ORIGINAL ARTICLE

Study on the Result of Unstable Intertrochanteric Fracture Treated by Trochanter Stabilizing Plate (TSP) in 65 Years and Above Old Age Group

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Abstract

Introduction: *The management of unstable intertrochanteric fractures, particularly in individuals aged 65 and older, presents a significant challenge for orthopedic surgeons. A sliding screw device offers numerous benefits; however, its application in unstable trochanteric fractures has been linked to issues such as collapse and medialization of the femoral shaft. The trochanteric stabilizing plate (TSP), an add-on plate that extends proximally from the side plate, providing a lateral support to the greater trochanter. This study aimed to assess the outcomes of selected unstable intertrochanteric fractures classified as AO type 31-A2.2, 2.3, and 3.3, which were treated with TSP in patients aged 65 years and older.*

Methods: *This was a prospective observational study, carried out in National institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka from July 2017 to June 2018. After fulfilling inclusion and exclusion criteria a total of 10 cases treated with TSP superimposed on the regular DHS analysed.*

Results: *Out of 10 cases, 6 were female and 4 were male. Mean age 74.20 years (SD 7.64). Sedentary working job were the prominent occupation with 90% cases. Left side was involved in 60% cases. Maximum of 50% cases had ASA stage II. Abbreviated mental test score mean was 8.80 with SD 1.13. Mean interval between injury & operation was 7.10 days (SD 2.37). Mean operation duration was 94.50 minutes (SD 14.23) and hospital duration was 13.40 days with SD 2.98. Lateralization of the greater trochanter and lag screw cut-out was successfully prevented in all fractures. Average lag screw sliding was 5.90 mm with SD 2.84. All fractures had healed within 18 weeks. More than 10° varus deformity observed in one case, but functional outcome was fair. One patient had persistent hip pain needed re-operation, followed by full gain of function. One patient had superficial wound infection, which was improved conservatively. One patient died of unrelated to operation after radiological union. Pre-fracture Parker Mobility Score 7.60 with SD 0.96 and on last follow-up 7.10 with SD 1.66. Hip functional results were satisfactory in 80% of patients and unsatisfactory in 20% according to the Salvati-Wilson score.*

Conclusion: *In selected unstable intertrochanteric fractures characterized by a small or absent lateral cortical buttress in individuals aged 65 years and older, incorporating a TSP with the DHS provides effective support for the unstable greater trochanter fragment. This addition can help avert lateralization, screw cut-out, and limb shortening, thereby enhancing surgical outcomes.*

Keywords: *Unstable intertrochanteric fracture, Trochanter stabilizing plate, Dynamic Hip Screw*

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Introduction:

Intertrochanteric fracture (ITF) which is one of the common fractures in elderly[1,2], have greater risk of loss of independence among that age group.[3,4] Though their union rates are high, but without surgery functional outcomes tend to be disappointing.[5] According to members of the American Academy of Orthopaedic Surgeons (AAOS) approximately 50% of 350,000 patients treated for hip fractures annually in the United States do not regain pre-fracture level of mobility.[5] Its

frequency increases with age which poses a public health issue.[6]

Operative treatments of these fractures are challenging for all Orthopaedic surgeons. With diversity of fixation devices available for treatment of ITF demonstrate difficulties encountered in the actual treatment.[7] Of them two types are most widely used to fix ITFs, one is intramedullary nailing and another is screw with plate fixation.[4,7-9] Nails have advantage of preventing excessive sliding and medialization of shaft, lower implant failure rate, makes no dissection at fracture site.[4] However, they usually costly, may cause iatrogenic abductor injury and this gets complicated with case of having additional femoral shaft fractures below the implant and the technique is more difficult than DHS.[10,11]

In contrast, Dynamic Hip Screw (DHS) is the standard fixation device for most of the ITF.[12] DHS has advantages such as controlled telescoping & impaction and short operation time and failure rates as low as 5% have been reported in studies.[12,13] However, unstable ITFs lack the posteromedial buttress, lateral buttress, or both. When treated with DHS, these fractures tend to exhibit significant medial displacement of the shaft accompanied by lateral dislocation of the greater trochanter fragment. This occurs due to excessive sliding of the screw within the barrel, leading to a higher incidence of screw cut-out and failure rates ranging from 5% to 12%.[7,12,13]

To address this issue, the AO has introduced the trochanteric stabilization plate (TSP), which is utilized in conjunction with the side plate of the DHS as a modular extension. This plate is fixed to the lateral femoral wall to provide stabilization to the greater trochanter. It showed equivalent biomechanical and clinical stability comparable to nailing and prevented excessive sliding or medialization of the shaft. Encouraging results have been reported by several groups using a trochanter buttressing plate in some series. [3,12]

We find no study of using TSP-DHS used in elderly with unstable ITFs in Bangladesh. The purpose of this study was to evaluate the result of unstable intertrochanteric fracture of AO type of 31-A2.2, 2.3 and 3.3 treated by Trochanter Stabilizing Plate (TSP) in elderly of 65 years and above age group.

