Fixation of Unstable Trochanteric Fractures with Trochanteric Antegrade Nail.

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The Egyptian Orthopedic Journal; 2021 supplement (1), June, 56: 6-11

Abstract

Background
Hip fractures rank in the top ten of all fractures worldwide. One-year associated mortality is approximately 20 percent. Intramedullary short or long nails were introduced in the 80s and usually entered from the area of the greater trochanter, with various diameters, anteversion angles, and proximal configuration as far as the size, shape, and number of lag screws. It is universally accepted that unstable trochanteric fractures are best treated with an intramedullary device.

Patients and methods
A prospective study was completed from March 2017 to September 2019 at Al-Azhar University Hospital [Damietta] with a follow-up period ranged from 6 to 24 months. It included 33 patients with unstable trochanteric fractures. All were treated by trochanteric antegrade nail insertion. The operative outcome had been assessed clinically and traced for as long as 24 months postoperatively.

Results
Postoperative Clinical assessment using Harris hip score at one year postoperative, revealed that 20 of them had excellent, 7 had good, 4 had fair and 2 patients had poor results. All patients showed radiological solid union by the end of the follow-up period. The mean time to achieve union was 12 [10-16] weeks. There were no intraoperative complications. Postoperatively, one patient had a superficial wound infection, which resolved with local measures and intravenous antibiotics, and one patient had a deep infection that resolved with nail removal after the solid union.

Conclusion
TAN in the treatment of unstable trochanteric fractures is associated with short operative time and screening duration, low blood loss, less postoperative morbidity, early weight-bearing, better fracture healing, and functional results. Thus, the TAN could be considered as a powerful and safe implant for the treatment of unstable trochanteric femoral fractures.

Keywords
Unstable; Trochanteric fractures; Internal fixation; Cephalomedullary nail; Trochanteric antegrade nail.

Introduction

The consequences for hip fractures in elderly individuals are significant in terms of lives lost and the associated negative impacts on hip fracture patients' functioning and quality of life[1]. One year mortality for patients after a hip fracture is approximately 20 percent[2]. A large number of implants have been developed for intertrochanteric fracture fixation. Since the 50s, when the compression/sliding hip screw (SHS) side plate concept was introduced, it represents the gold standard of extramedullary devices[3]. Intramedullary devices were introduced in the 80s and are typically represented from short or long nails entering from the area of the greater trochanter, with various diameters, anteversion angles, and proximal configuration as far as the size, shape, and number of lag screws[4]. The trochanteric antegrade nail (TAN) offers the same theoretical advantages of intramedullary fixation. It is also inserted through the greater trochanter and has a valgus offset of 5 degrees. It is offered in straight short and bowed long versions. The uniqueness of this device is that has two 6.4 mm proximal screws that stabilize the femoral head, theoretically providing better rotational control of the proximal fracture fragment[5]. It is universally accepted that unstable fractures are best treated with an intramedullary device, whereas an SHS has been shown to have fewer complication rates and no worse functional outcomes compared with intramedullary devices for more stable fracture patterns[4].

Aim of the Work

This study aims to evaluate the results of treatment of unstable trochanteric fracture by trochanteric antegrade nail.

Patients and Methods

This prospective study was performed according to the institutional review board (ethical committee) of Al-Azhar University. It was done from March 2017 to September 2019 at Al-Azhar University Hospital in Damietta. There were 33 patients with unstable trochanteric fractures. They were 11 females and 22 males.

Inclusion criteria were the radiological diagnosis of an unstable trochanteric femoral fracture (Figure 1), classified as 31-A2.1 to 3 and 31-A3.1 to 3 according to the AO/ASIF classification of long bone fractures[6]. The age of the patients ranged from 50 to 71 years with the mean age was 60.5 years. Falling on the ground and road traffic accidents were the mode of trauma. 21 patients had fractures on the right side and 12 patients had fractures on the left side. Informed consents were taken from the patients or legal guardians after a detailed discussion about the procedure of treatment, anticipated results, possible advantages, disadvantages, and complication of all ethical issues. The mean time between the trauma and surgery was 5 days (2-7).

