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Original Article

Locking Plate versus Cannulated Screws in the Management of Transcervical Fracture Neck Femur

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ABSTRACT

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Background: Transcervical neck fracture is common in daily orthopedic practice. Internal fixation is the curative option. However, there is controversy exists regarding the ideal fixation device.

The aim of the work: This study aims to compare the clinical, functional and radiological results of cannulated screws versus dynamic locking plate in fixations of femoral neck fractures.

Patients and Methods: Thirty patients with transcervical fracture neck femur were included. They were divided into two groups; the first for dynamic locked plate, and the second for cannulated screws. All were assessed preoperatively by radiological and clinical methods. Postoperative care consisted of routine vital data recording, intravenous antibiotics and appropriate analgesia. X-rays were done in the first postoperative to check fixation and after 12 weeks to check for union. The follow-up evaluation included questioning the patient about pain during activity and rest and about ability to walk and stand determining the range of motion of the hip joint using modified Harris Hip Scoring System.

Results: The mean operative time in screws group was 38 minute compared to 72 minutes in plate group with significant difference between both groups. Both groups showed high successful union rate with no significant difference. In the screw group, 3 cases fail to union while in plate group only one case failed. The mean union time in screws group was 19.7 weeks while in plate group was 18.3 weeks. Screws group showed 8 cases of complication, compared to 5 cases in the plate group. There was a significant blood loss [more than 500ml] in plate group.

Conclusion: Although both groups were comparable regarding union rate, the screw group was associated with significantly shorter operative time, and lower blood loss. The anatomical reduction is the main determining factor of success regardless the type of device used in fixation.

Keywords: Fracture Neck Femur; Anatomical Reduction; Rigid Fixation; Locking Plate; Cannulated Screws.



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INTRODUCTION

Fractures of the hip are frequent and account for about 20% of the surgical load of orthopedic traumatology. Specifically, fractures of the femoral neck represent around 50% of total fractures of the hip. Life anticipation is growing worldwide; thus, the numbers of hip fractures that occur worldwide are expected to increase [1-3].

Displaced intracapsular femoral neck fractures, especially in young active patients, pose a considerable challenge for the orthopedic surgeon; the therapeutic goal in most cases is the preservation of the femoral head [4-6].

Anatomic reduction and stable fixation reduce the relative risk of fracture healing complications and to avoid nonunion and osteonecrosis of the femoral head [7, 8]. The incidence of osteonecrosis and nonunion, however, remains high. These devastating complications lead to revision surgeries and early hip arthroplasty [9-10]. Fracture neck of the femur has been termed the unsolved fracture due to continuing controversy between preserving the femoral head using internal fixation or replacing the head with a prosthesis [11].

Internal fixation of fracture neck of the femur is clearly indicated for all undisplaced fractures and for those aged less than about 60 years with a displaced intracapsular fracture in which preservation of the femoral head is desired [12,13]. The use of partially threaded cancellous screws cannulated or not, inserted perpendicular to the fracture plane and directly adjacent to the femoral neck cortices, has been the standard treatment intervention for femoral neck fixation in the past several decades [14,15]. This construct allows for compression intraoperatively to aid in primary bone healing.

Although this ensures direct bony contact between the proximal and distal fragments, it ultimately may produce unintended and undesired consequences of femoral neck shortening [16-18].

Easily applicable fixed-angle implant designed specifically for femoral neck fractures was advised for two main reasons. First, the locking plate technology has greatly improved treatment in other periarticular fractures as the proximal tibia, distal femur, and proximal humerus fractures. Second, locking plate technology would allow for rigid fixation and resist any femoral neck shortening or collapse [19,20]. However, no studies were conducted in our locality about the comparison between the

locked plate and cannulated screws in the fixation of fracture transe cervical neck femur.

THE AIM OF THE WORK

This study aimed to compare the clinical, functional and radiological results of cannulated screws versus dynamic locking plate in fixations of femoral neck fractures among adult patients.

