

## **AIM OF THE WORK**

The aim of this work is to evaluate the results of hemiarthroplasty of the hip using minimally invasive antero-lateral approach in management of fracture neck of femur in elderly patients, (over 60 years).

## **PATIENTS AND METHODS**

This study included 20 patients with fracture neck of femur managed with hemiarthroplasty using minimally invasive antero-lateral approach.

Patients above 60 years old present with fracture neck of femur were included in the study.

Full preoperative assessment including clinical and radiological examination with routine investigations was done for every patient and postoperative clinical and radiological evaluation was done too.

### **Age:**

The age of the patients included in the study range from 62 to 86 with median age of 73.05 (table 1).

**Table 1: Age group**

Age group (in years)	No. of patients	(%)
60-70	8	40
>70-80	6	30
>80-90	6	30
Total	20	100.0

### **Sex:**

The study included 17 males (85%) and 3 females (15%).

### **Side:**

The study included 15 (75%) patients presented with right side hip fracture and 5 (25%) patient with left side hip fracture.

### **Type of fracture:**

There were 12 patients (60%) had Garden IV fracture, while 8 patients (40%) had Garden III type of fracture.

### **Body weight:**

The body weight of the patients ranged from 65 to 100 kg; with a mean of 76 kg.

### **Mechanism of injury:**

Simple fall on the ground was the responsible mechanism in 15(75%) patients and history of external rotation in 5 (25%) patients.

### **Time lapsed between injury and operation:**

It ranged from 1 day to 9 days with a median time 3.2 days (table 2).

**Table 2: Time lapsed between injury and operation**

Time lapsed between injury and operation (days)	No. of patients	%
< 3 days	11	55
3-6 days	7	35
> 6	2	10
Total	20	100.0

### **Medical history:**

There were 5 patients having no associated diseases, while the remaining 15 suffered from different medical problems. (Table 3)

**Table 3: Patients' Medical history**

Associated diseases	No. of patients	%
Medically free	5	25
HTN	10	50
DM	5	25
IHD	4	20
Others	4	20

### **Associated injuries:**

There were a single patient who had associated bimalleolar fracture left ankle, another patient had right olecranon fracture and another had fracture lower end right radius.

### **Hip examination**

Pain, shortening and external rotation deformities were present in all patients at time of admission.

### **Preoperative radiological assessment:**

Preoperative plain x-ray in the form of antero posterior view of both hips and lateral view of the affected hip were done for every patient and the fractures were diagnosed and classified according to Gardens classification.<sup>(82)</sup>

### **Laboratory investigations:**

Full laboratory investigations were done for every patient including

- Complete blood picture.
- Fasting blood sugar.
- Bleeding time, clotting time and prothrombin time.
- Blood urea and creatinine.
- Liver enzymes.

A single patient was found to be anemic, 5 patients were found to be diabetic, 1 patient was found to have liver disease and 2 patients were found to have renal insult.

### **Pre- injury functional ability score:**<sup>(97)</sup>

The patients were classified into five groups according their pre-injury functional ability score:

**Table 4: Pre injury score**

a	active ambulatory	4 points	4
b	Community ambulatory	3 points	10
c	Indoor ambulatory	2 points	6
d	Assisted by another person	1 point	0
e	Bedridden	0 point	0

### **Methods of treatment:**

All patients were treated by hemiarthroplasty using minimally invasive antero-lateral approach after taking informed consent from every patient.

### **Surgical technique (figure 26-31):**

- A- Spinal anesthesia for 17 patients and general anesthesia for 3 patients according to their medical condition.
- B- Preparation and draping in the lateral decubitus position.
- C- Intravenous antibiotics were given to all patients with the induction of anesthesia.
- D- Minimally invasive anterolateral approach was used in all patients.

Skin incision is oblique, 6 to 8 cm in length, starting from the tip of the greater trochanter and directed anteriorly, medially and distally, making an angle of about 45 degrees with the longitudinal axis of the thigh and continue in the interval between the gluteus medius and the tensor fasciae latae. The hip can then be exposed by flexion and external rotation of the femur, which delivers the fractured femoral neck out of the joint, thereby allowing access to the fractured head in the acetabulum. Three Hohmann retractors are used, the 1<sup>st</sup> one at the tip of the greater trochanter to retract the gluteus medius muscle, the 2<sup>nd</sup> one at the medial side of the neck of the femur and the 3<sup>rd</sup> one is put over the anterior rim of the acetabulum to allow direct vision of the hip joint.

E- Excision of the femoral head and neck.

F- Preparation of the femoral canal using reamers.

G- Irrigation of the femoral canal with saline and plug insertion in the appropriate position.

H- Application of bone cement.

I- Insertion of the unipolar prosthesis (Thompson) or insertion of the femoral component and the head with appropriate size if modular prosthesis (bipolar or modular unipolar) is used.

J- Reduction of the hip and examination of stability after reduction.

K- Closure in layers.



**Figure 25:** Minimally invasive anterolateral approach



**Figure26:** Skin incision



**Figure 27:** Excision of the femoral head



**Figure 28:** Femoral canal preparation



**Figure 29:** Insertion of cemented stem



**Figure 30:** Reduction of the hip



**Figure 31:** Closure in layers

## **Post operative care**

- A- **General** assessment of the patients for vital signs.
- B- Intravenous antibiotic administration for at least 2 days.
- C- Hemoglobin level was detected to decide for post operative blood transfusion.
- D- Early ambulation with walking aids on the second day postoperatively.

## **Radiological evaluation**

Following points were assessed using plain x-ray

- A- Position of the femoral component in the femoral canal (central, varus or valgus).
- B- Leveling of the prosthesis.
- C- Reduction of the head in the acetabulum.
- D- Position of the bone cement.
- E- Detection of any intraoperative complications.

## **Clinical assessment:**

All patients were encouraged for assisted weight bearing the second day postoperatively and evaluation was done two weeks later by the Harris hip score to detect the functional ability of every patient then final evaluation was done after six months to reach the final functional ability of every patient using the same score.

**The clinical results were assessed according to Harris hip scoring system:<sup>(98)</sup>**

- Three patients had Scores >90 and were considered excellent.
- Ten patients had Scores between 81 and 90 and were considered good.
- Four patients had Scores between 71 and 80 and were considered fair.
- Three patients had Scores <70 and were considered poor.

Excellent and good results were considered as satisfactory, while fair and poor results as unsatisfactory.

**Table 5:** The Harris hip score<sup>(98)</sup>

**1. Pain (44 possible)**

A. None, or ignores it	44
B. Slight, occasional, no compromise in activities	40
C. Mild pain, no effect on activities, rarely moderate pain with unusual activity, may take aspirin	30
D. Moderate pain, tolerable but makes concessions to pain. Some limitation of ordinary activity or work. May require occasional medicine stronger than aspirin	20
E. Marked pain, serious limitation of activities	10
F. Totally disabled, crippled, pain in bed, bedridden	0

**2. Function (47 possible)**

<b>2.A. Gait (33 possible)</b>		
2.A.1. Limp:		
	a. None	11
	b. Slight	8
	c. Moderate	5
	d. Severe	0
2.A.2. Support:		
	a. None	11
	b. Cane for long walks	7
	c. Cane most of the time	5
	d. One crutch	3
	e. Two canes	2
	f. Two crutches	0
	g. Not able to walk	0
2.A.3. Distance walked:		
N.B:Block=100 meters	a. Unlimited	11
	b. Six blocks	8
	c. Two or three blocks	5
	d. Bed and chair only	0
<b>2.B. Activities (14 possible)</b>		
2.B.1. Stairs:		
	a. Normally	4
	b. Using railing	2
	c. In any manner	1
	d. Unable to do stairs	0
2.B.2. Shoes & Socks:		
	a. With ease	4
	b. With difficulty	2
	c. Unable	0
2.B.3. Sitting:		
	a. Any chair one hour	5
	b. High chair half-hour	3
	c. Unable to sit comfortably	0
2.B.4 Enter public transport		1

**3. Absence of Deformity (4 points each if present)**

- A. Less than 30 degrees fixed flexion contracture.
- B. Less than 10 degrees fixed adduction.
- C. Less than 10 degrees fixed internal rotation in extension
- D. Limb length discrepancy less than 3.2 cm.

