Fixation of Trochanteric Fracture by Expert Femoral Nail

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ABSTRACT

Aim of the Study:
This work was to evaluate the results of the management of twenty patients with unstable trochanteric femoral fractures at Menoufia University Hospital with expert femoral nail

Patients & Method:
This is a prospective study of the management of twenty patients with unstable trochanteric femoral fractures, at Menoufia University Hospitals during the period from April 2019 to May 2021.
Informed consent was obtained from either the parents or caregivers for all cases. Approval by the ethical committee of the faculty of medicine, at Menoufia University was obtained.

Results:
The twenty patients have variable age groups and sex and variable BMI, occupation, and residence**.** Mechanism of injury varies between domestic fall and RTA, All fractures are unstable (31.A2 and 31.A3) and prehospital stay varies from one to 30 days. Open reduction was required in only four cases. Three cases had blood transfusions, The Time of operation ranged from 50- 100 mins. In this study, the incidence of infection was 5% (only one case was infected) and there was no significant association between infection and operation time or open reduction or DM. No significant relation between BMI and the operation time or the clinical result. There was no significant difference in clinical outcome between reversed obliquity trochanteric fracture and other types.

Conclusion:
Expert femoral nail is the Gold standard for the treatment of unstable trochanteric fractures. It has a lot of advantages as minimal invasion, less blood loss, good anatomical fixation even in unstable patterns of fracture, minimal morbidity to patients, less chances of complications, and early weight bearing. It can be used in all configurations of proximal femoral fractures.

Keywords: *Fixation, Expert Femoral Nail, Trochantric Fracture.*

INTRODUCTION

Trochanteric fractures are among the most prevalent fractures in the elderly population. The incidence of these fractures has significantly risen in recent decades due to the increasing life expectancy of the population [1]. Approximately 35 to 40% of these fractures are classified as unstable. The optimum management approach for regaining pre-fracture movement is surgical stabilisation of those fractures [2].
Approximately 40 to 50% of hip fractures classified as extracapsular fractures are eligible for intramedullary therapy [3]**.** From a statistical standpoint, it can be seen that more than 75% of individuals who have hip fractures are female, and over 90% of them are aged 70 or above [4].
Individuals with intertrochanteric fractures exhibit advanced age, a higher likelihood of being confined to home ambulation, and an increased need for assistance for activities of daily life, in comparison with individuals with femoral neck fractures [5]. These extracapsular fractures happen in the cancellous bone, which has a lot of blood flowing through it. Consequently, the occurrence of nonunion and osteonecrosis may be less troublesome in fractures of the femoral neck [6].
The implant needs to counteract any forces that might cause the fracture to move. In theory, these forces are most effectively transferred by an implant positioned at the center of axial loading. This positioning reduces the lever arm and decreases the bending moment. The implant must possess the capacity to withstand the whole load, in conjunction with the fracture pieces. The device should provide controlled fracture impaction, which involves a gliding mechanism, to promote impaction and compression, hence enhancing stability .[7]
The stability of a fracture is controlled by the existence of posterior-medial bone contact, which serves as a support to prevent the fracture from collapsing. Treating unstable fractures of inter-trochanteric femoral in elder osteoporotic individuals is difficult and subject to debate. The vast majority of individuals with this fracture undergo internal fixation, which may be achieved by the use of either intramedullary nails or extramedullary devices. The advantages of using an additional medullary plate are still a subject of

controversy due to the risk of fixation failure associated with calcar defect, involvement of the lateral wall, and extensive osteoporosis, that may need conversion to arthroplasty. Surgeons should carefully assess the advantages and disadvantages of intramedullary nails and extramedullary plates while making treatment decisions .[7]

During the last five decades, a diverse range of implants and fixation methods have been used for surgically stabilising intertrochanteric hip fractures. The implementation of the sliding compression hip screw and side plates in the 1950s was seen as a significant improvement compared to earlier nail-plate methods. The application of the sliding compression hip screw and side plate constituted the prevailing method of care for surgically managing these fractures. Initially, there was a preference for anatomical reduction using stiff internal fixation, which included excessive dissection of soft tissues, resulting in the fragment becoming avascular .[8]

