MJMR, Vol. 35, No. 1, 2024, pages (207-221).

Open Access
ISSN:2682-4558

Research article

Treatment of unstable subtrochanteric fracture by cephalomedullary nail with or without cerclage wiring

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DOI: 10.21608/MJMR.2024.150754.1125

Abstract

Purpose: The aim of this study was to assess functional and radiological results following cephalomedullary nailing of subtrochanteric fracture with or without use of cerclage wiring **Methods:** In a prospective study data collected between April 2021 and August 2022, a total of 30 consecutive patients (10 women and 20 men) with the diagnosis of subtrochanteric fracture were included. The mean age of patients was 58.3 ± 15.6 years. According to the AO/OTA classification, 10 A1 fractures, 5 A2 fractures, and 1 A3 fractures, 8 B1 fractures, 1 B3 fractures and 5 C1 fractures were found. **Results:** the OR and cerclage techniques had significantly longer operative time compared to the CR and non-cerclage techniques (Mann-Whitney U test, P = .003 and .008). Furthermore, significantly higher transfusion rates were reported with the OR group (Chi-square test, P = .000). On the other hand, no statistically significant difference was found between both reduction techniques regarding the length of hospital stays, time to union, functional outcomes, complications, or reoperation rates (P > .05). **Conclusion:** The additional use of cerclages provides intrinsic stability and enables axial alignment and medial cortical support during anatomical fracture reduction and cephalomedullary nail insertion. in spite of increased operative time and blood loss, the current study showed that open reduction and cerclage wiring resulted in comparable functional outcomes without significant difference in complication rate. Therefore, it can be recommended as a useful supportive tool especially in comminuted subtrochanteric fractures.

Keywords: Subtrochanteric fracture; cerclage; HHS; Intrinsic stability; Union

Introduction

The subtrochanteric region is defined as within 5 centimeters distal to the lesser trochanter. Subtrochanteric fractures account for approximately 7% to 34% of femur fractures. (1)

They occur not only in elderly osteoporosis patients, but also in young and middle-aged patients. Because the inferior trochanteric region of the femur is mainly composed of cortical bones, the blood supply is relatively insufficient compared to the intertrochanteric region. (2)

Subtrochanteric fractures are associated with high rates of nonunion and implant fatigue failure because of the greater mechanical stresses in addition to the strong deforming muscle forces in this region.

Most cases are caused by severe injury violence and often require surgical reduction and internal fixation to minimize the incidence of fracture malunion, nonunion, and coxa varus deformity.(3)

For subtrochanteric fractures of the femur, the medial cortical bone is mostly comminuted, resulting in bilateral mechanical asymmetry.

In the case of extramedullary plate and screw system fixation, the moment arm is longer than that in intramedullary fixation with weaker

antirotation ability and more time for postoperative mobilization.[4]

Compared with external medullary fixation, intramedullary fixation can conduct stress more uniformly, which greatly reduces the stress on the internal implant compared with the screw-plate system, thus greatly improving the postoperative stability of the fracture and reducing the incidence of complications such as postoperative fracture nonunion and hip varus.[5]

Due to the fracture configuration there is often an indication for the use of one or more supplemental wire cerclage aiming for safe fracture reduction as well as increased intrinsic primary stability as a prerequisite for complication free osseous healing. [6,]

Patients and methods

After approval of the local ethical committee and consent from the patients, this randomized prospective study was conducted on (30) thirty hips of thirty patients with unstable subtrochanteric femoral fractures presented to the trauma unit at Minia University Hospital from April 2021 to August 2022 fixed with cephalomedullary nail, in combination with cerclage wiring in six of them, after quality control department approval.

Inclusion Criteria:

1. The fracture line located within 5 cm below the lesser trochanter
2. Skeletally matured patients of either sex
3. Closed fractures
4. Recent fractures (within two weeks)

Exclusion Criteria

1. Skeletally immature patients
2. Open fractures
3. Old fractures > 2 weeks
4. Patients medically unfit for surgery

Preoperative assessment

After obtaining informed consent, each patient underwent a thorough workup that included a history, clinical examination, radiographic evaluation, and laboratory testing, as follows:

1- History:

Age, sex, side affected, mechanism of injury, associated injuries or diseases, medical illness, visual problems, history of previous surgery at the same limb, smoking, drug History, nutritional problems and lifestyle choices.

2- Examination:

a-General examination:

-Including simultaneous resuscitation of trauma patient that combines restoration and maintenance of vital functions with damage-control procedures.

-Heart, chest and other systems examination to assess other medical comorbidities.

b-Local examination:

Inspection : shortened, externally rotated limb is a classic feature of a hip fracture. Skin condition, related wounds and open fractures, ecchymosis, swelling

Palpation: Localized tenderness around the hip region.

Movement: Usually limited due to pain.

Neurovascular examination: integrity is confirmed by ensuring active dorsiflexion and planter flexion of the ankle and checking that sensation is present over dorsal and plantar surfaces of the foot. Locate the dorsalis pedis and posterior tibial pulses and confirm capillary refill.