Assessment:

The 33 patients had undergone preoperative clinical, radiological, and laboratory assessment. Clinical assessment recorded the mechanism of injury, previous treatment, and medical comorbidities. Clinical examination included the assessment of the fractured hip, the spine, chest, heart, and abdomen. The radiological assessment included standard two views radiographs for both hips: anteroposterior (AP) and lateral (Lat) views for the fractured hip. In some cases and on-demand, there were special radiological procedures were done as abdominal ultrasound (US), chest X-ray (CXR), electrocardiogram (ECG), and echocardiography. Laboratory investigations were complete blood picture (CBC), bleeding profile, blood glucose level, liver functions, and renal functions.

Surgical technique:

The prophylactic antibiotic was given to all patients 30-60 minutes before surgery. Spinal anesthesia was given. All patients were prepared and draped in a lateral position with the injured hip up on the fracture table, with the anterior tilt of 15 degrees of a fractured hip. Closed reduction was achieved. The tip of the greater trochanter was located and a 5 cm longitudinal incision was taken proximal from the tip of the greater trochanter. A parallel incision was made in the fascia lata and the gluteus maximus was split in line with its fibers. In AP view on C-arm, the entry point was determined on the tip or slightly lateral to the tip of the greater trochanter. The medullary canal was opened with the awl. The guidewire was inserted into a full-length of the femur with a T handle. Over the guidewire, a cannulated reamer was inserted through the protection sleeve and a reaming was done as far as the stop on the protection sleeve. The entrance site and proximal 9 cm of the medullary canal were reamed with a special one-step graduated reamer to accommodate the proximal part of the nail (13 mm). A nail of appropriate distal diameter and length was attached to the insertion jig and introduced into the canal with manual force only (no hammering). Gentle rotational motions facilitated the advancement of the nail until the hole for the distal screw (of the proximal two screws) was at the level of the inferior margin of the lesser trochanter. The long guidewire was removed. A 2.8 mm guidewire was inserted through the drill sleeve after a stab incision in the lateral thigh with its position in the caudal area of the femoral head. A second 2.8 mm guidewire was inserted through the drill sleeve above the first one. The final position of these guide wires was checked in AP and lateral view on the image intensifier. Drilling was done over the guide wires with a 6 mm cannulated drill bit to a depth up to 5 mm from the subchondral bone. Sometimes tapping was not done because of the osteoporosis. Distal locking was performed with cortical screws. For standard short nails, a distal aiming device was used. A drill hole was made with a 4 mm drill bit through both cortices and the length is measured directly from the drill marking. For long nails, distal locking was performed free hand under an image intensifier. The choice of the nail length depended on the bone quality: short nails in good bone quality while long nails in osteoporotic bone. After the fixation was finished, lavage was done using normal saline. The incision for entry was closed in layers. Sterile dressing was applied over the wounds. A suction drain was not used.

Postoperative Care

Intravenous injection of 2 gm of 3rd generation Cephalosporin per day for three days was given followed by 2gm per day tablets for 4-5 days. Analgesics were allowed to control pain. Precautions against DVT included compressive bandage of the affected limb in 1st few days followed by active and passive motions with active motion of the unaffected limb. Antithrombotic drugs were given. A postoperative X-

ray was done. Patients were allowed to mobilize on the second day postoperative. Partial weight-bearing was encouraged gradually as patients tolerated and according to the fracture pattern. Full unprotected weight-bearing was allowed at 6-8 weeks. The patients were discharged from the hospital after 3 days postoperative. Stitches were removed after 2 weeks.

Postoperative Follow up

Functional outcomes were assessed using the Harris hip scoring system (HHS)[7]. A total score of 70 is considered a poor result; 70–80 is considered fair, 80–90 is good, and 90–100 is an excellent result. As regards the radiological follow-up, radiographs were made immediately postoperative, after 2 weeks and 4 weeks later. Then after 3, 6, 12, 18, and 24 months. The fracture was considered united if three of four cortices had trabeculae bridging across the fracture site with visible callus across the fracture line. Non-union was defined as the absence of radiographic callus across the fracture line, including early re-displacement or progressive displacement. On the postoperative radiographs, the quality of fracture reduction was graded as good, acceptable (5—10 degrees varus/valgus and/or ante- or retroversion), or poor (>10 degrees varus/valgus and/or ante-or retroversion and cases with failure of internal fixation).