PATIENTS AND METHODS

The study took place at the department of orthopedic Surgery, Al-Azhar University Hospital, [Damietta] from January 2021 to Jul 2021. Thirty patients presented with Transcervical fracture neck femur were included. They were divided into two groups; the first group for dynamic locked plate, and the second group for cannulated screws. All were assessed preoperatively on radiological and clinical basis by the modified Harries Hip Score [HHS]. The assessment with the same score was repeated postoperatively.

Randomization was achieved by generating a series of numbers odd and even with 1:1 ratio. Each number was enclosed in an envelope and opened just before the operation by a nurse who did not participate in the study. Patients with odd numbers were enrolled in first group [dynamic locked plate], while patients with even numbers were enrolled in second group [cannulated screws].

We included only adult patients [18- 60 years old] with recent femoral neck fractures. On the other side, the exclusion criteria were old or neglected femoral neck fracture, pathological fracture, patient younger than 18 years or older than 60 years, severe multiple traumata or sever comorbidity, and skeletal abnormalities or osteoarthritis.

The sample size was calculated, and the number of patients to achieve a power of 80% and a significance level of 5% [two sided], for detecting an effect size of 0.7 between pairs was 30 patients, with an expected 10% drop out cases [21].

Ethical Consideration

This study was approved by Damietta Faculty of Medicine, Ethical committee, Al-Azhar University. All patients were voluntarily signed an informed consent form. Their right was assured and guaranteed. The research was completed according to Helsinki Declaration. The data were anonymized before analysis and are available on request.

For each patient, data of full history taking were documented. Then, all were subjected to full clinical assessment, which was conducted in a systematic pattern [general followed by local examination]. The laboratory investigations included complete blood count [CBC], serum creatinine, and international Normalized Ratio [INR]. The radiological workup consisted of standard anteroposterior [AP] and lateral plain X-ray views, AP in internal rotation view when needed, and computerized tomography [CT] scan was done for patients with suspected fractures of the neck of the femur while plain X-ray didn't show fracture.

The first aid measures were analgesia when indicated, skin traction for the affected hip, followed by orthopedic preparation for intervention.

Surgical techniques: All patients were operated under spinal anesthesia, and they received prophylactic antibiotics [2g cephalosporin] an hour before surgery. Patient was positioned carefully in supine position on a standard radiolucent table under image intensifier guidance [figure 1]. The hip was exposed through lateral approach, 5-8 cm downward longitudinal incision was made from the tip of greater trochanter of the femur, the iliotibial band and vastus lateralis muscle were incised and 4-5 cm of bone surface under the greater trochanter was exposed. Displaced fractures were first reduced by closed reduction [Leadbetter technique], the affected limb is flexed to 90 degrees and the thigh is internally rotated then traction is applied. Next the limb is circumducted into abduction, internal rotation then brought down to table in extension.

Fixation

Screws: A 2.5 mm guide-wire was inserted into the femoral neck away from the point of entry for temporary fixation of the fracture; guide-wires for the three cannulated screws were inserted through the guide sleeves. The first 3.0 mm guide-wire was inserted along the inferior portion of the femoral neck, parallel to the axis of the neck into the subchondral bone, the guidewire should be placed centrally in both AP and lateral views. The other two guide-wires were drilled into the femoral neck and adjusted so the guide-wires tips are in the subchondral bone at the position where the tips of the cannulated screws are placed, this should be approximately 5 mm from the joint line. The length of the guide-wires was measured with the measuring scale by holding it against the drill sleeve, and depth stop was attached to the drill and

adjust it to the measured length and the screw channel was bored open to the measured depth, the 7.3 mm partially threaded cannulated screws [short or long threads] of the selected length were inserted and tightened using the torque limiting screwdriver. The sleeve for the distal screw was inserted and a 4.5 mm cortical distal screw of the appropriate length was inserted and tightened to just penetrate the medial cortex of the femur. Finally, the wound was closed in layers and sterile dressing was applicate.

