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Femoral neck fracture osteosynthesis: comparative study between biplan double support screw fixation method and inverted triangle conventional method

Islam.S.Zaghloul, Elsayed.M.Mohammadi, Mahmoud.I.Qandil and Emad.S.Hussein
Orthopedic Surgery Dept., Faculty of Medicine, Benha University
E-mail: dr.islam8484@gmail.com

Abstract

Background: The rate of femoral neck fractures increases constantly among the aging population. The primary goal of this research was to evaluate the role of biplan double-support screws fixation (BDSF) method in comparison to inverted triangle cannulated compression screws (ICCS) for treatment of femoral neck fractures. **Methods:** This study included 30 patients who suffered from fracture of the neck of the femur 15 patients treated by internal fixation using the method of BDSF and 15 patients treated by ICCS. All patients were subjected to detailed history, Physical examination, and Radiological examination (Standard AP and lateral plain X-ray, AP in internal rotation when needed), CT scan when X-ray didn't show fracture **Results:** There was a significant relation between hospital stay (P=0.001) and complications (P=0.031), and the method of fixation. There was statistically significant relation between time till union and the outcome in BPDS group and ICCS group (P=0.012, P=0.001 respectively). There was statistically significant relation between Harris score of the fracture and the complication in BPDS group (P=0.031). There was statistically significant relation between Pawel classification, time till union, Harris score of the fracture and the complication in ICCS group (P=0.027, 0.010, and <0.001 respectively) **Conclusions:** BDSF method is biomechanically better than inverted triangle method by providing additional cortical support & increasing fixation strength. Even in uncooperative patients, the BDSF-method offers accurate fixation, early recovery, and outstanding long-term results.

Keywords: Femoral Neck Fracture, Biplan Double Support Screw Fixation, Inverted Triangle Conventional Method, Osteosynthesis.

1. Introduction

Fractures of the femoral neck are a common and problematic orthopedic ailment, especially among the elderly. These fractures are linked with substantial morbidity, death, and impairment of function. The selection of surgical approach for femoral neck fracture osteosynthesis is critical for attaining favorable results and reducing complications [1].

Biplan double support screw fixation and the inverted triangle traditional method are two extensively utilized techniques for femoral neck fracture treatment. The biplan double support screw fixation method entails the installation of numerous screws in a certain configuration, resulting in increased stability and load-bearing capability. The inverted triangle traditional approach, on the other hand, employs a triangular arrangement of screws to facilitate fracture reduction and fixation [2].

Due to the lack of consensus about the appropriate surgical method for femoral neck fracture osteosynthesis, comparative research is necessary. Although these methods have been widely employed, there is minimal information addressing their respective benefits and consequences [3].

Therefore, this study aimed to evaluate the role of BDSF method in comparison to ICCS for treatment of femoral neck fractures.

2. Methods

This study comprised 30 patients who presented to Nizwa Orthopedic and Traumatology Hospital with a femoral neck fracture. The patient was treated with internal fixation with 7.3 mm self-tapping cannulated screws and began restricted weight bearing with two crutches for 2–4 months.

The study was conducted after receiving approval from the Benha University Faculty of Medicine's research ethics committee. All involved subjects gave their informed permission.

All patients on admission underwent a detailed history from the patients including Personal data, History (mechanism of injury, affected side, time lapse between the injury and the time of management), Physical examination, and Radiological examination (Standard AP and lateral plain X ray, AP in internal rotation when needed). A CT scan was performed on individuals with suspected femoral neck fractures when a standard X-ray did not reveal a fracture.

All patients were treated with internal fracture fixation utilizing 7,3 mm self-tapping cannulated screws. Analgesia was administered to every patient.

Surgical technique:

The signs were Fractures of NOF, Garden kinds I through IV. The implants utilized were self-tapping cannulated screws measuring 7.3 millimeters in diameter. The reduction was accomplished with minimal traction, internal rotation, and abduction of the limb. Only anatomical reductions are permissible.

Approach: Starting at the level of the lower end of the greater trochanter and extending 6–10 centimeters distally, a straight lateral incision is made to perform the ICCS. At 6–7 cm, the periosteum of the lateral diaphysis is stripped away. In BPDS, we adjusted the procedure to be completely percutaneous. (**Figure 1a)**

Placement of the implants:

The surgical procedure begins with the insertion of the distal cannulated screw's guiding wire. The tip of the wire is positioned 5-7 cm distal to the base of the trochanter on the anterior one-third of the femoral diaphysis. After tangentially contacting the distal

femoral neck cortex, the wire enters the dorsal part of the femoral head.

Next, the center guiding wire is installed as the second step. Its entry point is located in the dorsal one-third of the diaphysis, approximately 2-4 cm proximal to the entry point of the distal wire. This wire is angled at 135-140 degrees relative to the diaphyseal axis, inclined from posteriorly-distally to anteriorly-proximally. It penetrates the front one-third of the femoral head after tangentially contacting the distal femoral neck cortex. In the frontal plane (A-P view), the tip of this guiding wire enters the distal one-third of the femoral head. **(Figure 1b,c)**

The proximal guiding wire is placed last, 1–2 cm proximally from the entry site of the middle wire, at the dorsal one-third of the diaphysis, close to the beginning of the trochanter. Parallel to the middle wire, the proximal wire penetrates the anterior one-third and proximal one-third of the femoral head. **(Figure 1d,e,f,g)**

The guiding wire's tip is maneuvered in the desired direction using a cannulated tool and the operator's free hand. As it passes through the thick diaphyseal cortex, the wire undergoes changes in orientation.

Subsequently, individual screw placement and drilling take place. The lateral cortex's intermediate and distal screw holes are enlarged using a 7.0 mm cannulated reamer before insertion. The proximal and intermediate screws, which are perpendicular to the fracture surface, are placed first. Following the removal of foot traction, additional screw tightening is performed to address any remaining fracture impactions. Finally, the distal screw is inserted. **(Figure 1h,i)**

The radiography length ranged from 0.2 to 0.3 minutes, while the average surgery duration using the BDSF approach was 39 minutes, with a range of 30 to 45 minutes.