Alternative ways remained accessible. A novel fixation device was invented in the early 1990s for treating intertrochanteric fractures. The device included a brief intramedullary nail put via the greater trochanter, together with a sizable proximal interlocking screw introduced in a retrograde manner up the femoral neck. The first iteration of this gadget was the Gamma nail. Since the first release of the Gamma nail, many other companies have launched comparable intramedullary fixation devices with varied designs.[8]

Intramedullary nails provide several benefits, such as straightforward insertion utilising a closed approach, preservation of the fracture hematoma, and a reduced risk of infection owing to reduced surgical dissection. Closed nailing is a method of biologically fixing the femur, that may lead to a faster healing period. The biomechanical benefits of these implants compared to screw/plate fixation are due to a decreased distance between the implant and the hip joint. This reduces the bending moment on the implant/fracture structure and enables the load to be directly transmitted to the femoral shaft by bypassing the calcar femoral. These traits provide potential benefits in the context of unstable fractures .[7]

Although nails offer theoretical benefits, they have also been linked to several consequences, such as a higher likelihood of fractures during surgery and thereafter (peri-implant fracture), thigh pain, and more technical challenges .[7]

Four key factors affect the success of operational fracture care: the patient's condition, the fracture itself, the fixation device used, and the surgeon doing the procedure. These elements exhibit intricate and interdependent relationships. Each of these components, both individually and together, exerts their impact on the result [9].

Obtaining precise weights for each of these individual characteristics is challenging, which restricts the therapeutic implications of a mathematical solution. However, it primarily signifies the equilibrium between the individual (the patient, the surgeon) and the physical components (the fracture, the fixation device) that mostly influence the therapeutic result [9].

PATIENTS AND METHODS:

This is a prospective work of management of 20 individuals with unstable trochanteric femoral fractures, at Menoufia University Hospitals during the period from April 2019 to May 2021.

Informed consent was gathered from either the parents or caregivers for all cases. Approval by the ethics committee of the faculty of medicine, at Menoufia University was obtained.

Inclusion Criteria:

- Unstable trochanteric fractures. •
  Closed fractures.
- Skeletally mature patients.
- Recent fracture within 3 weeks.

Exclusion Criteria:

- Stable trochanteric fractures.
- Skeletally immature patients.
- Associated vascular and neurological injury. •
  Pathological fractures.
- Pre-existing femoral deformity

Operative procedure:

I. Anesthesia

– The selection of an anesthetic method was according to the following:
✓ Associated medication and medical conditions
✓ Duration and complications of surgical procedures
✓ Preference of anesthetist and surgeon
✓ Patient preference
– All patients received spinal (subarachnoid) anesthesia.

II. Sterilization

– The number of persons in the operative theatre was kept to a minimum (about 6 persons).
– Traffic in and out of the theatre was minimized as much as possible.
– Double sterilization and draping were routinely performed in all cases.

III. Antibiotics

Prophylactic antibiotic (2nd generation cephalosporins) was administered to each participant half an hour before surgery.

IV. Operative procedures:

Patient positioning

The patient is positioned supine on the fracture table with the contralateral leg well-padded and positioned without pressure on the calf to prevent peroneal nerve damage or calf muscle compartment syndrome and fixed with the help of thigh support in a flexed and abducted position. Support underneath the ipsilateral buttock was given to facilitate the approach, particularly in obese patients. The ipsilateral arm was positioned in an adducted or elevated position so as not to intervene throughout the surgical procedure. The operated limb is adducted to 10 to 15 degrees and internally rotated to about 15 degrees. The image intensifier was positioned between the injured and uninjured legs so that both AP and lateral views could be obtained easily. The patient was then prepared and

draped up to the pelvic rim

Approach:

The skin incision location was determined by marking the tip of the greater trochanter and the axis of the femur using the image intensifier and by palpating the trochanter. Afterward, an incision of three to five centimeters is made on the proximal extension of the anatomical femoral bow, five centimeters proximal to the tip of the greater trochanter. The skin incision is done parallel to the curved axis of the femoral canal to reduce the chances of damaging the superior gluteal nerve and to minimize the possibility of uneven drilling of the proximal fragment, which might result in perforation of the back part of the femoral shaft.