2- Investigations:

a-Laboratory: routine lab investigations were done for all cases for preoperative fitness which included: Complete blood picture, fasting blood sugar, random blood sugar, prothrombin time and activity, blood urea and creatinine, liver enzymes, serum albumin level.

b-radiological : An anteroposterior (AP) View including both hips and knee joints and a lateral view of the fractured hip joint and proximal femur were taken for each patient.

Only one case needed further evaluation by CT scan.

No cases needed further evaluation MRI.

Operative Managment

All patients were managed surgically using cephalomedullary nail with the use of cerclage wiring in 6 cases. Informed consent was taken from every patient to be involved in the study.

Post-operative management

Post-operative measures:

1- Obtain full-length femoral radiographs postoperatively to confirm fracture reduction and correct nail and screw position.

2- Patients will be given antibiotics as per local antibiotic policy.

3- Daily wound dressing and muscular exercises.
4- Deep vein thrombosis prophylaxis begin on the first postoperative day if there are no contraindications.
5- Partial weight bearing (10 to 15 kg) with crutches or a walker in younger individuals was initiated in the first several days.
6- The goal in older individuals is to advance with full weight bearing as tolerated to facilitate rehabilitation.

Follow up protocol:

1) Regular clinical visits and radiographic evaluation of healing should be obtained at 4-6weeks intervals.
2) If the bone quality is good, the fracture reduction is anatomic, and minimal comminution is present, the patient can advance weight bearing status to tolerance over the next several weeks.
3) Gentle range of motion of the hip and knee are started during the first week postoperatively.
4) In elderly patients, calcium citrate and vitamin D3 supplementation are given.
5) Sutures are removed at 2 weeks.
6) Once callus appears radiographically, patients are allowed to advance weight bearing and strength training.
7) Once extremity strength is restored and the limp is resolved, the crutches or walker can be discontinued.
8) All patients were followed up for 6-12 months in the outpatient clinic of Minia University Hospital.
9) Follow up assessment included : Harris Hip Score (HHS) [7] , union rate, time to achieve full radiological union, postoperative complications, and reoperation rate

Results

A total of 30 patients presented with unstable subtrochanteric fractures and treated with proximal femoral nailing were enrolled in our study.

Age and Gender Distribution

The age of included patients ranged from 27 to 85 years, with a mean value of 58.3 (SD, 15.6) years, and a median value of 63.5 (IQR, 49.5 – 69). As shown in **Fig. 1**, patients were classified into three age groups: less than 40 (n = 6), between 40 and 70 (n = 19), and more than 70 (n = 5). In all, 20 (66.7%) patients were males, while 10 (33.3%) were females (**Fig. 2**).

Mechanism of Injury

The most common mechanism of trauma in our cohort was falling on ground representing 60% of patients. The mechanism of injury was road traffic accident in six (20%) patients and falling from height in three (10%) patients. Less common modes of trauma were impaction by a hard object, assault, and pathological fractures in three patients (**Fig. 3**).

Type of Fracture

According to the AO classification, the most common fracture type was A1 representing 33.3% of patients. The second most common type of fracture was B1 representing 26.7% of patients. The incidence of less common subtrochanteric fracture types A2, A3, B3, and C1 were 16.7%, 3.3%, 3.3%, and 16.7%, respectively (**Fig. 4**).

Associated Injuries

In our series, eight (26.7%) patients had additional injuries (**Fig. 5**). Two (6.7%) patients had abdominal injuries. Other two (6.7%) had distal radial fractures. Two (6.7%) patients had spine and/or pelvic fractures, one (3.3%) had an ipsilateral femoral fracture, one (3.3%) had ipsilateral tibial and patellar fractures, and one (3.3%) had an ipsilateral tibial fracture and contralateral calcaneal and ankle fractures.

Associated Comorbidities

In our series, five (16.7%) patients were smokers. One third of patients had associated medical illness (**Fig. 6**). Four (13.3%) patients were known to be diabetic, two (6.7%) were known to have a cardiac condition, one (3.3%) was asthmatic, one (3.3%) was known to be positive for HCV, and one (3.3%) had a breast cancer.

Operative Characteristics

1- Type of Anesthesia:

As shown in **Fig. 7**, 26 (86.7%) patients underwent surgical fixation under spinal anesthesia, whereas four (13.3%) required general anesthesia.

2- Surgical Technique

Closed reduction (CR) was used in 21 (70%) patients, while open reduction (OR) was used in

nine (30%) (**Fig. 8**). Supplementary cerclage wires were used in six (20%) patients (**Fig. 9**).

3- Operative Time

The operating time ranged between 45 to 190 minutes with a median value of 90 minutes. As shown in **Figure 10**, the median operative time was 80 minutes and 120 minutes in the CR and OR groups, respectively.

4- Blood Transfusion

Nine (30%) patients required perioperative blood transfusion. A total of nine units of packed RBCs were transfused. In the CR group, two (9.5%) patient required transfusion, while transfusion was necessary in seven (77.8%) patients of the OR group (**Fig. 11**).

5- Length of Hospital Stay

The length of hospital stay ranged between 1 to 7 days, with a mean of 1.97 ± 1.5 days, and a median of 1 day. As shown in **Fig. 12**, the median hospital stay was 1 days in the CR group, and 2 days in the OR group.