In the BDSF approach, three cannulated screws are strategically positioned in the frontal plane at a highly obtuse angle. The distal and intermediate screws are placed in a way that ensures tangential contact with the distal femoral neck's cortical curvature. From an anterior-posterior (A-P) perspective, when the leg is internally rotated, the projection of the distal screw overlaps with the projections of the other two screws, forming the shape of the letter "F" (referred to as the F-technique). **(Figure 1n,o)**

The BDSF technique utilizes the biplane placement approach, where the three screws are strategically positioned in two vertically oblique planes when viewed laterally. These planes are inclined in relation to the frontal plane and diverge towards the femoral head. The distal screw is positioned in the dorsal oblique plane, while the proximal and intermediate screws are located in the ventral oblique plane. **(Figure 1n,o)**

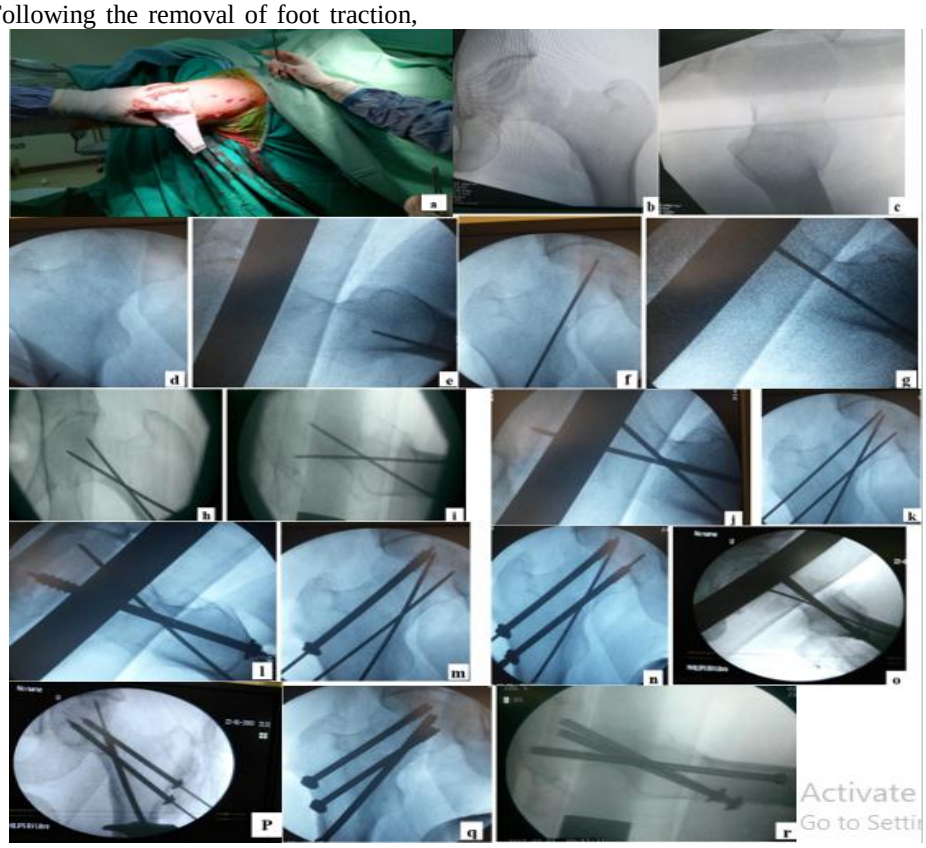


Fig. (1) Approach and placement. a) The percutaneous approach, b,c) Anatomical reduction of the fracture in AP and Lateral views, d,e,f,g) Placement of distal wire, h,i) Placement of the middle wire, j,k) placement of the proximal wire, l,m) placement of the proximal screw, n,o) placement of the middle screw, p) placement of the distal screw, q,r) final AP and lateral view of the BDSF technique.

Postoperative care and follow-up

Vital indicators were diligently documented throughout the post-operative period. Intravenous administration of antibiotics was maintained twice daily for three days. Adequate analgesics were provided as needed for pain management. On the day after surgery, X-rays were obtained to evaluate the quality of reduction and the positioning of the screws. A period of three months of limited activity followed. After three weeks, the incisions were removed. Subsequently, monthly follow-up appointments were scheduled for a duration of twelve consecutive months. During each follow-up session, patients underwent clinical and radiological assessments, including X-rays.

Clinical assessment:

During the follow-up assessment, patients were asked about any discomfort experienced during both activity and rest. Their ability to walk and stand was also evaluated. The range of motion of the hip joint was assessed using the Harris Hip Scoring System [4]. The overall functional outcome was categorized based on the total score as follows: an excellent outcome indicated a Harris hip score between 91-100, a good outcome fell within the range of 81-90, a fair outcome ranged from 71-80, and a poor outcome was defined as a score below 70. Satisfactory results were considered excellent or good, while unsatisfactory outcomes were categorized as fair or poor.

Radiological assessment:

Radiological assessments were conducted by obtaining plain X-ray images in both anterior-posterior (AP) and lateral views. These images were taken at monthly intervals to evaluate the progress of fracture union and identify any potential complications.

Statistical analysis:

Data were entered into the computer and analyzed using version 20.0 of the IBM SPSS software suite (Armonk, NY: IBM Corp). Qualitative data were characterized using numbers and percentages and analyzed with the chi-square test, Fisher's exact test, or Monte Carlo correction, as applicable. The Kolmogorov-Smirnov test was utilized to confirm the distribution's normality. The range (minimum and maximum), mean, standard deviation, and median were used to characterize quantitative data, which was analyzed using the Student t-test. At the 5 percent significance threshold, the acquired findings were deemed significant [5].