Methods:

This study was prospective observational research conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) in Dhaka, spanning from July 2017 to June 2018. Elderly patients aged 65 years and older, who were admitted with radiologically proven cases of intertrochanteric fractures that satisfy the eligibility criteria, were included in the study population. Inclusion criteria were Unstable trochanteric fracture AO type 31-A2.2, 2.3 and 3.3., age 65 years and above, all gender, close fracture and fracture less than 3 weeks old. Exclusion criteria were age below 65 years, history of previous surgery in proximal femur, AO type 31-A1, A3-3.1 & 3.2 fracture, open fracture, sign of infection, unstable medical illness that increase risk of morbidity or mortality and dementia.

A stable fracture is characterized by no post-fixation displacement. And an unstable fracture has been defined as fracture which has tending to collapse with axial loading after appropriate reduction and fixation.[1] AO type 31-A2.2 & 31-A2.3 and 31-A3.3– these fractures are characterized by the absence of the posteromedial buttress, the lateral buttress, or both.[12] The lag screw sliding distance defined as radiological difference between the lag screw length on anteroposterior (A-P) view taken immediately after operation and 6 months after the operation.[14] Radiological union of fracture defined when fracture line could barely be visible because of callus and sclerosis in plain x-ray and clinically when there is no tenderness at fracture site.[14] American Society of Anesthesiology (ASA) Score used to determine physical status before surgery.[15] Abbreviated mental test score was used to exclude patient with any cognitive impairment (e.g. Dementia).[16]

Surgical technique

All the patients of this study were operated under spinal anesthesia. Fracture table was utilized and patients were positioned supine. Standard lateral approach was applied to reach the proximal femur. Guidewire placement directed below the center of the femoral head in the A-P view and in the center or slightly posterior on lateral view. After performing triple reaming, appropriate size lag screw was inserted. We used 4-hole side plate, securing it to the femur with cortical screws in the 2nd and 4th holes by 2 cortical screws. If necessary, we contoured the proximal end of the TSP to accommodate the mass of the greater trochanter. The TSP was positioned over the DHS plate to ensure it was securely seated and that the screw holes aligned properly. We then fixed TSP using 2 cortical screws in remaining 2 holes, with washer if needed. Finally, compression screw was inserted. the entire procedure was conducted under fluoroscopic guidance. Skin closure was done in layers.[3,17]

On the first postoperative day, patient advised for to sit on bed, breathing exercise and static quadriceps exercise. Drain was removed after 24 to 48 hours. Subsequently, knee bending exercise begun. Stitches were removed on 14th postoperative day. The patient was advised to walk without bearing weight using crutches. After 12 weeks, if radiological union was observed, full weight bearing was allowed. Follow-up evaluations were conducted at the 4th, 12th, and 24th weeks by both clinically and radiologically.

Parker mobility score used to evaluate pre-fracture and last follow up mobility level.[18] Salvati & Wilson Hip Score employed to assess Hip function.[19] Data were collected by interview, observation and clinical examination and investigations. Data were processed and analyzed using IBM SPSS (version 20).

This research presents a number of limitations. Firstly, the sample size was small. Secondly, the duration of follow-up was comparatively short. Consequently, the results may have been premature. Finally, the surgeries were not conducted by a single surgeon. The varying operative skills among the surgeons could have influenced the treatment outcomes. Nevertheless, all procedures were carried out by experienced professionals.

Results:

A total of 10 patients, who fulfilled the inclusion & exclusion criteria were enrolled in this study. Age of patients range from 65 to 87 with mean 74.2 and SD 7.6. Of them 4 (40%) were male and 6 (60%) were female.