Results

Males were affected more than females. The operative time ranged from 1 to 1.5 hours (mean 70 min). All patients were treated with closed reduction and internal fixation with Trochanteric Antegrade Nail (TAN). The intraoperative blood loss ranged from 500 cc to 1000 cc. The hospital stays after surgery averaged 4 days (3-5). Radiological union occurred in all patients at a mean of 3 months (2-4). We used Harris Hip Score for the assessment of the results. A total score of less than 70 is considered a poor result; 70–80 is considered fair, 80–90 is good, and 90–100 is an excellent result. At a mean follow-up of 12 months (6-24 months) using Harris Hip Score (HHS), the excellent results in 20, good in 7 cases, and fair results were obtained in 4 patients, while the poor functional outcome was obtained in 2 cases. On the postoperative radiographs, the quality of fracture reduction was graded as good, acceptable (5—10 degrees varus/valgus and/or ante- or retroversion), or poor (>10 degrees varus/valgus and/or ante-or retroversion and cases with failure of internal fixation) [Table 1]. Partial weight-bearing was done at 3-5 weeks in 75% of patients; 6 – 8 weeks in 25%. The complications were reported in 2 patients: in the form of superficial wound infection in 1 patient and deep infection in 1 patient that resolved with nail removal after the solid union.

To search factors associated with favorable outcomes, patients with excellent and good outcomes were assigned as the favorable outcome (n= 27) and patients with poor and fair outcomes were assigned as a non-favorable outcome (n=6). The favorable outcome was associated with low AO classification, good radiological outcome, and shorter time to union (Table 2). Then, we presented pre-and postoperative x-ray images of two selected cases, as a representative of patients in our study (figures 1,2).

Table 1: Patient demographics and operative outcome

Variable		Statistics
Sex (n, %)	Male - Female	22 (66.7%)-11(33.3%)
Age (mean ± SD; minimum-maximum)		62.39 ± 5.74; 50- 71
Occupation (n, %)	Carpenter	4(12.1%)
	Farmer	13(39.4%)
	Housewife	11(33.3%)
	Employee	3(9.1%)
	Worker	2(6.1%)
Cause of trauma (n, %)	RTA - Fall on the ground	8(24.2%) - 25(75.8%)
Side (n, %)	Right - Left	21(63.6%) -12(36.4%)
OA classification (n, %)	31.A2.1	8(24.2%)
	31.A2.2	8(24.2%)
	31.A2.3	7(21.2%)
	31.A3.1	5(15.2%)
	31.A3.2	3(9.1%)
	31.A3.3	2(6.1%)
Radiological outcome (n, %)	Good - Acceptable	19(57.6%) - 14(42.4%)
Time to union (weeks) (mean ± SD; minimum – maximum)		12.66±1.83 (10-16)
Final result (n, %)	Excellent	20 (60.6%)
	Good	7(21.2%)
	Fair	4(12.1%)
	Poor	2(6.1%)

Table 2: factor associated with excellent and good outcome versus fair and poor outcomes

Variable		Favorable (n=27)	Non favorable (n=6)	Test	P value
Sex	Male	19(70.4%)	3(50.0%)	0.91	0.37
	Female	8(29.6%)	3(50.0%)		
Age (mean±SD)		61.74±5.48	65.33±4.63	1.40	0.17
Occupation (n,%)	Carpenter	4(14.8%)	0(0.0%)	2.47	0.64
	Farmer	11(40.7%)	2(33.3%)		
	Housewife	8(29.6%)	3(50.0%)		
	Employee	2(7.4%)	1(16.7%)		
	Worker	2(7.4%)	0(0.0%)		
Cause of Trauma	RTA	7(25.9%)	1(16.7%)	0.22	0.63
	Fall on the ground	20(74.1%)	5(83.3%)		
Side	Right	16(59.3%)	5(83.3%)	1.22	0.26
	Left	11(40.7%)	1(16.7%)		
AO Classification	31.A2.1	8(29.6%)	0(0.0%)	21.47	0.001*
	31.A2.2	8(29.6%)	0(0.0%)		
	31.A2.3	3(11.1%)	4(66.7%)		
	31.A3.1	5(18.5%)	0(0.0%)		
	31.A3.2	3(11.1%)	0(0.0%)		
	31.A3.3	0(0.0%)	2(33.3%)		
Radiological	Good	19(70.4%)	0(0.0%)	9.95	0.002*
	Acceptable	8(29.6%)	6(100.0%)		
Time to union (weeks)		12.11±1.50	15.66±0.75	4.80	<0.001*

