

## Effect of Rehabilitation Exercises on Shoulder Function after Proximal Humeral Fracture Surgery

Mervat Abd El-Fatah Ismael<sup>1</sup>, Martha Melek Labieb<sup>2</sup>, Shaymaa Sayed Khalil<sup>3</sup> & Eman Mohamed Hashem<sup>4</sup>

<sup>1</sup>Lecturer, Medical Surgical Nursing Department, Faculty of Nursing, Assiut University, Assiut, Egypt.

<sup>2</sup>Lecturer, Gerontological Nursing Department, Faculty of Nursing, Assiut University, Assiut, Egypt.

<sup>3</sup>Assistant professor, Medical Surgical Nursing Department, Faculty of Nursing, Assiut University, Assiut, Egypt.

<sup>4</sup>Lecturer, Medical Surgical Nursing Department, Faculty of Nursing, Assiut University, Assiut, Egypt

### Abstract

**Background:** Proximal humeral fractures are among the most common fractures. Functional recovery of shoulder is often slow and many people have ongoing disability during activities of daily life. **Aim:** To evaluate effect of rehabilitation exercises on shoulder function after proximal humeral fracture Surgery. **Research design:** Quasi-experimental research design. **Setting:** Trauma unit and orthopedic outpatient clinic at Assiut University Hospital. **Sample:** A convenient sample of one hundred patients with aged from (18-75) years old and from both sexes with proximal humeral fracture, divided into two equal groups (50 patients for each). **Tools:** I " Patient's health needs assessment sheet ", II " Shoulder function index ", **Tool III** " Numerical Rating Pain Scale" **Results:** There was a statistically significant difference between the study and the control group regarding total mean score of the shoulder function index & pain level during follow up periods after application of rehabilitation exercises post proximal humeral fracture Surgery (p-value 0.0179\* & 0.003 respectively). **Conclusion:** Application of exercises has positive effect on improving shoulder function and reducing pain after proximal humeral fracture surgery. **Recommendations:** rehabilitation exercises are recommended to be an integral part of the pre-operative nursing teaching for patients undergoing proximal humeral fracture surgery and a booklet should be available at Trauma Unit and Orthopedic outpatient clinic as a reference.

**Keywords:** Exercises, Proximal humeral fracture Surgery, Shoulder function.

### Introduction

A proximal humerus fracture (PHFs) is a break of the upper part of the bone of the arm (humerus). PHFs represent 5–6% of all fractures.

It is the third most common fracture in older adults. Typical signs and symptoms include pain, swelling, bruising, and limited range of motion at the shoulder. Deformity may be present in severe fractures; however, musculature may cause absence of deformity on inspection. Numbness over the outside part of the upper arm and deltoid muscle weakness may indicate axillary nerve injury. Symptoms from poor blood circulation in the arm is uncommon

due to collateral circulation in the arm (Elliott et al., 2022).

PHFs classically fall under a bimodal distribution by age and energy level. This bimodal pattern is very common and clinicians should recognize the high-energy (e.g. Motor vehicle accident in adult patients) versus low-energy (e.g. elderly patient status post ground level fall) paradigm in various groups and fracture patterns. PHFs most commonly occur in patients over 65 years of age. In the setting of osteoporosis or osteopenia, a low-energy fall resulting in a PHF is, by definition, a fragility fracture. Adult patients often present with these injuries following high-energy trauma such as Motor Vehicle Accident (Varacallo et al., 2021).

There are both non-surgical and surgical options for treatment of proximal humerus fractures. The recommended treatment is decided based on fracture stability as determined with imaging and clinical examination. Surgical options for unstable proximal humerus fractures include: Closed reduction with percutaneous pinning (CRPP), open reduction with internal fixation (ORIF), intramedullary rod fixation, shoulder arthroplasty and Reverse shoulder arthroplasty (Ebraheim, 2022).

Proximal humeral fracture (PHF) can have a substantial impact on the patient's physical function and independent living and are associated with higher morbidity and mortality. Functional recovery of the shoulder is often slow and many people have ongoing disability during activities of daily life. Also, PHF induce pain, reduce quality of life (QoL) and produce relevant direct costs including medical costs. After sustaining a PHF, the main focus of treatment is to regain the best possible function of the shoulder (Monticone et al, 2021).