Deep incision

Opening the fascia with scissors and splitting the fibers of the gluteus medius muscle. The trochanteric entrance point is located adjacent to the greater trochanter's tip in the anteroposterior view and precisely positioned in the center of the axial view to prevent eccentric reaming.

Determination of entry point (trochanteric entry) and guide-wire insertion

Insertion of guide wire

Determination of nail length and diameter:

The appropriate length of the nail is established by contrasting a secondary guide wire to the one that has already been placed. The accurate positioning of the guide wire in the distal canal may be assessed using an image intensifier or a radiographic ruler.

Insertion of reaming rod:

Once the tissue protector is in place, the reaming shaft, equipped with the initial reamer head, is put onto the guide wire. Typically, the process of reaming starts with a medullary reamer measuring 9 mm in diameter. Reaming is conducted progressively, with each step increasing by 0.5 mm. Reaming is done to ensure the smooth insertion of nails.

Exchange of guide wire:

The exchange tube passed over the guide wire and advanced into the medullary cavity till it entered the distal fragment. The ball-tipped guide wire is removed and replaced with the plane-tipped guide wire and then the tube is removed after confirming the positioning of the plane-tipped guide wire in the distal fragment of the medullary cavity under image intensifier guidance.

Connecting handle to nail:

Selecting the nail size considering the canal diameter, fracture pattern, and patient anatomy. The appropriate nail size is attached to the insertion handle and secured with the matching connection screw, utilizing a hexagonal screwdriver via the hole in the insertion handle.

Introduction of nail

Once the fracture reduction was deemed adequate, the nail was manually placed as deeply as feasible into the femoral aperture. The procedure was executed meticulously, using gentle twisting motions of the hand, until the hole for the 8mm screw aligned with the lower edge of the neck. The hole was then turned about 90 degrees from its initial position to its final orientation. The nail is manipulated underneath the direct guidance of the image intensifier, being pushed down until it reaches the fracture zone. Then, mild hammer blows are used to further advance the nail into the medullary cavity, all while ensuring the location of the nail's tip is accurately monitored depending on the image intensifier.

Distal locking

a. Align image
b. Determine incision point
c. Drill

Postoperative care

Postoperatively, participants' blood pressure, pulse, respiratory rate, and temperature were monitored. Antibiotics (3^{rd} generation cephalosporins twice daily for 5 days then oral broad-spectrum penicillin for 10 days) and analgesics (NSAIDs) were ongoing throughout the time after the surgery. Blood transfusion was administered based on the need.

Participants were advised to promptly engage in bed rest and start ROM and static exercises on the initial day following surgery. Participants received instruction on quadriceps setting exercises and knee mobilization starting on their initial day.

Following two weeks, participants were advised to gradually apply weight on their limbs using either axillary crutches or a walker, based on the particular patient's capacity to tolerate discomfort.

Weight-bearing was permitted following the fracture had completely healed.

RESULTS

The twenty patients have variable age groups and sex and variable BMI, occupation, and residence**.** Mechanism of injury varies between domestic fall and RTA, All fractures are unstable (31.A2 and 31.A3) and prehospital stay varies from one to 30 days.

Open reduction was required in only four cases. Three cases had blood transfusions, The Time of operation ranged from 50- 100 mins. Union occurred in 17 patients at a duration range from 2-11 months. According to the participant’s age, gender, BMI, and pre-existing medical disorders, there is no significant difference in the union rate of trochanteric fractures in our patients.

Backing out of screws occurred in 4 cases but two of them have united, there is no significant relationship between the backing out of screws and the union. There is a significant relationship between the postoperative pain and the nonunion. Patients with united fractures have high Merle d'Aubigne scoring. There is no substantial variation in the rate of union

among the reversed obliquity trochanteric fractures and other types.

In this study, the incidence of infection was 5% (only one case was infected) and there was no significant association between infection and operation time or open reduction or DM.

No significant relation between BMI and the operation time or the clinical result. There were no significant differences in clinical outcomes between reversed obliquity trochanteric fracture and other types. The open reduction has no significant association with abductor insufficiency.

Table 1: Comparison between union and non-union cases regarding socio-demographic data 6 months postoperative.

