Efficacy of a Therapeutic Exercise Program on Patients' Pain and Shoulder Mobility Following Proximal Humeral Fracture Surgery

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Abstract

Background: One of the most frequent types of fractures is proximal humeral fracture. Persons with shoulder injuries have a gradual and continuous recovery from their injury and also, many people have persistent disabilities that interfere with their daily routines. So, **the aim of the present study was to** explore the efficacy of a therapeutic exercise program on patients' pain and shoulder mobility following proximal humeral fracture surgery. **Research design**: To accomplish the goal of this study, a quasi-experimental research design was employed. **Setting**: The study was conducted in the orthopedic unit at Menoufia University Hospital. **Sample**: Within six months after surgery for proximal humeral fractures, a convenient sample of fifty patients was included in the current study. **Tools for data collection**: (I): Structured interview questionnaire, II: Numerical Rating Pain Scale, and Tool III: Shoulder function index. **Results**: There was a statistically significant difference improvement in the total mean score of the pain and shoulder mobility post therapeutic exercise program application among patients post-humeral fracture surgery. **Conclusion**: Therapeutic exercise program application has a significant effect on reducing pain and improves shoulder mobility among patients following proximal humeral fracture surgery**. Recommendations**: It is advised that patients undergoing proximal humeral fracture surgery get a therapeutic exercise program as a crucial component of their nursing education.

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Keywords: Pain, Patients post humeral fracture Surgery, Shoulder mobility, Therapeutic exercise program.

Introduction:

A Humeral fracture is abreak of the upper part of the bone of the arm (humerus). A humerus fracture represents 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. The deformity may be present in severe fractures; however, musculature may cause the 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 are uncommon due to collateral circulation in the arm **(Elliottet al., 2022)**.

Humeral fractures are the third most common fractures, following hip and distal radius fractures. They account for approximately 5% of all fractures, and they are increasing in frequency.1 The elderly population has a higher incidence of proximal humeral fractures and typically sustains more complex fracture patterns than those sustained by a younger patient population.1 Given the likelihood of poor bone quality in this population, the surgeon should maintain a high level of suspicion for fragility fracture associated with relatively minimal trauma **(Jo et al., 2021)**.

Furthermore, A Humeral fracture generates pertinent direct costs, such as medical expenses. Of these, the cost of hospitalization accounts for the largest portion (55%), contributing to the overall healthcare costs associated with A Humeral fracture. The long-term loss of earnings,

vocational rehabilitation costs, pensions and wage replacement costs, production delays, accident investigations, and, lastly, the hiring and training of workers to replace those injured are also anticipated, even though precise estimates of indirect costs are not yet available. A Humeral fracture frequently supports requiring follow-up medical care, including surgery and rehabilitation **(Rossi et al., 2022).**

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

A humeral fracture can have a substantial impact on the patient´s physical function and independent living and is 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, A humeral fracture induces pain, reduces quality of life, and produces relevant direct costs including medical costs. After sustaining a humeral fracture, the main focus of treatment is to regain the best possible function of the shoulder **(Monticone et al, 2021)**.

Exercise plays a vital role in 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 joint stiffness which is a common complication with this type of upper arm**.** Stretching of the shoulder girdle and upper limb muscles, strengthening of the humeral and upper limb muscles, and postural control of upper limb fractures are the major types of exercises **(Richard et al., 2020)**.

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 routines. Rehabilitation nurses determine the care needs of patients and provide education and support. Instruct patients in a home exercise program to improve the strength and endurance of the shoulder **(Ebraheim, 2022).**

Significance of the study:

Proximal humeral fractures are relatively common, accounting 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 is higher with age (Ebraheim, 2022**)**. PHF has a substantial impact on the patient´s physical function and independent living and is associated with higher morbidity and mortality. Exercises help to improve shoulder function after proximal humeral fracture Surgery **(Gutenbrunner et al., 2021)**, So this study was conducted to explore the efficacy of a therapeutic exercise program on patients' pain and shoulder mobility following proximal humeral fracture surgery.

Aim of the study:

To explore the efficacy of a therapeutic exercise program on patients' pain and shoulder mobility following proximal humeral fracture surgery through:

- Assess patients' pain level following proximal humeral fracture surgery pre and post therapeutic exercise program.
- Assess patients' shoulder mobility following proximal humeral fracture surgery pre and post therapeutic exercise program.
- Design the therapeutic exercise program according to patient's needs**.**
- Implement the therapeutic exercise program for patients

following proximal humeral fracture surgery**.**

- Evaluate the efficacy of a therapeutic exercise program on patients' pain and shoulder mobility following proximal humeral fracture surgery**.**

Research hypothesis:

H1: Patients who exposed to the therapeutic exercise program will be having less pain post-application than pre-application.
H2: Patients who exposed to the therapeutic exercise program will be maintaining good shoulder mobility post-application than pre-application.