Rehabilitation exercises play a vital role in the post-surgical management. Immediate physiotherapy following a proximal humerus fracture results in faster recovery with maximal functional benefit. Also, post-surgical exercises can help prevent the joint stiffness that is a common complication with this type of upper arm. Rehabilitation exercises mainly includes segmentary exercises of mobility of the shoulder and upper limb, strengthening of humeral and upper limb muscles, stretching of shoulder girdle and upper limb muscles, and postural control of upper limb fracture (Richard et al., 2020).

In rehabilitation, nurses have an active role in meeting the basic needs of patients, supporting their functional abilities and aiding them in taking protective measures for daily routine. Rehabilitation nurses determine the

care needs of patients and provide education and support. Instruct patients in a home exercise program to improve strength and

endurance of the shoulder (Gutenbrunner et al., 2021).

### **Significance of the study:**

Proximal humeral fractures are relatively common, account for 4 to 6 percent of all fractures in Adult patients and 1 to 3 percent of all fractures in elderly patients. The annual incidence ranges from 13 to 20 per 100,000 persons and has been found to be higher with age (Iglesias et al., 2021). PHF has a substantial impact on the patient's physical function and independent living and are associated with higher morbidity and mortality (Rundgren et al., 2020). Exercises help to improve shoulder function after proximal humeral fracture Surgery, So this study was conducted to provide patients with these exercises that provide information on how to stay as healthy as possible and to improve shoulder function after proximal humeral fracture Surgery

### **Aim of the study:**

To evaluate the effect of rehabilitation exercises on shoulder function after proximal humeral fracture Surgery.

### **Research Hypothesis:**

Patients in the study group will be restoring their shoulder function and have less pain than those in the control group.

### **Methods**

#### **Research design:**

A quasi-experimental research design was utilized in this study (study and control group) and was adopted (Lauren , 2022).

#### **Setting:**

This study was conducted in the trauma unit at Assiut University Hospital. The trauma unit consists of one floor, it consists of ten rooms each room has eight beds and there was the nursing room in this floor. Then follow up was conducted in the Orthopedic Outpatient Clinics.

**Sample:**

A convenient sample of 100 patients with aged between (18-75) years old and from both sexes with proximal humeral fracture. These patients were divided into two equal groups (study and control), fifty patients for each group. The control group received the usual hospital routine care only, while the study group received the usual hospital routine care and rehabilitation exercises.

**The sample size:**

The sample size was calculated using the epi info sample size calculation system "G power program 3.1.3 was used to calculate sample size, hypothesized effect size 0.7. Power 95 %" sample size of 95 increases of 5 patients was done considering any drop out of patients or non-compliance with the follow up or the application of rehabilitation exercises and final estimation of the results was done on 100 compliant patients.

**Tools**

**Three tools were used for data collection:**

It was applied three times (preoperatively, two months and four months post operatively).

**Conversion from raw score to SFInX score:**

Raw score	0	1	2	3	4	5	6	7	8	9	0	1									
FInX score	2	0	7	2	6	0	3	6	9	2	5	8	1	4	7	0	3	7	1	9	00

**Tool III: Numerical Rating Pain Scale:**

This scale developed by Anne et al., (2016). The Numerical Rating Scale (NRS) is designed for anyone over age 9. It is one of the most commonly used pain scales in health care.

**Tool I: Patient's assessment sheet:**

It was developed by researchers based on national and international literature review and consisted of two parts:

**Part 1: Demographic characteristics of patients:** It included age, gender, residence, educational level, occupation and length of hospital stay.

**Part (2): Medical data as:** It included medical data as surgical history, medical history (diabetes, hypertension, asthma, coronary heart disease, and cancer) and mechanism of injury.