**4. Range of Motion**

	<u>Arc of Motion</u>	<u>Index</u>	<u>Max. Possible</u>
Flexion	0-45 <sup>0</sup> (45 <sup>0</sup> )	1.0	45
	45-90 <sup>0</sup> (45 <sup>0</sup> )	0.6	27
	90-110 <sup>0</sup> (20 <sup>0</sup> )	0.3	6
	110-130 <sup>0</sup> (20 <sup>0</sup> )	0.0	0
Abduction	0-15 <sup>0</sup> (15 <sup>0</sup> )	0.8	12
	15-20 <sup>0</sup> (5 <sup>0</sup> )	0.3	1.5
	20-45 <sup>0</sup> (25 <sup>0</sup> )	0.0	0
External rotation in extension	0-15 <sup>0</sup>	0.4	6
	Over 15 <sup>0</sup>	0.0	0
Internal rotation in extension	Any	0.0	0
Adduction	0-15 <sup>0</sup>	0.2	3
	Over 15 <sup>0</sup>	0.0	0
Extension	Any	0.0	0
Total Motion Point Value = 100.5			
<b>Overall Range of Motion = Total Motion Point Value × 0.05</b>			
<b>Record Trendelenburg test as positive, level or neutral.</b>			

**Also, the patients were examined clinically for:**

**1. Trendelenburg's test:**

It was done for the affected hip and recorded whether negative (patient can stand on affected hip), positive or the patient was unable to perform it because of intolerable pain or he could not stand unsupported or bedridden.

**2. Straight leg raising test:**

It was done and recorded whether painful or not.

**3. Pain on internal rotation:**

It was recorded if present or not.

**4. Scar condition:**

It was recorded whether healing is by primary or secondary intention.

### **Methods of statistical analysis:**

After data collection, data were tabulated, coded and introduced to SPSS software version 11.5. Editing of the data was done using the computer program to find errors and inconsistency in the data.

- 1- Arithmetic mean ( $\bar{x}$ ).
- 2- Standard deviation.
- 3- Unpaired "t" test.
- 4- Chi-square test =  $\chi^2$

## RESULTS

### Overall results:

In this study, 13 patients (65.0%) had satisfactory results, three of them (15.0%) were excellent, and 10 (50.0%) were good, while 7 patients (35.0%) had unsatisfactory results, four of them (20.0%) were fair and three (15.0%) were poor (table 6).

**Table 6: Distribution of the studied patients group regarding the net results.**

	Frequency	Percent
<b>Satisfactory</b>	13	65.0
Excellent	3	15.0
Good	10	50.0
<b>Unsatisfactory</b>	7	35.0
Fair	4	20.0
Poor	3	15.0

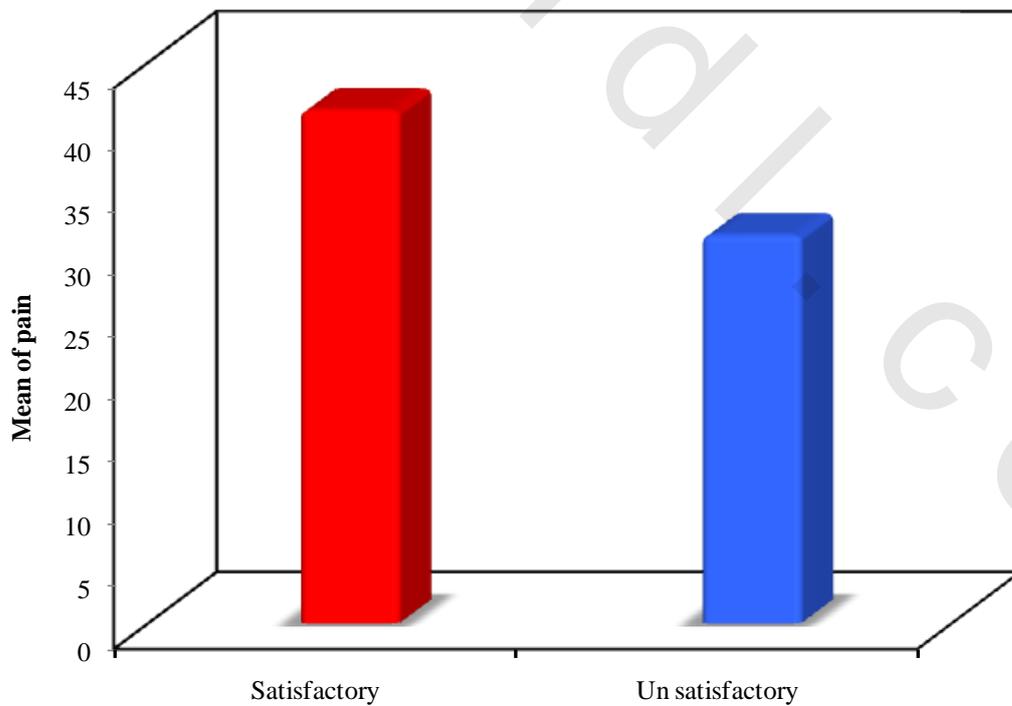
**Clinical results:**

**Pain:**

In satisfactory patients, the mean of pain grade was  $41.15 \pm 1.72$  points (out of 44 points), it was between slight to no pain. In unsatisfactory patients the mean was  $31.13 \pm 4.14$  (out of 44 points), it was between moderate to mild pain. The difference was statistically significant ( $P=0.036$ ) (table 7) (figure 32).

**Table 7: Relation between final results and pain**

	Satisfactory	Unsatisfactory
Pain		
Range	40-44	20-40
Mean	41.15	31.13
S.D.	1.72	4.14
T	2.328	
P	0.036*	



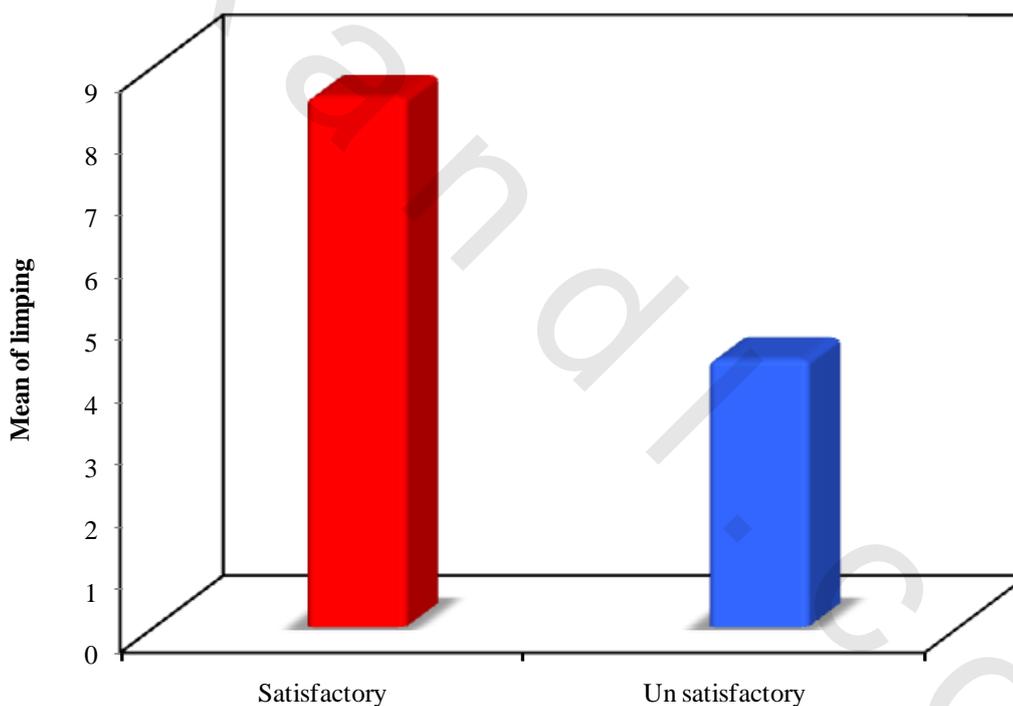
**Figure 32: Relation between final results and pain**

**Limping:**

The mean score for limping was  $8.5 \pm 0.75$  points (out of 11 points) in the satisfactory group and  $4.29 \pm 1.89$  points in the unsatisfactory group. This difference was statistically significant (table 8) (figure 33).