Socio-demographic data	**Union (n=17)**		**Non-union (n=3)**		**Test of significance**	**P-value**
	N	**%**	**N**	**%**		
Age (in years):						
Mean± SD	60.77±16.43		63.67±7.23		t= 0.296	0.771
Range	24-80		59-72			
Sex:						
Male	9	52.9	2	66.7	FE= 0.194	1
Female	8	47.1	1	33.3		
BMI (kg/m^2):						
Mean± SD	29.94±3.91		31.67±4.51		t= 0.692	0.498
Range	24-35		27-36			
Pre-existing medical conditions:	8	47.1	2	66.7	FE= 0.196	1
Yes	9	52.9	1	33.3		
No						

t: student t-test, FE: Fischer's exact test

Table 2: Comparison between union and non-union cases regarding operative data 6 months postoperative.

Operative data	**Union (n=17)**		**Non-union (n=3)**		**Test of significance**	**P-value**
	N	**%**	**N**	**%**		
Mechanism of injury:						
Falling	12	70.6	2	66.7	FE= 0.019	1
RTA	5	29.4	1	33.3		
Evans classification:						
Type 3	6	35.3	1	33.3	X^2= 2.82	0.244
Type 4	7	41.2	0	0		
Type 5	4	23.5	2	66.7		
AO classification:						
A 2:1	8	47.1	0	0		
A 2:2	0	0	1	33.3		
A 2:3	2	11.8	1	33.3	X^2= 8.889	0.114
A 3:1	3	17.6	1	33.3		
A 3:2	2	11.8	0	0		
A 3:3	2	11.8	0	0		
Time to surgery (in days):						
Mean± SD	3.24±6.93		1.33±0.58		U= 0.589	0.556
Range	1-30		1-2			
Operation time (in minutes):						
Mean± SD	71.47±14.01		93.33±5.77		t= 2.616	**0.017***
Range	50-90		90-100			
Open reduction:						
Required	2	11.8	2	66.7	FE= 4.804	0.088
Not-required	15	88.2	1	33.3		
Blood transfusion:						
Yes (one unit)	2	11.8	1	33.3	FE= 0.93	0.404
No	15	88.2	2	66.7		

*t: student t-test, FE: Fischer's exact test, U: Mann-Whitney test, X^2: Chi-square test, *Significant (P-value <0.05)*

Table 3: Comparison between union and non-union cases regarding post-operative data

Post-operative data	Union (n=17)		Non-union (n=3)		Test of significance (FE)	P-value
	N	%	N	%		
Infection:						
Yes	0	0	1	33.3	5.965	0.15
No	17	100	2	66.7		
Backing out of screws:						
Yes (occurred)	2	11.8	2	66.7	4.804	0.088
No	15	88.2	1	33.3		
Pain:						
Yes	0	0	3	100	20	**0.001***
No	17	100	0	0		
Merle d'Aubigne scoring:						
Mean± SD	15.29±2.23		6±1		t= 6.655	**<0.001****
Range	11-18		5-7			
Merle d'Aubigne clinical scoring system (classification):						
Excellent	4	23.5	0	0	X^2= 20	**<0.001****
Fair	6	35.3	0	0		
Good	7	41.2	0	0		
Poor	0	0	3	100		
Reversed obliquity:						
Present	5	29.4	1	33.3	0.019	1
Absent	12	70.6	2	66.7		
Abductor insufficiency (+ve Trendelenburg)						
Present	0	0	1	33.3	5.965	0.15
Absent	17	100	2	66.7		
Union of lesser trochanter:						
Yes	10	58.8	1	33.3	0.669	0.566
No	7	41.2	2	66.7		
thigh pain:						
Yes	4	23.5	1	33.3	0.131	1
No	13	76.5	2	66.7		
basicervical fracture:						
Present	0	0	1	33.3	5.965	0.15
Absent	17	100	2	66.7		
Death:						
Yes (6 months post-operative)	1	5.9	0	0	0.186	1
No	16	94.1	3	100		

