteric fractures in the late 1980s. The use of (DHS) in the treatment of trochanteric fractures has been well documented in the literature [2].

DHS mode of action depends on the controlled collapse and impaction at the fracture site while the patient ambulates. However, the use of this implant in unstable inter-trochanteric fractures has been associated with excessive collapse, femoral medialization, and lag screw cut-out [3]. Inter-trochanteric fractures in which the lateral femoral wall is fractured preoperatively or intra-operatively during triple reaming for DHS invariably unites in varus while using DHS alone [4]. So providing a buttress for the lateral wall

is important to achieve stable fixation and allow early weight-bearing. The addition of a Trochanteric stabilization plate (TSP) to the DHS can effectively reconstruct the lateral trochanteric wall and help in preventing complications such as excessive collapse and varus malunion [5].

On the other hand, many series have stated that (DHS) was not inferior to proximal femoral nail even for the unstable types of trochanteric fracture [6]. Also, the addition of a trochanter-stabilizing plate (TSP) helps to reinforce DHS fixation and reduces medialization and shortening of the femoral shaft. So, it was considered as a solution for treating such fractures, while it used a more familiar approach and easier implant application [7,8,9].

Our study aimed to assess the effectiveness of trochanteric stabilizing plate (TSP) used in conjunction with DHS in unstable inter-trochanteric fractures and evaluate this method radiologically (In terms of osseous fracture union rate, malunion, reduction loss implant-related complications) and functionally through the Harris hip score concerning operation.

Patients and methods

This is a prospective study, which was conducted in Kasr Alainy Cairo University Hospital in the period from June 2018 to June 2019 after the approval of the scientific board and the ethical committee of our department. It included a sample size of 40 patients. Skeletally mature patients (Range 50 to 90 years) with the unstable type of trochanteric fractures, AO/OTA classification 31-A2 and 31-A3, were included in the study. Open fractures, pathological fractures, polytrauma patients, patients with dementia or with diseases affecting walk before the fracture were excluded.

Informed consent was taken from each patient. A standard form was created, where demographic data and clinical findings were recorded. Clinical evaluation was done starting with the history of personal data, special habits of medical importance, mode of trauma, co-morbidities, pre-fracture level of activity, and associated injuries. This was followed by an examination of the patient's general condition, local examination of the injured limb, as well as the assessment of the vascular and neurological status. Investigations included AP pelvis view with both hips, AP and lateral views of the affected hip. CT scans were performed in cases where the diagnosis is doubtful or in comminuted cases, to determine the fracture pattern and the extent of comminution. The time interval before surgery was also recorded.

All patients were given 3rd generation cephalosporin injection one hour before surgery as routine prophylaxis. All patients were operated on under spinal or general anesthesia in the supine position on a fracture table. Before the incision, closed reduction of the fracture was obtained by traction and internal rotation of the lower limb with the fracture table. Posterior sag may first require anterior applied force to the posterior distal fragment before completing the reduction. If closed reduction fails, open reduction and provisional fixation with key wires are done. A standard lateral approach was applied to the proximal femur for the DHS implantation. Placement of the guidewire was directed below the center of the femoral head in the antero-posterior (A-P) view and the center or slightly posterior on the lateral view. Triple reaming was done and an appropriate size lag screw was inserted with tip-apex distance was not exceeding 25mm on both the lateral and anteroposterior views. The 4 holed side plate was fixed with the insertion of only the third screw. The trochanteric stabilizing plate was then placed on the DHS plate. The screws were taken from the trochanteric stabilizing plate TSP through the DHS plate to the shaft. In some cases, additional 3.5 cancellous screws were inserted from the proximal small holes of the TSP to the greater trochanter. Operative time; Blood transfusion was detected and verified.