Plate: The designed plate to fixate the fractures is consisted of proximal femur locking plate associated with cannulated screws. A minimally invasive technique are conducted in order to prevent iatrogenic damage to the vascular supply of the head and neck of femur, and to reinforce the mechanical stability. To ensure stability, we set up three cannulated screws, which fixed all together; in addition, such technique helps reducing the position location requisite of the screws, and avoids releasing and departure of the cannulated screws. This apparatus is easy, small, and intended to arrange to the proximal part of the femur; a short incision is suitable for locating and fixation. Hence, in contrast to the sliding hip screw apparatus, the proximal femoral locking plate takes the benefit of a minimally-invasive operative exposure with a reduced amount of blood loss; otherwise, cannulated screws are planned to lock the nail head and reinforce the mechanical stability.

Postoperative care consisted of routine recording of vital signs; intravenous antibiotic [1g cephalosporin] was given two times per day for three days and appropriate analgesia was administered when indicated. X-rays were done in the first postoperative day to check the position of the screws. Patients were rapidly mobilized in bed and instructed to start toe touch without weight bearing by crutches or a walker immediately. Partial weight bearing started when evidence of union of the fracture appeared in X-ray, usually after 12 weeks' average. Full weight bearing was permitted after complete union of the fracture.

Follow up work up included removal of sutures after two weeks; follow up visits every one month. X-rays were done with every follow up visit. The follow-up evaluation included questioning the patient about pain during activity and rest and about ability to walk and stand determining the range of motion of the hip joint using modified Harris Hip Scoring System, which is interpreted as either excellent, good, fair and poor [22, 23].



