ORIGINAL ARTICLE

Does the Trochantric Lag Screw Improve the Stability the Fixation of Fracture Neck Femur

Gamal A. El sawy *, Ayman Youssef Eltabbaa

Department of Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***Young adults typically sustain femoral neck fractures (Pauwels type III classification) as a result of high-energy trauma, and these fractures are commonly observed in conjunction with other injuries. Taking into account the debates around the best fixation for this fracture.***

Aim: ***To assess the trochantric lag screw's clinical therapeutic efficacy in fixing femur fractures.***

Methods: ***We selected one hundred consecutive patients with Pauwels' type III femoral neck fractures for this investigation.***

Results: ***The average age of the cases under study was 53.29 (±7.81 SD), with a range of 36 to 65. Of the cases under study, 43 (43%) were female and 57 (57%) were male. According to injury mechanism, there were 27(27%) injuries during a car accident, 59(59%) due to a fall, and 14(14%) during a motor accident and according to fracture 56(56%) had fracture in the right side and 44(44%) had fracture in the left side. The mean operation time was 117.48(±11.8 SD) with range(95-138) minutes, the mean intraoperative bleeding was 21.14(±3.34 SD) with range(15-27) ml. Among the studied cases, 94(94%) healed and 6(6%). The mean Harris score was 81.51 (±5.28 SD) with a range of 66-90, and 2 patients (2% of the total) had osteonecrosis of the femoral head.***

Conclusion: ***When fixing femoral neck fractures that are oriented vertically, a trochanteric lag screw construct significantly improves mechanical performance.***

Keywords: Inverted triangle construct; Trochanteric lag screw; Femoral neck fracture

1. Introduction

Fractures of the femoral neck in adults typically occur as a result of trauma with a high energy level. Care must be given to maintain the blood supply to the femoral head during anatomic reduction with internal fixation, which is the treatment of choice for these lesions.[1]

Over the course of several decades, the gold standard for treating femoral neck fractures has been refined.[2] A bimodal distribution according to age is observed for the condition; in the younger group, a high-energy mechanism causes the fracture to extend vertically.[3]

The choice of treatment depends on various aspects, such as the existence of comminution, the patient's overall health, and any concomitant lesions. Regardless of these circumstances, most agree that the intervention should involve strict internal fixation and accurate reduction.[4]

The Pauwels classification was first proposed in 1935 and uses fracture orientation to classify femoral neck fractures. Fractures classified as Type I occur at an angle of less than 30¬ from the horizontal, Type II occur at an angle of 30-50¬ degrees from the horizontal, and Pauwels type III fractures, whose best treatment strategy is still up for debate, are defined by a fracture line that is more than 50 degrees from the horizontal.[5]

Reducing and pinning high-energy femoral neck fractures with cannulated screws is one possible treatment strategy.[6] The traditional inverted triangle construct involves three partially threaded screws arranged in a parallel fashion in an inverted triangle orientation; however, the trochanteric screw construct involves a lag screw angled perpendicular to the fracture and two parallel cannulated screws into the femoral neck.[7]

Accepted 10 February 2025.
Available online 30 April 2025

* Corresponding author at: Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: gamal.ortho30@gmail.com (G. A. El sawy).

https://doi.org/10.21608/aimj.2025.446508

This research set out to determine how well trochantric lag screws work as a therapeutic device for fixing femoral neck fractures.

2. Patients and methods

Participants in this prospective clinical trial had to meet certain criteria in order to be considered for inclusion: they had to be between the ages of 18 and 65, have a displaced transcervical femoral neck fracture with a vertical orientation (Pauwels' angle>50 degrees), have no history of hip disease, have a unilateral femoral neck fracture, and an expected postoperative follow-up time of at least one year.

The following were listed as exclusion criteria: (i)skin conditions or diseases in the surgical area; (ii)severe osteoporosis; (iii)pathological fractures or old fractures (more than 14 days old); (iv)comorbid severe cardiovascular and cerebrovascular diseases, mental illness, and abnormal liver and kidney function; (v)women who were pregnant or nursing; (vi)autoimmune diseases; (vii)blood disorders; and (viii)incomplete clinical data.