Table I

Age and Gender distribution

Gender	Frequency	Age Range	Age Mean	±SD
Male	04 (40%)	65 – 87 (22)	78.00	±10.13
Female	06 (60%)	65 – 80 (15)	71.66	±4.93
Total	10	65 – 87 (22)	74.20	±7.64

All the female (6, 60%) were house wife, among male businessman 2(20%), retired service man 1(10%) and farmer 1(10%). Low velocity injuries (eg. falls to the ground) account for the majority with 8 cases (80%). Notably, all 6 female patients had a history of falling. Among the male patients, 1 experienced a high velocity injury (such as a road traffic accident), while 3 cases (30%) were attributed to low velocity injuries. Table II shows fracture type with AO 31-A2.2 is the leading type, followed by 31-A2.3 and lastly 31-A3.3 with 1 case. Fractures of the left side were more common than the right.

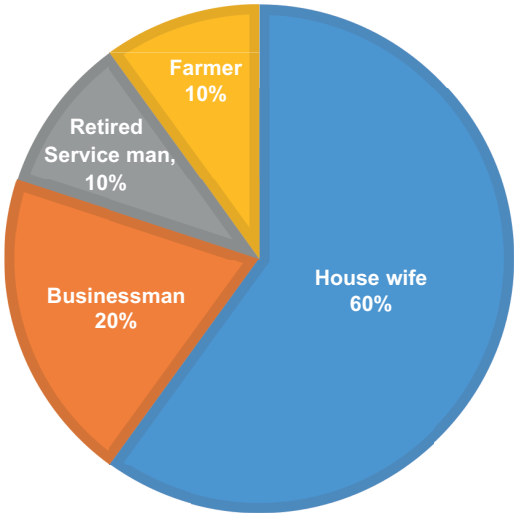

Figure 1: Patient Occupation distribution

ASA Score (Bhattacharya & Wray, 2004; American Society of Anesthesiologists, 2015) distribution shows 3 patients had ASA score stage I, five patients had stage II and 2 patients had stage III (Table II). Among the two patients, one presented with both uncontrolled diabetes mellitus and hypertension, while the other had only uncontrolled hypertension. All of these comorbid conditions were managed prior to the surgical procedure. Almost all the patients had good Abbreviated mental test score with mean 8.8 with SD 1.1. None of the patients had any cognitive impairment (Table III).

Table II

Fracture profile and ASA Score

Topic		Frequency (%)
Fracture type	AO 31-A2.2	5 (50%)
	AO 31-A2.3	4 (40%)
	AO 31-A3.3	1 (10%)
Side	Right	6 (40%)
	Left	4 (60%)
ASA Score	Stage I	3 (30%)
	Stage II	5 (50%)
	Stage III	2 (20%)

Table III

Abbreviated mental test score

Score		Frequency	Mean ± SD
Abbreviated mental test score	Severe (0-3)	0	8.80 ± 1.13
	Moderate (4-7)	0	
	Normal (≤8)	10	

Table IV

Management of fracture in hospital

	Range	Mean ± SD
Interval between injury and operation	3 – 11 days (8 days)	7.10 ± 2.37
Operation duration	75 – 120 mins (45 mins)	94.50 ± 14.23
Hospital stays	10 – 18 days (8 days)	13.40 ± 2.98

Time interval between injury and operation was from 3 days to 11 days, mean 7.10 with SD 2.37. Operation duration was from 75 minutes to 120 minutes, mean 94.5 minutes and SD 14.23. Hospital stays were from 10 days to 18 days, mean 13.4 days with SD 2.98. (Table IV)

Table V shows the post-operative complications. One patient (10%) who developed superficial wound infection, which was managed conservatively. There was no lateralization of greater trochanter, lag screw cut-out, implant failure, non-union and significant limb shortening (≥1cm) at final follow-up. One patient exhibited positive Trendelenburg sign and required reoperation after radiological union, due to persistent pain caused by impingement of proximal part of TSP. After reoperation patient regained abductor muscle function. Another patient of 31-A2.3 fracture type presented with a varus deformity exceeding 10°. Additionally, one patient died which was unrelated to operation, after radiological union. All patients had a minimum of 6-month follow-up (range 6 months to 12 months), mean 8.50 with SD 1.65. The mean of lag screw sliding was an average of 5.90mm with SD 2.84.

Table V

Postoperative Complications

Complications	Number of patients
Infection	1
Pulmonary complication	None
DVT	None
DHS screw cut-out	None
Implant failure	None
Lateralization of greater trochanter	None
Significant limb Shortening (≥1cm)	None
Non-union	None
Varus deformity ≥10°	1
Reoperation	1

The different movement of hip like flexion, rotation, abduction and adduction were evaluated at 12 and 24 weeks which are shown in table VI.

