Treatment of Intracapsular Femoral Neck Fracture with Multiple Cannulated Lag Screws and Minimal Capsulotomy

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Abstract:

Background: Intracapsular femoral neck fracture (ICFNF) was and still is a challenge for orthopedic surgeons; and among few accepted methods of treatment, the most widely used is multiple cannulated lag screws (CLS); but still there are some controversies in the accepted time lapse for operation and age limit of the patients.

Objective: To evaluate "fixation by multiple (CLS) and minimal capsulotomy" as a treatment of choice for (ICFNF) in wide variety age groups, and after different times since the fracture happened.

Patients and Methods: from (Dec. 2014-Sep. 2017) 23 patients with (ICFNF) were selected from those admitted to the orthopedic surgery department in Azadi Teaching Hospital Kirkuk. The time lapse before the surgery ranged from 1/2-6 days; the patient's ages ranged from 14-62years. All were treated by fixation with multiple (CLS) and minimal capsulotomy. The outcomes studied monthly both clinically and radiologically in duration from 8 to 20 months.

Results: Fourteen cases (61%) were rated as excellent, six cases (26%) as good, two cases (9 %) as fair, and one case (4%) was rated as poor; according to the pain, limp and range of movement (Severen's criteria). Complications were recorded in four cases (17%) in the form of superficial infection in one case, malunion in two and both in the other.

Conclusion: This method can be used successfully in treating (ICFNF) in wide age groups and even after a delay of up to 6 days.

Keywords: Intracapsular femoral neck fracture, Cannulated lag screws, Minimal capsulotomy, Fracture treatment.

Introduction:

The femoral neck is the commonest site of fractures in the elderly [(1)], but it can occur at any age according to the trauma mechanics and strength. Treatment of fractured neck of femur was and still is a challenge for orthopedic surgeons; and among few accepted methods of treatment, the most famous and widely used one is the use of multiple cannulated lag screws [(2, 3)]; but still there are some controversies in the accepted time lapse for operation and age limit of the patients [(1)]. In a trial to answer the above questions, the best efforts are tried in this study. There are many contributions to the healing of these types of fractures like articulation anatomy, the type and grade of the fracture, blood supply to the area and the method of the fixation, so we will try to give a brief about these [(1, 2, 3)].

The hip joint is the articulation between the hemispherical head of the femur and the cup-shaped acetabulum of the hip bone [(4)]. The capsule of the joint is attached circumferentially around the

labrum and transverse ligament, whence it passes laterally, like a sleeve, to be attached to the intertrochanteric ridge, but behind it being attached halfway along the femoral neck [4]. Blood supply of the femoral head[5]: trochanteric anastomosis provides the main source of blood for the supply of the head of the femur, the anastomosis lies near the trochanteric fossa; it is formed by anastomosis of the descending branch of the superior gluteal artery with the ascending branches of both lateral and medial circumflex femoral arteries. The inferior gluteal artery usually joins the anastomotic branches from the anastomosis and passes along the femoral neck beneath the retinacular fibers of the capsule [4, 5, 6], figure (1).

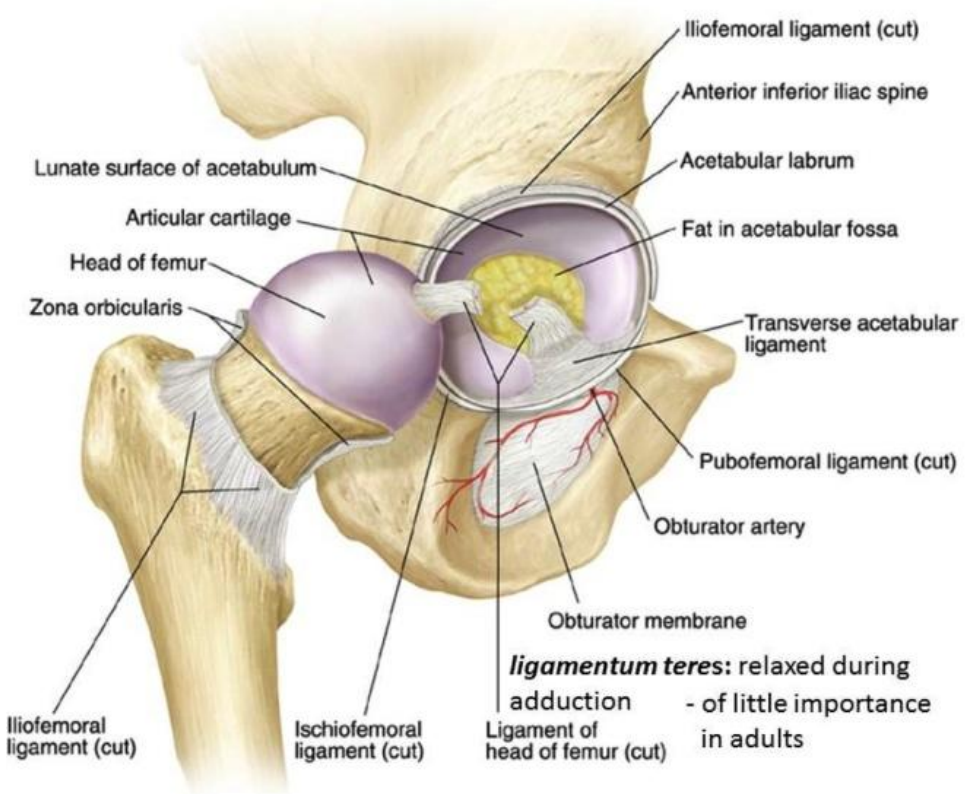


Figure (1): Hip joint anatomy.

