Original Article

Management Of Intracapsular Neck Femur Fracture By Targon Plate Versus Cannulated Screws

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Abstract

Introduction Targon locking plate (TLP) of femoral neck with cannulated screws was used in management of fracture neck femur in young adults. The aim of this study is to compare the clinical, functional and radiological results of using Targon locking plate versus cannulated cancellous screws (CCS) in management of femoral neck fracture. **Patients and methods** This was a prospective randomized controlled study conducted in Beni-Suef University Hospital in the period from November 2019 to October 2021. The study includes 50 patients presented with intracapsular fracture neck femur. They were divided into two groups; the first group for patients treated with Targon locking plate (TLP) and the second group for Cannulated cancellous screw (CCS) system. **Results** There was a statistically significant increase in operative time in Targon TLP group. Postoperative mean VAS score was significantly lower in TLP (3.086) than in CCS group (4.5) and also the mean HHS showed statistically significant improvement in TLP group (83.4 ± 2.1) as compared with CCS group (72.1 ± 3.2) ($P < 0.05$). Also, femoral neck shortening and nonunion rates were higher in CCS group. **Conclusion** TLP for femoral neck fractures improves hip functional recovery and reduces the femoral neck shortening and nonunion rate. Thus, TLP can be an alternative to CCS for the treatment of femoral neck fractures.

Keywords:

INTRODUCTION

Most of the patients with fractured neck femur are treated surgically. Non-operative treatment is reserved for patients who are at extreme medical risk for surgery. Hemi-arthroplasty or total hip replacement is the best choices for management of elderly patients with fracture neck femur.[1]

Young adults are managed by anatomic reduction & internal fixation. Many devices are available for internal fixation of fracture neck femur. The most popular devices are Cannulated screw system and Dynamic hip screw.[1] There is no clear evidence of superiority of one implant for other, since each device has its complications[2].

Cannulated cancellous screw (CCS) system have the advantage of being less invasive technique with less blood loss and less pain, but It is a weak construct for stabilizing the more vertically oriented femoral neck fracture (Pauwels' Type III) Leading to higher failure rates and non-union[3].

Targon locking plate (TLP) of femoral neck with cannulated screws was used in management of fracture neck femur in young adults. It is short and designed to configure to the proximal femur having the advantage of being less invasive surgical technique with less blood loss. Meanwhile, the locking plate strengthens biomechanical stability and provides adequate bending and torsional stability which avoids varus collapse and lagging out of screws.[4]
The aim of this study is to compare the clinical, functional and radiological results of using Targon locking plate versus cannulated screws in management of femoral neck fracture.

Patients and Methods

This was a prospective randomized controlled study conducted in Beni-Suef University Hospital in the period from November 2019 to October 2021. The study includes 50 patients presented with intracapsular fracture neck femur. They were divided into two groups; the first group for patients treated with Targon locking plate (TLP) and the second group for Cannulated cancellous screw (CCS) system.

The inclusion criteria were as follow

1. Fresh intracapsular hip fractures
2. Age between 18 and 60 years old
3. Both sexes. Patients were excluded in cases of neglected fractures more than one week, pathological fracture, previous surgery in the hip, sever multiple trauma or cases combined with disease which may affect the clinical outcome, such as renal osteopathy and autoimmune diseases.

This study was approved by Beni-Suef Faculty of Medicine, Ethical committee, Beni-Suef University. All patients were voluntarily signed an informed consent form. Their right was assured and guaranteed.

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 non medical staff personnel. Patients with odd numbers were enrolled in first group [Targon locking plate], while patients with even numbers were enrolled in second group [cannulated cancellous screws].

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 forty patients.

For all patients, data of full history taking were documented. Full clinical assessment was done in a systematic pattern. The laboratory investigations included complete blood count [CBC], blood sugar level, international Normalized Ratio [INR], kidney and liver functions. The radiological workup was standard anteroposterior [AP] and lateral plain X-ray views 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.

First aid management was done including stabilization of vital data, analgesics and Skin traction was applied followed by orthopedic preparation for intervention.