The intravenous broad-spectrum antibiotic was administrated for all patients for two days, then oral antibiotics for a total of two weeks. Subcutaneous (Enoxaparin), 40 IU, low molecular weight heparin was given every 24 hours postoperative to all patients for 28 days with proper IV analgesics. Passive hip mobilization and knee, ankle exercise started on the first postoperative day. Partial weight-bearing was allowed as tolerated according to the clinical improvement and radiological assessment.

After 2 weeks, the wound condition was checked for any superficial infection, and removal of stitches was done. The patients were reviewed at 4 weeks, 8 weeks, 12 weeks, and 24 weeks (At each review, A-P and lateral radiographs of the involved hip was taken) then every 6 weeks to detect bone union and record any postoperative complications as reduction loss, malunion or implant failure.

Union of the fracture determined clinically by painless weight-bearing and hip movement in all directions, and radiologically by the disappearance of the fracture line in 3 or 4 cortices on the lateral and anteroposterior radiograph and complete bone trabeculae crossing the fracture site. Functional outcome was done using Harris hip score every 3 months, in addition to postoperative complications assessment as infection and deep venous thrombosis.

Results

40 Patients met the inclusion criteria and were managed using (DHS) and trochanteric stabilizing plate with a mean follow-up period of 20 months (range: 18- 24 months). The mean age was 65.78 years ± standard deviation (SD) 7.24. Twenty (50%) patients were males and twenty (50%) patients were females. 23 patients (57.5%) had a left-sided fracture, and 17 patients (42.5%) had right-sided fracture. The mode of trauma in 36 patients (90%) fell to the ground (FTG), fall from height (FFH) in two patients (5%), road traffic accident RTA in two patients (5%).

According to the AO/OTA classification; there were 28 patients (70.0%) with a fracture pattern of A2-2, 11 patients (27.5%) with A2-3 fracture pattern and one patient (2.5%) with A3-3 (table 5). The preoperative hospital stay between the admission day and the operation day ranges from three to 10 days (mean 6.03 days). Seven cases (17.5%) needed blood transfusion (500 ml). The mean operative time was 105.5± SD 24.06 minutes. All cases were united at the last follow up visit where the time to full bony union ranged from 11 to 22 weeks (mean: 16.38 weeks SD ±3.01). No nonunion, malunion, reduction loss, or implant failure was encountered

Functional outcome was calculated using the Harris Hip Score (HHS). At 3 months follow-up, there were 13 patients (40%) have a poor functional outcome, 11 patients (34.4%) have fair functional outcomes, 8 patients (25%) had a good functional outcome. HSS ranged from 43 to 89 with a mean of 70.22 ± SD 12.65.

At 6 months follow up, one patient had poor functional outcome (3.1%), 10 patients (31.2%) had fair functional outcome, 10 patients (31.2%) had good functional outcome and 11 patients had excellent score (34.4%). HSS ranged from 50 to 100 with a mean of 82.81 ± SD 10.37 points.

At 12 months follow up there was one patient (3.1%) with poor functional outcome, 3 patients (9.4%) had fair functional outcome, 14 patients (43.8%) had good functional outcome and 14 patients had excellent score (43.8%). HSS ranged from 55 to 100 points with a mean of 89.09 points ± SD 9.20.

At 18 months follow up there was one patient (3.1%) with poor functional outcomes, 9 patients (23.1%) with good functional outcomes, and 22 patients had excellent scores (68.8%). HSS ranged from 62 to 100 with a mean of 93.84 ± SD 7.95.

Infection occurred in five cases (12.5%) and was all treated by proper antibiotic administration. There was one case (2.5%), who had deep vein thrombosis DVT and was treated by anticoagulative measures, one case (2.5%) had foot drop that was resolved on the 6 months postoperatively. (Figures 1-2)