Intracapsular femoral neck fractures Classification: There are many classifications, but the most famous and widely used is Garden's classification [1, 2]: Garden stage I: the fractures are incomplete, with the head tilted in a posterolateral direction and these called impacted fractures. Garden stage 2: the fractures are complete but undisplaced. Garden stage 3: the fractures are complete and partially displaced, as judged by the direction of the trabecular stream in the head fragment, but the two fragments remain in contact with each other. Garden stage 4: the fractures are completely displaced and the trabeculae of the femoral head realign themselves with the trabeculae within the acetabulum [5, 6], figure (2).

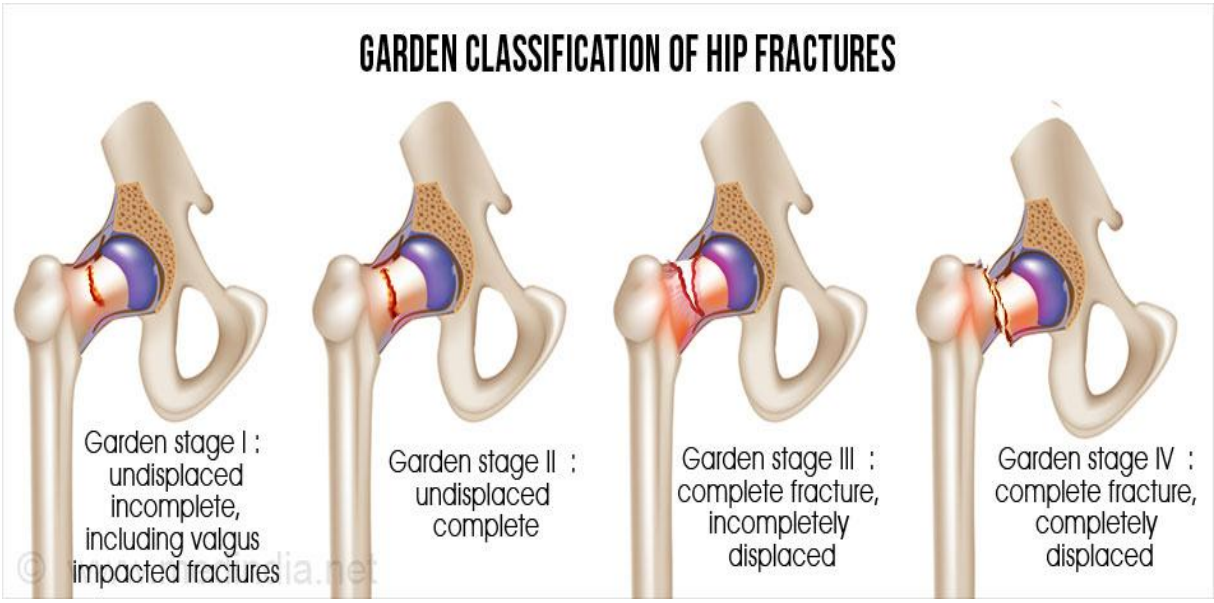


Figure (2): Garden's classification of (ICFNF).

Patients and Methods:

Patient's collection: In this retrospective study, from December 2014 to September 2017, 23 patients with intracapsular fracture neck of femur in different age groups, different classes, and presented after different time intervals since the fracture happened, all were studied and analyzed following treatment by internal fixation with multiple cannulated lag screws and minimal capsulotomy in orthopedic department of Azadi Teaching Hospital. Most of the patients presented with the classic picture of (shortened externally rotated affected lower limb) [1, 2], except in those with impacted fractures, where they looked normal apart from pain, tenderness and difficulty in moving the limb. Resuscitation was done for them, legal police observation reports and routine laboratory investigations, according to their age and needs, (hemoglobin, blood glucose, blood urea, serum creatinine, electrocardiogram) were done for them accordingly, then after application of Thomas splint and/ or skin traction, they were send to radiology department for x-rays which revealed fractured neck of femur with different classes and types.

Excluding criteria:

1. Those who are not fit to general or spinal anesthesia.
2. Those with associated acetabular fractures.
3. Those with compound fractures.
4. Those with delay presentation for more than two weeks.
5. Those with comminution of the lateral wall.
6. Those who refused to accept treatment by this technique.