Subjects and Methods:

Research design:
To accomplish the goal of this study, a quasi-experimental research design was employed**.**

Setting:
The study was conducted in the orthopedic unit at Menoufia University Hospital.

Subjects:
Within six months after surgery for proximal humeral fractures, a convenient sample of fifty patients was included in the current study aged from 20 to 60 years and from both sexes with proximal humeral fracture.

Tools of data collection:

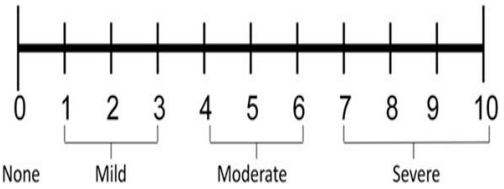
Tool (I): Structured interview questionnaire:

After examining relevant national and international literature **(Rossi et al., 2022; Ebraheim**, 2022; **Richard et al., 2020)**, the researchers developed it. This tool was divided in to three parts:

Part 1: Patients' personal data: It included data on the age, gender, education level, and place of residence of the patients.
Part 2: Patients' medical data: It included data related to having chronic disease such as (diabetes, hypertension, asthma, coronary heart disease, and cancer), previous surgery, hospital stay, and mechanism of injury

Tool (II):- 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. 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 patienthas no pain, while 10 represents the most intense pain possible.



Tool (III): Shoulder function index: (Van et al., 2015). It was used to evaluate the patient's shoulder function. It was applied three times (preoperatively, and two months postoperatively). It included 13 items. The 13 items cover a range of activitiestypically done in and around the house, for self-care and keeping the household.

Scoring system:

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

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	

Validity of the tools:

The content validity of the tools, their clarity, comprehensiveness, appropriateness, and relevance were reviewed by y 5 experts (three professors in the field of Medical-Surgical nursing, and two professors in the orthopedic surgery department. Sentence clarity and content appropriateness were ensured by making modifications to the panel's decision.

Reliability of the tools:

Cornbach's alpha is the most widely used method for evaluating internal consistency of the research tools .The **Numerical Rating Pain Scale** reliability coefficient and **Shoulder function index** were (0.90, 0.89) respectively.

Methods of data collection:

The study was conducted with ethical consent granted by the Ethical Research Committee of the Faculty of Nursing at Sohag University, the directors of the previously selected setting granted permission for this study to be carried out. To obtain permission for collecting research data, the purpose of the project was outlined.

A pilot study

A pilot study was carried out on 10% (five patients) of the all sample to evaluate the feasibility and clarity of the research design. No changes were made to create the tools in their final version. The pilot study patients included in the study.

Ethical considerations:

To obtain their cooperation and explain the study's goal, the researchers had a meeting with the directors of the selected setting before the study. Informed consent was obtained by the researchers from the patients. Enrollment in the study was entirely voluntary, and the patients were informed that they could withdraw their consent at any time, for any reason. Patients were told that data would be utilized for research purposes only.

Filed work: – An official permission to carry out the study was obtained from the responsible hospital authorities of the selected settings. – Data collection was started June from the beginning of to the end of November 2023

Implementation of the study included three phases (assessment phase, implementation phase, and evaluation phase).

Assessment phase:

– The researcher initially established a friendly relationship with the patients by having brief talks with them. Every patient was interviewed before the program was conducted . Baseline data were collected from patients and their current medical records before operation by using study tools I, II, III.

The therapeutic exercises program:

The general objective of therapeutic exercises program sessions:

At the end of the **therapeutic exercises program** sessions, the patients will be having less pain and maintain shoulder mobility following - proximal humeral fracture surgery

Specific objectives of the awareness program:

- Know the anatomy of the proximal humeral fracture surgery.
- List causes of proximal humeral fracture surgery.

- Enumerate indications of the proximal humeral fracture surgery.
- List the signs & symptoms of the proximal humeral fracture surgery.
- Identify the complications of the proximal humeral fracture surgery.
- Know the diagnosis of the proximal humeral fracture surgery.
- Identify management and treatment of proximal humeral fracture surgery
- List Complications prevention of proximal humeral fracture surgery
- List therapeutic exercises that can be done, frequency, precautions that can be taken

III. Implementation phase:

Therapeutic exercises were developed by the researcher based on deficiency in of studied patients' needs. 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 (five sessions—two theoretical and five practical phases).