**Significant (P-value <0.05), ** Highly significant (P-value <0.001)*

Table 4: Comparison between cases with and without infection

	Infection				Test of significance (FE)	P-value
	Yes (n=1)		No (n=19)			
	N	%	N	%		
Operation time (in minutes):						
Mean± SD	90		73.95±15.24		t= 1.027	0.318
Range	90		50-100			
Diabetes mellitus:						
Yes	0	0	6	31.6	0.451	1
No	1	100	13	68.4		
Backing out of screws:						
Yes (occurred)	1	100	3	15.8	4.211	0.2
No	0	0	16	84.2		
Open reduction:						
Required	1	100	3	15.8	4.211	0.2
Not-required	0	0	16	84.2		

Table 5: Relation between the union of lesser trochanter and thigh pain

	union of lesser trochanter				Test of significance (FE)	P-value
	Yes (n=11)		No (n=9)			
	N	%	N	%		
Thigh pain:						
Present	0	0	5	55.6	8.148	**0.008***
No	11	100	4	44.4		

**Significant*

DISCUSSION

Platzer et al. Follow-up tests, including clinical and radiographic, were completed in 92 individuals (97%) at 3, 6, and 12 months following the event. Among the remaining individuals (3%), the evaluation at 6 months was incomplete due to their failure to attend a follow-up examination. Functional outcomes indicated that 88 of the participants (93%) had successfully resumed their preinjury levels of activity within one year following the event. Seven individuals (7%) reported experiencing difficulties in their regular activities, namely in engaging in various sports such as climbing, mountain biking, or skiing. There were no individuals who required walking assistance, and we observed no significant functional deficits in hip function. The mean hip flexion angle was 120° (with a range of 90° to 130°), and there were no significant variations compared to the other side. There were no significant differences seen in the external or internal rotation measurements while the individual was lying down, nor were there notable differences in the average adduction or abduction measurements when the individual was in a lateral position, for both hips. 16 individuals (17%) reported intermittent discomfort when walking long distances (n=6) or during weather changes (n=10), but overall expressed satisfaction with their therapy. [10]

This thesis conducted comprehensive clinical and radiological follow-up assessments on 20 individuals at 3, 6, and 12 months after surgery. Functional outcomes showed that 85% of those receiving treatment (17 individuals) had resumed their preinjury level of activity one year after the surgery. 3 individuals, accounting for 15% of the total, had functional deficits in hip function and required the assistance of walking aids. The mean hip flexion angle was 120° (range, 90 – 130°), and there were no statistically significant variations compared to the other side. There were no significant differences seen in the external or internal rotation measurements while the individual was lying down, nor were there notable differences in the average adduction or abduction measurements when the individual was in a lateral position, for both hips. Out of the total number of participants (n=7), seven individuals (35%) reported experiencing intermittent discomfort when engaging in long-distance walking. However, overall, they expressed contentment with their therapy. A single patient received an arthroplasty operation.