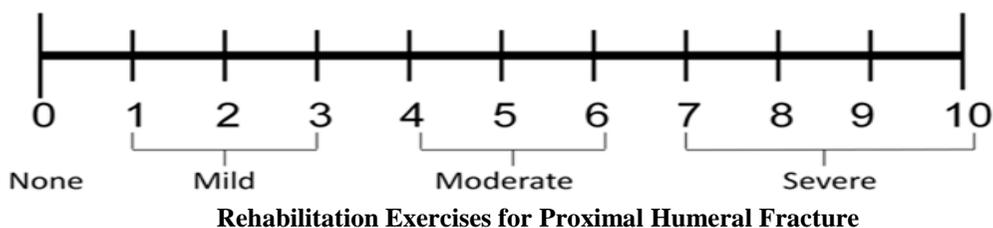
**Tool II: Shoulder function index (Water et al., 2015):**

Shoulder function index (Van De Water et al., 2016). It was used to evaluate the patient's shoulder function. It was applied three times (preoperatively, two months and four months post operatively). It included 13 items. The 13 items cover a range of activities typically done in and around the house, for self-care and keeping the household.

**Scoring system:**

It using a three-point Likert scale, and description intensity ranging from 0 = unable, 1 = partially able, 2 = Able used for each item.

To use it, the patient just says the number that best matches the level of pain the patient is feeling. **Scoring system:** Zero means the patient has no pain, while 10 represents the most intense pain possible.



This tool was developed by the researchers after reviewing current national and international literatures. It included knowledge about rehabilitation exercises as preparation for doing the exercises, types of exercises that can be done, frequency, precautions that can be taken.

#### **Procedure:**

##### **Content validity and reliability:**

The content validity of the study tools was checked by 5 experts (3 professors in the field of Medical - Surgical nursing, 1 professor in orthopaedic surgery department and 1 professor in the field of Gerontological nursing; they reviewed the tools for clarity, relevance, comprehensiveness, understanding, applicability and easiness for administration.

**Reliability:** Cornbach's alpha is the most widely used method for evaluating internal consistency of the research tools. It can be interpreted like other reliability coefficients. The normal range of value is between 0.00 and 1.00, and higher values reflect a higher internal consistency. The reliability of the study tools was (0.94, 0.83).

##### **A pilot study:**

- A pilot study was carried out to test the feasibility, clarity and practicability of the study tools on 10% of sample (10 cases). It also provided an estimate of time needed to fill out the tools, and those patients were excluded in the main study.

#### **Ethics consideration:**

The Nursing Faculty's Ethical Committee has authorized a research proposal. During the implementation of the research, there was no risk to the study participants. Common ethical standards for clinical research were followed during the investigation. After

discussing the nature and goal of the investigation, oral consent was sought from participants who were either patients or guides in the study. Anonymity and confidentiality were guaranteed. The study subject always had the option of declining to participate or leaving the study without giving a reason. Data collecting took study subject privacy into account.

##### **Filed work:**

- An official permission to carry out the study was obtained from the responsible hospital authorities of the trauma unit and outpatient clinics at Assiut University Hospital.

- Data collection was started and completed within 10 months from the beginning of May 2022 up to the end of February 2023)

- Baseline data were collected from patients and their current medical records in both the control and study groups before operation by using study tools I, II, III. To avoid transmission of the intervention to the control group, data were collected first from the control group then from the study group.

- Rehabilitation exercises were developed by the researcher based on deficiency in knowledge and practices of studied patients. It was written in simple Arabic language and consistent with the related literature. Moreover, met patients' level of understanding.

- The researcher met the patients after collecting the baseline data, then schedule the educational sessions (2 sessions) 45 minutes to one hour for each. All sessions were done preoperatively after filling all tools and then the researcher visited each patient of study group daily to encourage and observe for understanding and applying rehabilitation exercises.

**The first session:** contained teaching patients about simple anatomical humerus

overview, Proximal humeral fracture management; definition, incidence, mechanism of injury, classification, signs and symptoms, diagnosis, complications of fracture, treatment, complication after surgery. Finally, this session ended by pre & postoperative and follow up visits instructions.

**The second session:** included training on the basic rehabilitation exercises which is designed to guide patient through the next few months with some simple exercises to gradually increase the movement, decrease the pain and steadily improve the shoulder function. The exercises program classified to four phases:

▪ **Phase I:** immediate post operation (initial Range of motion) started from 1-4 weeks after surgery, wear sling during first three weeks and complete to one week after removing the sling (Shoulder pendulum and Elbow, Wrist & Hand Range of motion exercises then gentle strengthening exercises (ball squeezes & Scapular retraction).

▪ **Phase II:** started from 4-8 weeks after surgery: Range of motion exercises (Supine shoulder ROM flexion, side lying shoulder flexion, low punch & strengthening exercises: Biceps curls, Triceps extension and Prone Rows).