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 therapeutic 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 therapeutic 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.

- .From 9 a.m. to 1 p.m., three days a week, the researchers were accessible in the study settings. The previously indicated study techniques were used for one-on-one interviews with each patient.
- The teaching methods used in application of therapeutic 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 therapeutic exercises program classified to five phases (**practical sessions) were done as follows:**

PHASE I: IMMEDIATE POST-OP: Initial ROM (1-4 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Reduce discomfort and inflammation; • Prevent fractures and promote optimal bone healing
Sling	• Preserve elbow, wrist, and hand function; • Restore shoulder passive range of motion (PROM); • Wear sling for a minimum of three weeks. Exercise and daily tasks including eating, dressing, and bathing should be performed without the sling on at least four times a day. • No abduction beyond 90 degrees
Precautions	• Shoulder ER: 0–40°C
Interventions	• Avoid driving until you have enough range of motion, the sling is removed, and you are not using any narcotic painkillers. • Avoid lifting more than one pound. • Avoid making movements that hurt.
	• Squeezing balls
Criteria to Progress	Exercises for scapular retraction and mobility; weaning from the sling after four weeks; sufficient pain management; complete arc of motion in the elbow; shoulder PROM flexion to 140 degrees, ER to 40 degrees, and abduction to 90 degrees

PHASE II: INTERMEDIATE POST-OP: AAROM and AROM (4-8 WEEKS AFTER SURGERY)

Rehabilitation Goals	Full shoulder PROM; initiation of shoulder active assisted range and active range of motion (AAROM/AROM); initiation of shoulder isometrics; initiation of gentle elbow isotonic strengthening; encouragement of the return to normal ADLs with lifting precautions; prohibition of lifting more than 2 pounds prior to 6 weeks; initiation of shoulder AROM at 6 weeks post-op; absence of forceful end range over pressure to involved shoulder; and absence of isotonic strengthening of the shoulder
Precautions	Full shoulder PROM; initiation of shoulder active assisted range and active range of motion (AAROM/AROM); initiation of shoulder isometrics; initiation of gentle elbow isotonic strengthening; encouragement of the return to normal ADLs with lifting precautions; prohibition of lifting more than 2 pounds prior to 6 weeks; initiation of shoulder AROM at 6 weeks post-op; absence of forceful end range over pressure to involved shoulder; and absence of isotonic strengthening of the shoulder
Additional Interventions **Continue with Phase I interventions*	Flexibility and Mobility AAROM
Criteria to Progress	• Lawn chair advancement

PHASE III: LATE POST-OP: Initial Strengthening (8-12 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Range of motion/mobility AAROM • Full shoulder AROM • Start shoulder strengthening • Advance elbow and wrist strengthening
	• No lifting more than 10 pounds • No painful or forceful stretching • No excessive weight bearing on involved extremity • Standing shoulder flexion with dowel • Standing shoulder abduction with dowel AROM
Precautions	• Standing shoulder elevation • Prone I, Prone Y, Prone T stretching • Doorway Stretch • Pec/biceps stretch • Cross body stretch strengthening • Straight arm pull-down
Additional Interventions *Continue with Phase I-II Interventions	Resisted shoulder ER, Resisted shoulder IR: neutral shoulder position • Low punch with resistance • Supine shoulder protraction • Complete shoulder AROM with appropriate mechanics • Pain or compensatory strain
Criteria to Progress	Supine shoulder protraction • Complete shoulder AROM with appropriate mechanics • Pain or compensatory strain

PHASE IV: Advanced Strengthening (12 WEEKS AFTER SURGERY)

Rehabilitation Goals	• Return to regular functional activities; • Increase shoulder strength with higher resistance and compound motions; • Keep improving shoulder range of motion as needed.
Additional Interventions **Continue with Phase II-III interventions*	bolstering
Criteria to Progress	• Stabilisations in rhythm

Evaluation phase:

In this phase, the researchers reassess the efficacy of a therapeutic exercise program on patients' pain and shoulder mobility following proximal humeral fracture surgery as post-test). The studied patients were evaluated with the study tools using the same tools used in the pretest (II, III). This evaluation was performed 2 times (two months and four months postoperative)

Statistical analysis:

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 is used to appear in the association between scores. All analyses were performed with the IBM SPSS (26) software.