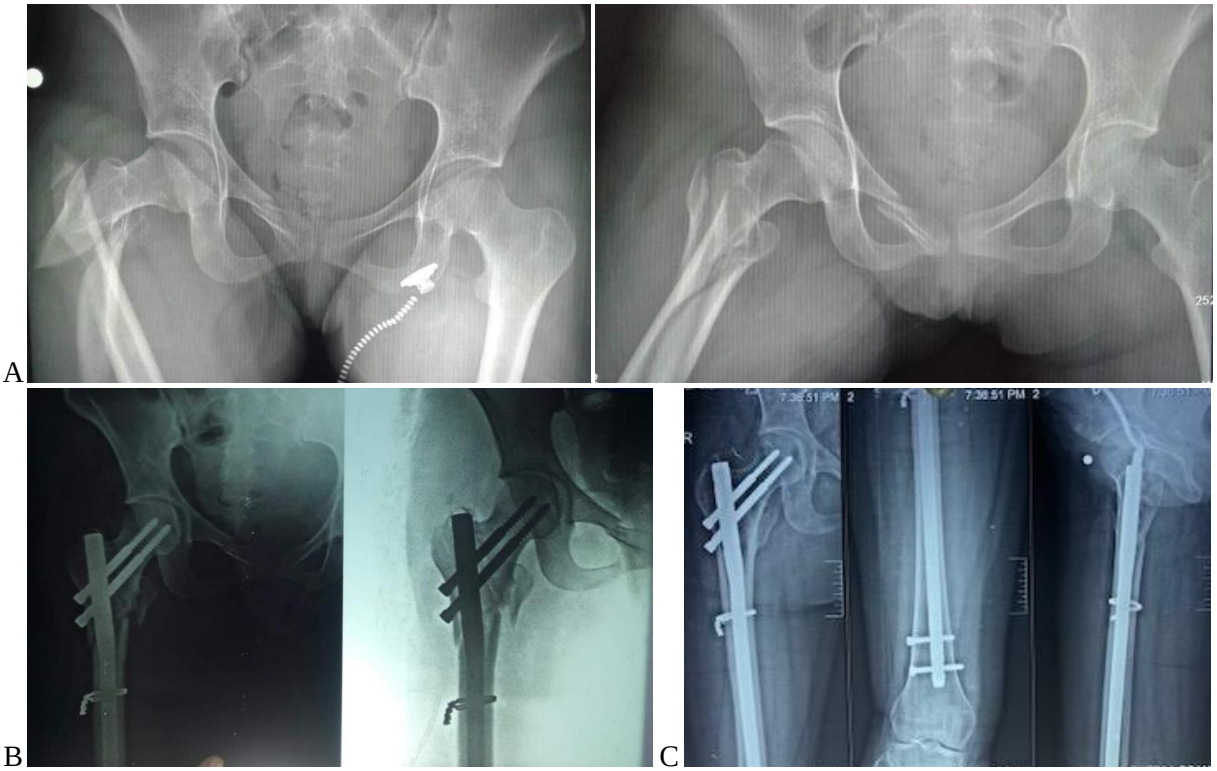

Fig 1: Female patient, 24 years old, BMI 24, Fracture grading: trochanteric fracture 31A3:3, Treatment modality: open reduction &cerclage, Postoperative program: touch weight-bearing started after 2ws postoperative, Partial weight-bearing after 1.5, full weight-bearing after 4 months. A: Preoperative. B: Postoperative. C: 6 months Postoperative follow-up

In a study conducted by Yasir S Siddiqui et al., it was shown that 3 out of a total of 45 individuals with unstable trochanteric fractures who received therapy with PFN from July 2013 to June 2015 had differential migration of screws, also known as the Z effect or Reverse Z effect. The specifics about them are presented in Table ( ).[11]

Platzer et al. discovered that out of the fifty-seven individuals who had treatment with a cephalomedullary nail, four of them (4%) experienced complications related to wound infection. 3 individuals had superficial infections, which were effectively resolved

with a course of antibiotic treatment lasting an average of 7 days. One individual had a profound infection of the wounds with continuous discharge, which ultimately resolved following undergoing a revision procedure and temporary placement of gentamicin-impregnated beads.[10]

But in this thesis, we found that the incidence of infection was 5% (only one case was infected and developed deep wound infections with persisting discharge that finally resolved after removal of the hardware and good debridement) and there was no significant association between infection and operation time or open reduction or DM.

Tucker et al. found that the intramedullary femoral nail in obese patients with (BMI) ≥ 30 had been correlated with a 52% greater average operative time (94 minutes) contrasted with nailing in the non-obese group with (BMI) < 30 (62 minutes; P < 0.003).[12]

However, in this thesis, we found no significant relationship between BMI and operation time.

Yoo et al. found that BMI has a more significant impact on clinical outcomes compared to BMD. These results indicate that the use of intramedullary nails offers mechanical stability even in individuals with osteoporosis. The accurate closed reduction procedure, which involves the correct positioning of lag screws, may encounter challenges in high BMI individuals due to the increased difficulty in placing the entry point and achieving closed reduction compared to low BMI individuals.[13]

However, in this thesis, we found no significant relationship between BMI and clinical outcomes.

J. Yoo, et al. found that fixation failure was seen in 11 individuals, accounting for 5.7% of the total. The study found that greater BMI (p = 0.003) and basicervical fracture (p = 0.037) were non-modifiable patient characteristics linked with fixation failure. Therefore, it is extremely likely that the basicervical type of fracture on 3D-CT is strongly correlated with fixation failure. The use of 3D-CT in assisting with fracture classification may provide more advantages when doing IM nails for trochanteric hip fractures.[13]

In this thesis, we found that fixation failure occurred in 3 patients comprising 15% of the sample (one of them was associated with basicervical trochanteric fracture and was revised by total hip arthroplasty).