Surgical procedure

Spinal anesthesia was used for all patients and third generation cephalosporin antibiotics was given at the time of induction of anesthesia and continued for three days post operatively. Positioning of the patient on the fracture table with slight traction and internal rotation of the affected hip to achieve anatomical reduction was done. Intraoperative image intensifier was used to insure anatomical reduction on both AP and lateral view **(Fig.1)**.
Lateral approach to the hip (5 cm incision) was used from the tip of greater trochanter of the femur, the iliotibial band and vastus lateralis muscle were incised to expose 4-5 cm of bone surface below the greater trochanter.

In the Targon locking plate TLP group

Targon plate of femoral neck is short and designed to configure to the proximal femur. Proximal fixation was achieved with multiple cannulated cancellous screws to allow for rotational stability. The screws were locked with the plate to prevent subtrochanteric fractures due possible stress riser effect and to enhance the mechanical stability **(Fig.2).**

Preliminary fixation of the fracture using multiple k-wires was done to hold the anatomical reduction. The plate was applied at the lateral aspect of the proximal femur end fixed with K wire so that the upper limit of the plate is positioned approximately at the lower end of the greater trochanter **(Fig.3a)**.

The sleeve for the guide of the cannulated screw was applied followed by drilling, measuring, and application of the screws all were done under guidance of image intensifier **(Fig.3b).** 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 closure of the wound by layer and application of sterile dressing were done.

In the CCS group

After Preliminary fixation of the fracture using multiple k-wires, three guide wires forming an inverted triangle configuration were inserted around in an ante-version angle of 15^0 and testified by the C-arm image intensifier. Then those guide K-wires were measured and drilled, in order to insert three cannulated 6.5 mm partially threaded cancellous screws **(Fig. 4)**.

Postoperative care consisted of intravenous antibiotic [3rd generation cephalosporin for three days and appropriate analgesia was administered when indicated. Low-molecular weight heparin (0.2–0.4 ml, according to the weight of patients) was routinely injected until discharge then Oral anticoagulants (Rivaroxaban) were prescribed for 3 weeks after discharge to prevent deep vein thrombosis.

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 progressive union of the fracture appeared in X-ray, usually after 8 weeks' average. Full weight bearing was permitted after complete union of the fracture. All patients were followed up in the outpatient clinic for at 1, 3, 6, 9, and 12 months postoperatively and then once every 6 months thereafter **(Fig. 5 and 6)**.

Outcome measurement

All clinical data for operative time, incision size, length of stay, incidence of postoperative complications, femoral neck shortening, and fracture healing time were assessed and recorded. AVN of the femoral head and nonunion were judged according to the criteria described by Dhar et al. [5]. The degree of shortening of the femoral neck was categorized as none/mild, < 5 mm; moderate, 5–10 mm; and severe, > 10 mm[6]. The pain was evaluated by visual analogue scale (VAS).[7] Hip function was assessed using the Harris hip score HHS which includes three sections of pain answered by patients, function, and range of motion for deciding the patient hip function, with a total score of 100.[8]

Statistical analysis

Continuous variables were showed as mean ± standard deviation (SD) and statistical analysis was performed using Student's t test. The chi-square test was used to analyze categorical variables. Ranked data was tested by the Mann-Whitney U test. All statistical analyses were performed using SPSS 26.0. $P < 0.05$ was considered as statistically significant.

Results

Our study compared 25 patients treated with TLP to 25 patients treated with CSS. All patients were followed up for at least 1 year (12-36 months). There are no statistically significant differences between the two groups in terms of age, gender, injury sides, Garden classification, and Time before surgery (Table 1, all $P > 0.05$).

Table (1) Showing patients demographics and fracture classification data.

	TLP	CCS	P value
Total number	25	25	-
Gender Male (%) Female (%)	16 (64%) 9 (36%)	18 (72%) 7 (28%)	0.035
Side Right left	14 11	13 12	0.686
Mean age (years)	49.94 ± 8.258	44.8 ± 11.7	0.440
Garden type Nondisplaced (1& 2) Displaced (3 & 4)	11(44%) 14(56%)	13 (52%) 12 (48%0	0.562
Time before surgery (hours)	36.0 ± 24.0	40± 18.0	0.426

No significant differences were found in terms of incision size and length of stay ($P > 0.05$). However, there was a statistically significant increase in operative time in Targon TLP group. Postoperative mean VAS score was significantly lower in TLP than in CCS group and also the mean HHS showed statistically significant improvement in TLP group (83.4 ± 2.1) as compared with CCS group (72.1 ± 3.2) ($P < 0.05$, Table 2).