Methods: Preoperative planning was done by revision of the operative technique details, rechecking of the radiograms and preparation of the operative tools (cannulated lag screws set) with screws of different sizes, while the final measurement is usually done peroperatively with the use of a guide wire and the aid of image intensifier. General assessment for all patients was

done in cooperation with the anesthetist and the physician, and prophylactic antibiotics were used for all patients in form of (l gram Cefotaxime) intravenously at time of induction of anesthesia and repeated 12 hourly postoperatively for at least 72 hours [7]. Then operation did in form of open reduction and minimal capsulotomy to evacuate the hematoma and internal fixation done with multiple cannulated lag screws [8, 9].

After care: The following steps were focused on in cooperation with the physiotherapist [7, 10]:

Day 0: encouraging breath exercises to prevent chest complications.

Day 1: encouraging the patient to move from the hospital bed to a chair, or at least dangling his feet from the side of the bed.

Day 2: encouraging beginning getting up and walking with a walker and support (protected) without placing too much weight on the affected side. After being able to move a little comfortably, the wound was examined, the dressing changed, and then they were discharged.

The follow up: The patients were followed monthly clinically and accordingly radiologically in the outpatient or the private clinics. Radiographs were examined for evidence of union of the fracture and for any evidence of avascular necrosis and collapse of the head of the femur.

Clinically, the patients were examined periodically for skin incision healing, presence of signs of infections, any deformity, range of hip motion, gait and limb length discrepancy. Also, all the patients were questioned for the presence of pain, stiffness and ability to perform daily activities and this was done by direct interview sometimes and by phone calling most of the times. All the above results were recorded continuously. And the assessment had done according to the following criteria:

Radiological assessment: The first radiological signs of union were decrease in density of the edge of the fracture site, and then trabeculae formation across the fracture gap.

Clinical assessment: The results were assessed according to Severin's criteria [11, 12] in which the patients are classified into excellent, good, fair and poor results, table (1).

1) The results were considered Excellent if there was no pain; no limping was noticed or trivial limping and full movements of the hip or less than 10° restriction of movement of the hip joint.

2) The results were good if there was no pain, slight limping was noticed and restriction of movement was between 10°-20°.

3) The results were Fair when occasional pain, and noticeable limping occurred and moderate restriction of movement of the hip was 20°-30°.

4) The results were Poor if regular or marked limping occurred or severe restriction of movements was more than 30°.

Results:

Patients criteria Age, gender and fracture side: The patients were 14-62 years of age with an average of 38 years,12 of them were females (52%) and 11 were males (48%), in 13 of them the right femur was fractured (57%) and in the other 10 the left femur was fractured (43%), table (2).

Causes of the fractures: Four cases (17%) were caused by trivial traumas after simple fall from a chair or simple slipping and falling on ground, six (26%) cases were because of falls from height, three cases (13%) were because

of sport injuries, other 10 cases (44%) were because of road traffic accidents, table (2), figure (3).

Fractures classification: X-ray revealed intracapsular fractured neck of femur with Garden stage I in three cases (13%), Garden II in eleven cases (48%), Garden III in seven cases (30%), and Garden IV in two cases (9%), table (2), figure (4).

Time interval between the fracture happening and the operation: The time interval between the injury that caused the fracture of the femoral neck and the internal fixation operation varied from 12 hours to 144 hours (1/2 a day to 6 days) with an average of 39 hours (around 2 days), table (2), figure (5).

Final results Radiological assessment results: Radiographs were examined for evidence of union of the femoral neck fracture and for signs of avascular necrosis of the femoral head, figure (6), figure (7).

The union rate: According to the radiological assessment and follow up union occurred in all the cases (100%), but the union completed in each case after different times, ranged from 2 to 6 months with an average of 3.5 months, table (3), figure (8).

Clinical assessment results: Follow up duration ranged from 8 to 20 months with average of (14) months. The above grading (Severen's) was applied to the patients after complete union according to the radiological signs evaluation, and final results of this study are as follows:

1) Fourteen cases were rated as excellent (61%).

2) Six cases were rated as good (26%).

3) Two cases were rated as fair (9%).

4) One case was rated as poor (4%), figure (9).

Complications: Few complications in four (17%)cases were recorded in this study and those are: one of them case No. 21 was superficial infection-stich site- responded well to antibiotics and did not required even drainage, the other case No. 7 was malunion-coxa valgum-causing apparent shortening of about 2.5 cm with moderate restriction of flection, abduction, and external rotation making the patient walk with apparent limping and treated by shoe raising, and this caused fair result but tolerated well by the patient, figure (10). The third case was No. 18 again simple infection treated easily, but there was also some residual malunion with some limitation of movement accepted by the patient (fair result). But the 4th complicated case was case No. 22 which was simple malunion but the pain was un-tolerated by the patient (poor result), eventually treated by one stage hip joint replacement. Although the complications rate look high but the types of them were simple and treated with accepted final results, table (4).