Postoperative Outcomes

1- radiological full union

In our series, 28 (93.3%) patients achieved radiological full union at last follow-up. The union time ranged from 3 to 4 months, with an average of 4.16 ± 1.9 months, and a median of 4 months.

2- Harris Hip score

The majority of patients had satisfactory functional outcome measured by HHS, including 11 (36.7%) patients with excellent scores, and 12 (40%) had good scores. Fair functional scores were reported in five (16.7%) and two (6.7%) patients had poor functional outcomes. Overall, seven (23.3%) patients had at least one postoperative complication. **Fig. 13**

3- Post-operative complications

Postoperative complications, included surgical site infection (10%), delayed union (16.7%), and nonunion (6.7%). Revision surgery was required for two (6.7%) patients who failed to achieve union. **Fig. 14**

Effect of Technique on Surgical and Functional Outcomes

Twenty-one patients underwent CR, while OR was performed in nine patients. In addition, proximal femoral nailing with supplementary cerclage wiring was used in six patients, whereas proximal femoral nailing without cerclage wires was used in 24 patients. the OR and cerclage techniques had significantly longer operative time compared to the CR and non-cerclage techniques (Mann-Whitney U test, P = .003 and .008). Furthermore, significantly higher transfusion rates were reported with the OR group (Chi-square test, P = .000). On the other hand, no statistically significant difference was found between both reduction techniques regarding the length of hospital stays, time to union, functional outcomes, complications, or reoperation rates (P > .05).