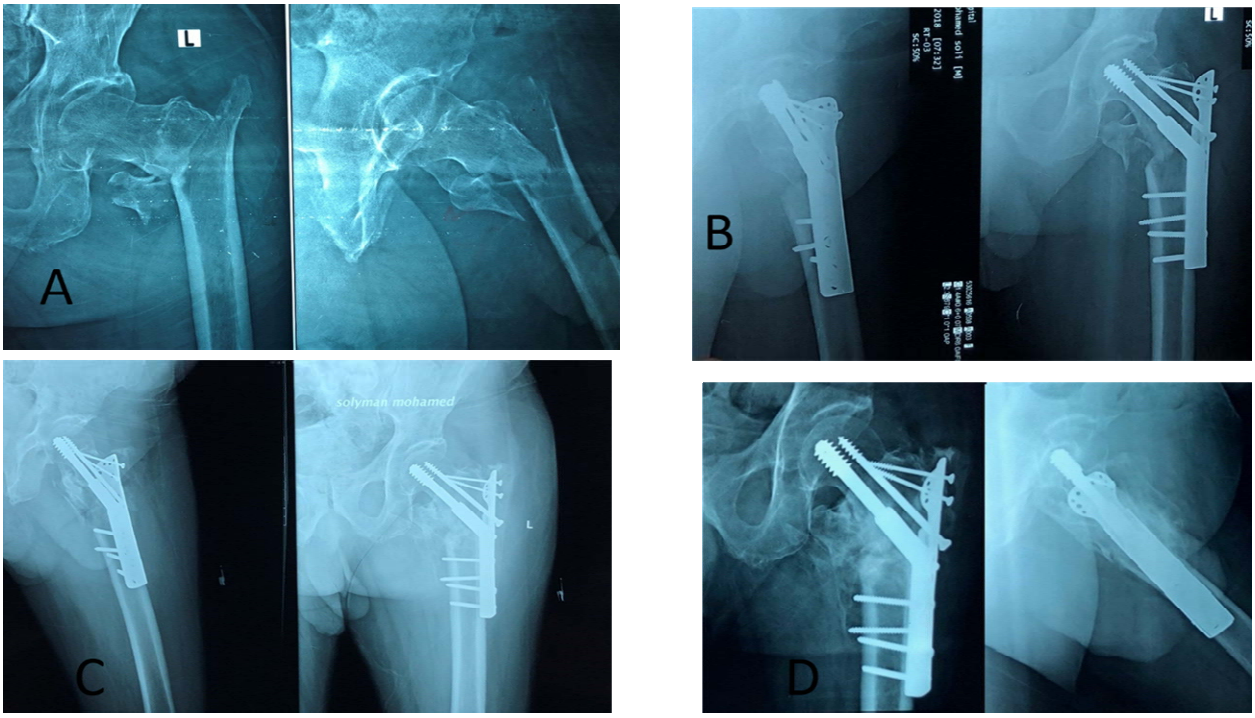

Figure 1: 70 years old female patient presented with trochanteric fracture (31A2-2) of the left femur after falling to the ground, treated with DHS and TSP after 10 days from admission. Full weight-bearing was allowed after 20 weeks. After 18 months, HSS was 97. A] Preoperative x rays. B] Immediate postoperative X-rays. C] 3 months follow up x-ray. D] 6 months follow up x-ray.