Table (1): Severen's criteria for clinical assessment of patients after hip surgery.

	Group	pain	gait (limp)	Movements
1	Excellent	no pain	no, or trivial limp	full movement, or simply restricted
2	Good	no pain	slight limp	mildly restricted movements 10-20 degrees
3	Fair	occasional pain	noticeable limp	moderately restricted movements 20-30 degrees
4	Poor	regular pain	marked limp	severely restricted movements >30 degrees

Table (2): Patients criteria.

No.	gender	age	fracture side	cause of the fracture	Garden class	time lapse before surgery	follow up duration
1	female	14 years	right	road traffic accident	II	12 hours	20 months
2	male	16 years	right	road traffic accident	III	12 hours	18 months
3	female	17 years	left	fall from height	III	24 hours	8 months
4	male	21 years	left	fall from height	IV	18 hours	10 months
5	male	23 years	right	sport injury	II	16 hours	12 months
6	female	27 years	right	road traffic accident	II	18 hours	10 months
7	male	28 years	right	road traffic accident	III	48 hours	18 months
8	male	32 years	right	road traffic accident	II	24 hours	16 months
9	male	35 years	left	sport injury	I	24 hours	15 months
10	male	37 years	left	road traffic accident	II	18 hours	18 months
11	female	37 years	right	road traffic accident	II	16 hours	12 months
12	female	38 years	right	road traffic accident	I	20 hours	12 months
13	male	42 years	left	road traffic accident	I	12 hours	12 months
14	male	42 years	right	sport injury	II	17 hours	10 months
15	female	43 years	right	road traffic accident	II	16 hours	12 months
16	male	45 years	left	fall from height	II	48 hours	18 months
17	female	45 years	right	fall from height	IV	72 hours	10 months
18	female	50 years	left	trivial trauma	II	96 hours	12 months
19	female	51 years	left	fall from height	III	24 hours	19 months
20	female	52 years	left	fall from height	III	72 hours	10 months
21	female	55 years	right	trivial trauma	III	144 hours	15 months
22	male	61 years	right	trivial trauma	III	72 hours	12 months
23	female	62 years	left	trivial trauma	II	72 hours	20 months

Table (3): The union rate.

union time	number of patients
< 2 months	0
2-3 months	6
3-4 months	10
4-5 months	3
5-6 months	3
> 6 months	1

Table (4): Clinical and radiological results.

case	union time	pain	gait (limp)	movements	result	complication
1	2 months	no	normal	normal	Excellent	No
2	3 months	no	slight limp	mild restriction	Good	No
3	2 months	no	normal	normal	Excellent	No
4	3.5 months	no	slight limp	mild restriction	Good	No
5	3.5 months	no	normal	simple restriction	Excellent	No
6	3 months	no	normal	normal	Excellent	No
7	5 months	occasional	noticeable	moderate restriction	Fair	Malunion
8	2 months	no	normal	normal	Excellent	No
9	2.5 months	no	normal	normal	Excellent	No
10	3.5 months	no	normal	normal	Excellent	No
11	3 months	no	normal	normal	Excellent	No
12	3.5 months	no	trivial limp	simple restriction	Excellent	No
13	2 months	no	normal	normal	Excellent	No
14	2.5 months	no	slight limp	mild restriction	Good	No
15	3 months	no	slight limp	mild restriction	Good	No
16	3 months	no	normal	normal	Excellent	No
17	4 months	no	trivial limp	simple restriction	Excellent	No
18	5 months	occasional	noticeable	moderate restriction	Fair	infection & malunion
19	4 months	no	trivial limp	simple restriction	Excellent	No
20	3 months	no	slight limp	mild restriction	Good	No
21	6 months	no	slight limp	mild restriction	Good	Infection
22	4 months	regular	marked limp	severely restricted	Poor	malunion
23	5 months	no	trivial limp	simple restriction	Excellent	No