Figure 1. Age Distribution

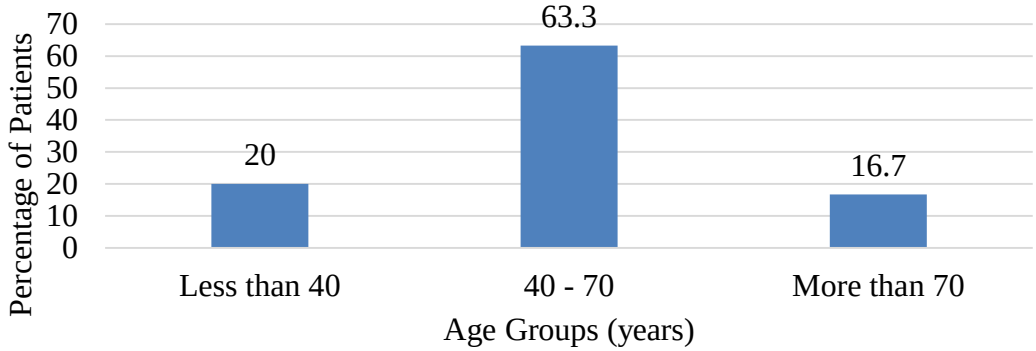

Figure 2. Gender Distribution

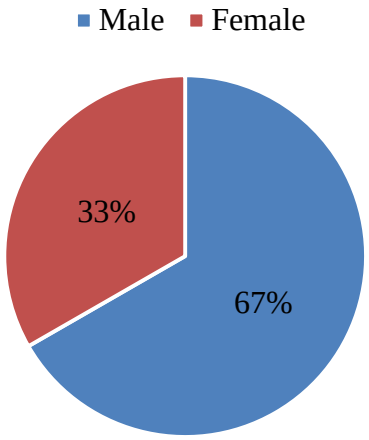

Figure 3. Mechanism of Injury

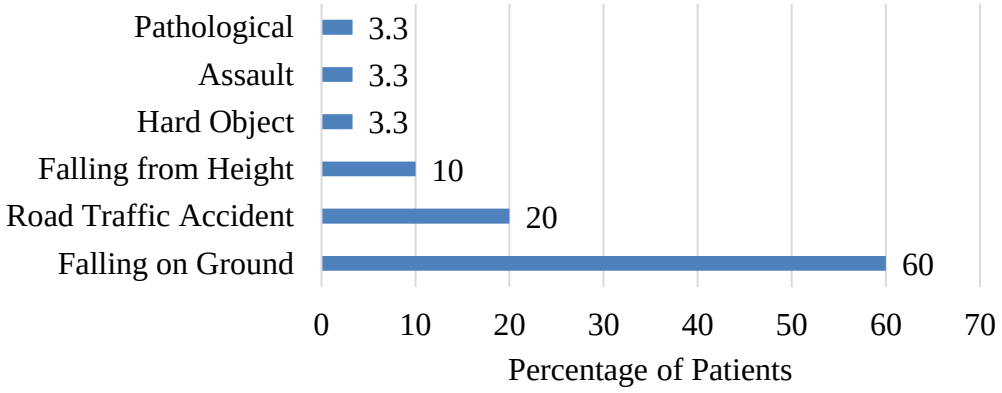

Figure 4. AO Type of Fracture

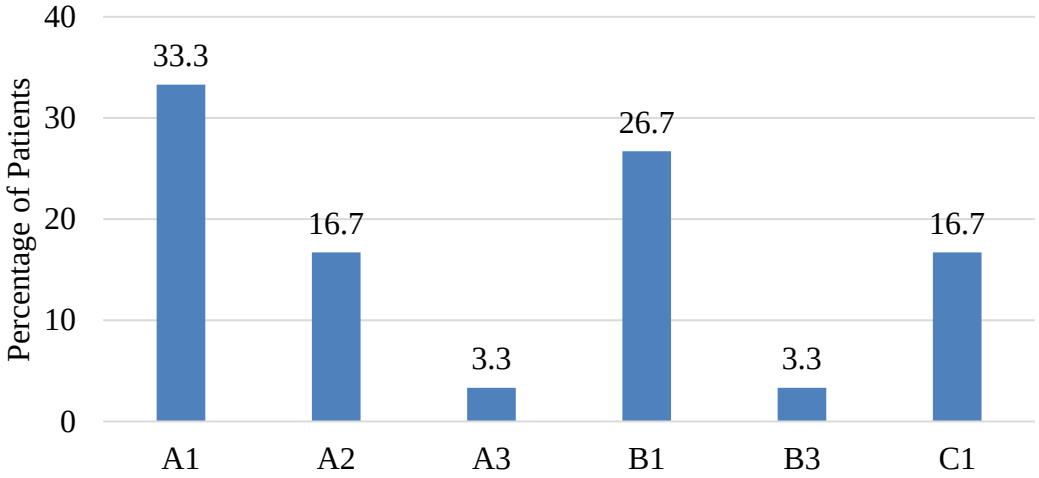

Figure 5. Associated Injuires

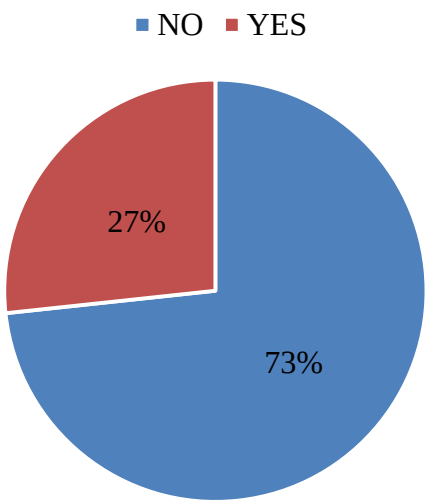

Figure 6. Asscoiated Medical Ilness

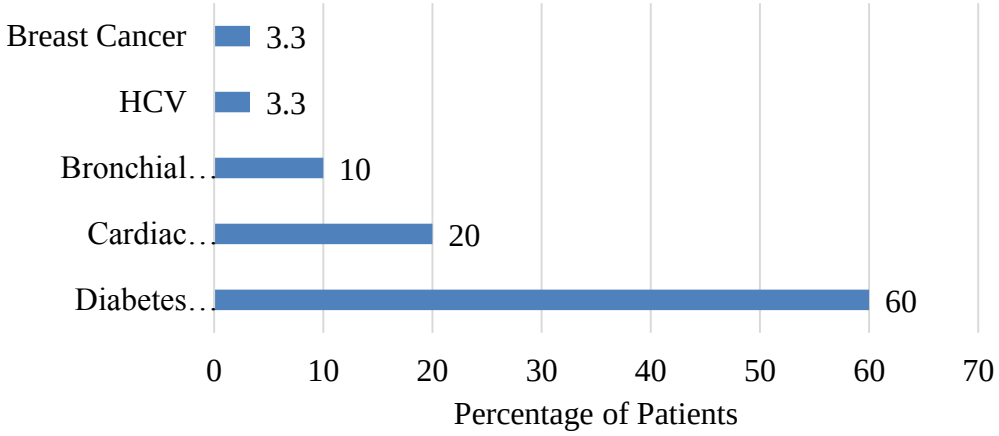