Figure [1] showing intraoperative patient positioning

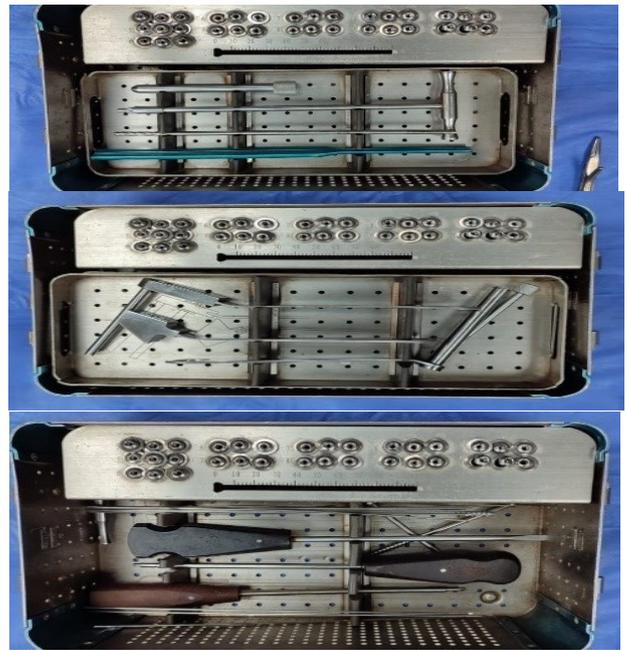


Figure [2] showing the implant set of screws

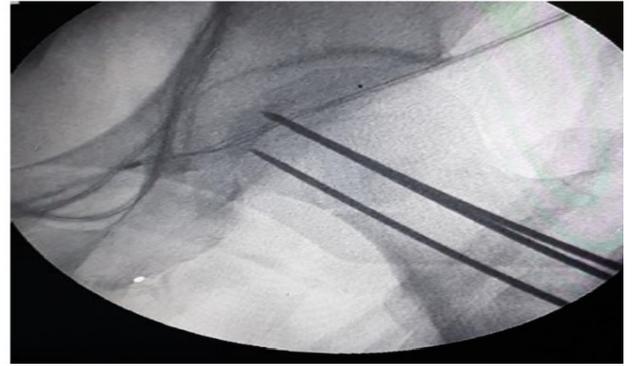
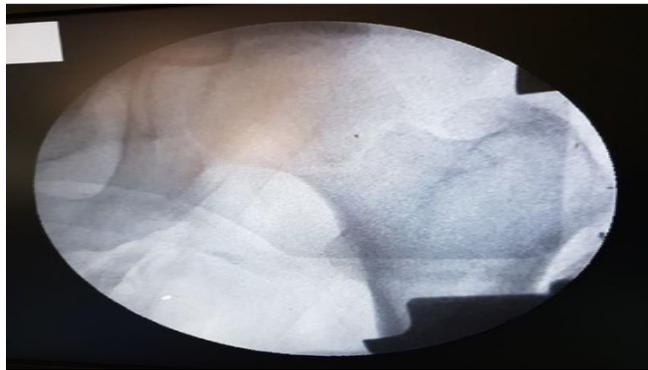


Figure [3] showing anatomical reduction and inserting guidewires under fluoroscopy



Figure [4] showing the implant set of plate

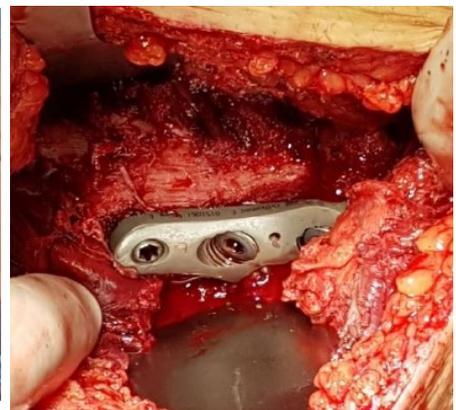


Figure [5] showing surgical steps of plate fixation

The quality of the reduction was assessed by the following scale: <2-mm step-off and no angulation = excellent, <4-mm step-off and <5° angulation = good, >4-mm step-off and <10° angulation = fair, and >5-mm step-off and >10° angulation = poor. The score was calculated under the C-arm in the anteroposterior and lateral X-ray views for all patients.

The next figure present an example of our work for a male patient aged 32 years old presented to Al-Azhar university hospital in Damietta by lift transcervical fracture neck of femur [Garden II] resulted from road traffic accident, operation was done 4 hours after injury, after final follow up he is graded as excellent [figure 6].