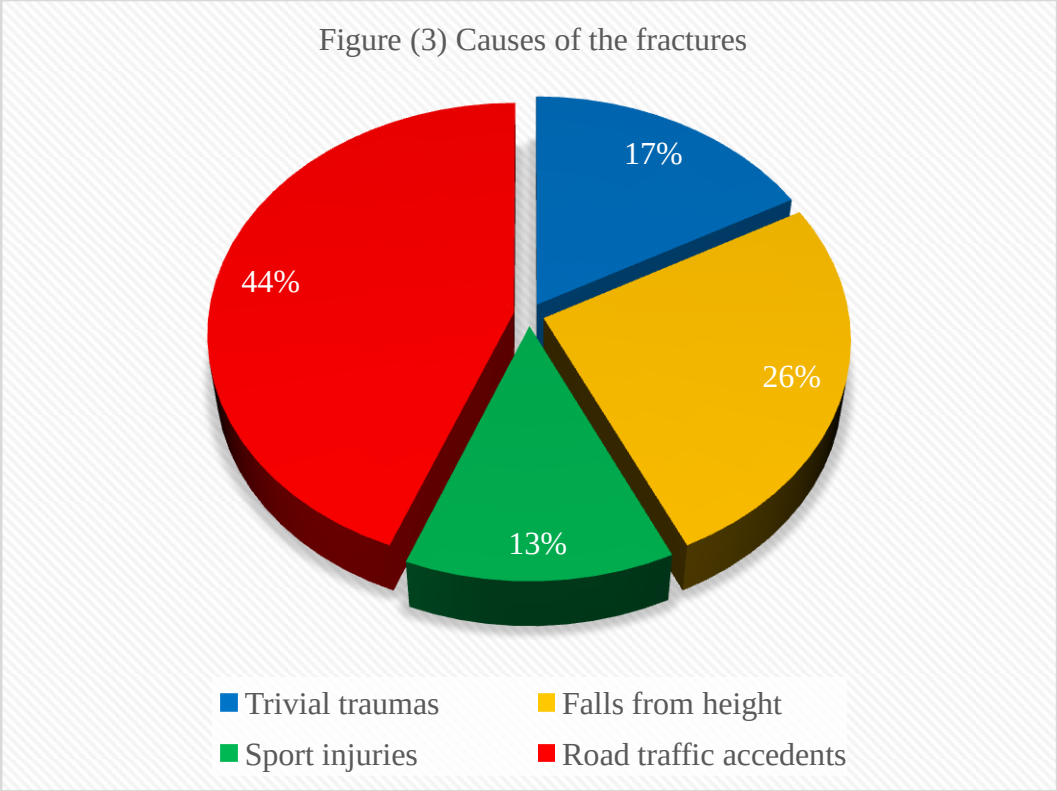


Figure (4) no. of cases in each class.

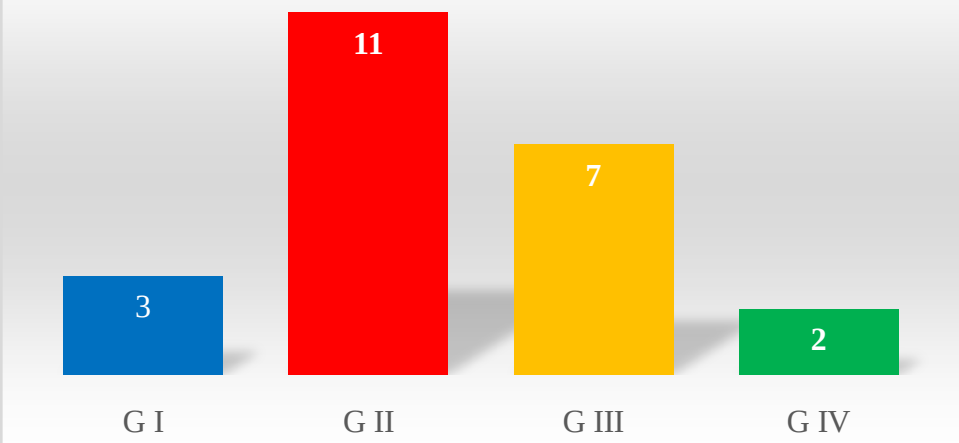
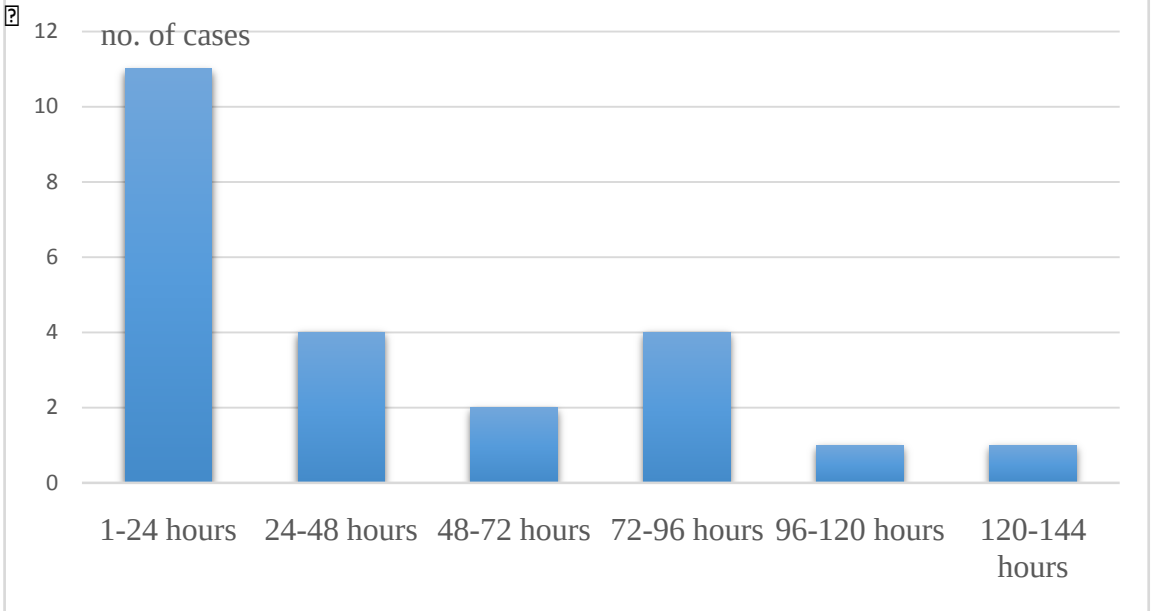


Figure (5) time interval between the fracture happening and the operation.