Results:

Table 1 shows that 66% of the patients evaluated were female, and 48% of them were between the ages of 45 and 55, with a mean age of 53.27±9.7 years. In terms of place of residence, 58% of the patients under study were in rural regions. Regarding the patients' educational attainment, 32% percent were illiterate. 62% percent of the patients under study were housewives.

From Table (2): it was observed that (42%) of them have diabetes, the majority of thestudied patients do not have a surgical history (76 %). Concerning mechanism of injury: The highest percentage of the studied patients was related to falls down (60 %) followed by motor car accidents (20%),. Regarding hospital stay, it was found that 54% of the studied patients stayed in hospital for 4- 10 days.

Figure (1) demonstrates that 92% of the studied patients did not participate in training programs concerning therapeutic exercise following proximal humeral fracture surgery .

Figure (2): Demonstrates that 60% of the studied patients stated that doctors were the main source of **knowledge** about therapeutic exercise following proximal humeral fracture surgery.

Table 3 demonstrates that a statistically significant differences and reduction were detected between patients' pain scores post-two and four months of the therapeutic exercise program at the <0.05 level.

Figure (3) indicates that (32%) of the studied patients had severe pain levels post-two months of therapeutic exercise program implementation compared to no one who had severe pain levels post-four months of therapeutic exercise program implementation.

Table (4): Shows that a statistically significant difference between the studied patients ' total shoulder functions scores pre-, post-2 months, and 4 months of therapeutic exercise program **application** (p-value 0.0185*).

Table (5): Shows that there is an association between patients' shoulder function total mean score and personal data post therapeutic exercise program **application** post proximal humeral fracture surgery.

Table (1): Personal data of the studied patients (No = 50):

Personal data	N.	%
Age group (years):		
20 ≤ 25	2	4.0
25 ≤ 35	4	8.0
35 ≤ 45	7	14.0
45 ≤ 55	24	48.0
55 ≤ 65	23	26.0
Mean ± SD	**53.27±9.7**	
Gender:		
Male	17	34.0
Female	33	66.0
Residence		
Urban	21	42.0
Rural	29	58.0
Educational level		
Illiterate	16	32.0
Read and write	14	28.0
Secondary	14	28.0
High	6	12.0
Occupational status		
Working	19	38.0
Housewives	31	62.0

Table (2): The studied patients' medical data (No = 50):

Medical data	Study sample N=100	
	N.	%
Chronic illness		
Diabetes	21	42.0
Hypertension	9	18.0
Asthma	7	14.0
Coronary Heart Disease	10	20.0
Cancer	3	6.0
Previous surgical history	12	24.0
Yes	38	76.0
No		
Mechanism of injury	30	60.0
Fall down	10	20.0
Motor car accident	6	12.0
Assault	4	8.0
Gunshot wound		
Hospital stay Length:		
1-3 days	22	44.0
4-10	27	54.0
>10 days	1	2.0

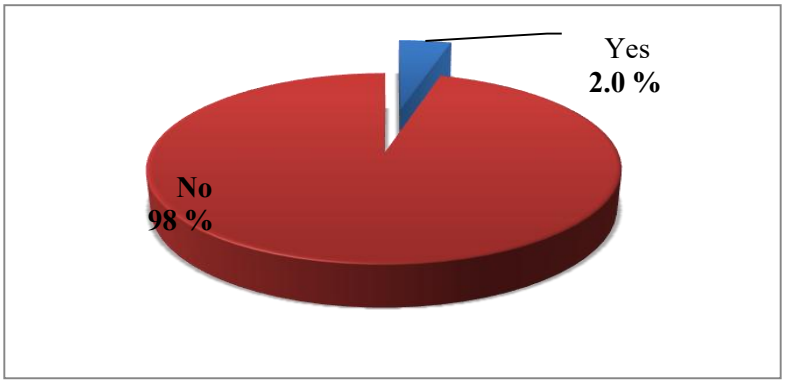


Figure (1): The studied patients' distribution according to attending training programs concerning therapeutic exercise following proximal humeral fracture surgery (N=50).