Table (2) Comparison of operative and postoperative outcomes of two groups

	TLP	CCS	P value
Operative time (minutes)	40.7 ± 16.4	55.4 ± 12.9	. 0.03*
Incision size (cm)	6.0 ± 0.42	5.0 ± 0.55	0.284
Length of stay (days)	5.5 ± 1.3	4.8 ± 1.4	0.214
VAS score [mean]	3.086	4.5	0.009*
Mean Harris hip score	83.4 ± 2.1	72.1 ± 3.2	0.04*

In the TLP group, moderate to severe femoral neck shortness (>5mm) occurred in 9 (36%) of 25 patients. In the ICCS group, moderate - sever femoral neck shortness occurred in 13 of 25 (52%) patients. A significant difference was found between the two groups ($P < 0.05$). There was no significant difference in fracture healing time between the TLP group and the CCS group (3.97 ± 0.35months vs. 4.28 ± 0.39 months, $P > 0.05$). In the TLP group, nonunion occurred in 2 (8%) patients which was significantly lower than CCS group which was 5(20%) patients. There was no statistically significant difference in incidence of a vascular necrosis AVN (1case in each group); infection and overall complications **(Fig.6)** (table 3). Cases developed AVN underwent total hip arthroplasty.

Table (3) Comparison of postoperative follow-up and complications between the TLP and CCS groups

	TLP	**CCS**	**P value**
Fracture healing (months)	3.97 ± 0.35	4.28 ± 0.39	0.431
union	23 (92%)	20 (80%)	0.037*
Nonunion (%)	2(8%)	5(20%)	<0.05*
AVN (%)	1(4%)	1(4%)	
Infection	1(4%)	0	0.481
Overall complications	4(16%)	6(24%)	0.246
>5mm femoral neck shortening	9(36%)	13(52%)	0.035*

Discussion

The results of fixing femoral neck fractures mainly depend on the age of the patient, type of fracture, anatomic reduction, and stable internal fixation[9].

Several implants used for internal fixation of femoral neck fractures and it can be divided into three categories: multiple cannulated cancellous screws, fixed-angle devices that allow dynamic compression, and fixed-angle devices that do not allow for sliding/compression.[10]

Multiple cancellous screws have been proven to be effective in treating femoral neck fractures. However, more and more shortcomings are exposed, that is, the three cancellous screw treatment program has higher complications. the main reason is that the design length of the cancellous screw cannot prevent femoral neck shortening due to bone resorption during the fracture healing process, specifically the head of the screw is located outside lateral wall of femur and the risk of internal fixation loosening is higher[10] .

Targon plate of femoral neck short and designed to configure to the proximal femur. Its proximal fixation with multiple cancellous screws provides rotational stability. The locking plate strengthens biomechanical stability and provides adequate bending and torsion stability which avoids varus collapse and lagging out of screws[11].

In this study, both groups were comparable as regarding the preoperative parameters. Although no significant differences were found in the incision size however, there was a statistically significant increase in operative time in Targon TLP group as compared to cancellous screw group. Alshameeri et al.[12] in a comparative study involving 2004 patients between Targon Femoral Neck (TFN) locking plate system or cannulated cancellous screws reported that the length of surgery was slightly (but statistically significant) higher in the TFN.

We found statistically significant better functional outcomes in TLP group as regarding postoperative VAS score (3.086) versus 4.5 in cannulated screws group and also the mean HHS (83.4 ± 2.1 v. 72.1 ± 3.2). this results are similar to previous study performed by Tang, Y., et al., [13] in 2021 who reported that Harris hip score was significantly better in the femoral neck locking plate group(88.9 ± 4.3) than in the CCS group (84.4 ± 3.2, $P < 0.05$).

The rates of nonunion were 8% in the TLP group which is significantly lower than in CCS group (20%). Femoral neck shortening more than 5mm was much higher in the CCS group. However, the AVN and overall complications didn't differ between both groups. We assume that the major reason for the higher rate of nonunion and femoral neck shortening in the CCS group was insufficient mechanical stability and inability to control rotation. Because of the lack of support on the medial side behind the femoral neck and in cases where the outer cortex was unable to withstand a certain torque, multiple-screw fixation would not be ideal.