Table VI

Range of motion at follow-up

Movement	On 12th week	On 24th week	p – value
Flexion	105.00 ± 10.80	126.50 ± 8.18	< 0.0005
Internal rotation	33.00 ± 4.83	38.50 ± 4.74	< 0.0005
External rotation	27.00 ± 6.32	35.50 ± 5.98	< 0.0005
Abduction	27.00 ± 4.83	35.50 ± 5.50	< 0.0005
Adduction	23.00 ± 4.83	27.50 ± 4.24	< 0.0005
Knee Flexion	107.50 ± 13.59	128.00 ± 9.77	< 0.0005

*Paired T-test was employed to analyze the data.

Table VII

Radiological union and Parker Mobility Score

Radiological union	Union in weeks	Number of patients	Percentage	Mean ± SD
	12 - 14	8	80%	14.30 ± 1.88
	15 – 18	2	20%	
Parker Mobility Score[18]	Pre-fracture	Last Follow-up		P-value
	7.60 ± 0.96	7.10 ± 1.66		< 0.05

Table VIII

Salvati & Wilson Hip function evaluation result [19]

Result	Number of patients	Percentage		Mean ± SD
Excellent	2	20%	Satisfactory 80%	28.20 ± 5.28
Good	6	60%		
Fair	2	20%	Unsatisfactory 20%	
Poor	0	0		

Table VIII shows Salvati & Wilson Hip function evaluation result. No cases had poor result. Satisfactory result was 80% and unsatisfactory 20%.

All fracture united within 18 weeks. Highest union observed between 12 to 14 weeks. Eight (80%) patients had identical Parker mobility score in pre-fracture & at last follow-up. Two (20%) had decreased mobility score, of them one patient had 3 points, and another two had 1 point difference in pre-fracture & last follow-up. There were lag screw sliding range from 2 mm to 10 mm with average 5.9 mm with SD 2.8.

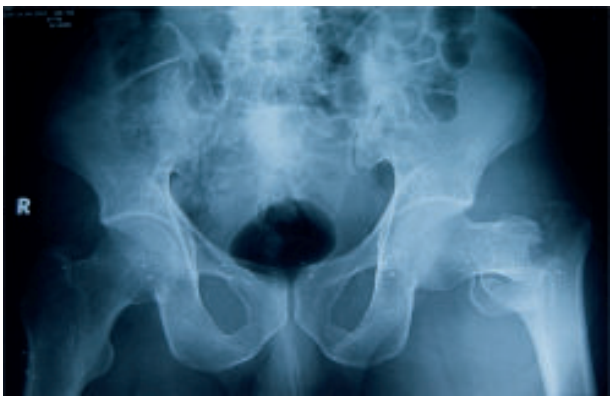

Image 1: Pre-operative X-ray of 65 years old male.

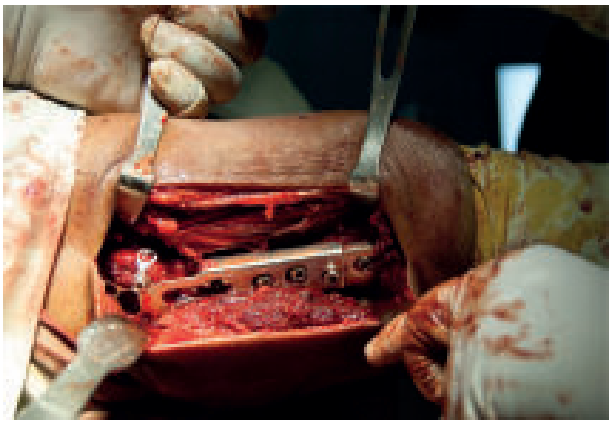

Image 2: DHS-TSP applied.