▪ **Phase III:** initial strengthening started from 8-12 weeks late post-operative (stretching and strengthening and shoulder ROM).

▪ **Phase IV:** Advanced strengthening started from 12 weeks after surgery (Rhythmic stabilization, push up progression, resisted shoulder and shoulder plyometrics).

– The teaching methods used in application of rehabilitation exercises were booklet handouts, power point and videos on mobile. Also the researchers used pictures and diagram to help them retain the learned material for patient with learning difficulties.

– The study and control groups were evaluated with the study tools (II, III). This evaluation was performed 2 times (two months and four months postoperative)

#### Statistical design:

Categorical variables were described by number and percent (N, %), where continuous variables described by the mean and standard

deviation (Mean, SD). Chi-square test used to compare categorical variables where compare between continuous variables by t-test. A two-tailed  $p < 0.05$  was considered statistically significant. Person correlation are used to appear in the association between scores. All analyses were performed with the IBM SPSS (26) software.

#### Results:

**Table (1):** Shows that more than two third the studied patients were females (68%), their age more than 55 years and living in rural areas in both study and control group, as regard level of education; the highest percentages in both study and control group were illiterate (39 %) and not working (64 %).

**Table (2):** Shows that the majority of the studied sample in both study and control group don't have a surgical history (75 %). According to medical history: (41%) have a diabetes, (17%) have an asthma, (20%) have a coronary heart disease, (19%) have a hypertension, and (3%) have a cancer. According to mechanism of injury: The highest percentage of the studied patients in both study and control group was related to fall down (61 %), followed by motor car accident (31%), gunshot wound (5%) and assault (3 %). Regarding to hospital stay, it was found that the highest percentages in the studied patients stayed in hospital for 4- 10 days.

**Table (3):** Shows that there was a statistically significant difference between the study and the control group regarding total mean score of the shoulder function index during follow up periods after application of rehabilitation exercises post proximal humeral fracture Surgery (p-value 0.0179\*).

**Fig. (1):** Shows that there was a statistically significant difference between the study and control group regarding the total mean score of the pain level 2 months and 4 months after application of rehabilitation exercises post proximal humeral fracture Surgery (p-value 0.003\*).

**Table (4):** Shows that there is a relation between total mean score of the shoulder

function and demographic data except gender after application of rehabilitation exercises post proximal humeral fracture surgery as the following age, residence, educational level, occupation, length of hospital stay (p value: 0.006\*, 0.064\*, 0.096\*,0.021\*, 0.037\*) respectively.

**Fig. (2):** Shows that there is a negative correlation between total pain level and total mean score of shoulder function index among studied patients after application of the exercise (p value:0.024\*) this means when the total mean score of shoulder function index improve the total pain level decreased in study group than in control group.

**Table (1): Comparison between study and control group of the studied patients regarding demographic characteristics (No = 50 for each group):**

Demographic data	Study group N=50		Control group N=50		P.value
	N.	%	N.	%	
<b>Age group (years):</b>					
- 18 ≤ 25	0	0	1	2	<b>0.477</b>
- 25 ≤ 35	5	10	2	4	
- 35 ≤ 45	9	18	14	28	
- 45 ≤ 55	10	20	9	18	
- > 55	26	52	24	48	
<b>Mean ± SD</b>			<b>53.35±12.11</b>		
<b>Gender:</b>					
- Male	20	40	12	24	<b>0.068</b>
- Female	30	60	38	76	
<b>Residence</b>					
- Urban	20	40	22	44	<b>0.089</b>
- Rural	30	60	28	56	
<b>Educational level</b>					
- High	9	18	8	(16)	<b>0.758</b>
- Secondary	7	14	11	22	
- Read and write	13	26	13	26	
- Illiterate	21	42	18	36	
<b>Occupational status</b>					
- Working	18	36	18	36	<b>0.982</b>
- Nonworking	32	64	32	64	

Chi square test    Significant at P. values ≤ 0.05

**Table (2): Comparison between study and control group of the studied patients regarding medical data (No = 50 for each group):**