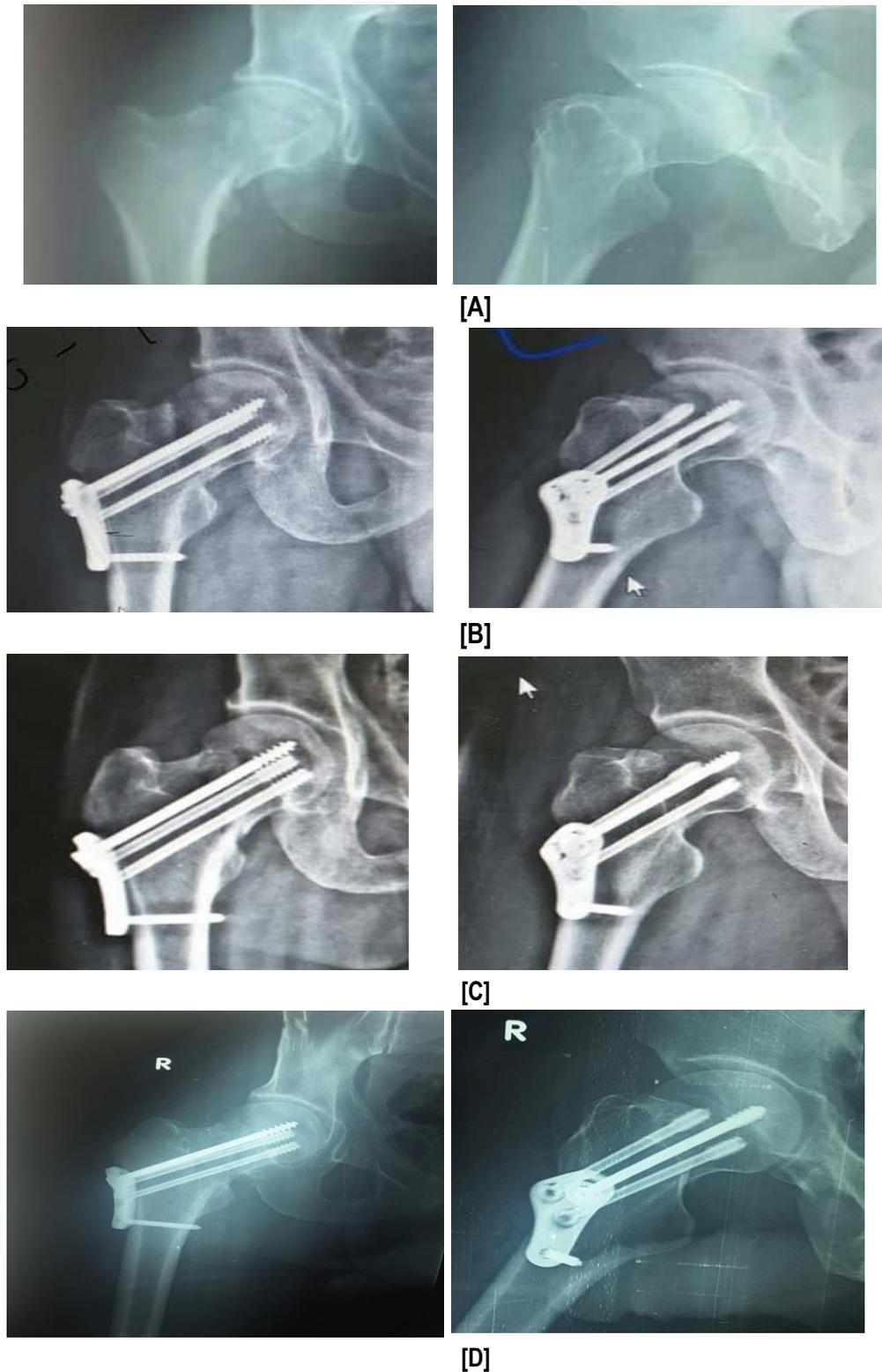


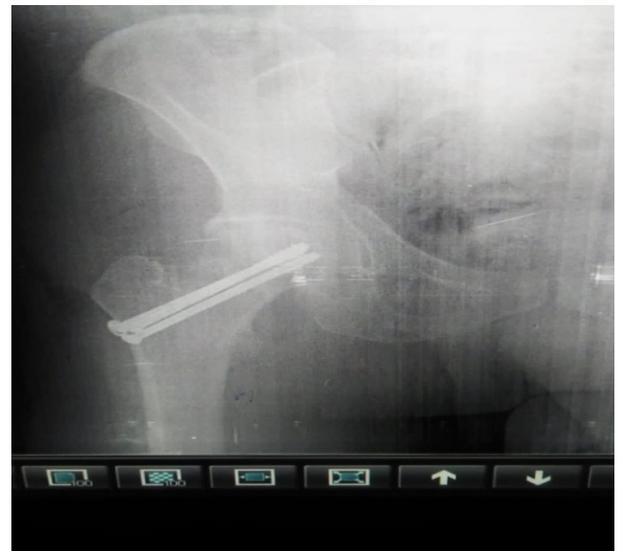
Figure [6]: Male patient 32 years old with lift transcervical fracture neck of femur [Garden II]. A: preoperative X-ray, showing fracture neck femur; [B]: postoperative X-ray, showing fixation by locked plate; [C]: follow up X-ray after 8 weeks; [D]: follow up X-ray after 14 weeks showing union

Another case for a female pt. 55 years old presented to Al-Azhar university hospital in Damietta by left transcervical fracture neck of