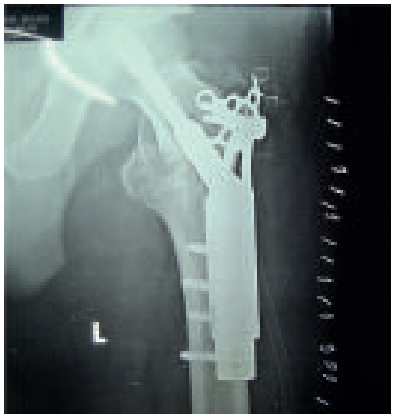

Image 3: Post-operative X-ray

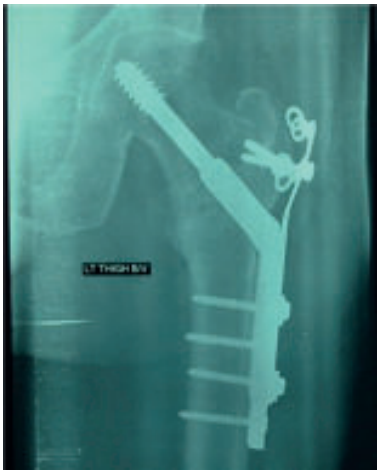

Image 4: 12 weeks after operation

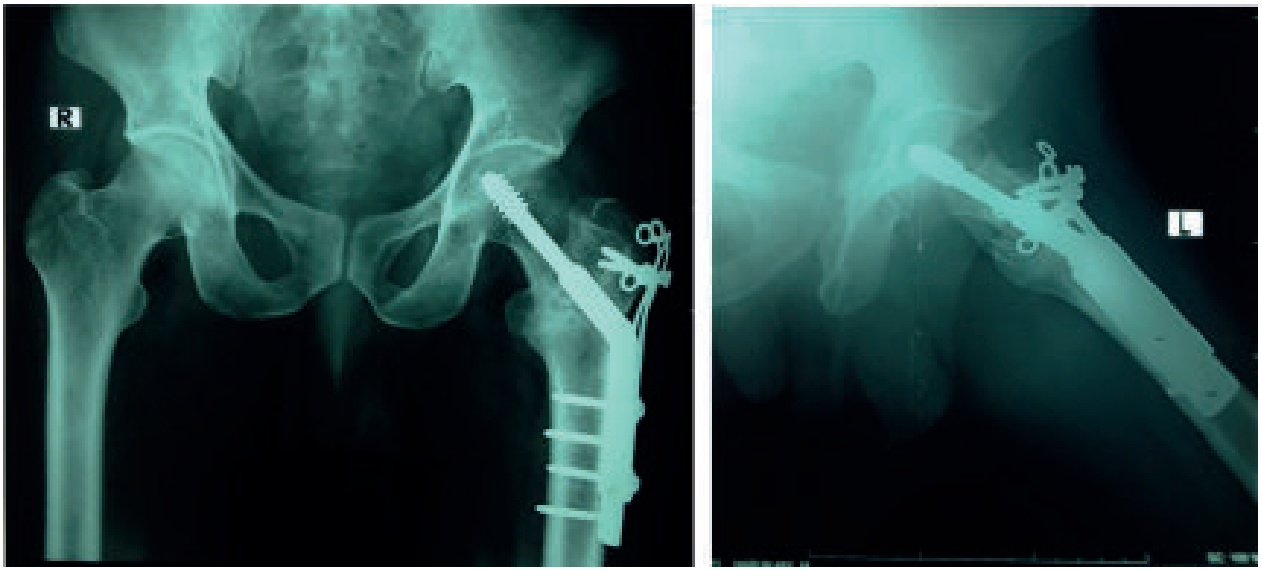

Image 5: *24 weeks after operation*

Discussion:

In our study, selected unstable intertrochanteric fracture of AO type 31-A2.2, A2.3 and A3.3 was tested. These fractures have lateral wall fracture or with posteromedial comminution. DHS alone tends to allow lateral wall collapse, varus collapse, medialization of the femoral shaft, and excessive sliding of lag screw.[12] In patients aged 65 and older, the presence of osteoporosis and reduced regenerative capacity, coupled with existing comorbidities, results in slower healing times, a higher risk of complications, and possibly less effective functional recovery.

TSP seems to reconstruct or buttress this lateral wall, thereby improving load distribution, reducing the lever arm of deforming forces, reducing telescoping, shortening, and improving abductor mechanics. In older patients with weaker lateral walls, this role is even more critical. Also, the TSP permits the sliding screw to slide freely through a hole in the plate, thus facilitating controlled fracture impaction, which is likely crucial for healing of these difficult fractures and represents the fundamental principle underlying the sliding screw plate systems.[12]