Medical data	Study group N=50		Control group N=50		P. value
	N.	%	N.	%	
<b>Surgical history</b>					
- Yes	13	26	12	24	<b>0.817</b>
- No	37	74	38	76	
<b>Chronic illness</b>					
- Diabetes	21	42	20	40	<b>0.955</b>
- Hypertension	10	20	9	18	
- Asthma	8	16	9	18	
- Coronary Heart Disease	9	18	11	22	
- Cancer	2	4	1	2	
<b>Mechanism of injury</b>					
- Fall down	31	62	30	60	<b>0.613</b>
- Motor car accident	16	32	15	30	
- Assault	1	2	2	4	
- Gunshot wound	2	4	3	6	
<b>Length of hospital stay:</b>					
- 1-3 days	16	32	15	30	<b>0.513</b>
- 4-10	26	52	24	48	
- >10 days	9	18	11	22	

Chi square test Significant at P. values  $\leq 0.05$ **Table (3): Correlation between study and control group of the studied patients regarding total mean score of the shoulder function index pre, after 2months and 4 months of the exercise application (No = 50 for each group)**

Shoulder function index		Pre	After 2 months	After 4 months (Follow up)	P.
Study	Mean± SD	32.0± 6.09	97.07±9.97	98.2±1.80	<b>0.0179*</b>
Control	Mean ±SD	31.12±1.37	74.38±21.2	92.38±14.88	
	P	0.326	0.001*	0.0001**	
	F	0.975	64.79	12.89	

ANOVA test Significant at P. values  $\leq 0.05$

Fig (1): Correlation between the total mean score of the pain level among the study and control groups pre, after 2months and 4 months of the exercise application (n.=50 for each group)

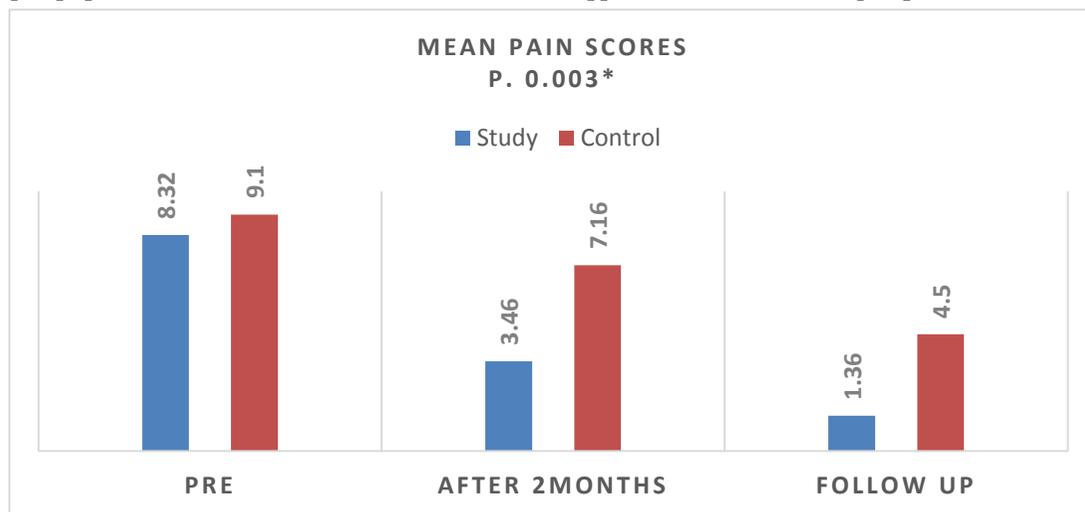
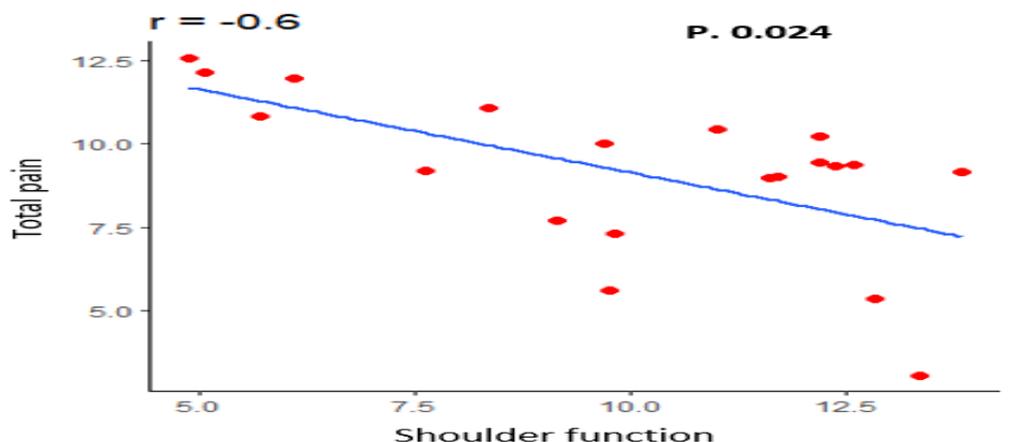