3. Results

The research comprised a total of 30 participants diagnosed with femoral neck fractures. Among them, 15 individuals were treated using the Biplane Double Supported Screw Fixation (BDSF) method, while the remaining 15 patients underwent treatment with the inverted triangle conventional compression screw fixation (ICCS) technique.

In BPDS group Patients below 40 years were 4 patients (26.7%), 5 patients aged 40 –60 years (33.3%) Six patients aged above 60 years (40%). In ICCS group 8 patients (53.3%) aged 40-60 years, 4 patients aged above 60 years and 3 patients aged above 40 years.

In BPDS group nine patients (60%) were males and the other 6 (50%) patients were females while in ICCS group eight patients (53.3%) were females and seven patients (46.7%) were males.

In BPDS group there are 3 fractures (20%) Patients classified as garden type I, 4 fractures (26.7%) classified as garden type II, 5 fractures (33.3%) classified as garden type III and 3 fractures (20%) classified as garden type IV. In ICCS group there are 6 fractures (40%). Patients were classified as garden type I, 3 fractures (20%) classified as garden type II, 3 fractures (20%) classified as garden type III and 3 fractures (20%) classified as garden type IV.

In BPDS group there are 5 fractures (33.3%) Patients classified as pauwel type I, 3 fractures (20%) classified as pauwel type II, 5 fractures (46.7%) classified as pauwel type III. In ICCS group there are are 6 fractures (40%) Patients classified as pauwel type I, 4 fractures (26.7%) classified as pauwel type II, 5 fractures (33.3%) classified as pauwel type III**.**

Hospital stay had a mean value of 2.67±0.82 days in BPDS group and 4.60±1.64 days in ICCS group.

BPDS: thirteen patients (80%) had a satisfactory outcome, while two patients (20%) had an unsatisfactory outcome. ICCS: 9 patients (80%) had a satisfactory outcome, while 6 patients (20%) had an unsatisfactory outcome, 3 of them (10%) didn't unite. **Figure 2**

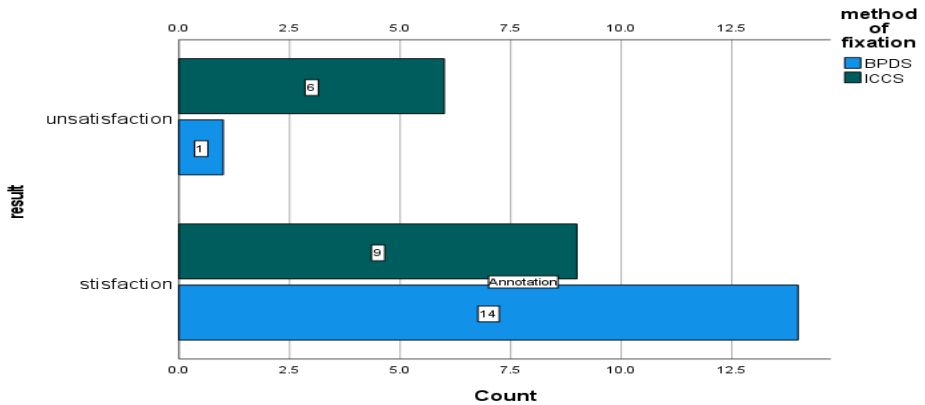


Fig. (2) Distribution of the studied patients regarding outcome.

A significant association was observed between the method of fixation and both hospital stay (P=0.001) and complications (P=0.031). However, no significant relationship was found between the method of fixation and variables such as time till union, blood loss, Harris score of the fracture, fracture outcome, days before surgery, surgical time, and X-ray exposure. **Table 1**

Table (1) Relation between Method of fixation, time till union, blood loos, Harris score, results, complications, Days before surgery, Surgical time & x-ray exposure and hospital stay (days).

		Method of fixation		x^2	p
		BPDS (n = 15)	**ICCS (n = 15)**		
Time till union	**≤3**	11 (73.3 %)	8 (53.3 %)	1.292	0.256
	>3	4 (26.7 %)	7 (46.7 %)		
Blood loss	**Mild**	14 (93.3 %)	13 (86.7 %)	0.370	1.000
	Moderate	1 (6.7 %)	2 (13.3 %)		
Harris score	**Excellent**	10 (66.7 %)	4 (26.7 %)	7.071	0.070
	Good	3 (20 %)	5 (33.3 %)		
	Fair	2 (13.3 %)	2 (13.3 %)		
	poor	0 (0 %)	4 (26.7 %)		
Harris score	**Satisfactory**	13 (86.7 %)	9 (60 %)	Fisher	0.099
	unsatisfactory	2 (13.3 %)	6 (40 %)		
Complication	**Yes**	1 (6.7 %)	6 (40 %)	4.65	0.031*
Days before surgery		1.67±1.11	1.40±0.74	-0.696	0.486
Surgical time & x-ray exposure		72.33±13.15	63.93±20.75	1.3	0.196
hospital stay (days)		2.67±0.82	4.60±1.64	-3.269	0.001*

Data is presented as mean ± SD or frequency (%), *significant as P<0.05.