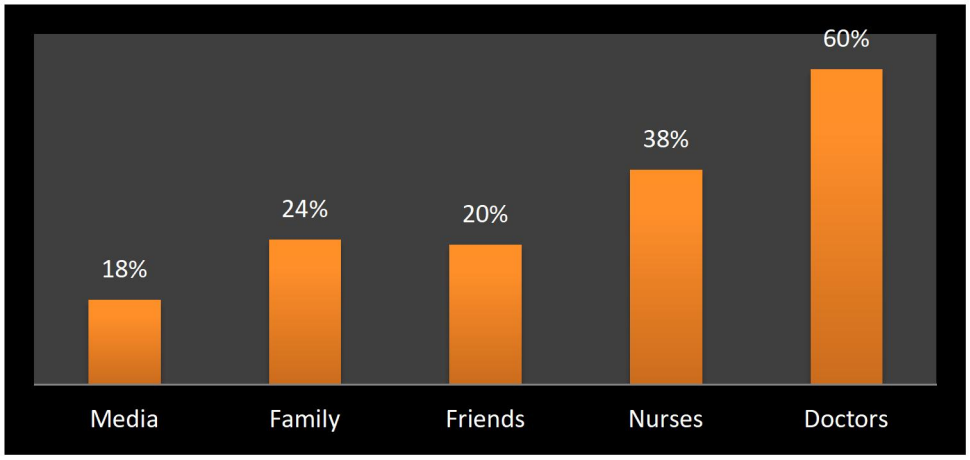


Figure (2): Patients' source of knowledge about **therapeutic exercise following proximal humeral fracture surgery**

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Table 3: Differences in pain scores post-two and four months of the therapeutic exercise program among the studied patients

Items	Pain level				X^2	p-value
	Post-two months of therapeutic exercise program		Post- four months of therapeutic exercise program			
	Mean Score	SD	Mean Score	SD		
Pain levels	6.14	0.22	4.66	0.23	63.75	<0.001**

NS=Non-significant, *= significant at p<0.05 level

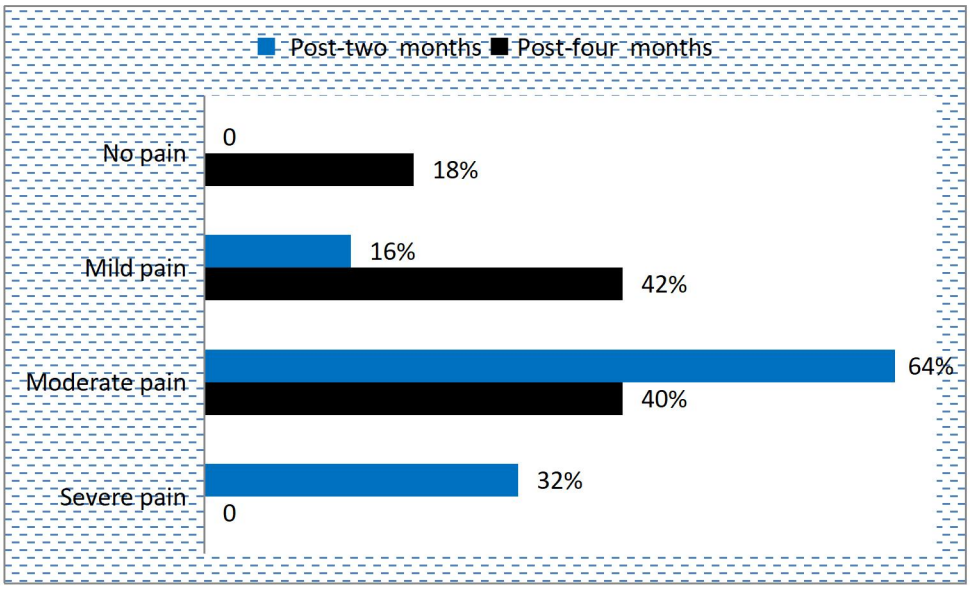

Figure (3): Total pain levels of the studied patients post-two and four months of therapeutic exercise program application (n=50).

Table (4): Correlation between the studied patients regarding total mean score of the shoulder functions pre-, post-months, and 4 months of therapeutic exercise **program application (No = 50)**

Items	**Pre** therapeutic exercise **program application**	**Post 2 months of** therapeutic exercise **program application**	**Post 4 months of** therapeutic exercise **program application**	**P.**
Shoulder function index	34.0± 5.07	94.03±5.45	96.2±1.22	**0.0185***
	0.336	0.001*	0.0001**	
	0.975	68.78	15.68	

Significant at P. values ≤ 0.05

Table (5): Association between the patients' shoulder function total mean score and their peronal data pre, post 2months and 4 months of the therapeutic exercise program **application (n.=50)**