**Table 8: Relation between final results and limping**

	Satisfactory	Unsatisfactory
limping		
Range	8-11	0-5
Mean	8.5	4.29
S.D.	0.75	1.89
T	5.98	
p	0.0004*	



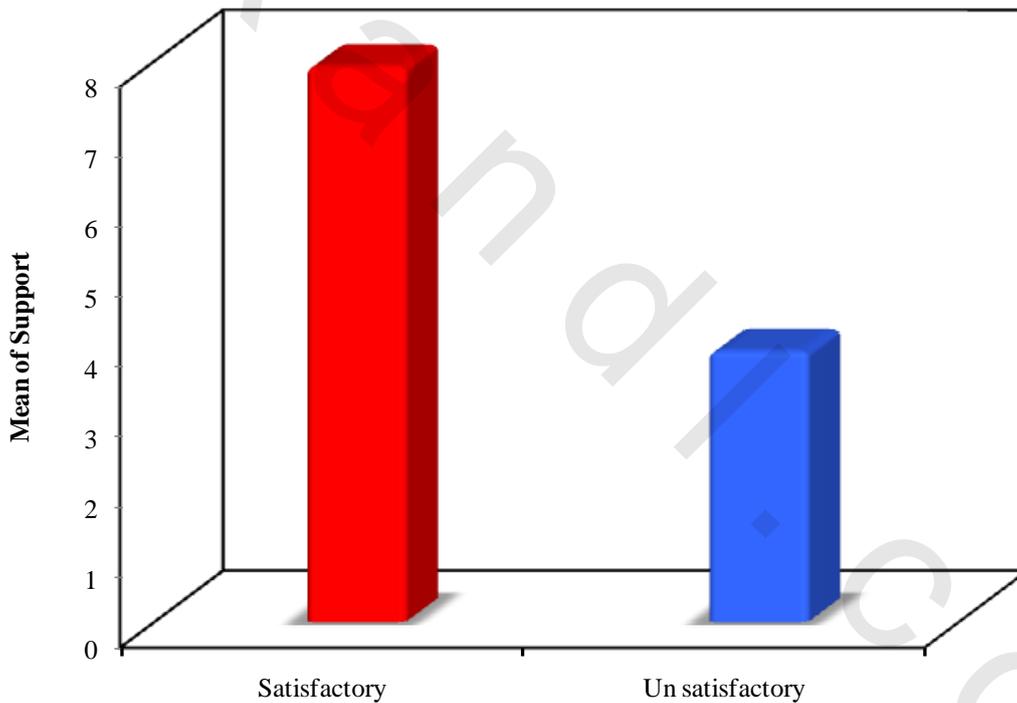
**Figure 33: Relation between final results and limping**

**Support:**

The mean score for use of support was  $7.92 \pm 1.93$  points (out of 11 points) in the satisfactory group and  $3.86 \pm 1.07$  points in the unsatisfactory group. This difference was statistically significant (table 9) (figure 34).

**Table 9: Relation between final results and support**

	Satisfactory	Unsatisfactory
Support		
Range	5-11	3-5
Mean	7.92	3.86
S.D.	1.93	1.07
T	8.96	
p	0.00001*	



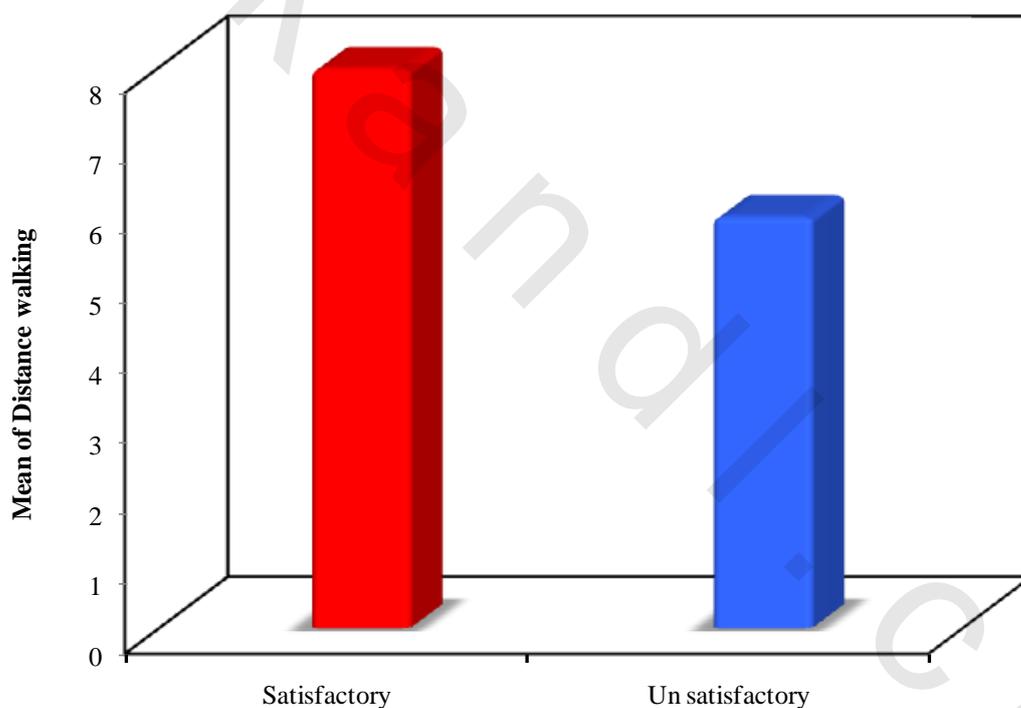
**Figure 34: Relation between final results and support**

**Walking distance:**

The mean score for walking distance was  $7.97 \pm 0.83$  points (out of 11 points) in the satisfactory group and  $5.86 \pm 1.46$  points in the unsatisfactory group. This difference was statistically significant (table 10) (figure 35).

**Table 10: Relation between final results and distance walking**

	Satisfactory	Unsatisfactory
Distance walking		
Range	5-11	5-8
Mean	7.97	5.86
S.D.	0.83	1.46
T	3.85	
p	0.002*	



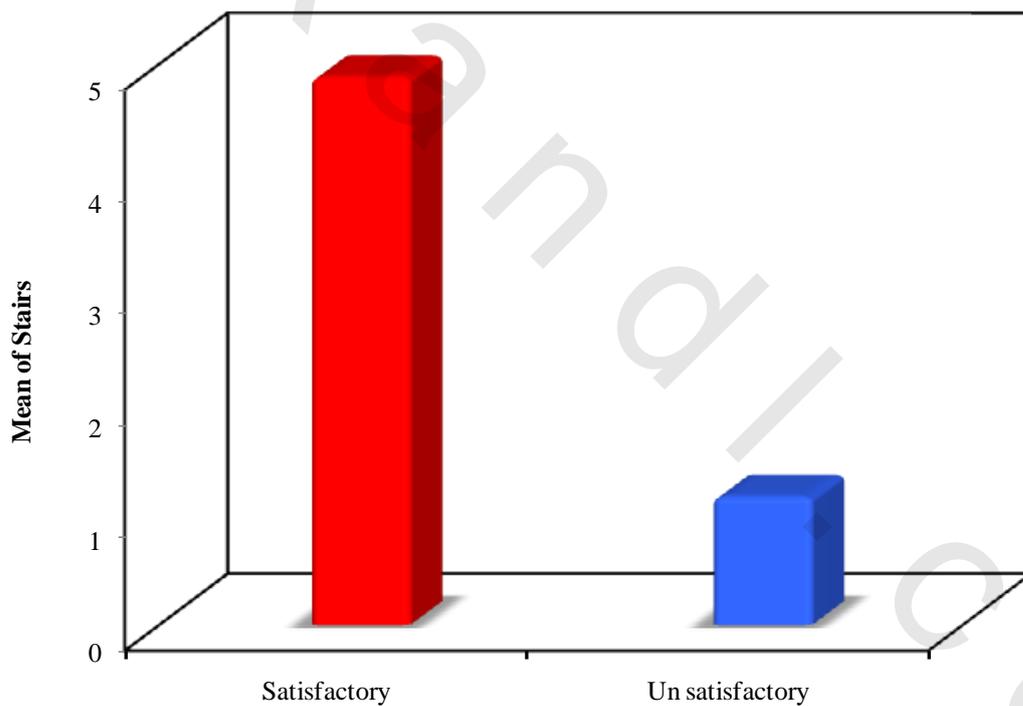
**Figure 35: Relation between final results and distance walking**

**Stairs:**

The mean score for climb the stairs was  $4.88 \pm 1.71$  points in the satisfactory group and  $1.14 \pm 0.38$  point in the unsatisfactory group. This difference was statistically significant (table11) (figure 36).