A statistically significant association was observed between the time till union and the outcome (P=0.012). However, in the BPDS group, no statistically significant relationship was found between variables such as age, sex, side affected, Garden Classification, and Pawel classification of the fracture and the outcome. **Table 2**

Table (2) Relation between outcome and age, sex, side affected, garden classification of fracture, Pawel classification, time till union of the patients in BPDS Group

		Outcome		P
		Satisfactory (n = 13)	**Unsatisfactory (n = 2)**	
Age (years)	**<40**	4 (30.8 %)	0 (0 %)	0.649
	40 – 60	4 (30.8 %)	1 (50 %)	
	>60	5 (38.5 %)	1 (50 %)	
Sex	**Male**	9 (69.2 %)	0 (0 %)	0.063
	Female	4 (30.8 %)	2 (100 %)	
Side affected	**Right**	6 (46.2 %)	1 (50 %)	0.919
	Left	7 (53.8 %)	1 (50 %)	
Garden	**I**	2 (15.4 %)	1 (50 %)	0.511
Classification	**II**	4 (30.8 %)	0 (0 %)	
	III	4 (30.8 %)	1 (50 %)	
	IV	3 (23.1 %)	0 (0 %)	
Pawel classification	**I**	4 (30.8 %)	1 (50 %)	0.719
	II	3 (23.1 %)	0 (0 %)	
	III	6 (46.2 %)	1 (50 %)	
Time till union (day)	**≤3**	11 (84.6 %)	0 (0 %)	0.012*
	>3	2 (15.4 %)	2 (100 %)	

Data is presented as frequency (%), *significant as P<0.05.

A statistically significant association was found between the time till union and the outcome (P=0.001). However, in the ICCS group, no statistically significant relationship was observed between variables such as age, sex, side affected, Garden Classification, and Pawel classification of the fracture and the outcome. **Table 3**

Table (3) Relation between outcome and age, sex, side affected, garden classification of fracture, Pawel classification, time till union of the patients in ICCS Group

		Outcome		p
		Satisfactory (n = 9)	**Unsatisfactory (n = 6)**	
Age (years)	**<40**	2 (22.2 %)	1 (16.7 %)	0.886
	40 – 60	5 (55.6 %)	3 (50 %)	
	>60	2 (22.2 %)	2 (33.3 %)	
Sex	**Male**	3 (33.3 %)	4 (66.7 %)	0.205
	Female	6 (66.7 %)	2 (33.3 %)	
Side affected	**Right**	6 (66.7 %)	3 (50 %)	0.519
	Left	3 (33.3 %)	3 (50 %)	
Garden Classification	**I**	5 (55.6 %)	1 (16.7 %)	0.113
	II	2 (22.2 %)	1 (16.7 %)	
	III	2 (22.2 %)	1 (16.7 %)	
	IV	0 (0 %)	3 (50 %)	
Pawel classification	**I**	5 (55.6 %)	1 (16.7 %)	0.79
	II	3 (33.3 %)	1 (16.7 %)	
	III	1 (11.1 %)	4 (66.7 %)	
Time till union (day)	**≤3**	8 (88.9 %)	0 (0 %)	0.001*
	>3	1 (11.1 %)	6 (100 %)	

Data is presented as frequency (%), *significant as P<0.05.

A statistically significant correlation was observed between the Harris score of the fracture and the occurrence of complications (P=0.031) in the BPDS group. However, no statistically significant relationships were found between variables such as age, sex, side affected, garden classification of the fracture, Pawel classification, time till union, and the occurrence of complications. **Table 4**

Table (4) Relation between complications and Age, sex, side affected, garden classification of fracture, Pawel classification, time till union, and Harris score in BPDS Group

		Complications				
		nil (n = 14)	**screw (n = 1)**	**cut**	**out**	**P**
Age (years)	**<40**	4 (28.6 %)	0 (0 %)			0.343
	40 – 60	4 (28.6 %)	1 (100 %)			
	>60	6 (42.9 %)	0 (0 %)			
Sex	**Male**	9 (64.3 %)	0 (0 %)			0.205
	Female	5 (35.7 %)	1 (100 %)			
Side affected	**Right**	6 (42.9 %)	1 (100 %)			0.268
	Left	8 (57.1 %)	0 (0 %)			
Garden Classification	**I**	3 (21.4 %)	0 (0 %)			0.543
	II	4 (28.6 %)	0 (0 %)			
	III	4 (28.6 %)	1 (100 %)			
	IV	3 (21.4 %)	0 (0 %)			
Pawel classification	**I**	5 (35.7 %)	0 (0 %)			0.542
	II	3 (21.4 %)	0 (0 %)			
	III	6 (42.9 %)	1 (100 %)			
Time till union (day)	**≤3**	11 (78.6 %)	0 (0 %)			0.086
	>3	3 (21.4 %)	1 (100 %)			
Harris score	**Excellent**	10 (71.4 %)	0 (0 %)			0.031*
	Good	3 (21.4 %)	0 (0 %)			
	Fair	1 (7.1 %)	1 (100 %)			

Data is presented as frequency (%), *significant as P<0.05.

In the ICCS group, a statistically significant relationship was observed between the Pawel classification (P=0.027), time till union (P=0.010), Harris score of the fracture (P<0.001), and the occurrence of complications. However, no statistically significant associations were found between variables such as age, sex, side affected, and garden classification of the fracture in relation to the occurrence of complications. **Table 5**

Table (5) Relation between complications and Age, sex, side affected, garden classification of fracture, Pawel classification, time till union, and Harris score in ICCS Group