Figure 7. Type of Anesthesia

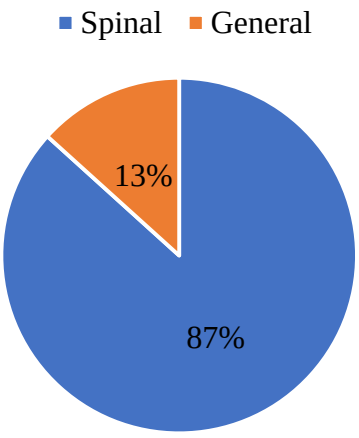

Figure 8. Technique of Reduction

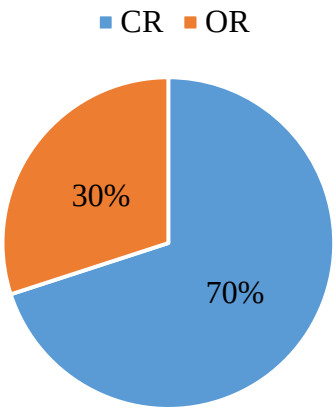

Figure 9. Cerlcage Wire

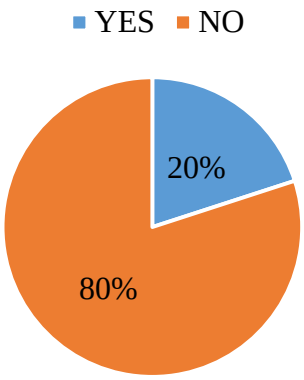

Figure10. operative time

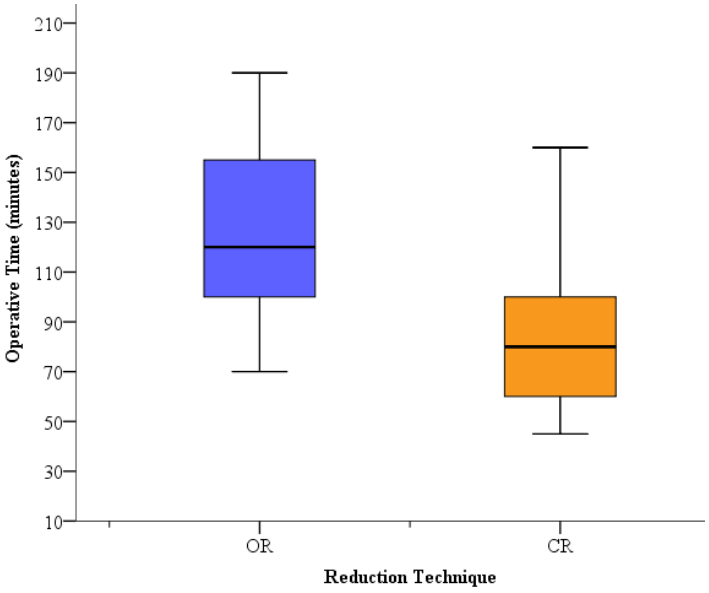

Figure 11. Blood Transfusion

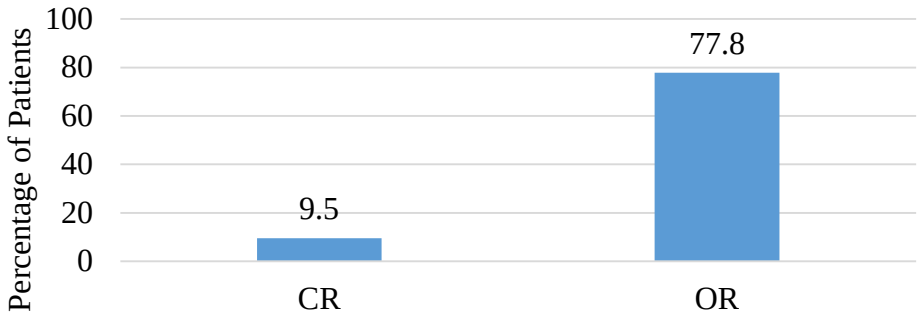

Figure12. Hospital stay

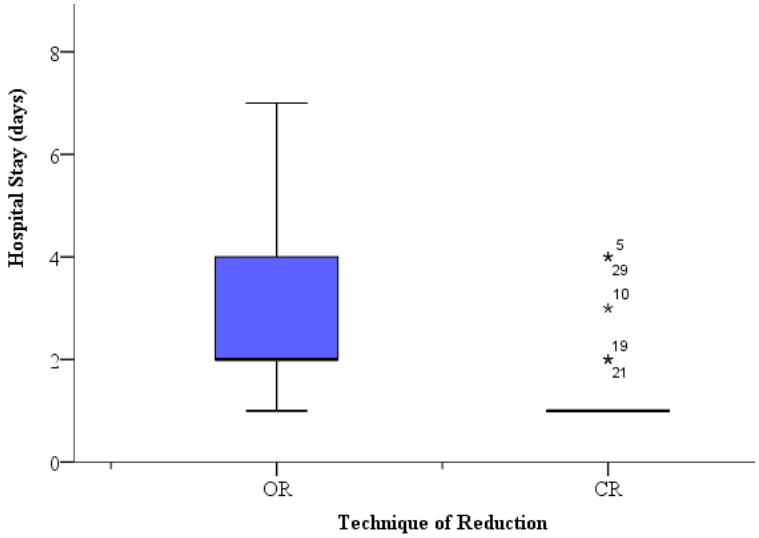

Figure 13. Functional Outcomes (HHS)