**Table 11: Relation between final results and stairs**

	Satisfactory	Unsatisfactory
Stairs		
Range	2-4	0-2
Mean	4.88	1.14
S.D.	1.71	0.38
T	4.68	
p	0.0013*	



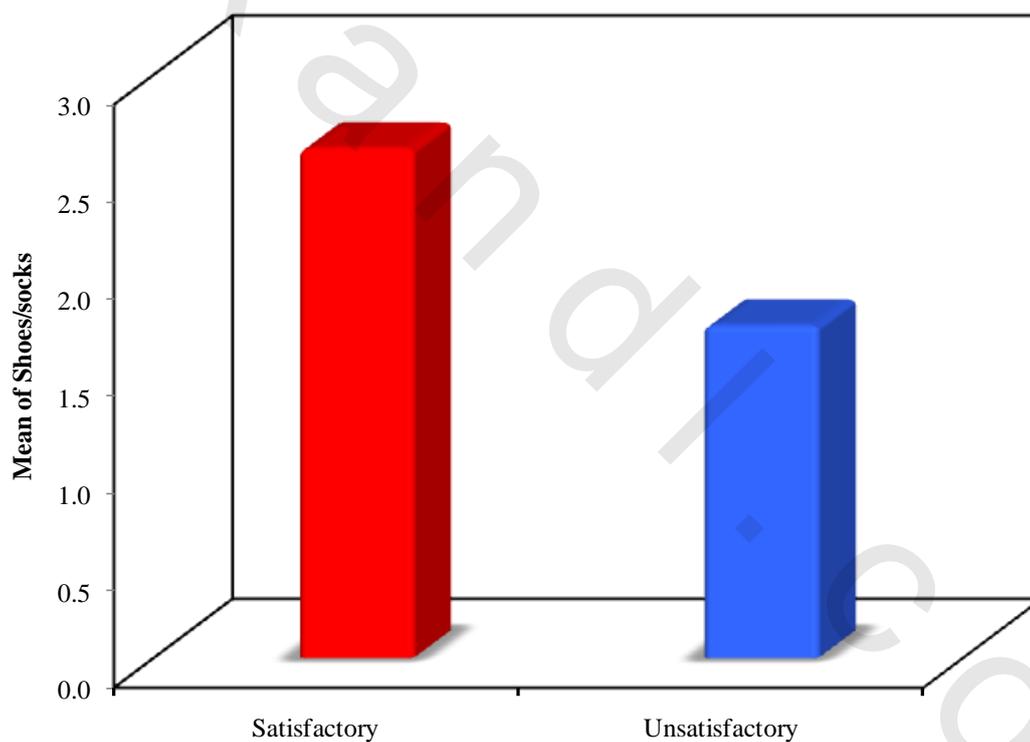
**Figure 36: Relation between final results and stairs**

**Shoes and socks:**

The mean score for shoes/socks was  $2.62 \pm 0.96$  points in the satisfactory group and  $1.71 \pm 0.76$  points in the unsatisfactory group. This difference was statistically significant (table 12).

**Table 12: Relation between final results and shoes/socks**

	Satisfactory	Unsatisfactory
Shoes/socks		
Range	2-4	0-2
Mean	2.62	1.71
S.D.	0.96	0.76
T	3.25	
p	0.0177*	



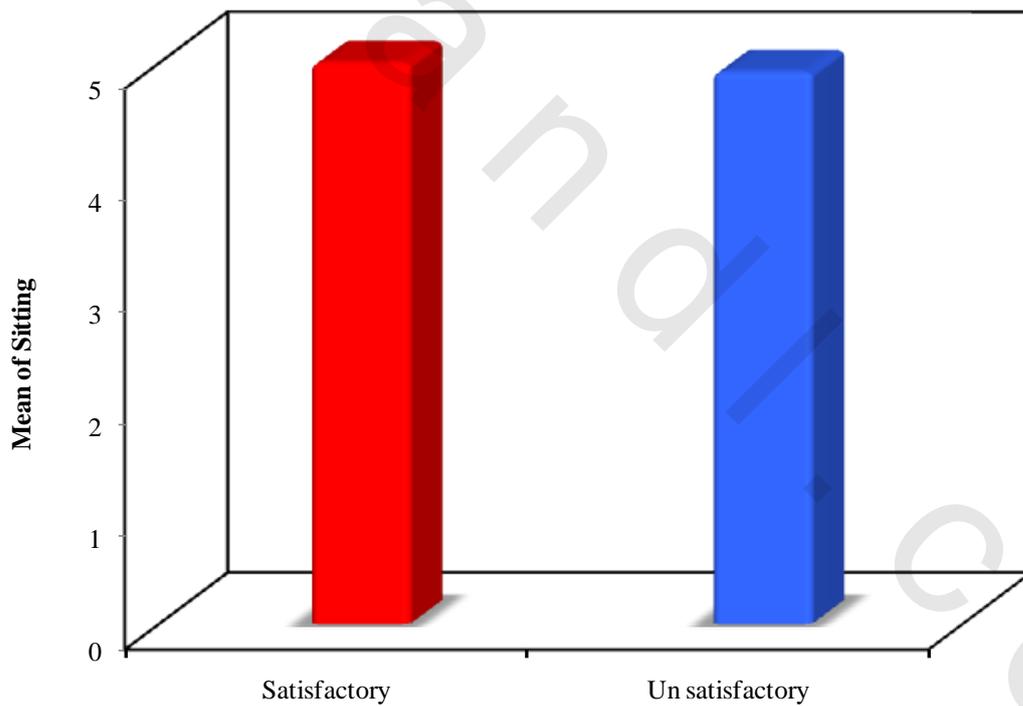
**Figure 37: Relation between final results and shoes/socks**

**Sitting on chair:**

The mean score for sitting on chair was  $5.00 \pm 0.0$  points in the satisfactory group and  $4.92 \pm 0.49$  points in the unsatisfactory group. This difference was not statistically significant (table 13) (figure 37).

**Table 13: Relation between final results and sitting**

	Satisfactory	Unsatisfactory
Sitting		
Range	5-5	3-5
Mean	5.00	4.92
S.D.	0.00	0.49
T	1.98	
p	0.292	



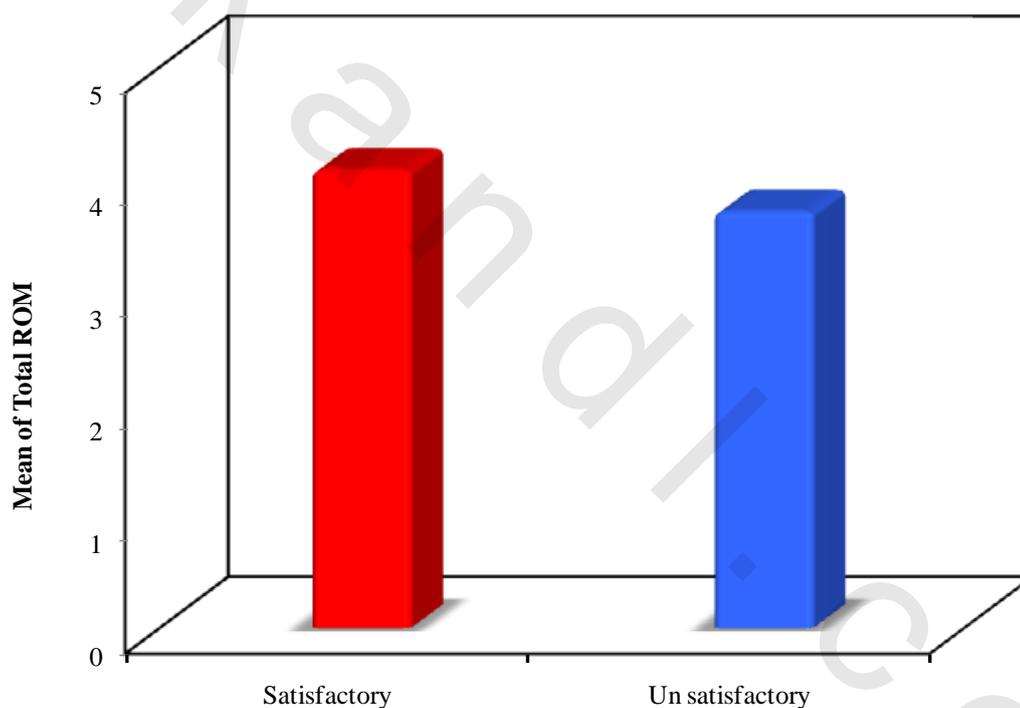
**Figure 38: Relation between final results and sitting**

**Range of motion:**

The mean score for total range of motion was  $4.08 \pm 0.28$  points (out of 5 points) in the satisfactory group and  $3.71 \pm 0.49$  points in the unsatisfactory group. This difference was statistically significant ( $P=0.05$ ) (table 14) (figure 38).

**Table 14: Relation between final results and total ROM**

	Satisfactory	Unsatisfactory
Total ROM		
Range	4-5	3-4
Mean	4.08	3.71
S.D.	0.28	0.49
T	1.98	
p	0.05*	



**Figure 39: Relation between final results and total ROM**

**Deformity:**

In this series seven out of thirteen (54%) patients with satisfactory result had fixed flexion deformity while four of seven (57%) patients with unsatisfactory results had deformity and three out of thirteen patients (23%) with satisfactory results had fixed internal rotation deformity.

**Clinical results**

**Trendelenburg's test** was negative (patient can stand on affected hip) in 84.6% of patients with satisfactory results, and 28.6% of unsatisfactory results (P=0.001).

**Straight leg raising test** was negative in 92.3% of satisfactory results, and 28.6% of patients with unsatisfactory results (P=0.0001).

**Internal rotation** of the hip joint was not painful in all patients with satisfactory results, and painful in 85.8% of unsatisfactory results (P=0.00001).

Relationship was statistically significant in the above mentioned clinical tests (table 15).

