Effect of Simulation-Based Training on Nurses' Performance regarding care of patients undergoing humeral fracture surgery

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Abstract

Background: Proximal humerus fractures (PHF) are very common and a serious health problem. They are the seventh most frequent fractures in adults. Simulation-based training serves as a link between classroom learning and clinical practice. It aids nursing competency before working with patients in a real-life environment, hence improving the quality of care and ensuring patients' safety. **This study aimed to** evaluate the effect of simulation-based training on nurses' performance regarding care of patients undergoing humeral fracture surgery. **Method**: A quasi-experimental design (one group pre/ post-test design) was used. **Setting**: The study was conducted in orthopedic wards at Mansoura University Hospital. **Subjects**: All nurses (50) who were working in the previously mentioned setting during the study period regardless of their age, education, or years of experience. Tools for data collection: **Tool (1)** Humeral fracture surgery questionnaire sheet included **Part 1:** Demographic characteristics of nurses &**Part (2):** The nurses' knowledge of humeral fracture surgery, and **Tool (2)** Humeral fracture surgery's observational checklist were used to collect data. Results: There was a highly statistically significant difference in the knowledge and practice of the nurses under study. Before the introduction of simulation-based training, the study's findings showed that over two-thirds of the nurses under investigation had a poor level of knowledge regarding care of patients undergoing humeral fracture surgery, and over half of them had incompetent level of practice. After putting simulation-based training into practice, the great majority of the nurses under study had a good level of knowledge, and a competent level of practice. There was a highly statistically significant difference and improvement in nurses' performance after simulation-based training compared pre- training. **Conclusion**: The present study concluded that simulation-based training had a positive effect on improving nurses' performance regarding care of patients undergoing humeral fracture surgery. **Recommendations**: The study recommended that simulation-based training should be integrated as an effective method in nurses' training regarding care of patients undergoing humeral fracture surgery.

Keywords: Humeral fracture surgery, Nurses' performance, Simulation-based training.

Introduction:

The humerus is a long bone that extends from the shoulder and scapula (shoulder blade) to the elbow. It is sometimes referred to as the upper arm bone. A humerus fracture can be categorized as either a proximal humerus fracture or a humerus shaft fracture. Proximal humerus fractures can occur at different levels and with varied fracture patterns, such as simple or comminuted, and they typically happen at the shoulder joint. Conversely, a fracture of the humerus shaft is limited to the middle region of the upper arm (**Rämö et al., 2020).**

Upper limb fractures are on the rise in industrialized Western nations, with an estimated 370,000 ER visits expected annually in the United States. With 50% of all occurrences, the proximal humerus is the most common location for fractures. In comparison to men, women experience higher rates of humeral fractures (36 visits per 100,000 persons), with 78 visits per 100,000 people experiencing a fracture and a higher frequency in the 45–64 age range. Humeral fractures cause pain and limitations in activities of daily living (ADL) and reduce quality of life **(Iglesias-Rodríguez et al., 2021).**

Frequent causes of humerus fractures include falls, physical trauma, excessive physical stress, and pathological diseases. Elderly persons with osteoporosis who fall on an outstretched arm most frequently sustain proximal humerus fractures. Following firearm incidents, car crashes, and severe muscle spasms brought on by an electric shock or seizure, proximal fractures are less frequent. Low bone mineral density, poor vision and balance, and tobacco use are additional risk factors for proximal fractures. Throwing too much, as pitching in baseball, can result in a stress fracture of the proximal and shaft regions (Daw et al., 2022). Most commonly, falls or physical trauma result in middle fractures. Transverse fractures are caused by physical force to the humerus shaft, while spiral fractures are caused by falls. The most common cause of distal humerus fractures **(Lauder& Richard, 2020).** There are three different types of fractures: distal humeral fractures, proximal humeral fractures, and humeral shaft fractures. X-rays are typically used to confirm the diagnosis. For proximal fractures, a CT scan may be performed to obtain further information **(Bahrs et al., 2009).**

A humeral fracture typically presents with pain, edema, bruising, and restricted shoulder range of motion. Severe fractures may have the deformity, however musculature may be the reason for the absence of the

deformity upon inspection. A possible sign of an axillary nerve damage is weakness in the deltoid muscle and numbness over the outside portion of the upper arm. Due to collateral circulation in the arm, symptoms of impaired blood circulation in the arm are unusual **(Handoll et al., 2022).** Age and energy level have a bimodal distribution when it comes to humeral fractures. This bimodal pattern is extremely prevalent, and doctors should be able to distinguish between high-energy (e.g., motor vehicle accident in adult patients) and low-energy (e.g., elderly patient status following ground level fall) paradigms in different groups and fracture patterns **(Ismael et al.,2023).**

Surgery, bracing, splinting, or slings are possible forms of treatment. A sling is frequently enough for proximal fractures that are well-aligned (**Baker et al., 2022**). Instead of surgery, a brace may be used to treat a number of humerus shaft fractures. Intramedullary nailing, closed reduction and percutaneous pinning, and open reduction and internal fixation are possible surgical alternatives. Another alternative might be a joint replacement. While the prognosis for distal fractures can be less favorable, that of proximal and shaft fractures is typically favorable. They account for roughly 4% of fractures **(Handoll et al., 2022)**.