Patients' age, sex, BMI, ASA score, smoking and alcohol use history, injury mechanism, fracture side, operation time, and follow-up time were among the supplementary data points gathered.

In order to determine if the patient had a vertical femoral neck fracture, preoperative anteroposterior position (AP) plain radiographs of the hip were taken. The use of preoperative radiographs to accurately estimate the coronal fracture angle was recognized when rotation of the lower limb prevented this, and radiographs taken immediately after fixation were then utilized. Finding the best-fitting fracture line on these radiographs and comparing it to a horizontal (or perpendicular) line to the femoral shaft allowed us to calculate the vertical fracture angle.

Surgical Procedure:

Patients were continuously epidurally anesthetized while lying on their backs with the hip of the affected side raised about 15-20 cm. As quickly as feasible, the injured side's lower limb was kept in abduction while the unaffected side bent at the knees and coxa. There was a 30-degree internal rotation and 30-degree abduction fixed on the affected side's lower leg. Following that, preoperative traction reduction was used to treat the fracture while C-arm fluoroscopy was being utilized for guiding.

A 5-centimeter longitudinal incision was made in the inferior femoral trochanter once enough reduction had been achieved. This incision was used to remove and separate subcutaneous tissue in order to access the lateral bone cortex. The initial K-wire was passed through the femoral head and on to the femoral neck in a parallel fashion. The additional two K-wires were placed to form an inverted triangle and were positioned 125° from the femoral shaft under the intraoperative X-ray control. The third K-wire was introduced posteriorly, starting from the lateral side of the greater trochanter and working its way towards the posterior. It was punctured at a right angle to the fracture line. In order to achieve the requirements of the tip-apex distance, it should be advanced until it is within 5mm of the subchondral bone.

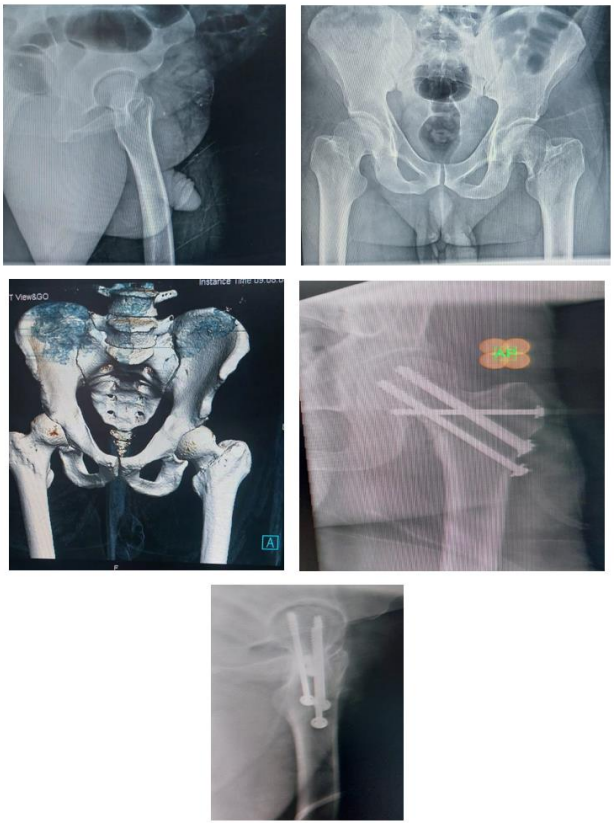

Figure 1. Plain x-ray anteroposterior view showing fixation of the fracture neck of the femur by a cannulated screw with a transtrochanteric screw.

Postoperative Management

Early functional exercise is performed under the supervision of a physiatrist and is tailored to each patient's specific condition. Following surgery, patients were provided with oxygen, ECG monitoring, dietary assistance, and sufficient antibiotics to avoid infection. Patients were re-evaluated for AP plain radiographs and hip CT scans until their conditions stabilized. Skilled physiatrists created individualized rehabilitation programs for patients following surgery. Patients often used axillary crutches to walk for six weeks while bearing some weight, and then for another six weeks, they only had to bear some weight. At3,6, and 12 months after surgery, all patients underwent clinical and radiological follow-up to

systematically evaluate complication rates, hip joint function, and quality of life.