**Table 15: Relation between clinical results and final results.**

	Satisfactory		Unsatisfactory		p
	No.	%	No.	%	
<b>Trendelenburg test</b>					
Positive	2	15.4	5	71.4	0.001*
Negative	11	84.6	2	28.6	
<b>Straight leg raising test</b>					
Positive	1	7.7	5	71.4	0.0001*
Negative	12	92.3	2	28.6	
<b>Pain on internal rotation</b>					
Positive	0	0.0	6	85.8	0.00001*
Negative	13	100.0	1	14.2	
<b>Total</b>	13		7		

**Radiological results: (table16)**

**Table 16: Relation between radiological results and final results.**

	Satisfactory		Unsatisfactory		p
	No.	%	No.	%	
<b>Containment of the head</b>					
Contained	13	100.0	7	100.0	-
Not contained	0	0.0	0	0.0	
<b>Neck shaft angle</b>					
Mean	116.5		128.5		0.0133*
S.D.	4.32		5.03		
<b>Position of stem in the medullary cavity</b>					
valgus	6	46.2	0	0.0	0.0001*
Central	7	53.8	1	14.3	
varus	0	0.0	6	85.7	
<b>leveling of the prosthesis</b>					
Appropriate	13	100.0	1	14.3	0.0001*
Inappropriate	0	0.0	6	85.7	
<b>Total</b>	13		7		

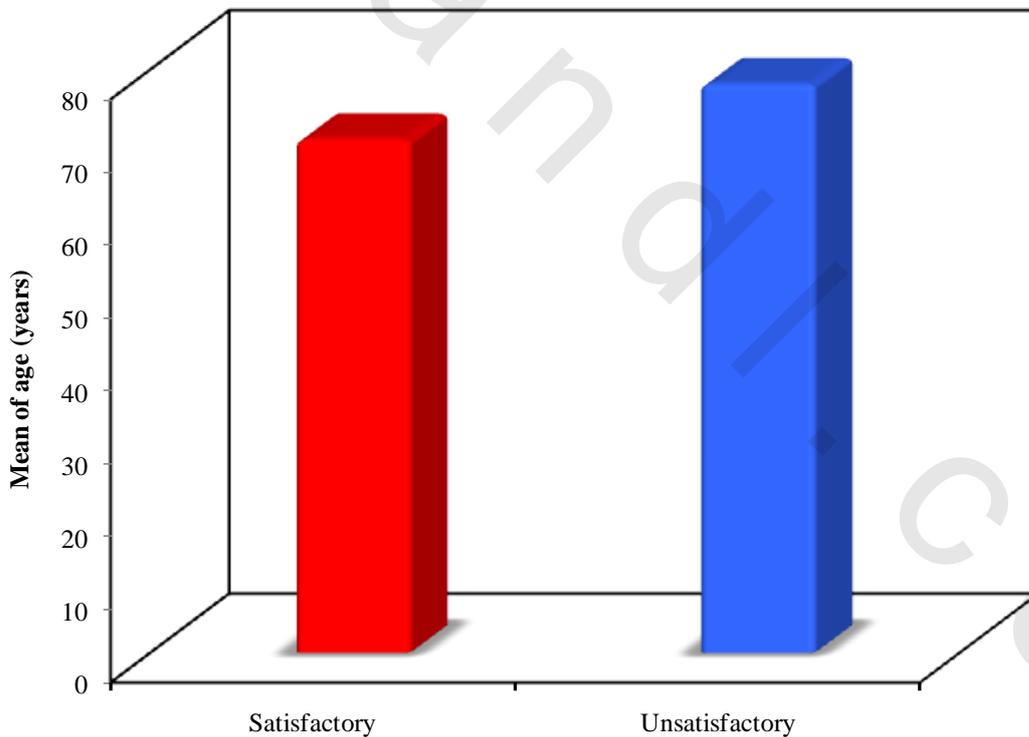
## Factors affecting the results

### 1. Age:

The mean age for satisfactory patients was  $70.38 \pm 6.58$  years, while for unsatisfactory patients  $78 \pm 6.19$  years. There were statistical significant differences between final results and age of the patients ( $P=0.0116$ ) (table 17).

**Table 17:** Relation between final results and age of the patients.

	Satisfactory	Unsatisfactory
Age		
Range	62-84	69-86
Mean	70.38	78
S.D.	6.58	6.19
T		
P	0.0116*	



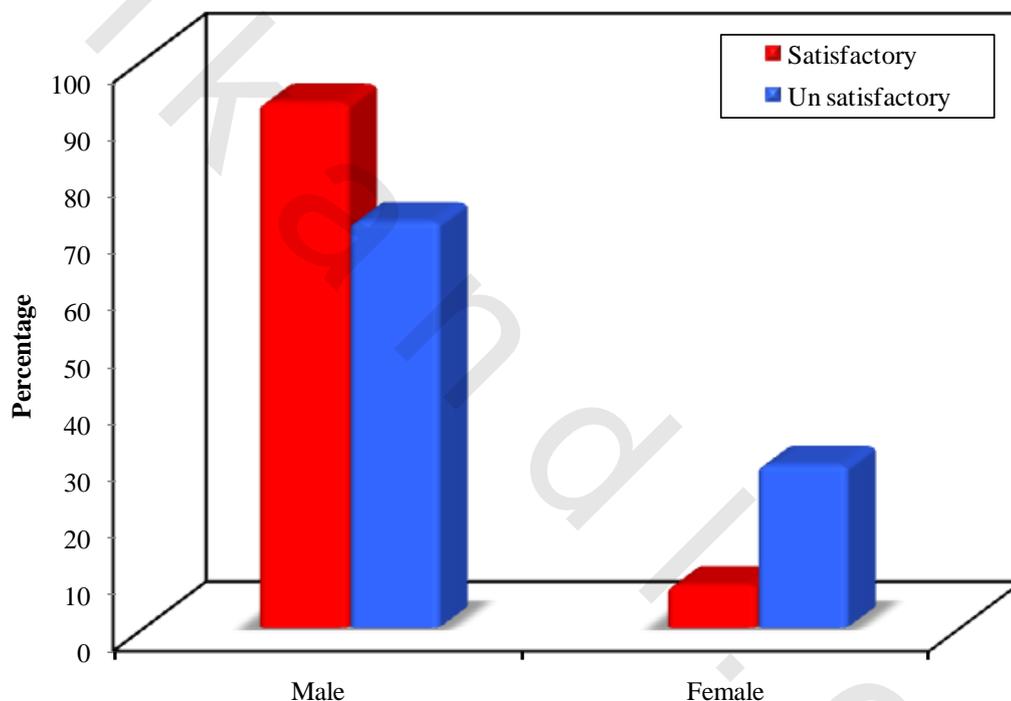
**Figure 40:** Relation between final results and age of the patients

**2. Sex:**

There were no statistical significant differences between final results and sex of the patients (p=0.21) (table18) (figure 39).

**Table 18: Relation between final results and sex of the patients.**

Sex	Satisfactory " No.=13"		Unsatisfactory " No.=7"	
	No.	%	No.	%
Male	12	92.3	5	71.42
Female	1	7.4	2	28.58
X <sup>2</sup>	1.56			
P	0.21			



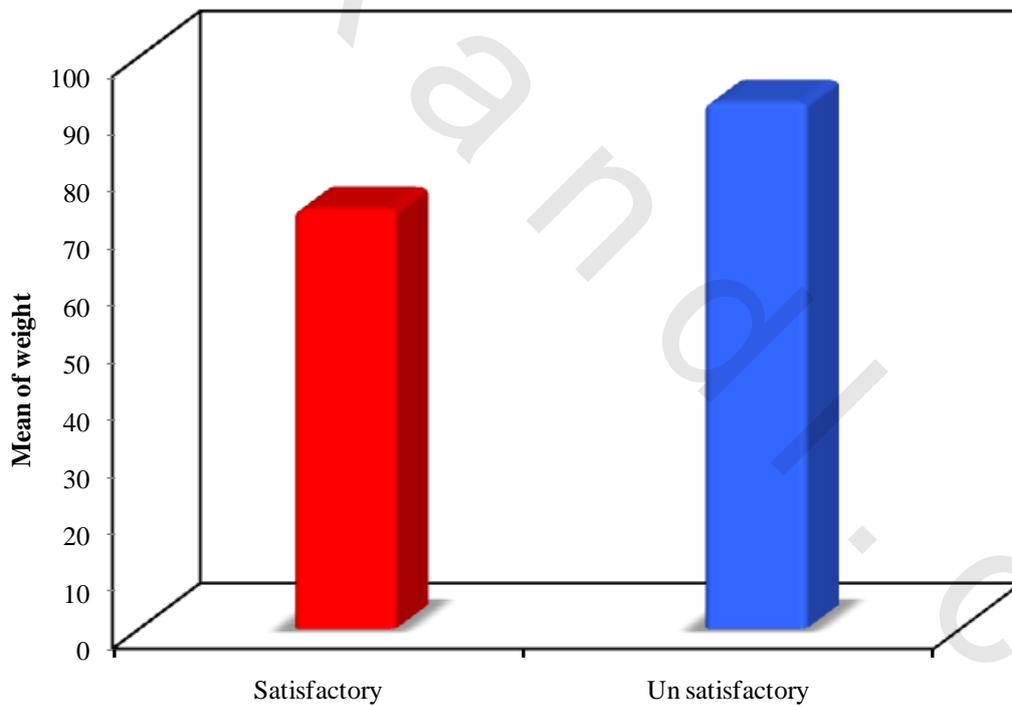
**Figure 41: Relation between final results and sex of the patients**

### 3. Weight:

The mean weight for satisfactory patients was 73.31 kg, while for unsatisfactory patients 92.0 kg. There were statistical significant differences between final results and weight of the patients ( $P < 0.001$ ) (table19) (figure 40).