Table (4): Relation between the total mean score of the shoulder function index among the studied patients and their demographic data pre, after 2months and 4 months of the exercise application (n.=50 for each group)

Mean± SD		Pre	After 2months	Follow up	
Age groups	18-25	30.73± .01	97.00± 11.5	98.00± 10.7	<b>0.006*</b>
	26-35	31.59± 0.01	88.46± 20.41	88.73± 5.81	
	36-45	32.21± 6.41	86.95± 21.24	90.65± 10.95	
	46-55	32.52± 7.05	88.86± 20.14	91.12± 14.9	
	> 55	30.9± 5.81	83.86± 15.14	92.12± 10.9	
<b>P.</b>		<b>0.889</b>	<b>0.668</b>	<b>0.050*</b>	
Gender	Male	31.73± 5.81	90.38±19.1	98.79±6.79	0.217
	Female	31.48± 3.81	83.54 ±20.25	94.96±12.64	
<b>P.</b>		<b>0.551</b>	<b>0.124</b>	<b>0.003*</b>	
Residence	Urban	31.59± 1.541	79.56± 21.41	96.46± 10.41	<b>0.064*</b>
	Rural	31.79± 5.41	89.15± 18.24	96.15± 11.24	
<b>P.</b>		<b>0.165</b>	<b>0.011</b>	<b>0.957</b>	
Educational level	High.	30.7± 0.01	82.86± 20.14	96.15± 11.5	<b>0.096*</b>
	Secondary	31.1± 1.81	84.86± 21.14	94.12± 14.9	
	Read and write	32.2± 6.16	83.86± 21.38	91.15± 11.5	
	Illiterate	31.68± 4.91	89.15± 19.24	92.56± 10.89	
<b>P.</b>		<b>0.417</b>	<b>0.329</b>	<b>0.049*</b>	
Occupation	Working	32.59± 7.541	83.56± 20.41	96.90± 10.41	<b>0.021*</b>
	Unworking	31.09± 1.41	86.15± 19.24	95.75± 11.24	
<b>P.</b>		<b>0.561</b>	<b>0.362</b>	<b>0.350</b>	
Length of hospital stay:	1-3 days	30.76± 0.01	91.60± 15.93	99.± 10.88	<b>0.037*</b>
	4-10 days	31.54± 4.03	80.15± 21.68	93.85± 13.68	
	>10 days	31.96± 6.09	96.95± 10.97	98.82± 12.76	
<b>P.</b>		<b>0.184</b>	<b>0.217</b>	<b>0.341</b>	

ANOVA test Significant at P. values ≤ 0.05

Figure (2): Correlation between total pain level and shoulder function among study group after application of the exercise



### Discussion:

The present study investigated the effective of rehabilitation exercises on shoulder function after proximal humeral fracture Surgery.

The results of the present study revealed that: most of the studied patients their age range more than 55 years. This result was disagreed with **Klug et al., (2019)** in study entitled "Trends in surgical management of proximal humeral fractures in adults: a nationwide study of records in Germany from 2007 to 2016" who revealed that; the majority of studied patients their age more than 70 years.

The present study conducted that, the majority of the studied patients were females. This study finding disagreed with **Sintini et al., (2018)** in their study titled " Investigating gender and ethnicity differences in proximal humeral morphology using a statistical shape model "who reported that the majority of the study group were males.

In the present study; it was found that the majority of the studied patients were illiterate, not workers and live in rural area which was in line with **Monticone et al., (2021)** which reported that; the largest number of them originated from rural areas and not workers.