Mean± SD	**Pre**	**After 2months**	**Follow up**	
Age groups	0.876	0.678	0.054*	0.006*
Gender	0.573	0. 132	0.004*	0.067*
Residence	0.158	0.014	0.956	0.063*
Educational level	0.419	0.348	0.049*	0.096*
Occupation	0.549	0.357	0.352	0.022*
Length of hospitalstay:	0.175	0.229	0.343	0.039*

ANOVA test Significant at P. values ≤ 0.05

Discussion:

Fracture movement and pain were central symptoms that led to the loss of basic capabilities to perform activities, work, and recreation in the following weeks and months. Their lack of capability disrupted the patients' independence and self-image. The massive need for support from family or caregivers forced some patients to move their residences, and others developed social anxiety due to the fear of pain and re-injury. Patients' preferences were considered in the treatment decision-making process and could change through the treatment course according to the prevailing symptoms of gross fracture movement with pain and inability to perform basic activities (**Sargeant, 2020).**

The results of the present study indicated that less than three half of the studied patients their age range 45 and 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 results of the present study revealed that more than three fifths of the studied patients were female. 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 thehigh percentage of the studied patients were illiterate, not workers and more than three fifths of are 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, according to the researchers point of view, it could be connected to a knowledge deficit,.

The results of the present study mentioned that, slightly more than two fifths of the studied patients have a diabetes 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.

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 present study revealed that, fall down accounted for the three fifths of the initial causes of fracture, 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 hospital length of hospital stay, it was found that more than half 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 ± 14.1 days.

According to the present study finding demonstrated that almost of the studied patients did not participate in training programs concerning therapeutic exercise following proximal humeral fracture surgery. From the researchers' point of view, this confirmed the regent need to apply therapeutic exercise programs.

Finding of the present study revealed

that three fifths of the studied patients stated that doctors were the main source of **knowledge** about therapeutic exercise following proximal humeral fracture surgery. From the researchers' point of view, this reflected that the studied patients seek the right way in health issues.

Finding of the present study indicated that a statistically significant differences and reduction were detected between patients' pain scores post-two and four months of the therapeutic exercise program at the <0.05 level. From the perspective of the researchers, this demonstrated the beneficial impact of therapeutic exercise application in pain reduction.

In this respect, a randomized controlled trial was done by, **Holmgren et al.,** (**2019**) found that a 12-week exercise program significantly 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.

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 **Lopiz et al., (2019)** evaluated the effectiveness of physical therapy interventions for patients with proximal humeral fractures but did not find significant improvements in pain level. Also, this is in contrast to a prior study that revealed no difference in pain relief between two and three weeks of immobilization (**Wirbel et al., 2019**).

The results of the present study illustrated that high percentage of the studied patients had severe pain levels post-two months of therapeutic exercise program application compared to no one who had severe pain levels post-four months of therapeutic exercise program application. According to the researchers' point of view, this demonstrated how the therapeutic exercise program had a good impact on the patients' practices and associated with reduction level scores pain. According to **Chen et al. (2022**), the program was more effective in reducing pain in working patients who had undergone surgery to treat humerus fractures.

This result is in the same line with **Dunlop et al., (2019**), who reported that pain perception had reduced by the end of treatment and follow-up periods. This reflects the positive combined effect of the awareness program.

Healthcare professionals should think about including exercise therapy in their treatment plans for patients with proximal humeral fractures since it can generally be a beneficial part of rehabilitation following surgery **(Davey et al., 2022).**

The results of the present study illustrated that, a statistically significant difference between the studied patients ' total shoulder functions scores pre-, post-2 months, and 4 months of therapeutic exercise program **application**. 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 matched 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. Similarly, these findings done by **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.

In the same line, a prospective cohort study conducted by **Yoon et al., (2017)** and 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.

The results of the current study revealed that there was an association between patients' shoulder function total mean score and personal data post therapeutic exercise program application post proximal humeral fracture surgery. 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. 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 menand 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.

In the other hand, This result is not 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. 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.

Conclusion:

Based on the findings of the current study, it can be concluded that therapeutic exercise program application has a significant effect on reducing pain and improves shoulder mobility among patients following proximal humeral fracture surgery**.**

Recommendations:

The following suggestions are put forth in light of the current study's findings:

It is advised that patients undergoing proximal humeral fracture surgery get a therapeutic exercise programme as a crucial component of their nursing education.

All patients scheduled for proximal humeral fracture surgery should have easy access to printed copies of the exercises in the orthopedic clinic and departments.

To generalize the findings, the current study needs to be conducted again on bigger sample populations.

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