**Table 19: Relation between final results and weight of the patients**

	Satisfactory	Unsatisfactory
Weight		
Range	65 – 87	85 – 100
Mean	73.31	92.0
S.D.	72.0	90.0
T	6.345*	
P	<0.001*	



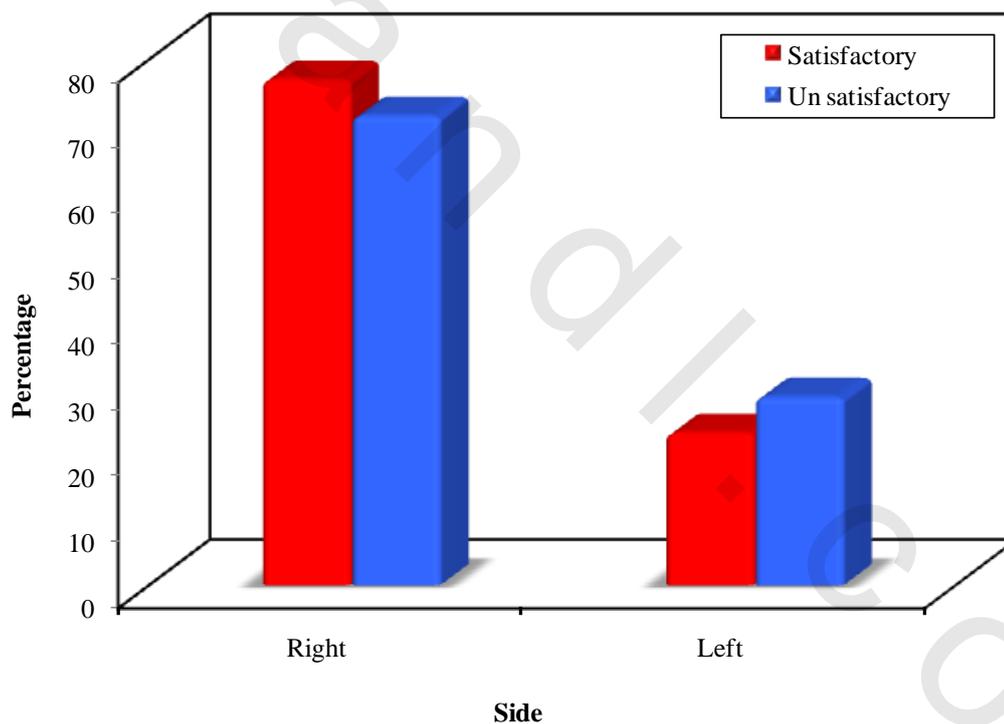
**Figure 42: Relation between final results and weight of the patients**

**4. Side affected:**

The results in the right side were better (76.9%) than left side (23.1%) for satisfactory patients. The same results we found for unsatisfactory results, the right side were 71.4% than left side 28.6%. There were no statistically significant relation between final results and side affected (P=0.78) (table 20) (figure 41).

**Table 20: Relation between final results and side affected.**

Side	Satisfactory "No. =13"		Unsatisfactory "No. =7"	
	No.	%	No.	%
Right	10	76.9	5	71.4
Left	3	23.1	2	28.6
X <sup>2</sup>	0.07			
P	0.78			



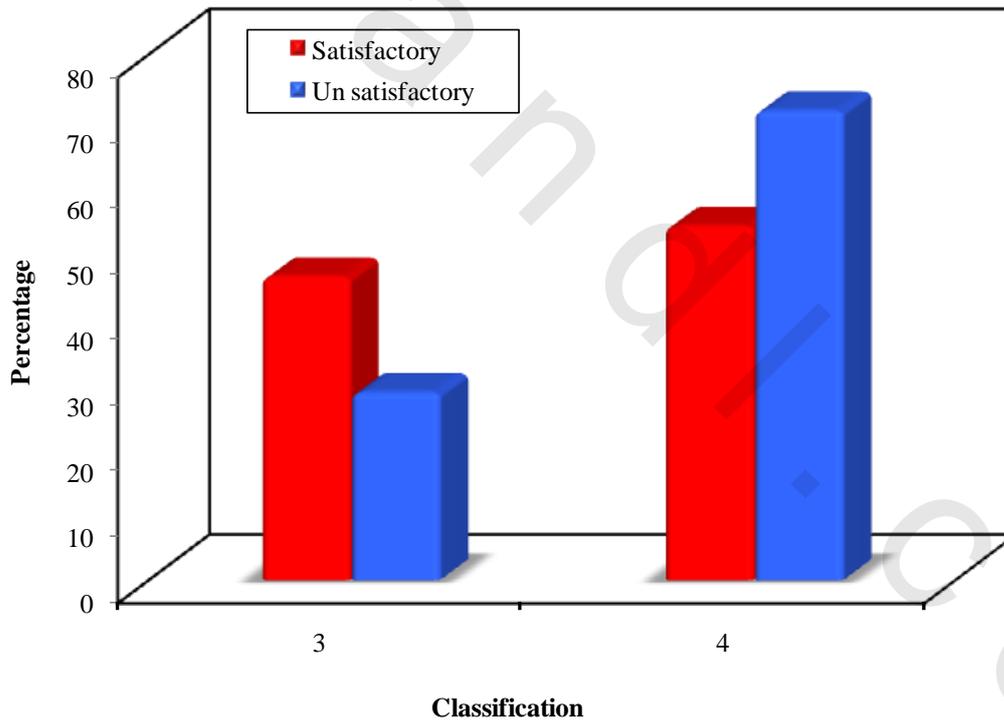
**Figure 43: Relation between final result and side affected**

### 5. Classification

In patients with Garden's classification type 3 there were 6 (46.15%) satisfactory and 2 (28.57%) unsatisfactory, while patients with Garden's classification type 4, there were 7 (53.8%) were satisfactory and 5 (71.43%) unsatisfactory. There were no statistically significant relation between final results and Garden's classification (P=0.44) (table 21) (figure 42).

**Table 21: Relation between final results and classification**

Classification	Satisfactory " No.=13"		Unsatisfactory " No.=7"	
	No.	%	No.	%
3	6	46.15	2	28.57
4	7	53.84	5	71.43
X <sup>2</sup>	0.59			
P	0.44			



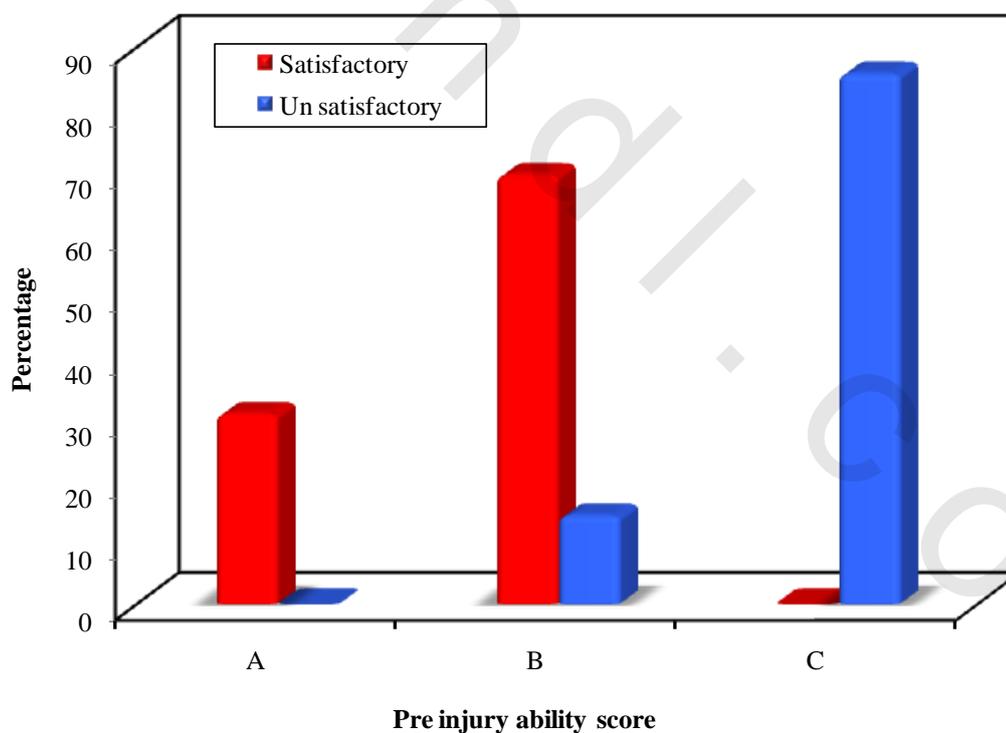
**Figure 44: Relation between final results and classification**

## 6. Pre injury ability score

It was found that, pre injury ability score A and B for satisfactory patients were higher than in unsatisfactory patients, 30.7% were A and 69.3% of patients were B score for satisfactory and 0.0% for C, while for unsatisfactory patients 0.0% were A, 14.3% were B and 85.7% were C score. There were highly statistical significant relation between final results and classification pre injury ability (P=0.0001) (table 22) (figure 43).