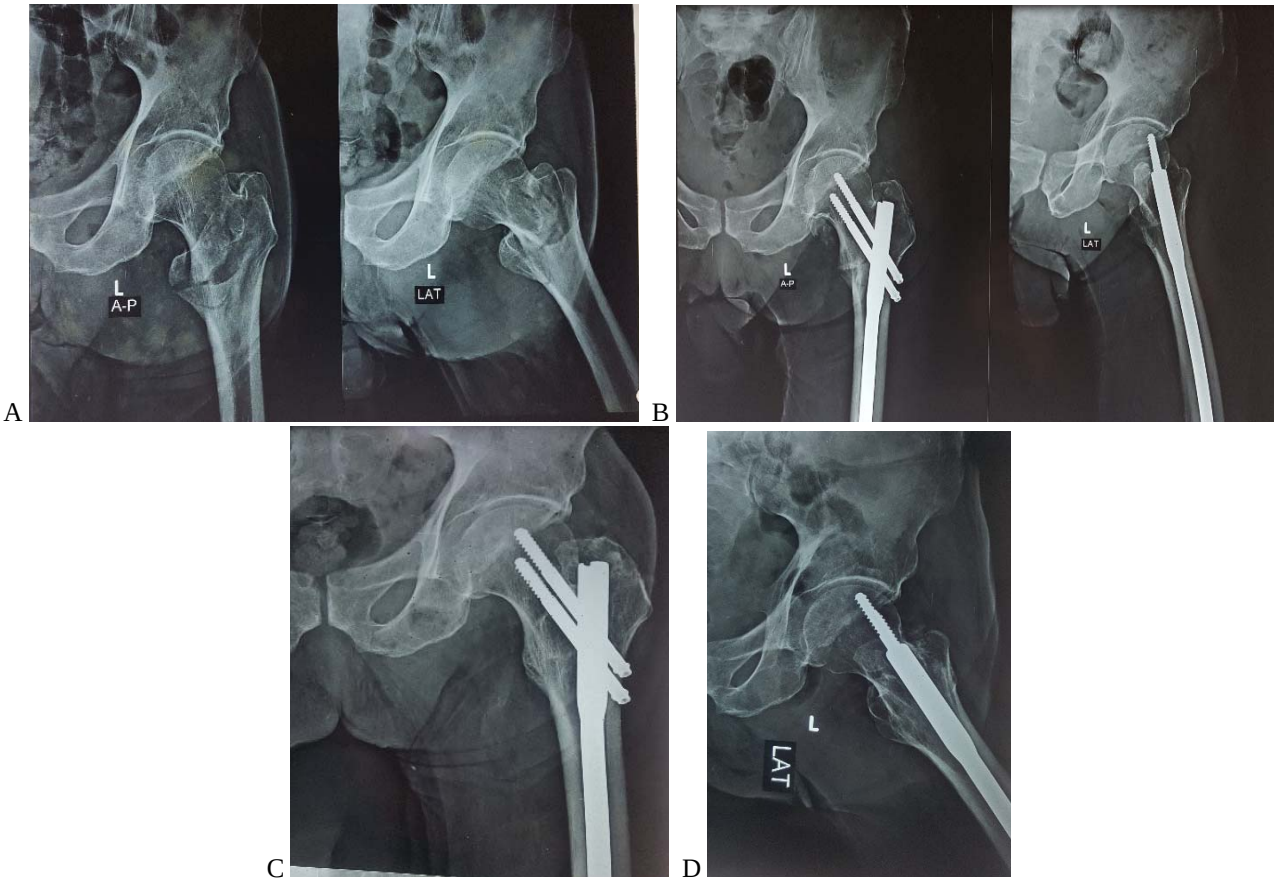

Figure 1: a: Preoperative AP and lateral x-ray showing trochanteric fracture (left side) B: Postoperative AP and lateral X-rays showing internal fixation by ATN C: AP view after two years. D: Lateral view after two years