In our study, the mean age was 74.2 years, which is lower compared to other studies. Madsen et al. (1998)[20] reported a mean age of 78.9 years in the DHS/TSP group, while Cho et al. (2011)[14] found it to be 76 years, and Babst et al. (1998)[12] reported 79.7 years. This lower average age can be explained by the study conducted by Parker et al. (2003)[21], who indicated that in developing countries, the average age tends to be lower than in developed countries. In gender distribution in this study, female was the predominantly effected with 60% cases, compared to male with 40% cases with ratio of 6:4. This female predominant coincide with finding of other studies.[7,14,20]

Among occupations, sedentary works are predominating like businessman, house wife and service holder. Active worker like farmer is lest patient group. This is maybe due to sedentary work predispose to hip fracture.[22] Falls accounted for the majority of injuries in out study, representing 90% of all cases. This finding did agree with study by Babst et al. (1998).[12] Also, in the study by Gupta et al. (2010), 85% cases were due to fall and only 15% cases due to RTA.[7] This is attributed to fragility fractures, which are predominantly associated with postmenopausal osteoporosis. In this study, all six female patients experienced trauma resulting from low-energy incidents (such as falls), and the majority were postmenopausal, suggesting that osteoporosis may be a contributing risk factor.

In the current study, there were 5 cases (50%) of AO 31-A2.2 fracture, followed by 31-A2.3 with 4 cases (40%) and 31-A3.3 with 1 case (10%). Also 60% cases had their left trochanter fractured. Babst et al (1998) also had predominant of AO 31-A2.2 fracture type, and left side is more fractured than right. Therefore, the findings of the current study align with that of the previously mentioned study.

In accordance of Madsen et al. (1998)[20], ASA stage II was predominant findings with 40% cases of DHS/TSP group. Hsu et al. (2015)[3] also found stage II predominance with 50% cases. In present study also agree with former two, where ASA stage II present in 50% cases.

All the fractures in Babst el al. (1998) study fixed within 24 to 48 hours of injury. Where, in our study, range of time interval between injury and operation was from 3 days to 11 days. The longer delay was attributed to insufficient logistical support in a developing country such as Bangladesh. The average operation time observed in study by Babst el al. (1998) in 46 cases was 119 minutes (range 50 to 240 minutes). Sliding hip screw systems such as the DHS, have established themselves as the standard implant type for the fixation of stable intertrochanteric fractures over the last few decades. Consequently, the majority of surgeons are well-acquainted with the conventional implantation technique. The superposition of the TSP is technically simple once the DHS screw is inserted and the side plate fixed to the shaft fragment. For surgeons familiar with the DHS, the learning curve seems minimal. A shorter learning curve is consistent with a better outcome of the procedure since it reduces operative time and the incidence of operative complications.[3,7] Surgeons in current study were familiar with the DHS, the additional surgical time for adding modular TSP over DHS was only needed. That's why this study mean operation time was mean 94.50 minutes which is lower than former study.

Madsen et al. (1998) stated in their study that hospital stay was significantly longer in the DHS/TSP group with average 14.9 days, compared with 10.2 days in CHS group and 12.9 days in Gamma group. In present study average hospital stay was 13.4 days, which is slightly better than DHS/TSP group, but still longer than other 2 groups in the mentioned former study.

The occurrence of hip fractures is associated with a considerable risk of death during the initial 1st year post-fracture, with studies proposing a mortality range of 8.4% to 36%.[23] Babst et al. (1998)[12] reported 5(11%) death in their study, Madsen et al. (1998)[20] reported 11(22%) death in their TSP/DHS group. Russell (2013) mentioned that Bentler et al. reported on Medicare data from the United States during 1993 to 2005 and stated that mortality rate of intertrochanteric fracture at 6 months is 19%. In the current study, there was one death (10%), which was not related to the operation following radiological union. This rate is lower than that reported by Madsen et al. and Bentler et al., but is similar to the findings of Babst et al. (1998).[12]

About incidence of complications, Madsen et al. (1998)[20] reported a low infection rate of 2.4% in their DHS/TSP cohort, in contrast to the Gamma group which had a rate of 10% and the CHS group with 8.5%. Babst et al. (1998)[12] discovered that 2 cases (5%) in their research experienced infections, one being a deep infection and the other a superficial wound infection. In the current study, there was only a single case of superficial wound infection, which did not appear to extend the patient's hospital stay or affect the rate of fracture healing. The reason for the low infection rate may be attributed to a heightened awareness of infection issues among these patients, emphasizing general hygiene both pre- and postoperatively, along with a somewhat more proactive approach to diagnosing and treating infections.[3,12,20]