**Table 22: Relation between final results and pre injury ability score**

Pre injury ability score	Satisfactory " No.=13"		Unsatisfactory " No.=7"	
	No.	%	No.	%
A	4	30.7	0	0.0
B	9	69.3	1	14.3
C	0	0.0	6	85.7
X <sup>2</sup>	13.51			
P	0.0001*			



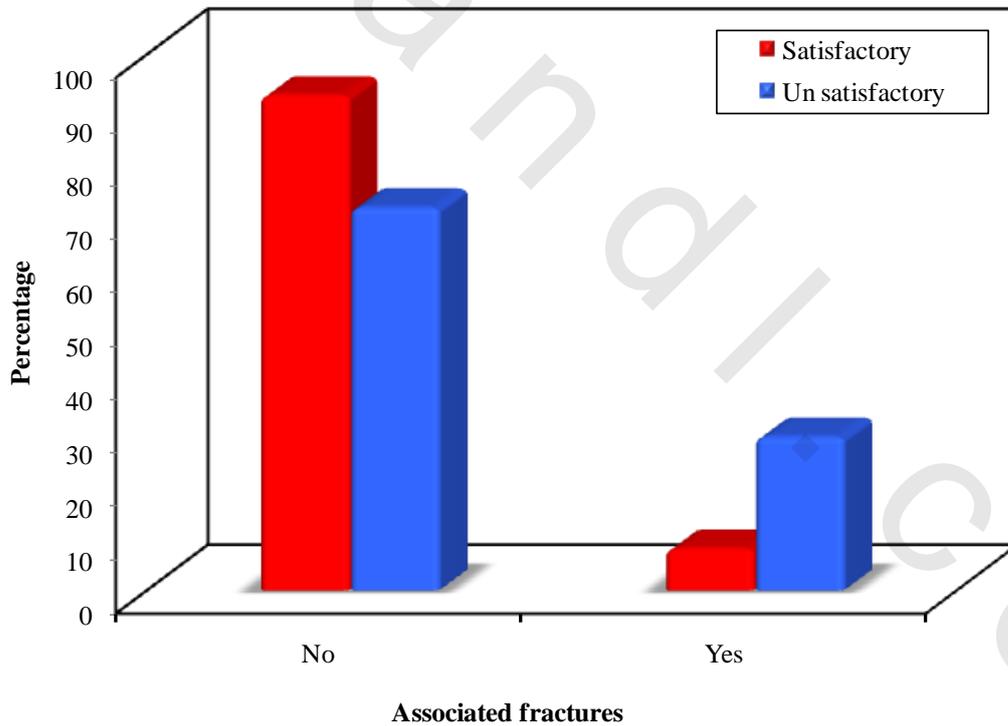
**Figure 45: Relation between final results and pre injury ability score**

**7. Associated fractures**

Relation between final results and associated fractures showed that 12 (92.3%) patients with satisfactory results and 5 (71.4%) patients with unsatisfactory results had no associated fracture, while 1 (7.7%) patient with satisfactory result and 2 (28.6%) patients with unsatisfactory had associated fractures. There were no statistical significant relation between final results and associated fracture (table 23) (figure 44).

**Table 23: Relation between final results and associated fractures**

Associated fractures	Satisfactory " No.=13"		Unsatisfactory " No.=7"	
	No.	%	No.	%
No	12	92.3	5	71.4
Yes	1	7.7	2	28.6
X <sup>2</sup>	1.56			
P	0.21			



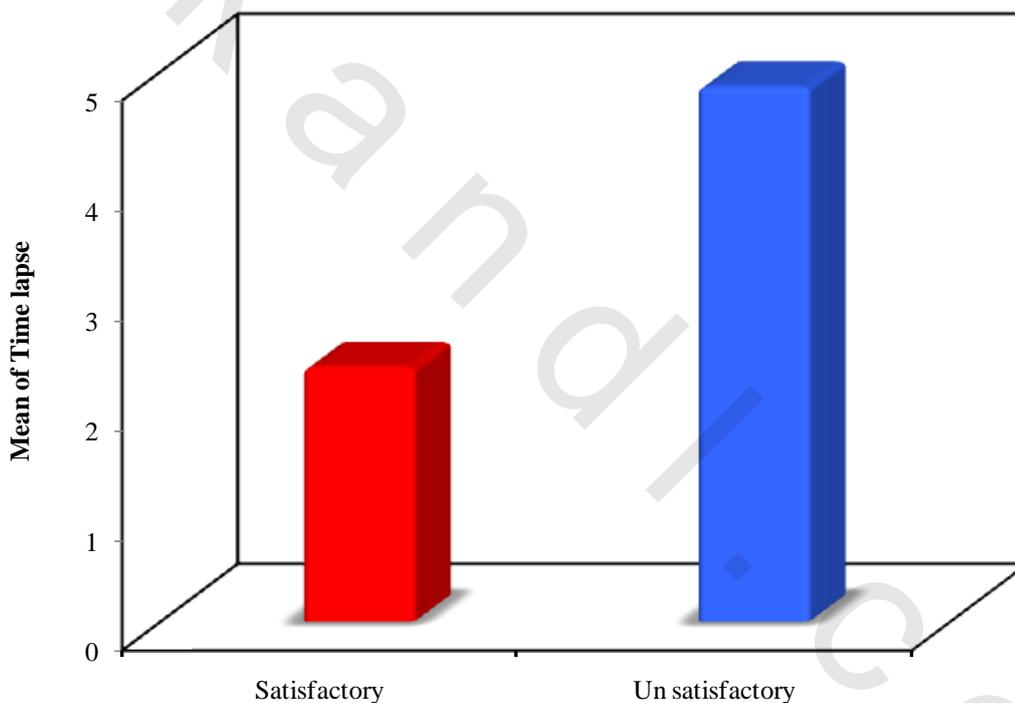
**Figure 46: Relation between final results and associated fractures**

### 8. Time lapse before operation

The mean time lapse for satisfactory patients was less than unsatisfactory patients. It was  $2.31 \pm 0.95$  and  $4.86 \pm 2.48$  for satisfactory and unsatisfactory patients respectively. The difference was found to be statistically significant ( $P = 0.0172$ ) (table 24) (figure 45).

**Table 24: Relation between final results and time lapse before operation (days).**

	Satisfactory	Unsatisfactory
Time lapse		
Range	1-5	2-9
Mean	2.31	4.86
S.D.	0.95	2.48
T	2.11	
P	0.0172*	



**Figure 47: Relation between final results and time lapse before operation**

### **9. Associated medical diseases**

It was found that, 50.0% of patients have hypertension disease, 20.0% have ischemic heart disease, 20.0% with other disease and 25% have no disease. There was more than one medical disease in the same patients (table 25).