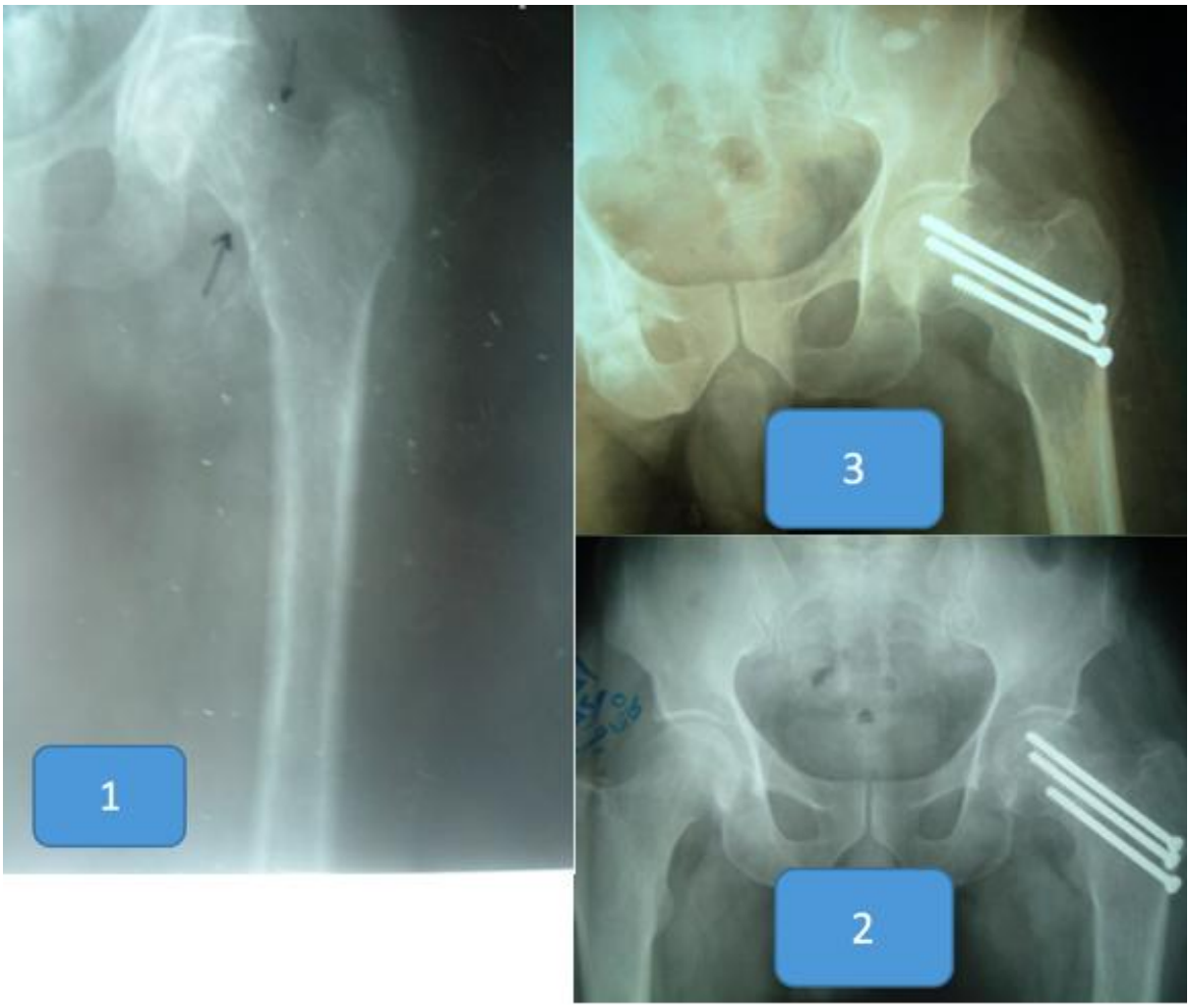


Figure (6): Case 18 from table 2 in the result. Radiological assessment (1 at presentation, 2 after one-month post-operative, 3 three months' post-operative).