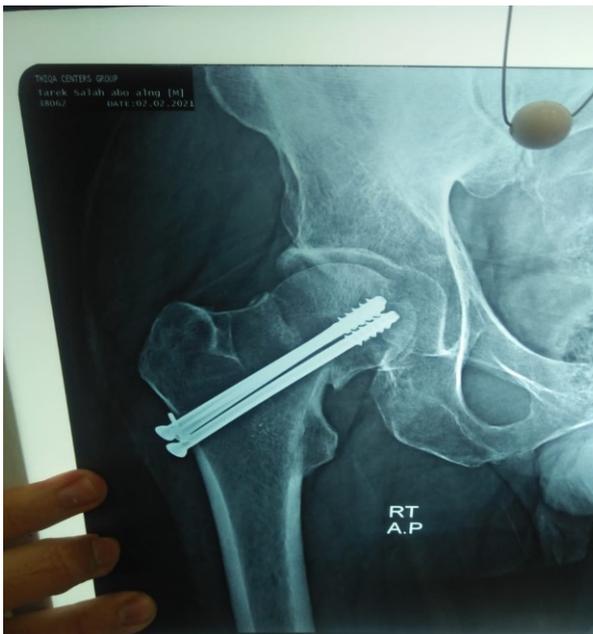
femur [Garden IV] resulted from falling from high operation was done 16 hours after injury, final follow up is graded as excellent [figure 7].



[A]



[B]



[C]

Figure [7]: Female patient 55 years old by left transcervical fracture neck of femur [Garden IV]. [A]: Pre – operative X ray; [B]: Post-operative x ray; [C]: Post-operative x ray after 6months

Statistical analysis: Data were studied using IBM SPSS Version 22.0. Categorical variables were described as number and percent. Continuous variables are described as mean and standard deviation. Chi-Square test or Fisher's exact test were used for comparison of categorical variables. Student t-test was used to compare 2 independent groups. P value less than or equal to 0.05 was set as significant.

RESULTS

The mean age was 40.2 ranged from [20-60] years, in screws group was 40.4 years; while in plate group was 40 years. 15 patients were males [50%] and 15 patients were females [50%] in screws group 7 [46.7%] were female; while in plate group 8 [53.3%] were female. According to associated diseases 4 patients had diabetes mellitus and hypertension [14.3%], 6 patients had hypertension [21.4%]; in screws group 2 patients had diabetes mellitus and hypertension [13.3%], 2 patients had hypertension [13.3%]; while in plate group 2 patients had diabetes mellitus and hypertension [15.4%], 4 patients had hypertension [30.8%] [Table 1]

According to laterality of injuries 10 cases in screws group had RT side fracture and 9 cases in plate group had RT sided fracture. As regard to

mode of injuries in screws group 4 cases were RTA, 9 cases FFH and only 2 cases were Failing down; while in plate group 5 cases were RTA, 7 cases FFH and only 3 cases were Failing down. We found in screws group Garden class I was two cases, 4 cases class II, 7 cases class III and 2 cases class IV; while in plate group Garden class I was three cases, 5 cases class II, 7 cases class III and 2 cases class IV [Table 2].

In present study 15 cases undergoes cannulated screws procedures and 15 cases were undergoing Dynamic locked plate procedures. The mean operative time in screws group was 38 min; while in plate group was 72 min. with significant difference between both groups. Both groups showed high successful union rate without any statistically significant; in screw group only 3 cases fail to union while in plate group only one case. The mean union time in screws group was 19.7 weeks while in plate group was 18.3 weeks without statistically significant. Screws group showed 8 cases of post-operative complication in form of 3 case of nonunion, 2 cases of infection and one case of AVN; while plate group 5 cases in form of 3 case of AVN, one case of infection and one case of non-union. There was a significant blood loss [more than 500ml] in plate group, and there was insignificant difference between fixation results between both groups [Table 3].