In previous similar studies, Wang et al., [14] reported 5.88% nonunion rate in the Targon group and 23.53% in the CCS group. Also Overall complications occurred in (8.82%) treated with Targon plate and in (32.35%) treated with CCS. Parker et al. [15] reported a nonunion rate of 7% in 46 patients who were treated with Targon Femoral Neck Hip Screw for displaced fractures. However, that study had neither a control group nor randomization and was conducted in higher age group. Several studies reported femoral neck shortening was significantly worse in fractures treated with CCS as compared to TLP [13, 14, 16] which match the results of our study.

On the other side Alshameeri et al. studied the treatment of neck fracture using the TFN over a period of 28 years[12]. They demonstrated a 2.7% nonunion rate after undisplaced fractures and 15.4% after displaced fractures.

They 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. Also, Griffin et al. in their randomized controlled study didn't find any evidence that the TLP reduces the risk of fixation failure in patients with an intracapsular fracture of the hip as compared to CCS[17].

We acknowledge some limitations of the current study. First, the trial was conducted at a single center and the sample size is small. Second, although the patients were randomized, double blinding was not performed. Third, the short follow-up time might have an impact on clinical outcomes. Therefore, our results should be confirmed in larger multicentre randomized controlled trials with a longer follow-up period.

Conclusion

Targon locked plate TLP as a treatment for femoral neck fractures has comparable efficacy to CCS with respect to incision length, fracture healing time, AVN and overall complication rates but with longer surgical time. Moreover, TLP achieves superior Harris score, lower VAS score, decreased nonunion rate and less femoral neck shortening. Thus, TLP is a feasible alternative to CCS for the treatment of femoral neck fractures.

Conflict of interest and financial disclosure
None to be disclosed.

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Figure (1) A: Showing positioning of the patient B: showing the reduction of the fracture under image intensifier.

Figure (2) Showing the design of Targon plate with locked screws.

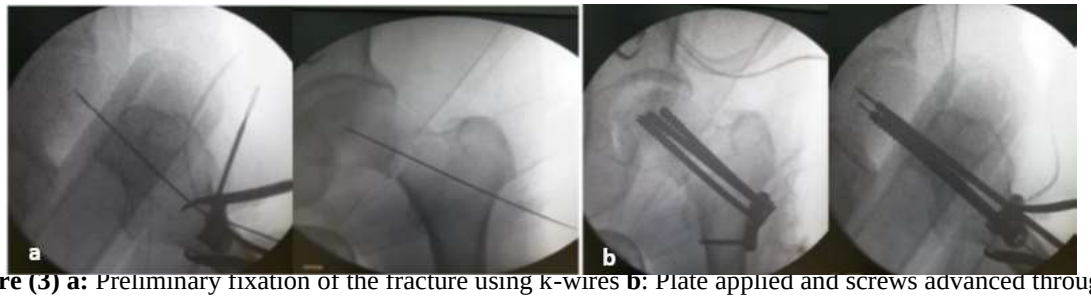

Figure (3) a: Preliminary fixation of the fracture using k-wires **b**: Plate applied and screws advanced through guide wires and position was checked by fluoroscopy at (A.P. and Lateral views).

Figure (4) Showing intra-operative fixation of fracture neck femur with 3 CCS.

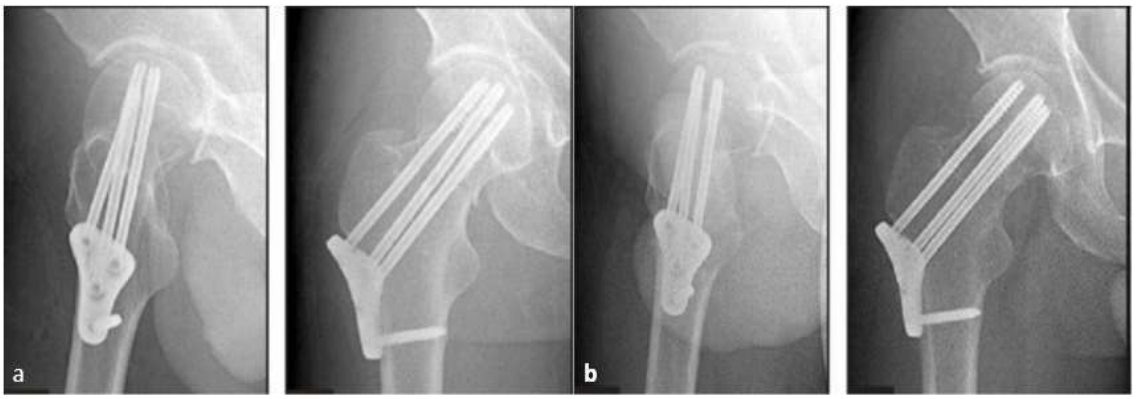

Figure (5) Showing follow up of a 45years old female treated with TLP at one month (a) and at 6 months with complete healing of fracture neck femur.