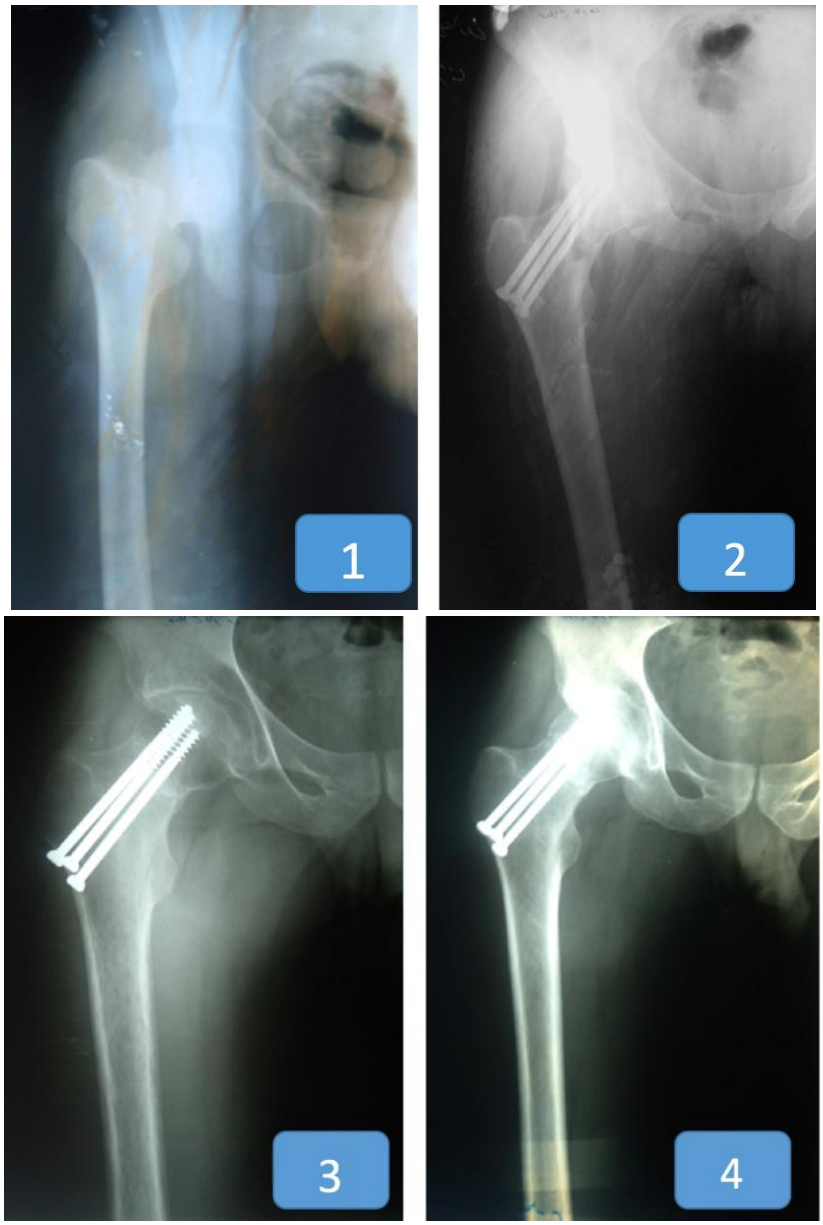


Figure (7): Case 6 from table 2 in the result. Radiological assessment (1 at presentation, 2 post-operative, 3 after one month, 4 after two months).

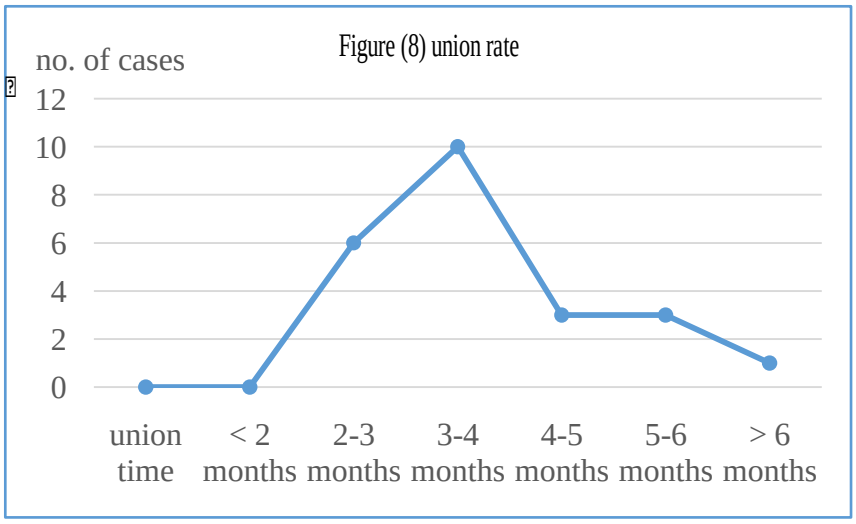


Figure (10): X-ray film of case 19 from table 4 show malunion coxa valgum as complication. Note: the directions of screws became wrong after the malunion.