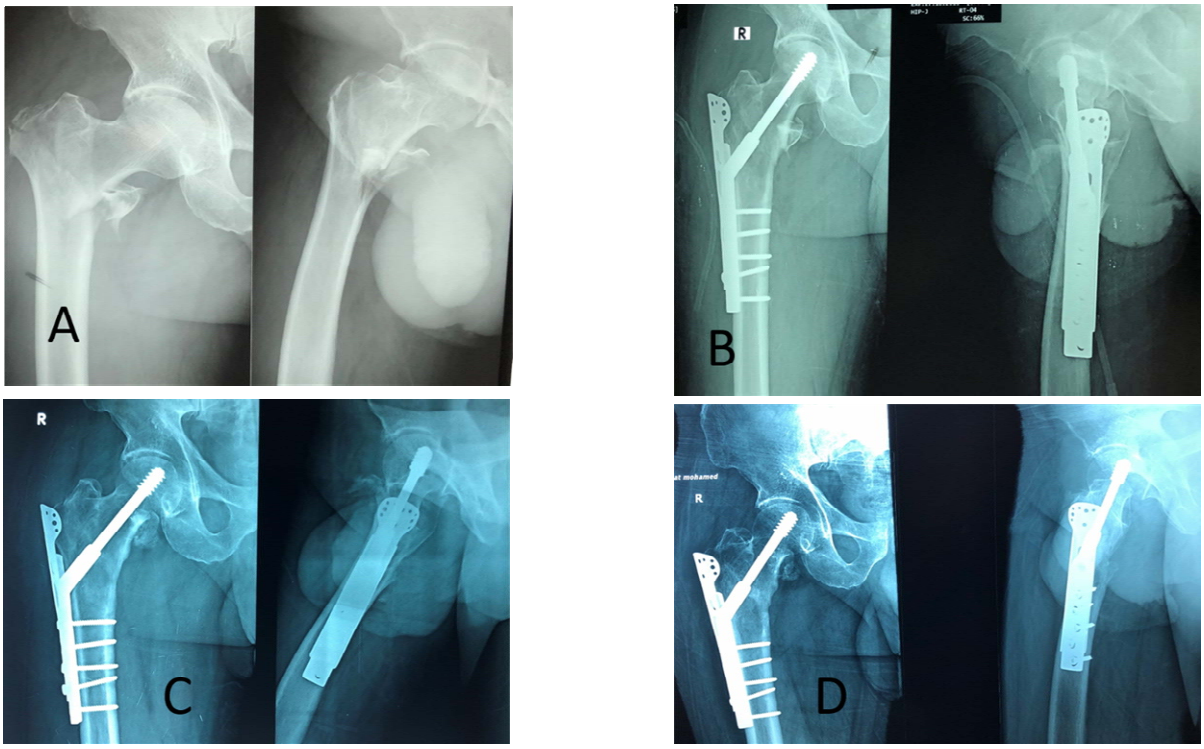

Figure 2: 60 years male patient presented with per trochanteric fracture (31A2-2) of the right femur after falling to the ground, treated with DHS and TSP after 7 days from admission. Full weight-bearing was allowed after 16 weeks. After 18 months, HSS was 100. A] Preoperative x-rays. B] Immediate postoperative X-rays. C] 3 month follow up x-ray. D] 6 month follow up x-ray

Discussion

Trochanteric fractures are very common injuries that affect mainly the elderly population more than young people. (DHS) and other ordinary implants can manage stable fracture patterns. On the other hand, unstable trochanteric fractures are very challenging with a high incidence of implant failure and complication [5, 6].

DHS can achieve rigid fixation and early weight-bearing. However, massive collapse at the fracture, medialization of the shaft of the femur, and lag screw cut off are the main complications, when used in unstable fracture types with a thin lateral wall [7]. Also, increased reoperation rates have been reported in patients who had intraoperative or post-operative lateral wall fractures [8]. The importance of lateral wall integrity in intertrochanteric fractures fixed with DHS was first noted by Parker [9]. In a series of 1039 patients treated with DHS, all the failed cases had uncontrolled medialization of the distal fragment relative to the proximal fragment. He also noted that all of these cases had a fracture of the lateral femoral wall at the site of insertion of the lag screw [9].

Gotfried stated that all patients of his series, who developed postoperative fracture collapse, had a fracture of the lateral cortex of the femur. As (DHS) mode of action is to achieve fracture impaction, an intact lateral cortex of the femur is very important in achieving stable fixation [10]. When there is a fracture in the lateral cortex of the femur, the fracture line becomes parallel to the sliding vector of the DHS and this allows the proximal part of the fracture (femoral head and neck fragment) to slide laterally and the femoral shaft medially, resulting in implant failure.