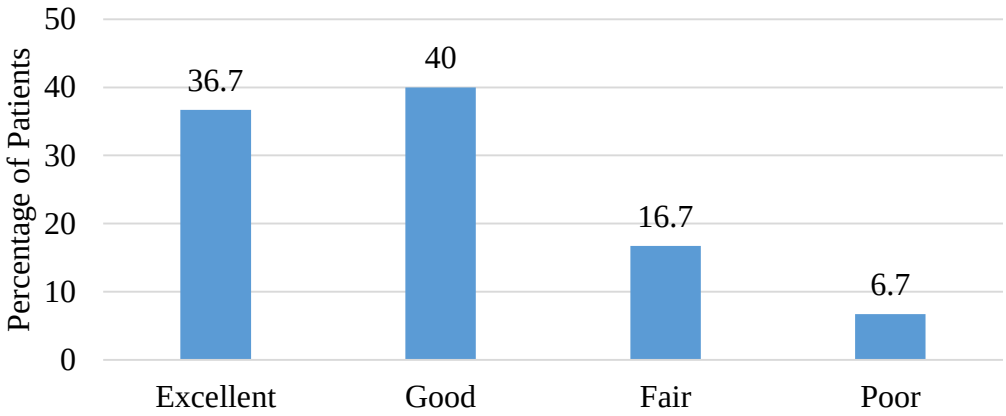

Figure 14. Postoperative Complications

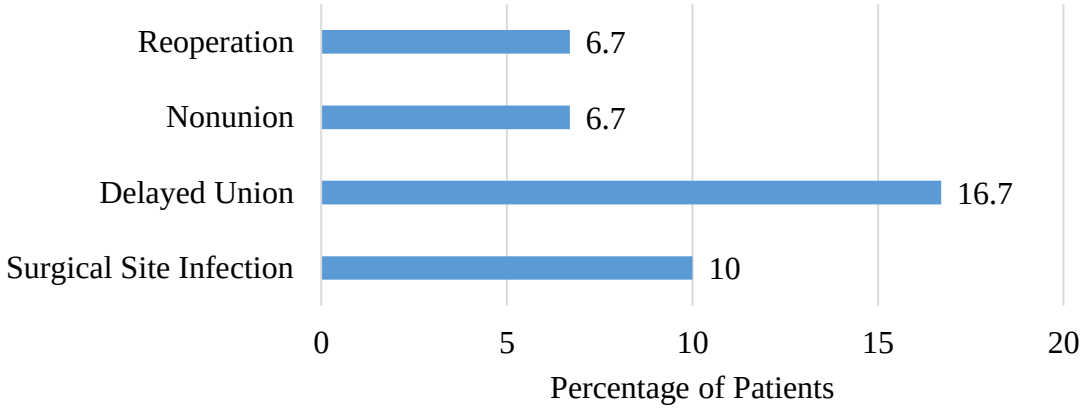

Table 1. Operative Characteristics (N = 30)

Characteristic	Value
Type of Anesthesia	
Spinal anesthesia	26 (86.7%)
General anesthesia	4 (13.3%)
Method of Reduction	
Closed reduction	21 (70%)
Open reduction	9 (30%)
Use of Cerclage	
Yes	6 (20%)
No	24 (80%)
Operating Time (minutes)	Median 90 (IQR, 64 – 110)
Transfusion Rate	9 (30%)
Total Units Transfused	9 units
Length of Hospital Stay (days)	Median 1 (IQR, 1 – 2.25)

Table 2. Functional Outcomes and Complications (N = 30)	
Characteristic	**Value**
Union Rate	28 (93.3%)
Time to Full Radiological Union (months)	Median 4 (IQR, 3 – 4)
HHS	
Excellent	11 (36.7%)
Good	12 (40%)
Fair	5 (16.7%)
Poor	2 (6.7%)
Complications	
Surgical Site Infection	3 (10%)
Delayed Union	5 (16.7%)
Nonunion	2 (6.7%)
Reoperation	2 (6.7%)

Table 3. Comparison between CR and OR Techniques (N = 30)			
	CR (N = 21)	**OR (N = 9)**	***P* value**
Operative Time (minutes)[a]	80 (57.5 – 100)	120 (95 – 167.5)	.003*
Transfusion Rate	2 (9.5)	7 (77.8)	.000**
Hospital Stay (days)[a]	1 (1 – 1.5)	2 (1.5 – 4.5)	.063*
Union Time (months)[a]	4 (3 – 5)	3.5 (3 – 4)	.746*
HHS[b]			.808*
Excellent	6(28.6)	5 (55.6)	
Good	9 (42.9)	3 (33.3)	
Fair	4 (19)	1 (11.1)	
Poor	2 (9.5)	0 (0)	
Complications[b]			.925**
SSI	2 (9.5)	1 (11.1)	
Delayed Union	4 (19)	1 (11.1)	
Nonunion	2 (9.5)	0 (0)	
Reoperation[b]	2 (9.5)	0 (0)	.523**

[a] Data are presented as median (interquartile range); [b] data are presented as No. (%).
* Mann-Whitney U test; ** Chi-square test.

Table 4. Comparison between Cerclage and Non-Cerclage Techniques (N = 30)			
	Non-Cerclage (N = 24)	**Cerclage (N = 6)**	***P* value**
Operative Time (minutes) [a]	80 (60 – 100)	115 (108 – 145)	.008*
Hospital Stay (days) [a]	1 (1 – 2)	2 (1.8 – 4.3)	.073*
Union Time (months) [a]	4 (3 – 4.5)	4 (2.8 – 4.8)	.935*
HHS [b]			.339*
Excellent	7 (29.2)	4 (66.7)	
Good	11 (45.8)	1 (16.7)	
Fair	4 (16.7)	1 (16.7)	
Poor	2 (8.3)	0 (0)	
Complications [b]			.666**
SSI	2 (8.3)	1 (16.7)	
Delayed Union	4 (16.7)	1 (16.7)	
Nonunion	2 (8.3)	0 (0)	
Reoperation [b]	2 (8.3)	0 (0)	.464**

[a] Data are presented as median (interquartile range); [b] data are presented as No. (%).
* Mann-Whitney U test; ** Chi-square test.

Discussion

Subtrochanteric (ST) femur fractures are defined as fractures of the proximal femur that occur within 5 cm of the lesser trochanter [(8).]
Subtrochanteric fractures are associated with high rates of nonunion and implant fatigue failure because of the greater mechanical stresses in addition to the strong deforming muscle forces in this region [(9).]
A fracture can be demonstrated with increasing age, especially following minor trauma [(10).]