		Complications				
		nil (n = 9)	**Non-union (n = 4)**	**AVN (n = 1)**	**screw cut out (n = 1)**	**p**
Age (years)	**<40**	2 (22.2 %)	1 (25 %)	0 (0 %)	0 (0 %)	0.315
	40 – 60	5 (55.6 %)	3 (75 %)	0 (0 %)	0 (0 %)	
	>60	2 (22.2 %)	0 (0 %)	1 (100 %)	1 (100 %)	
Sex	**Male**	3 (33.3 %)	3 (75 %)	0 (0 %)	0 (0 %)	0.267
	Female	6 (66.7 %)	1 (25 %)	1 (100 %)	1 (100 %)	
Side affected	**Right**	6 (66.7 %)	2 (50 %)	0 (0 %)	1 (100 %)	0.475
	Left	3 (33.3 %)	2 (50 %)	1 (100 %)	0 (0 %)	
Garden Classification	**I**	5 (55.6 %)	0 (0 %)	0 (0 %)	1 (100 %)	0.059
	II	2 (22.2 %)	0 (0 %)	1 (100 %)	0 (0 %)	
	III	2 (22.2 %)	1 (25 %)	0 (0 %)	0 (0 %)	
	IV	0 (0 %)	3 (75 %)	0 (0 %)	0 (0 %)	
Pawel classification	**I**	5 (55.6 %)	0 (0 %)	0 (0 %)	1 (100 %)	0.027*
	II	3 (33.3 %)	0 (0 %)	1 (100 %)	0 (0 %)	
	III	1 (11.1 %)	4 (100 %)	0 (0 %)	0 (0 %)	
Time till union (day)	**≤3**	8 (88.9 %)	0 (0 %)	0 (0 %)	0 (0 %)	0.010*
	>3	1 (11.1 %)	4 (100 %)	1 (100 %)	1 (100 %)	
Harris score	**Excellent**	4 (44.4 %)	0 (0 %)	0 (0 %)	0 (0 %)	<0.001*
	Good	5 (55.6 %)	0 (0 %)	0 (0 %)	0 (0 %)	
	Fair	0 (0 %)	0 (0 %)	1 (100 %)	1 (100 %)	
	poor	0 (0 %)	4 (100 %)	0 (0 %)	0 (0 %)	

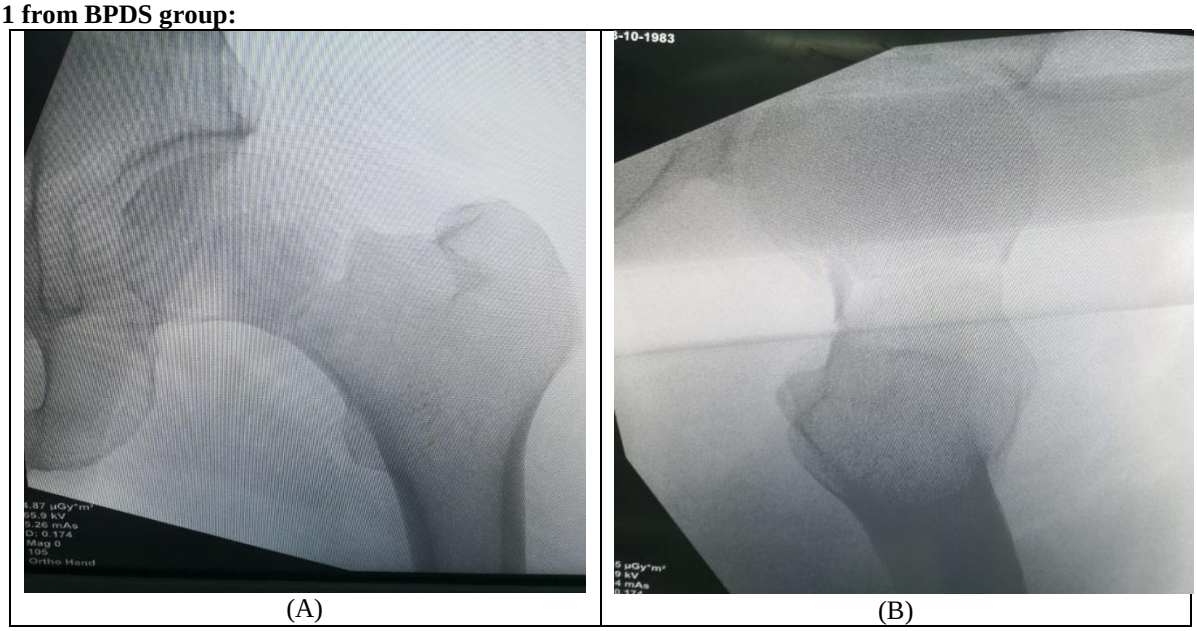
Data is presented as frequency (%), *significant as P<0.05.

Four of our cases were complicated by nonunion all are in ICCS study group and were treated by THR and vascularized fibular graft, there was one case of AVN in ICCS study group, there was no case complicated by infection either superficial or deep, and there were 2 cases complicated by disabling shortening and screw cut out one case in each study group.

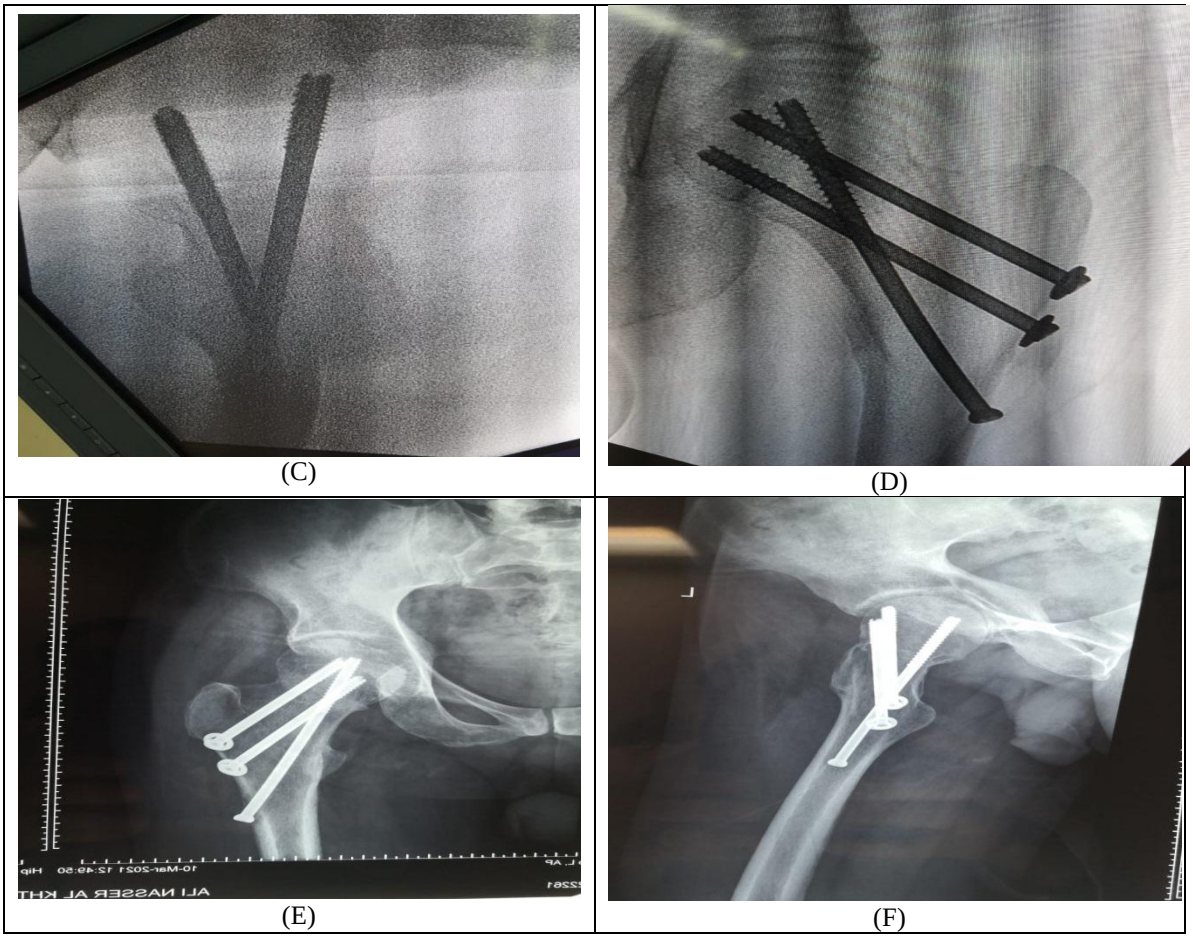
Cases:

Case 1 from BPDS group:

Male patient aged 55 years old, was presented to emergency unit with left hip pain and inability to weight bearing with history of falling down one day before. Routine X ray was done, and we found fracture left neck of femur Garden III. She Operation was done after 24hrs. Limited weight bearing for 2 months. Union occurred within 4 months. He was graded as excellent. **Figure 3**



(A) (B)

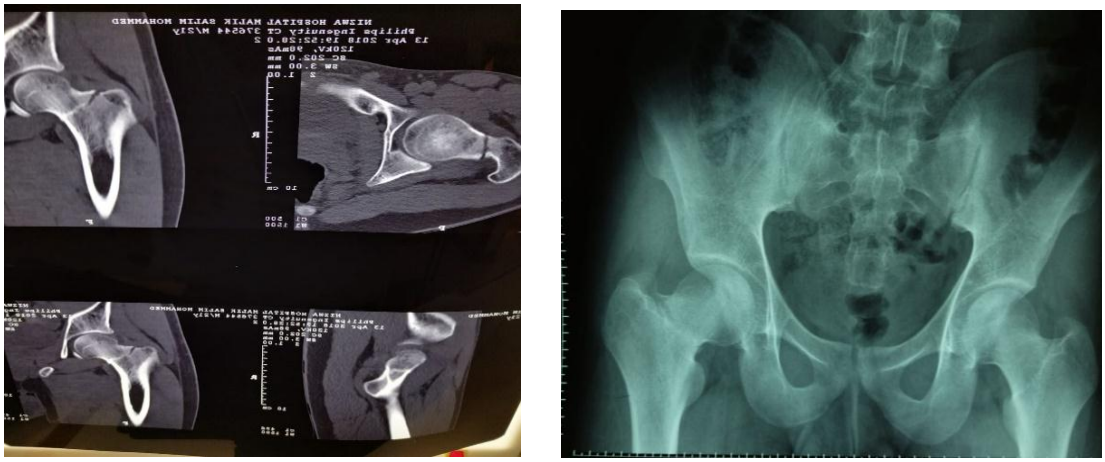


(C) (D) (E) (F)

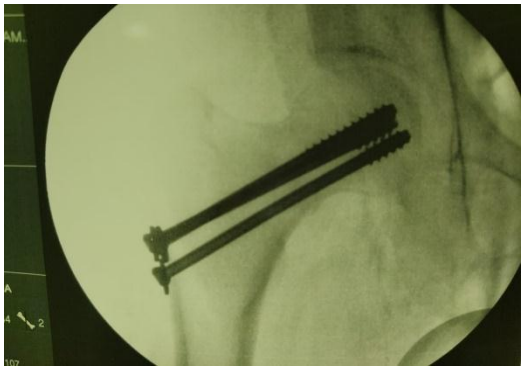
Fig. (3) (A, B) Pre-operative X-rays, C,D) Post-operative X-rays, E, F) Follow up X-rays.

Case 1 from ICCS group:

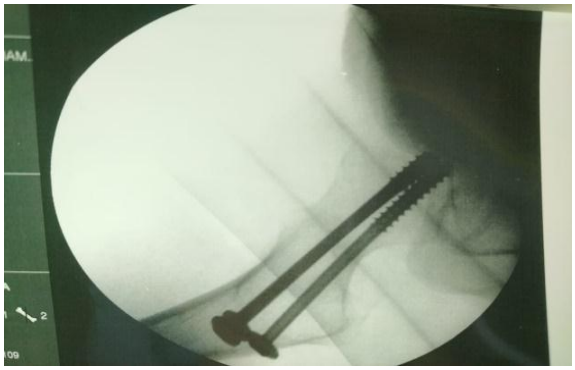
Male patient aged 23yrs years was presented to the emergency unite with lt hip pain and inability to weight bearing after falling from 3meter height. Routine x-rays showed fracture neck of the right femur garden III, confirmed with CT. Operation was done after 24hrs. Limited weight bearing for 1months. Union occurred within 3 months. The patient was graded excellent. **Figure 4**