However, when an intramedullary nail is used in the fixation of inter-trochanteric fractures, it stops the telescoping displacement of fracture by directly blocking the lateralization of the head-neck fragment [11]. Trochanteric stabilization plate (TSP) is a modular extension of the DHS. It is mounted on the greater trochanter and (DHS) side plate during fixation. A biomechanical study proved that TSP can provide extra stability and resists medialization of the femoral shaft similar to the intramedullary nail when used together with (DHS) [12]

There were 40 patients with unstable trochanteric fractures included in this study treated with (TSP) and (DHS) with a mean follow-up 18 months. All cases were united at the last follow up visit with Harris hip score ranged from 62 to 100 with a mean of 93.84 ± SD 7.95, showing one patient with poor functional outcome, nine patients with good functional outcome, and 22 patients with an excellent score (68.8%)

Bong et al. conducted their study over 32 patients with unstable trochanteric femur fractures followed up for 6 months. 15 patients had The RUSH scoring system for bone healing of value 10-20 and 17 patients had a score of 20-30 with a mean of 21.03+ SD 2.13. Nine of the 32 patients had excellent results as per the Harris hip score, 10 patients had good results, nine had fair and four had poor results [12].

Raman et al. followed up 49 patients with unstable trochanteric fracture femur managed with DHS and TSP for a minimum of 6 months. The average time taken for clinic-radiological consolidation of fracture was 15.8 weeks. 42 patients (86%) had an excellent HHS of > 90 points and 7 patients (14%) had a good HHS of > 80 points [13].

Patidar et al. study was conducted over 81 patients, who were separated into two groups. Group A with 40 patients operated using DHS with TSP, and group B with 41 patients operated using DHS alone. The average HHS was 76 in patients operated with TSP with DHS & 61.68 in the group treated with DHS alone. 28 patients (70%) out of 40 in the TSP group had HHS > 60 after 6 months of surgery, whereas only 17 patients (41.5%) out of 41 in the DHS group had HHS more than 60. After six months of follow-up in the TSP group, there were 11 patients with an excellent score, 17 patients with a good score, 11 patients with a fair score and one patient had poor results [14].

Rho et al. conducted a study of over 66 patients. 38 patients were operated on using TSP and 28 patients were operated on using proximal femoral nail PFN. The mean bony union time for the TSP group was 19 weeks with a standard deviation of 1.2 weeks. There was one case of screw cutout, one case of plate breakage, and one case of plate loosening. There were no differences between the groups in the meantime to the bone union [15].

Patil et al. followed up 44 patients with unstable trochanteric fracture femur for 6 months. 22 patients were managed using DHS with TSP and 22 patients were managed using PFN. Bony union for the TSP group was achieved in an average of 14 weeks (4 – 20 weeks) while in the PFN group the bony union had an average of 12 weeks (6-16 weeks). After 6 months follow up for the TSP group, HHS has a mean of 85.45 points and the PFN group had a mean of 84.72. Complications in the TSP group were excessive valgus in four patients and superficial infection in one patient. In the PFN group, there were two patients with an iatrogenic fracture at the distal locking screw, 3 patients with excessive valgus, and one patient with implant breakage [16].

Fu et al. followed 171 patients with unstable trochanteric fractures managed with TSP over DHS and 70 patients with PFN for more than 10 months. In the postoperative radiographic evaluation, 94.2% of the DHS+TSP group reached bony union and 94.3% of the PFNA group reached bony union without implant failure. Ten patients in the DHS+TSP group had a failure of the implant, which included nine screw cut-out and one fracture non-union. In the PFNA group, three patients had blade screw cut-out and one fracture non-union [17].

Conclusion

TSP together with DHS represent an effective method of fixation of unstable trochanteric fractures, provide excellent functional and radiological outcomes with minimal complication and early rehabilitation rates.

Funding disclosure:

The authors confirm that no funding was received for this study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

Conflict of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Ethics review committee

This study has been approved by the appropriate ethics committee (the Scientific Board of the Department of Trauma & Orthopaedic Surgery, Cairo University Hospitals). Details that might disclose the identity of the subjects in the study have been omitted

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