Table [1]: Demographic Data

		Screws [15]	Plate [15]	P Value
Age		40.4± 12.7	40± 13.8	0.93
Sex	Female	7 [46.7%]	8 [53.3%]	0.43
	Male	8 [53.3%]	7 [46.7%]	
Co-Morbidity	No	11 [73.3%]	9 [60.0%]	0.49
	HTN	2 [13.3%]	4 [26.7%]	
	DM and HTN	2 [13.3%]	2 [13.3%]	

Table [2]: Clinical Data

Clinical		Screws	Plate	P Value
Time from Injuries [Hrs]		8± 3.9	7.7± 4.3	0.845
Mode	RTA	4 [26.7%]	5 [33.3%]	0.798
	FFH	9 [60.0%]	7 [46.7%]	
	FD	2 [13.3%]	3 [20.0%]	
Side	Rt	10 [66.7%]	9 [60.0%]	0.488
	Lt	5 [33.3%]	6 [40.0%]	
Garden Class	I	2 [13.3%]	3 [20.0%]	0.62
	II	4 [26.7%]	7 [46.7%]	
	III	7 [46.7%]	3 [20.0%]	
	IV	2 [13.3%]	2 [13.3%]	
Associated Injuries	No	10 [66.7%]	11 [73.3%]	0.879
	At the same side fix sup & inf pubic rami	1 [6.7%]	0 [0.0%]	
	Compression fracture L1	2 [13.3%]	1 [6.7%]	
	Contralateral tibial plateau fracture	1 [6.7%]	2 [13.3%]	
	Ipsilateral calcaneal fracture	1 [6.7%]	1 [6.7%]	

Table [3]: Operative time and Post-Operative data

		Screws	Plate	P Value
Operative time		38±7	72± 9	<0.001*
Union Rate	No	3 [20.0%]	1 [6.7%]	0.353
	Yes	12 [80.0%]	14 [93.3%]	
Union Time [weeks]		19.7± 3.2	18.3± 4.7	0.421
Complication	AVN	2 [13.3%]	3 [20.0%]	0.514
	Infection	0 [0.0%]	1 [6.7%]	
	Nonunion	3 [20.0%]	1 [6.7%]	
Blood Loss		7 [46.7%]	12 [80.0%]	0.037*
Results	Excellent	4 [26.7%]	7 [46.7%]	0.3
	Good	6 [30.0%]	3 [20.0%]	
	Fair	2 [13.3%]	4 [26.7%]	
	Poor	3 [20.0%]	1 [6.7%]	

*: significant

DISCUSSION

In this study, we didn't find any significant difference between both methods as regard to union rate, time and post-operative complication. However, we had noticed a significant blood loss in dynamic lock plate fixation. Both groups showed high successful union rate without any statistically significant. In screw group, only 3 cases fail to union while in plate group only one case.

Screws group showed 8 cases of post-operative complication in form of 3 case of AVN, 2 cases of infection and one case of non-union; while in the plate group, there were 5 cases with complication in the form of 3 case of AVN, one cases of infection and one case of non-union. There was a significant blood loss [more than 500 ml] in the plate group, and there was insignificant difference between fixation results between both groups.

Postoperative infections were successfully responded to systemic antibiotic and multiple debridement. Non-union cases were treated by valgus osteotomy and AVN cases were admitted for total hip replacement. Yousry *et al.* [22] showed that valgus inter-trochanteric osteotomy achieved better results than traditional methods with fewer complications.