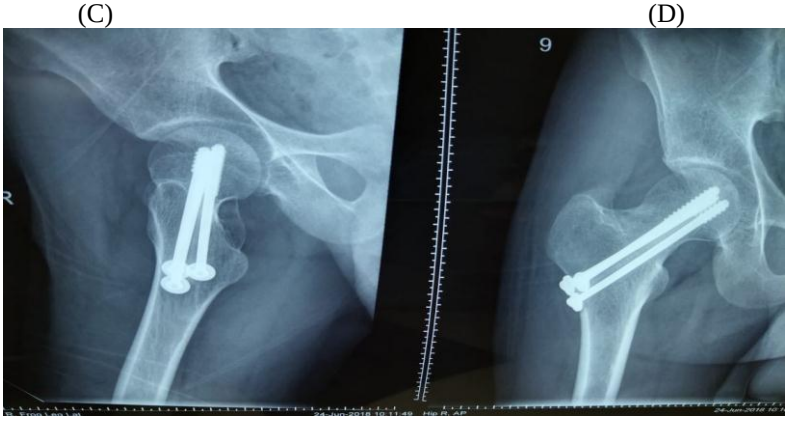
(A) (B)



(C)



(D)



(E)

Fig. (4) (A, B) Preoperative X-rays, and CT, C, D) Postoperative X-rays, E) Final AP and lateral views of the fracture

4. Discussion

Femoral neck fractures remain one of the unsolved fractures; these are fractures with a high incidence of nonunion and avascular necrosis. The incidence of these complications is higher in displaced fractures than non-displaced fractures.[6]

In this work, the treatment of femoral neck fractures using cannulated screws was assessed.

We reviewed the literatures. And we found that there are many authors who studied the same subject.

In a prospective, randomized research, C. Rogmark et al. compared the effectiveness of internal fixation and primary arthroplasty in the treatment of displaced fractures of the femoral neck in 409 patients aged 70 or older. The failure rate for the internal fixation group was revealed to be 43%, compared to 6% for the arthroplasty group. 36 percent of patients in the internal fixation group suffered walking disability and 6 percent had severe pain, compared to 25 percent and 1.5 percent, respectively, in the arthroplasty group. There was no mortality difference between the two groups [7].

In a prospective, randomized study, Blomfeldt R et al. investigated the effects of treating 102 patients with displaced fractures of the femoral neck with internal fixation and primary arthroplasty. The mortality rate in both groups was judged to be 25%. The incidence of hip complications was 4% among patients treated with total hip replacement and 42% among those treated with internal fixation. Comparatively, the reoperation rates were 4% and 47%. In the arthroplasty group, hip function was significantly enhanced and the decline in health-related quality of life was substantially less pronounced than in the fixation group. [7].

They discovered that, compared to internal fixation, initial complete hip replacement provides a superior outcome for cognitively capable older patients with a displaced femoral neck fracture. The rates of complications and reoperation are drastically decreased, while hip function and health-related quality of life are dramatically enhanced.

Implant choice

Kadakia, et al. [8] In a retrospective study of 97 patients with femoral neck fractures treated with cancellous screws, average age 81.3 years, median operative delay 2 days, with mean follow up 12 months. 79.4% of patients achieved good outcome, 19.6% reoperative rate, of which; 6.4% arthroplasty, 6.5% removal of screws, 30% of patients did not return to their prefracture activity level.

Higgins G.A., et al. undertook a retrospective analysis of the outcomes of 116 femoral neck fractures treated with A.O. cancellous screws, comprising 104 non-displaced fractures, with a minimum of two years of follow-up. The median age of the patients was 71, and two-thirds of them were female. They noticed that 85% of patients regained to their pre-disease level of ambulation and 90% received good pain relief, therefore they concluded that cancellous screws fixation of the fractures in the neck of the femur is a successful treatment option [9].

Our work included 30 patients suffered from femoral neck fractures 15 patients treated by BPDS and 15 patients treated by ICCS using A.O. cannulated

screws, we got in BPDS groups 13 (86.7%) satisfactory cases and 2 (13.3%) unsatisfactory cases, and in ICCS group 9(60%) satisfactory cases and 6(40%) unsatisfactory cases

According to Harris Hip score, the functional outcome of the patients in BPDS group were 10 excellent, 3 good and 2 fair and 0 poor results, and in ICCS group were 4 excellent, 5 good and 2 fair and 4 poor results, the union occurred within 3 to 6 months.

From these studies, they concluded that internal fixation of femoral neck fractures using A.O. cancellous screws by BPDS method is a better option of treatment with low incidence of complications than ICCS method.

Diagnosis of fractures of the neck of the femur

The diagnosis of femoral neck fractures may need imaging techniques other than ordinary plain x-ray.

Lee CE, et al. [10] demonstrated the role of MRI in diagnosis of non-displaced fractures of the neck of the femur.

In our work, we found patients with normal x-rays and their fractures diagnosed after further investigations e.g. CT scan, so many patients may be lost by this way with subsequent displacement of primary non displaced fracture and its conversion into displaced fracture with increased risk of complications.

Factors affecting fixation:

Age: Parker et al. evaluated the relationship between age or gender and the incidence of fracture healing complications in 1133 patients with femoral neck fractures treated with internal fixation. They observed that the incidence of nonunion increased with age, from 1 of 17 (5.9%) in patients younger than 40 to 84 of 337 (24.9%) in patients older than 70. With the exclusion of individuals who passed away within a year after injury, the rate of nonunion continued to grow among patients aged 80 and beyond. [11].

In the present investigation, there was no correlation between age and outcome in either study group.

2- Delay of surgery:

In their study, Karaeminogullari O et al. evaluated the impact of fracture displacement and delay of surgery on the prognosis of internally repaired femoral neck fractures. The risk of avascular necrosis was 12.5 percent among patients who underwent surgery within 12 hours, compared to 14 percent among those who underwent surgery more than 12 hours later. Nonunion rate was 25% for individuals who underwent surgery within 12 hours and 27% for those who underwent surgery afterwards. [12].