The primary complications of intertrochanteric fractures fixed with DHS are postoperative late collapse leading to shortening of the limb, screw cut-out and coxa vara.[7] Babst et al. (1998)[12] stated that Müller-Färber et al. discovered a correlation between the degree of screw sliding and postoperative mobility. Specifically, screw sliding of less than 6.7 millimeters did not influence mobility levels, while an average screw sliding of 13.4 millimeters led to a decrease in mobility, and 18.7 millimeters resulted in the lowest mobility levels. The mean sliding observed in this study was calculated to be 5.90 mm. This average sliding measurement was considerably lower than those reported in earlier studies that utilized DHS alone. For instance, Larson et al. (1990)[13] documented an average sliding of 12.4 mm in cases of unstable fractures. In a similar vein, Jacobs et al. (1976, as cited in Gupta et al., 2010, p. 127) noted an average sliding of 15.7 mm in unstable fractures. Additionally, Hardy et al. (1998)[11] reported an average sliding of 10.2 mm.

In the current study, no notable discrepancy in limb length was detected, which is consistent with the findings reported in the literature by Gupta et al. (2010).[7] Though one study had average 2 cm shortening in 12 out of 62 cases.[24] These statistics underscore the significance of anatomical reduction during surgical procedures; however, this can only be accomplished if the stability of these fractures is secured by buttressing the lateral wall. These observations support the conclusions of Babst et al. (1998),[12] who similarly noted a considerable decrease in excessive collapse and a subsequent reduction in limb length discrepancy through the use of a TSP in conjunction with DHS.

There exists a positive correlation between the strength of abduction and the lengths of the lever arm of the abductor muscles following total hip replacement.[25] In intertrochanteric fractures excessive collapse on the fracture side can change the lever arm and may account for muscle weakness, as demonstrated by a positive Trendelenburg sign. The weakness of the abductors may be a significant factor that accounts for the differences in

mobility levels observed postoperatively compared to pre-trauma. Preventing substantial limb shortening could play a crucial role in enhancing functional outcomes. As stated by Jong-Keon et al. (2010),[10] the use of an intramedullary device can lead to iatrogenic injury of the abductor muscles, potentially impacting the functional outcome of the hip. In the current study, the assessment results for hip abductor function at the final follow-up were significantly improved, supporting the perspective that the DHS combined with TSP is likely to enhance abductor function due to the stability it provides to the greater trochanter.[7]

Babst et al. (1998)[12] discovered that the lateralization of the greater trochanter was successfully avoided in all cases by employing a prototype buttress plate in conjunction with the DHS during their investigation. In a prospective, randomized study, Madsen et al. (1998)[20] evaluated the outcomes in 170 patients who had undergone treatment for an unstable intertrochanteric hip fracture using a Gamma nail, a compression hip screw, and DHS/TSP. Their findings indicated that both the DHS/TSP and Gamma nail groups effectively prevented the lateral displacement of the greater trochanter. The current study has confirmed that these complications can be mitigated with the TSP, as it significantly decreases the sliding of the lag screw and the lateralization of the greater trochanter while also limiting excessive medialization of the femoral shaft, all without hindering fracture healing. This demonstrates that the effectiveness of TSP is comparable to that of intramedullary devices in preventing the lateralization of the greater trochanter.

The current study reported no instances of non-union. A similar outcome was observed in the research conducted by Cho et al. (2011).[14] In their comparative study, Madsen et al. (1998)[20] identified a varus mal-union exceeding 10° at 6 months in 2.4% of cases within the DHS/TSP group, compared to 12% in the Gamma Nail group and 14% in the CHS group. Additionally, Gupta et al. (2010)[7] documented 2 cases of varus mal-union in their investigation. In the present study, 2 patients exhibited mal-union characterized by a varus deformity greater than 10°. Therefore, this study corroborates the findings of Madsen et al. that TSP is more effective in reducing varus union compared to Gamma Nail and CHS. The mal-alignment likely resulted from a loss of fracture reduction during the surgical procedure, which could have been prevented through proper reduction.

In the research conducted by Madsen et al. (1998)[20], it was observed that five patients (6%) out of a total of 85 in the DHS/TSP group required reoperation; four of these cases involved lag screw cut-out, while one was associated with an unrelated supracondylar fracture of the femur resulting from a fall at home. In another study, three patients out of 74 (4%) necessitated reoperation.[7] A more recent investigation revealed that a higher number of patients in the IM nail group underwent reoperations due to fractures around the implant and local pain from the implant compared to the SHS group (7.1% vs. 4.5%).[26] In our study, only one patient (5%) required reoperation after achieving radiological union, attributed to persistent pain in the hip area caused by impingement of the proximal section of the TSP. This complication rate aligns with the findings of the previous two studies. Following reoperation, the patient fully regained their pre-fracture level of mobility.