The aim of this study was to achieve biomechanically stable subtrochanteric fracture reduction and fixation for early rehabilitation.
A randomized prospective study is conducted on 30 (thirty) patients with unstable subtrochanteric femoral fractures presented to the trauma unit at Minia University Hospital and to the supervisors of the study.

On comparing our results with results of other studies:
We compared our study with 4 recent studies Huang et al.,[(4)] (2021) , Gong et al.,[(11)] (2016), Rehme et al.,[(3)] (2021) and Karayiannis & James[(12)]

Our results showed that, the age of included patients ranged from 27 to 85 years, with a mean value of 58.3 (SD, 15.6) years, and a median value of 63.5 (IQR, 49.5 – 69). 20 (66.7%) patients were males, while 10 (33.3%) were females.
Rehme et al., 2021 reported that, a total of 260 consecutive patients (155 women and 105 men) with the diagnosis of AO/OTA A1 to A3 fractures were included, the mean age of patients was 76.4 ± 15.6 years.

Huang et al., 2021 noted that, 52 patients with unstable subtrochanteric fractures were enrolled in the study, The mean age of the patients was 76.53 ± 6.38 years. There were 35 male cases and 17 female cases included.

In another study by Karayiannis & James, 2020 aimed to assess the potential impact of using cerclage cables or wires when undertaking fixation of unstable intertrochanteric and subtrochanteric fractures. 465 patients were included (157 in the cerclage/wire group and 308 without). Mean age of 79.6 years, with 330 females and 135 males, there was no statistical

difference between the groups in relation to baseline demographics.

Another study by Gong et al., 2016 included 13 patients with a mean age of 61.2 years (range, 43-76 years) who underwent the technique of reduction assisted with pointed clamp and cable cerclage and intramedullary nail for oblique and spiral subtrochanteric fracture of the femur (AO class 32-A1.1, 32-B1.1 and 32-C1.1). They excluded the patients who had a transverse fracture or comminuted fracture (range, AO class 32-C1.2 to 32-C3.3), which could not captured by the pointed clamp. For obvious reasons, any patient whose fracture reducedanatomically with closed reduction was also excluded.

According to the AO classification, the most common fracture type in our study was A1 representing 33.3% of patients. The second most common type of fracture was B1 representing 26.7% of patients. The incidence of less common subtrochanteric fracture types A2, A3, B3, and C1 were 16.7%, 3.3%, 3.3%, and 16.7%, respectively.

Rehme et al., 2021 specified Type A fractures with 72 × A1 fractures (26 × A1.1, 40 × A1.2, 6 × A1.3), 124 × A2 fractures (60 × A2.1, 35 × A2.2, 29 × A2.3), and 64 × A3 fractures (25 × A3.1, 10 × A3.2, 29 × A3.3) .

The AO classification in study done by Karayiannis & James, 2020 observed that The incidence of subtrochanteric fracture types A1,A2, A3, B1, B2, B3, C1 and C3 were 14 (3.01%), 171 (36.77%), 170 (36.56%), 53 (11.40%), 2 (0.43%), 1 (0.21%), 53 (11.40%) and 1(0.21%) respectively.
Gong et al., 2016 Specified (AO class 32-A1.1, 32-B1.1 and 32-C1.1) the most common fracture type in their study was B1 (38.5%) 5 patients and C1 (38.5%) 5 patients. The third most common type of fracture was A1 (23.1%) 3 patients.

The most common mechanism of trauma in our cohort was falling on ground representing 60% of patients. The mechanism of injury was road traffic accident in six (20%) patients and falling from height in three (10%) patients. Less common modes of trauma were impaction by a hard object, assault, and pathological fractures in three patients. In our series, eight (26.7%) patients had additional injuries . Two (6.7%) patients had abdominal injuries. Other two (6.7%) had distal radial fractures. Two (6.7%) patients had spine and/or pelvic fractures, one (3.3%) had an ipsilateral femoral fracture, one (3.3%) had ipsilateral tibial and patellar fractures, and one (3.3%) had an ipsilateral tibial fracture and contralateral calcaneal and ankle fractures.

Rehme et al., 2021 reported that, the causes of accident were falls from a standing position in 194 patients, falls from a height more than three metres in 27 patients, highspeed trauma in road traffic in 13 patients, bicycle accidents in 14 patients, and 12 fractures in connection with sports injuries.

Huang et al., 2021 noted that, in 16 cases, patients were injured by traffic accidents. In 36 cases, patients fell from height, resulting in fracture.

Of all 13 cases included in Gong et al., 2016 study, cause of injury was traffic accidents 5(38.5%) patients and falls 8(61.5%) patients. Five patients suffered associated injury, which included tibial fracture, radial fracture, spine fracture, foot fractures, pelvic injury and chest trauma like rib fractures. No patient had an open fracture, and there was no major neurovascular injury.

As regards comparison of other results:
In the current study Supplementary cerclage wires were used in six (20%) patients. In agreement Rehme et al., 2021 showed that, in 27.7% patients open reduction and internal fixation with cephalomedullary nailing and auxiliary cerclage wiring was used.

Study done by Karayiannis & James, 2020 showed that, among 465 patients included for analysis there were 308 patients had intramedullary nail fxation only (66.2%) compared to 157 patients (33.8%) that had their fxation augmented with at least 1 cerclage cable or wire.