Discussion:

George, H.L. et al treated 40 patients with femoral neck fractures presented within 24- 78 hours, age group between 14-48 years, operated on by primary fixation using 6.5 mm AO cancellous screws, after follow up of 2-5 years, in a retrospective study they reported union in all cases [13], just like ours all united, but the union were (80%) within 8 weeks in our study within 11 weeks this difference could be because of the technique of capsulotomy or the type of the screws, they recorded one infection and we recorded two mostly because of the protocols of sterilization in the theater, the final results are merely the same.

Barnes, R. et al in a long-term investigation of 1,503 subcapital fractures of the femur, almost all of which were treated by reduction and internal fixation (with different methods). Delay of up to one week before operation had no significant effect on the incidence of non-union or of late segmental collapse. The age and physical state of the patient, the accuracy of reduction, and the security of fixation had the greatest influence on union [14], in our study we also noticed that delay up to 6 days had no effect on causing non-union by using this method. Although many articles insist on the point that the surgery should be done as early as possible with no delay.

Rehnberg, L. et al described a method of internal fixation for femoral neck fractures with two cannulated screws in 44 consecutive patients, all fractures healed within 12 months, 4(9%) cases developed segmental collapse [15]. In our study we used 3 screws, all fractures healed within 6 months, (9%) were fair result because of residual pain and some malunion (segmental collapse). So no significant difference in union rate but earlier with the use of 3 screws.

Lu-Yao GL. et al they used fixation with different methods in 106 patients with Garden III and IV, within 2 years (33%) were converted to arthroplasty [16]. In our study cases were all Garden classes, we converted only (4%) to arthroplasty within the 1st year, this because Garden I, II fractures give better results using this technique.

Rosell PA. et al found that the functional ability of the patients after hip fractures decline in (15-20%) of them [17]. In our study the sum of fair and the poor results were (13%), this may be due to the social difference (closed family members) and lower demands of our patients.

Gerber C. et al treated 54 young and 397 old patients with fractured neck femur, they have (3.5%) of cases with different complications and about (20%) needed revision surgery [18]. While in this study complication rate is higher about (17%), while revision rate is lesser (4%), mostly because of the influence of health insurance companies and the low demand society of our patients, the small sample size in our study too.

Robinson CM. et al in study done on 166 cases of fractured neck femur, both infection and malunion rate together were (5%) [19] the complication rate was (17%) in our study much higher but all were simple except one (4%), which considered not significant comparing the sample sizes.

Bray TJ. et al Concluded that early (within 24 hours) rigid reduction and cannulated screws fixation with capsular hematoma decompression achieved optimum outcome [20]. In our

study open reduction within 6 days and internal fixation with multiple cannulated lag screws and minimal capsulotomy to evacuate the hematoma resulted in excellent and good outcome in (87%), and accepted outcome in other (9%).

Xu JT. Et al in meta-analysis of studies on mortality of early surgery vs delayed in femoral neck fractures concluded that early surgery was associated with low risk of death [21]. In our delay for 6 days also not caused death, but we had some exclusion criteria.

Wang W. et al in meta-analysis of studies of healing rate and avascular necrosis after open reduction vs closed reduction of fracture neck femur, they says that healing rate is the same but avascular necrosis higher in closed reduction [22]. We also recorded no avascular necrosis – mostly- because we performed capsulotomy (open) in the cases.

Gao H. et al in meta-analysis on displaced femoral neck fractures in elderly found that arthroplasty can reduce the risk of major complication and reoperation [23]. Arthroplasty in our study was done only in one case, but the others did well mostly because of their low social demands (they are not obliged to work to live they got big families close to each other) not like abroad.

Damany DS. Et al in meta-analysis of 18 published studies they observed that displaced intracapsular hip fractures were more common than undisplaced (79.9% vs 25.6%) overall [24]. In our study undisplaced fractures were more common (61% vs 39%) mostly because of our exclusion criteria (compound, associated with lateral wall, and associated with acetabular fractures).

Conclusions and Recommendations:

Conclusions:

Minimal capsulotomy and fixation with multiple cannulated lag screws is a simple and good method for treating intracapsular femoral neck fractures in wide age groups even after a delay up to 6 days, but still the rate of complications was relatively high, although' they were simple and easily treatable with functionally accepted final outcome, especially in societies like our locality. This technique is doing well when other methods of treatment are not applicable or available because it will not affect future procedures like total or partial hip replacement arthroplasties.

Recommendations:

Further collections of cases in order to evaluate more precisely this technique in more wide and different age groups. Increase the follow up duration for more time to be able to exclude more accurately segmental collapse and avascular necrosis.

Acknowledgements:

Many people contribute to the conduct of this study, this section seek to acknowledge their valuable assistance. So we would like to thank all members of orthopedic surgery department and all members of anesthesia department in Azadi Teaching Hospital. And our special thanks for Dr. Ali Adwal for providing the motivation to publish this, and his generous scientific support.

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