Outcome Evaluation

Operative Time

The duration of the procedure was documented from the start of the skin incision all the way to the surgical closure. This could be an indication of the surgeons' skill with these two methods as well as the potential for infection.

Blood Loss

The amount of blood lost during surgery was determined by adding up the amount of blood that came out of the suction and the amount that bled out of the gauze. The amount of hidden bleeding was determined by subtracting the value of the hemoglobin before and after surgery from the value that came out of the normal blood test.

Quality of Reduction

As previously described by Haidukewych [8], The reduction of fractures was ranked as follows: excellent (less than 2mm displacement and less than 5° angulation in any plane), good (between 2 and 5mm displacement and 5 to 10° angulation), fair (between 5 and 10mm displacement and 10 to 20° angulation), or poor (greater than 10mm displacement and 20 degrees or more angulation, or any varus).

Hospital Time

All days spent in the hospital were recorded beginning with the time of emergency admittance and ending with the time of discharge per the doctor's orders. The appropriate surgery was performed on all patients within 72 hours, using a uniform procedure. So, the amount of time patients spent in the hospital reflected their perioperative recovery and the money they spent.

Visual Analogue Scale

The patients' pain levels were estimated using the visual analogue scale scoring system. Here is the VAS pain scoring standard, which ranges from 0 to 10: From 0 to 3, the patient had pain that was manageable; from 4 to 6, the patient was in discomfort but could still sleep; and from 7 to 10, the patient was in excruciating pain that they could not bear.

Harris Hip Score

An adult population's hip function recovery after surgery was assessed using the Harris hip score.[9] The four basic components of the HHS scoring system are mobility, function, lack of deformity, and discomfort. Pain (one item, 0-44 points), function (seven things, 0-47 points), lack of deformity (one item, 4 points), and range of motion (two items, 5 points) were all part of the score standard, which could go up to 100 points (the best possible outcome).

Complications

As part of the follow-up process, radiographic and clinical assessments were carried out to assess the healing of the fracture, as well as any femoral neck shortening, fixation failure, or necrosis of the femoral head. Radiographic evaluation of femoral head necrosis was conducted using the Ficat criteria.10 Nonunion was described as the fracture line still being visible six months after surgery, whereas union was defined as the fracture line disappearing entirely and the bone trabecular structure being essentially normal.[11] The measurement of femoral neck shortening was conducted in both the horizontal (abductor moment arm shortening) and vertical (femur length decrease) planes, following the protocol outlined by Zielinski et al.[12]. At every imaging examination, we looked for signs of screw out, screw loosening, and screw extraction—the three main types of internal fixation failure.

Statistical analysis

Information was input into the computer and examined with the help of IBM SPSS software package version 20.0.(Armonk, NY: IBM Corp) Qualitative data was described numerically and as a percentage. To ensure distribution normality, the Kolmogorov-Smirnov test was adopted. Minimum and maximum values, as well as the data's range, standard deviation, median, and interquartile range (IQR) were used to describe the quantitative data. The results were deemed statistically significant at the 5% level.

3. Results

This study was a prospective, clinical trial that was performed over 100-cases with vertical orientation(Pauwels' angle>50 degrees).

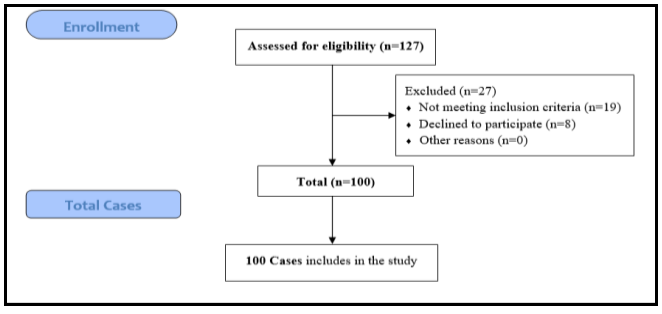

Figure 2. Flowchart of the study.

We started with 127 patients, but we had to cut 27 of them because they didn't fit our inclusion criteria or because they refused to take part. This left us with 100 cases to analyze.

Table 1. Cases examined distributed according to historical data.