On the other hand all patients 13(100%) in Gong et al., 2016 study had open reduction and

Supplementary cerclage wires were used in 5 (38.5%) patients

Huang et al., 2021, the study was primarily done on cases of subtrochanteric fracture treated by cephalomedullary nail with the use of cerclage wiring technique, in all cases 1 or more auxiliary cerclage wires were used.

We found that, the operating time ranged between 45 to 190 minutes with a mean value of 94.8 (SD, 39.1) minutes, and a median value of 90 (IQR, 64 – 110) minutes. The length of hospital stay ranged between 1 to 7 days, with a mean of 1.97 (SD, 1.5) days, and a median of 1 (IQR, 1 – 2.25) day. We noted that both increased in patients needed open reduction and cerclage wiring.

Huang et al., 2021 noted that, the operation times of all patients ranged from 60 to 130 min, with an average of 82 min, and the length of hospital stay was 5–37 days, with an average of 13.68 days.

Rehme et al., 2021 found that, operation time was 122.5 ± 36.9 minutes in the treatment group with cerclages versus 66.7 ± 25.6 minutes in the group without cerclages ($p < 0.001$).

In a study Gong et al., 2016 Average operation time was 105 min (range 85-135 min). Proximal femoral nail antirotation (PFNA, Synthes®, Oberdorf, Switzerland) were used for all patients.

Patients with cerclage cable or wire to augment fxation had a signifcantly longer length of stay in Karayiannis & James, 2020 study with a mean of 16.27 days in the cerclage/wire group compared to 12.63 in the non-cerclage group. this may be explained by the need for an open reduction to allow passage of cerclage cables/wire. This requires a larger incision, with the potential for increased blood loss and postoperative pain.

In the current study the majority of patients had satisfactory functional outcome measured by HHS, including 11 (36.7%) patients with excellent scores, and 12 (40%) had good scores. Fair functional scores were reported in five (16.7%) and two (6.7%) patients had poor functional outcomes.

Gong et al., 2016 reported that, all patients achieved an excellent to good functional result with a mean Harris hip score of 90.7 (range 83-95).

According to Rehme et al., 2021 Independent of the fracture pattern (A1 + A2 + A3 fractures), functional outcome according to the LEFS was 65.3 ± 17.2 points in the group with cerclages versus 58.4 ± 21 points in the group without cerclages ($p = 0.04$)

In Huang et al., 2021 According to the Sanders score of hip joint function, there were 28 cases of excellent results (55–60 points), 22 cases of good results (45–54 points), and 2 cases of poor results (35–44 points), with an excellent and good rate of 96.15%. None of the patients had incision inflammation infection, internal fixation fracture, unequal limb length, coxa vara, or other complications.

Karayiannis & James, 2020 With regard to functional outcomes, cerclage cabling or wiring had no significant impact on functional outcomes for patients. Barthel scores decreased in both groups over time and the trends in mobility were similar with reduced mobility noted in both groups as time from fracture increased. There was no difference in mortality noted.

The present study observed that, Closed reduction was carried out in 21 (70%) patients, while open reduction was used in nine (30%). Blood loss and the need for blood transfusion occurred only in open reduction patients who required perioperative blood transfusion. A total of nine units of packed RBCs were transfused.

In the current thesis our results showed that, illustrated the reported postoperative complications, including surgical site infection (10%), delayed union (16.7%), and nonunion (6.7%). Revision surgery was required for two (6.7%) patients who failed to achieve union.

Rehme et al., 2021 reported that, the complications in the patient group with

auxiliary cerclages did not result in any vascular injury, but in three surgical revisions (1 torsional deviation, 1 seroma, and 1 hematoma). Nonunion rate in this treatment group was 6% (4 out of 72 patients). In the patient group without auxiliary cerclages, wound secretion without the need for surgical revision was assessed. Nonunion rate in this group was 4% (8 out of 188 patients).

Huang et al., 2021 noted that, none of the patients had incision inflammation infection, internal fixation fracture, unequal limb length, coxalvarus, or other complications. Post-operative deep vein thrombosis occurred in 3 cases, and fracture nonunion occurred in 1 case. No infection, loose fracture of internal fixation or hip varus deformity occurred.

Karayiannis & James, 2020 reported that, Fourteen patients sufered aseptic non-union were managed by either exchange nailing (8 patients), locking plate and bone graft (3 patients), total hip replacement with cable plate (2 patients) and proximal femoral replacement (1 patient). No patients within this cohort had, at time of writing, further surgical intervention. Four patients had an infected non-union. These were managed by either removal of all metalwork if patients were unfit for significant further surgery (2 patients) or two-stage revision to either total hip replacement (1 patient) or proximal femoral replacement (1 patient).
Contrary in another study by Gong et al., 2016 there was no major complication, such as infection, implant failure, or nonunion encountered.

Conclusion

At the end of our study we concluded that; achieving a satisfactory closed reduction is sometimes not possible and therefore an open reduction is required. Increasingly following this open reduction, cerclage cables or wires are being used to assist with the reduction and augment fracture fixation. Cerclage wires have the potential benefits of improving quality of reduction and increasing stability of the entire construct that enable early rehabilitation with minimal complications .

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