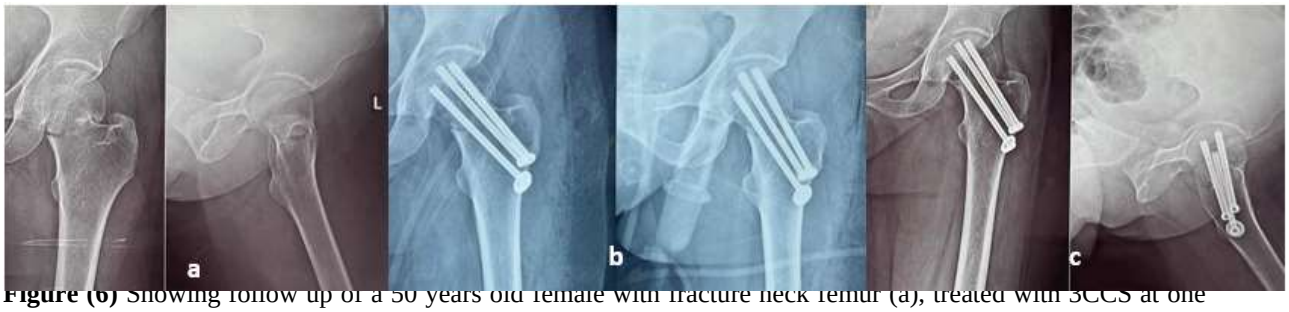

Figure (6) Showing follow up of a 50 years old female with fracture neck femur (a), treated with 3CCS at one month (a) and at 6 months with complete healing.

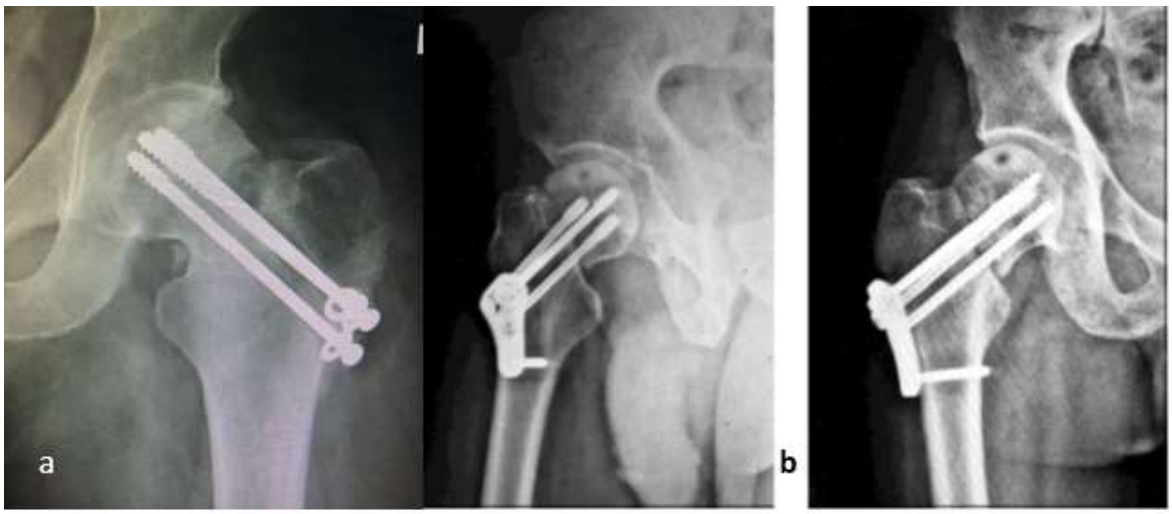

Figure (7) examples of complications we met in both groups (a): femoral neck collapse and nonunion after 7 months of fixation with cannulated screws.(b): A vascular necrosis after fixation with Targon locked plate