Both methods of fixation were almost the same. Achieving good anatomical fixation is the main objective in treatment of trans-cervical fracture neck femur. A retrospective study by Thein *et al.* [24] that included 78 patients with displaced intra-capsular femoral neck fractures. Patients were divided into two groups who submitted to reduction and internal fixation of the fracture with either Targon device [group 1; 31 patients] versus multiple cancellous screws [group 2; 47 patients]. In their study, one [3%] patient in Targon device

group and 22 [47%] patients in the multiple cancellous screws group had a nonunion; four [13%] patients in Targon device group and 16 [34%] patients in the multiple cancellous screws group submitted to re-surgery; four [13%] patients in Targon device group and 4 [8%] patients in the multiple cancellous screws group had AVN of the femoral head. These finding suggest that achieving internal fixation through a fixed angle apparatus reduced the rates of nonunion and re-surgery; however, no significant difference was observed regarding the frequency of osteonecrosis. It had to be noted that the union rate among cancellous screws group in our study was much better than Thein *et al.* [24] study [20% vs. 47%], while the frequency of AVN was much better in their study than ours [8% vs. 20%].

Lin *et al.* [16] conducted a prospective study included 41 patients with femoral neck fractures treated with a proximal femoral locking plate with cannulated screws, twenty-five men and 16 women had a mean age of 47 years [range, 21-65 years], three patients had a Garden type I fracture, 9 a type II, 18 a type III and 11 a type IV, mean time to union was 15.5 weeks, two patients [4.9%] did not achieve union, and 4 patients [9.8%] had AVN. Unlike our finding they had lower union time [19 weeks], non-union rate and AVN [14.3% and 17.9%] respectively.

In agreement with our results Kaplan *et al.* [25] Sixty-six patients with femoral neck fracture were treated with percutaneous cannulated screws [n=33] or with DHS [n=33] between August 1999 and October 2003. Functional outcome was measured using Harris Hip Score, and period of union, amount of bleeding and complications were also recorded. There was no superiority between cannulated screws and DHS according to union times and functional results.

Parker *et al.* [26] a consecutive series of 320 patients with an intracapsular fracture of the hip treated with a dynamic locking plate [Targon Femoral Neck [TFN]] were reviewed, during the follow-up period 109 patients died. There were 112 undisplaced fractures, of which three [2.7%] developed nonunion or re-displacement and five [4.5%] developed avascular necrosis of the femoral head, revision to an arthroplasty was required for five patients [4.5%], there were 208 displaced fractures, of which 32 [15.4%] developed nonunion or re-displacement and 23 [11.1%] developed avascular necrosis, a further four patients [1.9%] developed a secondary fracture around the TFN, revision to a hip replacement was required for 43 patients [20.7%] patients. It is suggested that the stronger distal fixation combined with rotational stability may lead to a reduced incidence of complications related to the healing of the fracture. These findings disagree with our results in dynamic locked plate group, hence nonunion rate was [7.7%] and AVN rate was [23%].

Khoo *et al.* [27] A five-year retrospective study was carried out in 53 consecutive patients between 2006 to 2010 to determine the pattern of injuries, management, outcomes and the associated predictive factors. All the patients underwent cannulated screw fixation, with 37 [69.8%] having had surgery within 24 hours and the remaining 16 [30.2%] 24 hours after the initial injury. Good outcome was observed in 43 [81.1%] patients leaving only 10 [18.9%] patients with a poor outcome, of whom nine developed avascular necrosis [90%] and one non-union [10%]. We have much better outcome according to non-union rate and AVN [8.5% Vs 20%] respectively.

Yousry *et al.* [22] in a systematic review of literatures was conducted on five studies [306 patients] published in literature in the last 10 years using different methods of fixation. Comparing complications in different fixation methods showed that complications are inevitable yet manageable, but higher complication rate associated with the fixation of neck femur fractures using DHS by achieving 26,4% rate of nonunion and 26,4% rate of AVN; while rate of non-union was 7,3% in valgus intertrochanteric osteotomy by broad DCP and rate of AVN was 11%.

The small numbers of included patients representing a limiting step of the current study. In addition, the short duration of follow up is another limiting step. Thus, it is recommended to increase the duration of follow up in the future studies for a large sample size.

In conclusion, both groups give the same results regarding the overall union and complications rate. However, the screw group had the advantages of significantly shorter operative time and low blood loss.

Conflict of interest and financial disclosure

None to be disclosed

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