**Table 25: Distribution of the studied patients group regarding the associated medical diseases.**

	<b>Frequency</b>	<b>Percent</b>
<b>Associated medical diseases</b>		
None	5	25.0
IHD	4	20.0
DM	5	25.0
HTN	10	50.0
Others	4	20.0

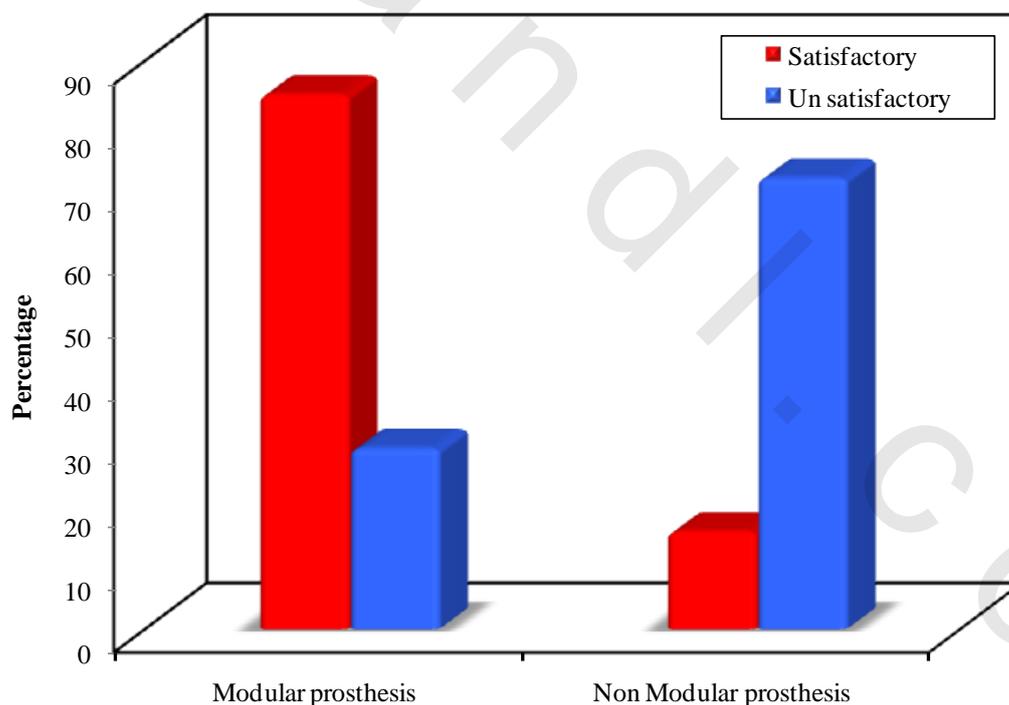
There was more than one medical disease in the same patients

### 10. Type of prosthesis:

In this study 13 patients were treated by modular prosthesis (bipolar or modular unipolar), while 7 patients were treated by unipolar hemiarthroplasty (Thompson). There were statistical significant differences between final results and type of prosthesis used in the study. ( $p=0.022$ ) (table 26) (figure 46).

**Table 26: Relation between final results and type of prosthesis**

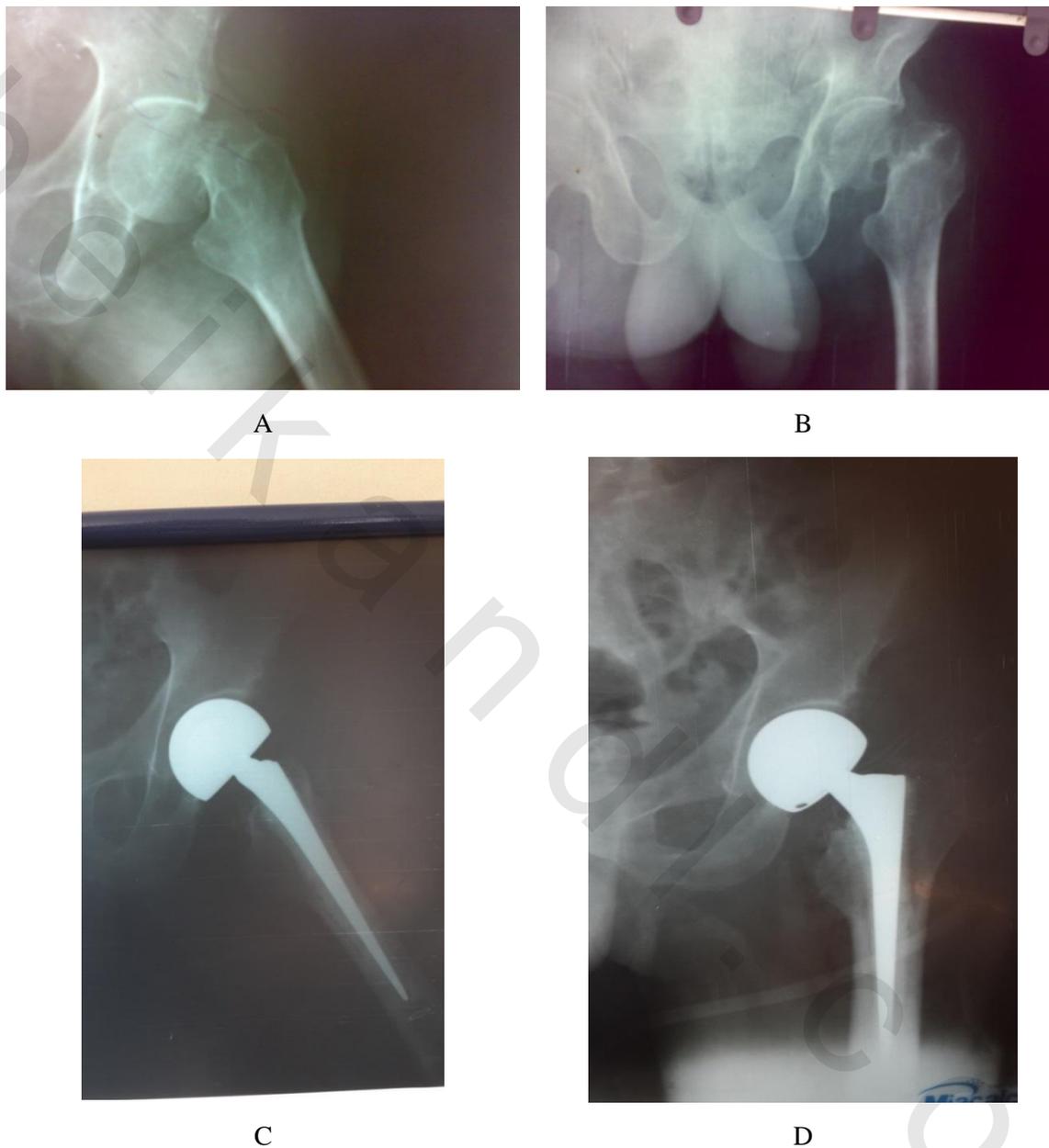
Type of prosthesis	Satisfactory " No.=13"		Unsatisfactory " No.=7"	
	No.	%	No.	%
Modular prosthesis (bipolar or modular unipolar)	11	84.6	2	28.6
Non Modular prosthesis (unipolar)	2	15.4	5	71.4
X <sup>2</sup>	6.282*			
P	0.022*			



**Figure 48: Relation between final results and type of prosthesis**

## Case Presentation

Male patient aged 65 years old had fracture neck of left femur after falling down. He was followed up for 12 months. His final result was excellent with Harris hip score 91.



**Figure 49:** (A, B) Pre operative X-rays show Garden 4 fracture neck of femur (C, D) Postoperative X-rays with bipolar hemiarthroplasty properly positioned stem that is central in AP and lateral view with well contained head



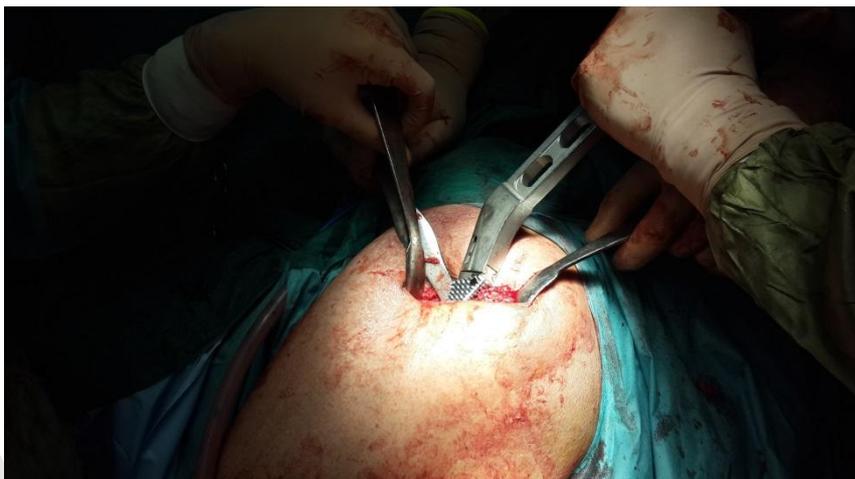
**Figure 50:** Skin incision



**Figure 51:** Excision of the femoral neck



**Figure 52:** Excision of the femoral head



**Figure 53:** Femoral canal preparation



**Figure 54:** Insertion of plug



**Figure 55:** Insertion of cement



**Figure 56:** Insertion of femoral stem



**Figure 57:** Insertion of head



**Figure 58:** Gluteus medius intact after reduction of the hip



**Figure 59:** Closure in layers



**Figure 60:** Surgical wound after removal of sutures