Figure 2: a: Preoperative AP and later view showing trochanteric fracture. B: Posoperative AP view. C: Postoperative lateral view. D: Follow up after 2 years

Discussion

Trochanteric femoral fractures are common in the elderly and are more seen in the aging population[8]. The primary target of proximal femoral fracture fixation, especially for frail elderly patients, is mobilization and full weight-bearing as soon as possible after the surgery[9]. The cephalomedullary nail attempts to combine the advantages of a sliding lag screw with those of intramedullary fixation while decreasing the moment arm as compared with that for dynamic hip screw (DHS) system. It can be inserted by a closed procedure that retains the fracture hematoma, an important consideration in fracture healing[10].

The intramedullary nails had significantly higher compression stiffness than the plate in the treatment of comminuted proximal femur fractures. The intramedullary nails are based on the concept of the load-sharing implant[11].

The current work aimed to present the results of the clinical and radiological outcomes of the trochanteric antegrade nail (TAN) in the treatment of unstable intertrochanteric fractures. To achieve this aim, 33 patients (22 males and 11 females) who suffered from unstable intertrochanteric fractures were treated with cephalomedullary nail (TAN) and followed up by clinical and radiological means for at least two years postoperative. Overall, the final results were excellent in the majority of patients (60.6%), good (21.2%) (e.g., favorable outcome 81.8%), fair (12.1%) and poor (6.1%) (unfavorable outcome 18.2%). The favorable outcome was linked to low AO classification, good radiological outcome, and shorter time to union. Complications were mild and trivial and reported only in two patients. These results reflected the effectiveness and safety of TAN in the management of unstable trochanteric fractures. Makki et al.[12] reported that the failure rate was statistically significantly higher in the proximal femoral nail anti-rotation (PFNA) group compared to the TAN group and the time to radiological union was significantly shorter in the TAN group with the majority of patients achieving union within 6 months[12].

In addition, the gamma nail and proximal femoral nail have a proximal diameter of 17 mm, which is too large for the average femora, and may lead to widening of the trochanter and fractures. A single-screw configuration in the proximal femur is unstable, while proximal femoral nailing uses a two-screw configura-

tion that is more stable [as in TAN][13]. The double screw device provides adequate axial and rotational stability because of the presence of two screws. The anti-rotation screw prevents rotation of the proximal fragment and the other screw achieves compression at the fracture site. Gamma nail does not have an anti-rotation screw for the prevention of rotation so cut through, migration of gamma nail is relatively more common. Gamma nail does not prevent varus collapse[14]. Additionally, dual head screw constructs are believed to improve rotational stability and bony purchase within the femoral head and to resist cut-out and subsequent fixation failure. Based on biomechanical studies, dual head screw hip nails have shown significantly stronger fixation compared to single head screw hip nails when loaded to failure in an unstable intertrochanteric fracture model. Additionally, a dual-head screw hip nail may be useful in patients with a small proximal femur because of the smaller diameter of the head screws[15]. it is important to consider the disadvantage of using a longer implant. In addition to longer operative times and greater blood loss, longer implants have the additional risk of penetration of the anterior cortex of the distal femur. Although long nails have been promoted in elderly patients to protect more of the bone[16].

Although the results of the current work reflected the effectiveness and safety of TAN, which is a strength point; it is had two limitations: the first is the small number of cases included in the study and the second is the absence of the comparison group. Both limitations prevent the generalization of study results.

Conclusion

TAN in the treatment of unstable trochanteric fractures is associated with short operative time and screening duration, low blood loss, less postoperative morbidity, early weight-bearing, better fracture healing, and functional results. Thus, the TAN could be considered as a powerful and safe implant for the treatment of unstable trochanteric femoral fractures.

Financial disclosure
None

Conflict of interest
None

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