Q. Sun, et al. found that the significant displacement of the lesser trochanter might lead to higher rates of consequences and postoperative discomfort when treating unstable fractures of the trochanteric femur. Trochanteric fractures that are severely displaced in the lesser trochanter and managed with IM treatment may have a greater likelihood of problems contrasted to those with just modest displacement in the lesser trochanter. The incidence of complications reduced following surgical reduction of the displaced lesser trochanter in the management of fractures of the trochanteric with IM fixations.[14]

Q. Sun, et al. believed that the thigh discomfort may be attributed to a displaced lesser trochanter, which has potentially caused harm to the nearby muscle and nerve. Thigh discomfort among individuals was alleviated with the combination of NSAIDs and physical therapy [14].

Also in this thesis, we found that the displaced and non-united lesser trochanter has a significant association with thigh pain.

Cheng et al. found that the incidence of complications considerably rose with longer operating length, virtually doubling when the operative time exceeded 2 hours or beyond. Meta-analyses have also shown that for every extra 30 minutes of operating time, there is a 14% higher chance of experiencing problems.[15]

Also in this thesis, we found that the prolongation of operation time has a significant decrease in union rate.

Moein et al. found that performing femoral nailing via the tip of the greater trochanter, as opposed to the trochanteric fossa, may reduce the likelihood of injuring the superior gluteal nerve and causing injury to the muscular structures in the hip area during surgery. This might potentially lead to enhanced muscle performance. Thus, a lateral entry site might be a logical alternative to the traditional method of nailing into the trochanteric fossa. Inserting the femoral nails via the greater trochanter' tip seems to lead to improved hip function after surgery compared to inserting the nails through the trochanteric fossa. [16]

Also in this thesis, we found that only one patient has +ve Trendlenberg test (abductor insufficiency) comprising 5% of the sample, this patient had open reduction but generally in our thesis there was no significant association between open reduction and abductor insufficiency.

K. Ozkan, et al. performed a study from 2006 to 2008, 15 patients with reversed obliquity trochanteric fractures (AO/OTA 31 A-A3 fractures) had been managed by proximal femoral nails. 2 individuals (13.33%) had acceptable reductions, whereas 13 individuals (86.67%) achieved anatomical reductions. The mean Harris hip score was 74.66, with a range of 65 to 96. The mean Barthel activities score was 15.71, with a range of 12 to 20. 9 individuals had excellent outcomes, 4 achieved good outcomes, and 2 achieved poor outcomes based on the Harris hip score. Additionally, 2 individuals had a limited range of motion, 2 had a moderate range of motion, and 11 had a high range of motion based on the Barthel activity score. The average time of the surgical procedure was 48 minutes. All of the recipients had complete healing of their fractures, with an average time for the bones to fully consolidate of 8.6 weeks (ranging from 7 to 13 weeks). No difficulties during the surgery or technical failures after the surgery were seen. Additionally, there was no indication of stress shielding, as shown by the absence of cortical hypertrophy at the tip of the implant.[17]

In this thesis, 6 patients with reversed obliquity trochanteric fractures were treated by expert femoral nails. The fractures healed in 5 patients and one patient failed union and had poor results. There were no significant differences in clinical outcomes between reversed obliquity trochanteric fracture and other types.

CONCLUSION

The use of expert femoral nailing is

considered the most effective and widely accepted method for treating unstable trochanteric fractures. The procedure has several benefits, such as low invasiveness, reduced blood loss, effective anatomical fixation even in cases with unstable fracture patterns, little patient morbidity, decreased risk of consequences, and early weight bearing. It is applicable in all proximal femoral fracture configurations. The closed approach is used to maintain the integrity of the fractured hematoma and promote rapid healing and union. It can be efficiently employed in all stages of osteoporosis with consistent outcomes. The operation is expedient, involving a little incision and resulting in a significant reduction in blood loss. It yields favorable outcomes even in cases of non-anatomical reductions.
There were a few complications. However, achieving expert precision in nailing requires advanced surgical proficiency, a high-quality fracture table, excellent equipment, and precise control of the C-arm. It presents a significant challenge for learning. Therefore, it may be inferred that the skilled use of a nail, with appropriate training and technique, is a secure and straightforward method for treating complicated pertrochanteric fractures.