In the current study, there was no significant relation between delay of surgery and the outcome in both study groups, may be due to no delaying in the surgery in both groub the mean of delay of surgery in both groups was near to each other, in BPDS was 1.67 and in ICCS was 1.40.

Sex:

Lee YH, et al. [13] In their study, they found significant relation between outcome and sex, as the outcome become worse in elderly female patients. This is attributed to higher number of studied cases with higher age group (mean age 67).

In the current study, we did not find significant relation between the sex and outcome in both groups.

Fracture displacement:

Parker et al. investigated the association between fracture displacement and the occurrence of fracture healing problems in 1133 individuals with femoral neck fractures. They discovered that the incidence of nonunion was 19.3 percent overall. Fracture nonunion was observed less frequently in nondisplaced fractures than in displaced fractures (48 of 565 [8.5 percent] versus 171 of 568 [30.1 percent]) [11].

In the current study, we did not find significant relation between the fracture displacement and outcome in both study groups. This may be due to lower sample size in our work (30 patients).

Positioning of the screws

Filipov O. [14] examined 88 of 178 operated patients. Of the 88 patients reviewed, 27 (30.68 percent) are male and 61 (69.31 percent) are female. Average age is 76.9 years (with the youngest patient aged 38 and the oldest aged 99). The fractures have been classed as follows, in accordance with the Garden classification: Garden type I: 3 (3.41 %); Garden type II: 1 (1.14 %); Garden type III: 9 (10.23 %); Garden type IV: 75 (75 %). (75%). (85.02%). A 6 to 10 cm long, straight lateral incision originating at the level of the greater trochanter's inferior border. The three screws are positioned in two vertically divergent planes in accordance with the BDSF's biplane placement concept (in lateral view). Intermediate and proximal screws are positioned in the ventral oblique plane, whereas the distal screw is positioned in the dorsal oblique plane.

Fracture union was observed in 87 of 88 individuals (98.86%), whereas 1 patient had failure (1.13%).

Assessment using the Harris hip score: In ten cases, unfavorable results were seen (11.36%). Fair results – in 20 patients (22.72%). Excellent results – in 21 patients (23.86%). Excellent results – in 37 patients (42.04%).

In the current study, we used the Biplane double supported screw fixation (BDSF) method in fifteen patients with femoral neck fractures. Thirteen patients (87.3%) gave satisfactory outcome, while 2 patients (13.3%) gave unsatisfactory outcome, one of them has screw cut out and used inverted cannulated compression screw (ICCS) method in fifteen patients with femoral neck fractures. Nine patients (60%) gave satisfactory outcome, while 6 patients (40%) gave unsatisfactory outcome, four of them have nonunion, one patient has AVN, and one patient has screw cut out.

Advantages of BDSF method Than ICCS method

The proximal femur's angular, spiral form exposes the femoral neck to severe shear, bending, and torsion stresses. To offer resistance to shearing pressures in cases of osteoporosis, the implanted screws must be firmly linked to the distal fragment at a minimum of two supporting locations. Traditional femoral neck fixation methods, which consist of three cancellous screws placed parallel to each other and parallel to the femoral

neck axis, are linked with unsatisfactory results in 20 to 48 percent of patients [8, 15-18].

The new method of BDSF increases the fixation strength by its innovative concept of biplane positioning of the three screws, which makes it possible for the screws to be placed at an increased angle, so they lean on two solid supporting points.[19]

The BDSF-method comprises two calcar-buttressed implants, namely the distal and intermediate screws. With the BDSF approach, the entry sites of two of the implants may be positioned far more distally, in the solid cortex of the proximal diaphysis, and also lean into the distal cortex of the femoral neck [19].

Thus, we provide two supporting arguments. The solid cortex of the calcar serves as the medial supporting point, whilst the entry points of the distal and middle screws in the solid cortex of the proximal diaphysis serve as the lateral supporting point [19].

The position of the distal and central screws changes them into a simple, vertically loaded beam with an overhanging end. This beam with a protruding end successfully supports the head fragment by bearing body weight and passing it to the diaphysis while resisting shear forces (in a standing position). In the sagittal plane (in lateral view), the distal screw makes contact with the posterior cortex of the femoral neck, so providing a posterior supporting point that applies pressure in the posterior direction during the antero-posterior bending of the neck (e.g. when rising from a chair) [19].

In addition to the data given in the recently published biomechanical comparative research, the current clinical evaluation confirms that the enhanced effectiveness of BDSF is a result of its greater fixation strength.

With its very robust cortical support and greater screw angle, BDSF enables instantaneous full weight-bearing, as indicated by the high Harris Hip Score functional results and the patients' good independent daily living skills. In recent years, the use of hemiarthroplasties for displaced femoral neck fractures has increased, however it is crucial to note that more than 90 percent of these fractures can heal, and 85% of these fractures will heal without problems [20].

After a few guided applications, the BDSF technique can be readily taught; however, for less-experienced surgeons, anatomical fracture reduction and precise C-arm imaging interpretation may be more difficult. Even in reluctant patients, the BDSF-method provides precise fixation, rapid recovery, and exceptional long-term outcomes. BDSF is primarily aimed for those with contraindications to arthroplasty and conventional screw fixation [21].

The BDSF method has several advantages, including a small learning curve, low cost, short operative time, and the need for a standard operating room, but the only critical point is the perfect positioning of the guide wires, which at first may appear challenging but can be quickly mastered by adhering to the principles [22].

Limitations of the study: low sample size.

5. Conclusion

Anatomical reduction is the most significant aspect of either closed or open femoral neck fracture repair. Biomechanically, the BDSF approach is superior than the inverted triangle method because it provides more cortical support and increases fixation strength. Even in uncooperative patients, the BDSF-method offers accurate fixation, early recovery, and outstanding long-term results.

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