The average follow-up duration reported in Babst et al. (1998)[12] was 14 months, with a range of 12 to 20 months. In the present study, all patients underwent a minimum follow-up of 6 months, with a mean duration of 7.45 months, ranging from 6 months to 11 months. The shorter follow-up period in this study was attributed to the constraints of the study duration and the inclination of patients to avoid long-term follow-up.

Radiological union was observed in all cases at an average of 13.56 weeks in the research conducted by Gupta et al. (2010).[7] Radiological union in our study was with similar result, range of 12 to 18 weeks, mean 14.30 with SD 1.88. The highest rate of union was recorded within a period of 12 to 14 weeks, encompassing 80% of the cases.

The mean mobility score for Parker and Palmer[15], as reported in the study by Cho et al. (2011)[14], was 7.2 (SD 4.6) in the pre-fracture state, which decreased by 1 point to 6.2 (SD 3.5) at the final follow-up. In the current study, the pre-fracture score was 7.60 (SD 0.96), and the last follow-up indicated a half-point difference, resulting in a score of 7.10 (SD 1.66). This study demonstrated superior results compared to Cho et al., likely due to the variation in the mean age of the study population. Babst et al. (1998) found that 28 out of 39 cases (71%) achieved the same mobility score at both pre-fracture and last follow-up. Similarly, Madsen et al. (1998) reported in their comparative analysis that 69% of patients in the Gamma group, 73% in the CHS group, and 91% in the DHS/TSP group were able to return to their preoperative walking ability. In the present study, 80% of cases regained the same mobility score at both pre-fracture and last follow-up, which falls between the results of Babst et al. and Madsen et al., and is also an improvement over the Gamma and CHS groups noted in

Madsen et al.'s research. This discrepancy among the groups may indicate a lower incidence of secondary fracture displacement in the DHS/TSP group compared to the Gamma and CHS groups.

We used Salvati & Wilson hip functional scores to evaluate functional outcomes after intertrochanteric fracture surgery. Other studies[12,20] have employed the same scoring, allowing us to compare our results with theirs. Babst et al. (1998) utilized TSPs in 46 unstable ITFs, reporting Salvati & Wilson hip functional scores of 51% excellent, 36% good, 13% fair, and no cases with poor results, leading to a total satisfactory result of 87%.[12] This study provided the earliest and essential outcome data for TSP. In the clinical results presented by Madsen et al. (1998), the Gamma group showed a satisfactory outcome in 69%, while the TSP group achieved 91%, indicating superior results for the TSP-DHS group compared to the Gamma group.[20] In cases of unstable intertrochanteric fractures due to posterior, medial, and lateral comminution, the collapse at the fracture site associated with sliding hip screw fixation may exceed typical expectations. In such instances, weakness of the abductor muscles and the resulting fatigability are likely to be more pronounced. TSP significantly reduced the incidence of lateralization of the greater trochanter, with limited telescoping of comminuted fragments during weight bearing. These factors contributed to improved hip abductor function and a final Salvati-Wilson functional score, restoring pre-fracture mobility. The hip functional outcomes based on the Salvati & Wilson score in this study were classified as satisfactory in 80% of cases (20.0% excellent and 60% good), with 20% rated as fair and none as poor. The satisfactory results are comparable to those reported by Babst et al. (1998) but surpass those of the Gamma group mentioned in Madsen et al. (1998).[12,20] Therefore, this study suggests that the addition of a TSP to DHS is likely to enhance surgical outcomes in these specific types of unstable intertrochanteric fractures.

Conclusion:

The TSP-DHS effectively treats AO type 31-A2.2, 2.3 and 3.3 unstable intertrochanteric fractures in patients aged 65 and older. Outcome comparable to intramedullary nailing, while offering advantages of preserving the dynamic compression benefits of the standard DHS. This method establishes a biomechanically stable structure that facilitates lateral buttressing, which helps to prevent the lateralization of the greater trochanter and consequently limits the medialization of the femoral shaft. Future studies with a larger sample size, extended follow-up, and surgeries performed by a single surgeon may address the limitations.

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