	SUBJECTS (N=100)	
AGE		
RANGE.	36-65	
MEAN±SD	53.29±7.81	
SEX	No.	%
FEMALE	43	43.0
MALE	57	57.0
BMI		
RANGE.	22.2-31.9	
MEAN±SD	26.94±2.81	
ASA	No.	%
I	29	29.0
II	64	64.0
III	7	7.0
SMOKING	27	27.0
INJURY MECHANISM	No.	%
CAR ACCIDENT	27	27.0
FALL	59	59.0
MOTOR ACCIDENT	14	14.0
FRACTURE SIDE	No.	%
LEFT	44	44.0
RIGHT	56	56.0

Data are presented as frequency(%) unless otherwise mentioned, SD:Standard deviation

The average age of the individuals included in the study was 53.29 years old (±7.81 standard deviation), with a range of 36–65. Of these, 43 were female and 57 were male. The average body mass index (BMI) was 26.94 (±2.81 standard deviation), with a range of 22.2–31.9. Among these, 29 were classified as ASA I, 64 as ASA II, and 7 as ASA III. 27 were smokers, and 27 were injured in car accidents, 59 as a result of falls, and 14 as a result of motor accidents. As for fractures, 56 were on the right side and 44 were on the left, Table 1.

Table 2. Case distribution based on operational data.

	SUBJECTS (N=100)	
OPERATION TIME(MIN)		
RANGE	95-138	
MEAN±SD	117.48±11.8	
INTRAOPERATIVE BLEEDING(ML)		
RANGE.	15-27	
MEAN±SD	21.14±3.34	
FRACTURE REDUCTION QUALITY	No.	%
EXCELLENT	31	31.0
GOOD	37	37.0
NORMAL	26	26.0
POOR	6	6.0

Data are presented as frequency(%) unless otherwise mentioned, SD:Standard deviation

The average time it took to complete the operation was 117.48 minutes (±11.8 standard deviation), with a range of 95 to 138 minutes. The average amount of blood that was spilled during the procedure was 21.14 milliliters (±3.34 standard deviation), with a range of 15 to 27 milliliters. As for the quality of the fracture reduction, 31 percent had excellent quality, 37 percent had normal quality, 26 percent had normal quality, and 6 percent had poor quality,Table 2.

Table 3. Analysis of the cases based on the duration of follow-up.

	SUBJECTS (N=100)	
HEALING	No.	%
HEALED	94	94.0
RETREATED	6	6.0
OSTEONECROSIS OF THE FEMORAL HEAD	2	2.0
HARRIS SCORE		
RANGE.	66-90	
MEAN±SD	81.51±5.28	

Data are presented as frequency(%) unless otherwise mentioned, SD:Standard deviation

In the study, 94 instances (or 94% of the total) were found to be healed, while 6 cases (or 6% of the total) had osteonecrosis of the femoral head. The average Harris score was 81.51 (±5.28 SD), with a range of 66 to 90,Table 3.

4. Discussion

Fractures of the femoral neck (Pauwels type III classification) in young adults are commonly caused by high-energy trauma and often occur alongside other injuries. With all the debates going on about the best way to mend this fracture.[13]

A Pauwels angle greater than 50\° is indicated by a Pauwels type III. Nonunion, disruption of the femoral head blood supply, and avascular necrosis occur at both ends of the fracture due to the strong vertical shear stresses applied to the shattered ends, which can cause hip varus, collapse, and displacement of the proximal femur bone. Internal fixation has a greater clinical failure rate due to the increased shear strain and the fact that fracture injuries include vertical shear forces.[14]

Our study aimed to assess the clinical efficacy of trochanteric lag screws in fixing femoral neck fractures.

We were left with 100 instances in our prospective study after excluding 27 individuals (19 who didn't match our inclusion criteria and 8 who declined to participate).

The average age of the individuals included in the study was 53.29 years (±7.81 standard deviation), with a range of 36–65. Of these, 43 were female and 57 were male. The average body mass index (BMI) was 26.94 (±2.81 standard deviation), with a range of 22.2–31.9. Among

these, 29 were classified as ASA I, 64 as ASA II, and 7 as ASA III. 27 were smokers, and 27 were injured in car accidents, 59 as a result of falls, and 14 as a result of motor accidents. As for fractures, 56 were on the right side, and 44 were on the left.