Regarding hospital length of hospital stay, it was found that the highest percentages in the studied patients stayed for 4-10 days which was not in line with study performed by **Silva et al., (2022)** in Portugal entitled " Proximal humerus fractures: epidemiology and trends in surgical management of hospital-admitted patients in Portugal " which mentioned that mean length of stay was  $10.0 \pm 14.1$  days.

Regarding assessment of patient's medical data; the results of the present study illustrated that, the majority of the studied patients didn't have a surgical history which was in line with **Handoll et al., (2015)** in their randomised controlled trial under title " evaluating the clinical effectiveness and cost-effectiveness of surgical compared with non-surgical treatment for proximal fracture of the humerus in adults "who explained that most of the studied patients didn't have a surgical history.

The results of the present study mentioned that, the majority of the studied patients have a diabetes followed by coronary heart disease which was not in line with cohort study conducted with **Chen et al., (2021)** titled " Effect of chronic kidney disease on outcomes following proximal humerus fragility fracture surgery in diabetic patients: A nationwide population-based cohort study " and explained that the majority of the studied patients have a diabetes followed by chronic kidney disease.

The present study revealed that, fall down accounted for the majority of the initial causes of fracture followed by motor car accident, gunshot and assault, these results was in agreement with **Ganta et al., (2022)** who studied "Does mechanism of injury impact the outcome of operative fixation of geriatric proximal humerus fractures" and found that fall down was the most common followed by motor car accident.

#### **Regarding shoulder function:**

The results of the present study illustrated that, there was a statistically significant difference between the study and the control group regarding total mean score of the shoulder function index during follow up periods after application of exercises post proximal humeral fracture surgery. This suggests that the exercise intervention had a positive effect on shoulder function in patients who underwent surgery for proximal humeral fracture. This result was agreed with **(Taylor et al., 2021)** in an observational study entitled "Rehabilitation outcomes after proximal humeral fracture " who reported that there was a statistically significant difference regarding total mean score of the shoulder function index during follow up periods after application of shoulder exercise.

In a study entitled "Effectiveness of Shoulder Exercise Program in Patients with Proximal Humerus Fractures: A Randomized Controlled Trial" , **Kim et al., (2018)** investigated the effectiveness of a shoulder exercise program in patients with proximal humerus fractures who underwent surgical treatment that included 44 patients who were randomly assigned to either an exercise group or a control group and found that the exercise group had a statistically significant improvement in shoulder function at 3 months and 6 months post-surgery compared to the control group. Based on these findings, **Martinez-Catalan, (2023)** concluded that a shoulder exercise program is effective in improving shoulder function in patients with proximal humerus fractures who undergo surgical treatment.

#### **Regarding Pain level:**

According to the present study finding there was a statistically significant difference regarding the total mean score of the pain level after application of exercises post proximal humeral fracture Surgery for study and control group during follow up periods 4 months. In this respect, a randomized controlled trial was done by, **Holmgren et al.,** published in the Journal of Shoulder and Elbow Surgery in 2013 found that a 12-week exercise program significantly improved shoulder function and reduced pain in patients with proximal humeral fractures who had undergone surgery. The authors concluded that exercise therapy can be an effective treatment for improving shoulder function and reducing pain after surgery.

A prospective cohort study conducted by **Yoon et al., (2017)** and published in the American Journal of Physical Medicine and Rehabilitation, evaluated the effectiveness of a supervised exercise program in patients with proximal humeral fractures who had undergone surgery. The authors found that the exercise program resulted in significant improvements in shoulder function and pain at 12 weeks and 6 months after surgery. They concluded that a structured exercise program can improve outcomes in patients with proximal humeral fractures.

Overall, these studies provide support for the effectiveness of exercise programs in improving shoulder function and reducing pain in patients who have undergone surgery for proximal humeral fractures.

These results disagreed with **(Rummel et al., 2021)** who studied " Shoulder function after helical long PHILOS plate " and found that no relevant difference was obtained for pain during follow up periods between the two group. **Budharaju et al., (2023)** compared the effectiveness of early range of motion exercises versus immobilization in patients with proximal humeral fractures. The authors found that there were no significant differences between the two groups in terms of pain, function, or quality of life at 6 months or 1 year after surgery.

Controversy, a randomized controlled trial by **Lopez et al., (2019)** evaluated the effectiveness of physical therapy interventions for patients with proximal humeral fractures but did not find significant improvements in shoulder function or pain.