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REFERENCES:

1. Marks, R. Hip fracture epidemiological trends, outcomes, and risk factors, 1970--2009. *Int. J. Gen. Med.* **3**, 1 (2010).
2. Windolf, J., Hollander, D. A., Hakimi, M. & Linhart, W. Pitfalls and complications in the use of the proximal femoral nail. *Langenbeck's Arch. Surg.* **390**, 59–65 (2005).
3. Karagas, M. R., Lu-Yao, G. L., Barrett, J. A., Beach, M. L. & Baron, J. A. Heterogeneity of hip fracture: age, race, sex, and geographic patterns of femoral neck and trochanteric fractures among the US elderly. *Am. J. Epidemiol.* **143**, 677–682 (1996).
4. Johansen, A. *et al.* National hip fracture database: National Report 2013. *London R. Coll. Physicians* (2013).
5. Koval, K. J., Aharonoff, G. B., Rokito, A. S., Lyon, T. & Zuckerman, J. D. Patients with femoral neck and intertrochanteric fractures: Are they the same? *Clin. Orthop. Relat. Res.* **330**, 166–172 (1996).
6. Kuzyk, P. R. T. *et al.* Biomechanical evaluation of extramedullary versus intramedullary fixation for reverse obliquity intertrochanteric fractures. *J. Orthop. Trauma* **23**, 31–38 (2009).
7. Lee, Y.-K., Chung, C. Y., Park, M. S., Lee, K. M. & Koo, K.-H. Intramedullary nail versus extramedullary plate fixation for unstable intertrochanteric fractures: decision analysis. *Arch. Orthop. Trauma Surg.* **133**, 961–968 (2013).
8. Anglen, J. O., Weinstein, J. N., of Orthopaedic Surgery Research Committee, A. B. & others. Nail or plate fixation of intertrochanteric hip fractures: changing pattern of practice: a review of the American Board of Orthopaedic Surgery Database. *JBJS* **90**, 700–707 (2008).
9. Schipper, I. Treatment of unstable trochanteric fractures: the balance between man and material. (2003).
10. Platzer, P., Thalhammer, G., Wozasek, G. E. & Vécsei, V. Femoral shortening after surgical treatment of trochanteric fractures in nongeriatric patients. *J. Trauma Acute Care Surg.* **64**, 982–989 (2008).
11. Siddiqui, Y. S., Khan, A. Q., Asif, N., Khan, M. J. & Sherwani, M. K. A. Modes of failure of proximal femoral nail (PFN) in unstable trochanteric fractures. *MOJ Orthop Rheumatol* **11**, 7–16 (2019).
12. Tucker, M. C., Schwappach, J. R., Leighton, R. K., Coupe, K. & Ricci, W. M. Results of femoral intramedullary nailing in patients who are obese versus those who are not obese: a prospective multicenter comparison study. *J. Orthop. Trauma* **21**, 523–529 (2007).
13. Yoo, J., Chang, J., Park, C. & Hwang, J. Risk factors associated with failure of cephalomedullary nail fixation in the treatment of trochanteric hip fractures. *Clin. Orthop. Surg.* **12**, 29 (2020).
14. Sun, Q. *et al.* The influence of position of the displaced lesser trochanter on clinical outcome of unstable trochanteric femur fractures in the elderly. *Biomed Res. Int.* **2018**, (2018).
15. Cheng, H. *et al.* Prolonged operative duration is associated with complications: a systematic review and meta-analysis. *J. Surg. Res.* **229**, 134–144 (2018).
16. Moein, C. A. *et al.* Functional outcome after antegrade femoral nailing: a comparison of trochanteric fossa versus tip of greater trochanter entry point. *J. Orthop. Trauma* **25**, 196–201 (2011).
17. Ozkan, K. *et al.* Treatment of reverse oblique trochanteric femoral fractures with proximal femoral nail. *Int. Orthop.* **35**, 595–598 (2011).