In our study according to operation data, the mean operation time was 117.48(±11.8 SD) with range (95-138) minutes, the mean intraoperative bleeding was 21.14(±3.34 SD) with range(15-27) ml and according to fracture reduction quality there were 31(31%) with excellent quality, 37(37%) with normal quality, 26(26%) with normal quality and 6(6%) poor quality.

According to The results of Gao et al., According with our findings, in the research group, the operating duration varied between 74 and 157 minutes, with an average of 117.21±13.72 minutes, the intraoperative blood loss was 21.05±3.42 milliliters, and the percentage of fracture reductions with high or outstanding quality was 57.14% (32 out of 56). The average operating time in the control group was 44.15±6.53 minutes, and the intraoperative blood loss was 9.01±2.95 milliliters, ranging from 5 to 30 milliliters. Of the 75 fractures reduced, 58.67% had good or outstanding quality. There was a statistically significant difference between the two groups in terms of intraoperative bleeding and operating time ($P < 0.05$).[15]

In the study, 94 instances (or 94% of the total) were found to be healed, while 6 cases (or 6% of the total) had osteonecrosis of the femoral head. The average Harris score was 81.51 (±5.28 SD), with a range of 66 to 90.

Reports by Parker found that among Pauwels type III femoral neck fractures, nonunion affects 16–59% of cases, and osteonecrosis of the femoral head affects 11–86%.[16]

During the follow-up in the study of Gao et al., in one instance, the cannulated compression screws and medial femoral neck support screw group experienced a case of retreatment, leading to nonunion of the fracture. However, no necrosis of the femoral head was observed. Avascular necrosis of the femoral head occurred in 5 patients, while 8 patients in the group that had cannulated compression screws underwent cannulated compression screw retreatment; this disparity was shown to be statistically significant. The group that received cannulated compression screws in addition to medial femoral neck support screws had significantly better hip function (as measured by the Harris score) compared to the group that received only cannulated compression screws. Clinical trials have shown that the medial support screw speeds up the healing process for fractures. Additionally, it can lessen the likelihood of femoral head osteonecrosis and fight against internal fixation failure due to severe vertical shear. Furthermore, as is shown by biomechanical studies, functional hip joint rehabilitation can be enhanced with appropriate biomechanical stability. A little increase in operating time, intraoperative blood loss, and fluoroscopy delays may be caused by inserting the medial support screw. These three variables were statistically significant, but due to the limited sample size, they were insignificant in this particular operation. [15]

Virkus et al. examined the outcomes of 28 cases of vertical femoral neck fractures that were treated with conventional oblique screws with a transverse lag screw, a design comparable to the trochanteric lag screw build utilized in this investigation. Supporting the use of the trochanteric lag screw construct for vertical femoral neck fractures, the authors discovered an 86% healing rate that was positively associated with reduction quality.[17]

The majority of individuals under 65 who suffer from femoral neck fractures have strong bones, and high-energy traumas such as car accidents, falls from great heights, and severe crushing are the main causes of fractures. In addition to a significant risk of nonunion and femoral head osteonecrosis, these fractures have a high rate of reoperation. According to related research, the rates of avascular necrosis and postoperative nonunion are respectively 10–33% and 10%. 20–30% of the femoral head. [18,19]

Weaknesses of our study: Multicenter clinical trials are necessary to corroborate these findings because this is a single-center study with a small sample size. Being a prospective study, our results may not be applicable to disorders with a long latency period. Additionally, the measure of association can be skewed due to losses in follow-up. Because there was no control group in our trial, we cannot say with certainty which changes or outcomes were caused by the intervention and which were caused by other variables.

Strengths of our study: We can collect higher-quality data on the main exposure and confounding variables since our study is prospective. They are less likely to be biased since exposures are evaluated before outcomes take place. We looked at variables that might influence recovery, including as age, sex, BMI, ASA score, and smoking history.

4. Conclusion

Our study's findings indicate that a trochanteric lag screw construct significantly improves mechanical performance when used to repair femoral neck fractures that are oriented vertically.

Nevertheless, it may be difficult to draw any definitive conclusions from our study due to its tiny sample size. As a result, our findings necessitate additional research.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

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