**According to a relation between total mean score of the shoulder function and demographic data:**

The results of the present study illustrated that, there was a relation between total mean score of the shoulder function and demographic data except gender after application of exercises post proximal humeral fracture surgery as the following age, residence, educational level, occupation, length of hospital stay.

This suggests that these demographic factors may have an impact on shoulder function after surgery, and that exercise programs may be more or less effective depending on these factors. It's possible that gender would not have a significant impact on recovery. Hormonal differences: There are known differences between men and women in terms of hormonal profiles, which could potentially affect recovery after surgery. However, the impact of hormonal differences on shoulder function is not well understood and may not have been a significant factor in this particular study.

This supported by **Zhang et al., (2016)** who studied " Relationship of gender with functional outcomes after locking plate fixation of proximal humeral fractures " and found that there was no significant difference between men and women in terms of functional outcomes or complications at 1 year after surgery.

In the same respect, **Wu et al., (2018)** in a systematic review and meta-analysis of " Impact of gender on outcomes after surgery for proximal humeral fractures" reported that there was no significant difference between men and women in terms of shoulder function, pain, or range of motion at 6 months after surgery. However, it's important to note that the impact

of these demographic factors on shoulder function after surgery may vary depending on the specific patient population, exercise program, and other factors. Additionally, some studies may have reported conflicting results or found other factors that are more strongly associated with functional outcomes after surgery.

Here are a couple of examples of studies that have reported mixed or inconclusive results on the relationship between demographic factors and functional outcomes after surgery for proximal humeral fractures: **Page et al., (2018)** found that age, comorbidities, and fracture type were significant predictors of functional outcomes, while gender and preoperative function were not significant predictors.

Otherwise, **Tashjian et al., (2016)** study published in the Journal of Shoulder and Elbow Surgery examined the impact of gender on functional outcomes after reverse total shoulder arthroplasty for proximal humeral fractures. The authors found that women had significantly worse functional outcomes than men, even after controlling for other factors such as age and preoperative function.

However, **Olerud et al., (2017)** in their a randomized controlled trial study entitled " Hemiarthroplasty versus nonoperative treatment of displaced 4-part proximal humeral fractures in elderly patients: " did not directly report on the relationship between demographic factors and functional outcomes, but rather identified predictors of functional outcomes after surgery and found that age, comorbidities, and fracture type were significant predictors of functional outcomes, while gender and preoperative function were not significant predictors.

**According to a relation between total pain level and total mean score of shoulder function index:**

The present study mentioned that there was a relation between total pain level and total mean score of shoulder function index among studied patients after application of the exercise.

That supported with **Hanchard et al., (2016)** who studied " Surgery for proximal humeral fractures in adults " and revealed that patients who completed the exercise program had significant improvements in shoulder function and pain. Also, **Chen et al., (2018)** found that patients who received exercise therapy had a greater improvement in shoulder function than those who did not receive exercise therapy, and that the low in pain score.

In the other hand, **Launonen et al., (2012)** compared the effectiveness of non-operative treatment and operative treatment (locking plate fixation) for proximal humeral fractures and found no significant difference between the two groups in terms of shoulder function at 2 years of follow-up, but noted that patients in the operative group had a higher rate of persistent pain.

In summary, the evidence suggests that exercise therapy can be effective in improving shoulder function and reducing pain after surgery for proximal humeral fractures. While some studies report conflicting results or limitations in their findings, the majority of evidence supports the effectiveness of exercise therapy in improving both outcomes. Generally, exercise therapy can be a valuable component of rehabilitation after surgery for proximal humeral fractures, and healthcare providers should consider incorporating exercise therapy into their treatment plans for patients with these injuries.

### Conclusion:

Based on the findings of the current study, it can be concluded that implementation of rehabilitation exercises for patients who had undergone proximal humeral fracture surgery, significantly improved shoulder function and reduced pain level in the study group compared to the control group.

### Recommendations:

Rehabilitation exercises for proximal humeral fractures should be carried out on an individual basis from the beginning of this fracture to prevent shoulder dysfunction.

Printed copies of the rehabilitation exercises should be available in the orthopedic department and clinic to be readily available for all patients planned to undergo proximal humeral fracture surgery. The present study should be replicated on larger study populations for generalization of the results.

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