Nursing simulation-based clinical training encompasses more than just manipulating mannequins; it also includes a range of activities utilizing pediatric patient simulators, skilled personnel, lifelike virtual environments, and role-playing. Clinical simulation has grown to be a crucial component of nursing training, as defined by the National Council of State Boards of Nursing (NCSBN) as "an activity or event replicating clinical practice using scenarios, high-fidelity manikins, medium-fidelity manikins, standardized patients, role-playing, skills stations, and computer-based critical thinking simulations" (**Alexander et al., 2019**).

Simulation-based clinical education offers several benefits, including the ability to individualize learning, adjust the difficulty level, repeat practice learning, and quick feedback (**Gunn et al., 2021).** But the study found that undergraduate degrees usually don't provide many opportunity to practice nursing skills on actual patients (**Cant & Cooper, 2017**). This reality could affect the competency of upcoming, freshly qualified healthcare staff, raising the risk of mistakes and endangering patient safety **(Khalil et al., 2023).**

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 (PHFs) are common injuries and account for 5–6% of all adult fractures. The annual incidence ranges from 13 to 20 per 100,000 persons and has been found to be higher with age **(Iglesias-Rodríguez 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.The nursing assistants can handle the individual's pain and prevent complications by carrying out a precise nursing assessment regularly **(Rundgren et al., 2020**).

Nursing training can be accomplished effectively and safely with the use of simulation training. Given the chance to practice recently acquired skills and get immediate feedback in a nurturing setting, simulation training is seen as an effective teaching method. Increasing exposure to medical scenarios in simulated environments helps nurses become more confident in their abilities and create best practices for addressing emergencies **(Baayd et al., 2023; Angelina et al., 2021).** Recent studies indicated that simulation improves nursing knowledge, clinical practice, critical thinking, communication skills, improve self-confidence and satisfaction as well as clinical decision making. Simulation training is an effective method used to integrate realistic clinical situations in a safe environment, which allows nurses and intern students to develop knowledge and psychomotor skills **(Mundell, et al., 2013).** Hence the study was conducted to evaluate the effect of simulation-based training on nurses' performance regarding care of patients undergoing humeral fracture surgery.

Operational Definition:

Simulation-Based Training: Refers to the use of simulated scenarios, models, or virtual environments to provide nursing education and training regarding humeral fracture surgery. It involves the replication or representation of real-life clinical situations, allowing nurses to provide priority of nursing care in the clinical medical surgical skill lab as in a real situation **(Abdalla Jarelnape & Idris Sagiron, 2023).**

Aim of the study:

To evaluate the effect of simulation-based training on nurses' performance regarding care of patients undergoing humeral fracture surgery

Research hypothesis:

Simulation-based training is expected to have a positive effect on improving nurses' knowledge and practice regarding care of patients undergoing humeral fracture surgery.

Subjects and Methods:

Research design:

A quasi-experimental design (one group pre/ post-test design) was used.

Setting:

The study was conducted in orthopedic wards at Mansoura University Hospital.

Sample:

A convenience sample included all nurses (50) who were employed in the above mentioned setting regardless of their age, education, or years of experience during the period of data collection.

Tools for data collection

Two tools were used for collecting data in this study.

Tool (I): Humeral Fracture Surgery questionnaire: After examining relevant national and international literature **(Gutenbrunner et al.,2021, Iglesias-Rodríguez et al., 2021, Monticone et al., 2021, Richard et al., 2020),** the researchers developed it. The two components that made up this tool were as follows:

Part 1: This part contained information about the demographic characteristics of nurses such as nurses' age, gender, education, years of experience. , and attending previous training programs.

Part (2): A structured multiple-choice questionnaire (20 questions) was used to assess the nurses' knowledge regarding care of patients undergoing humeral fracture surgery. Before, immediately post, and one month after ,that included definition of the humeral fracture surgery, indications, causes, signs & symptoms, types, management and treatment methods, prevention of complications, assessment and preparation, and nurse' role to prevent the complications of humeral fracture surgery.

Scorings system

Every right response was valued at one, whereas every wrong response was valued at (zero). Three categories were used to classify the nurses' knowledge levels: poor (less than 50%), fair (50–75%), and good (more than 75%).

Tool II: Humeral Fracture Surgery observational checklist (pre/posttest). Using an observation checklist, The nurses' practices regarding care of patients undergoing humeral fracture surgery were evaluated in terms of patient assessment and preparation (6 items), dressing change (13 items), postoperative care (10 items), and post-surgical exercises and medications (11 items).

Scoring System

The scoring scheme for the observational checklist was as follows: correctly completed (2), incompletely completed (1), and not completed (0). The two categories of total nursing practices were competent and incompetent practice. Incompetent practice was defined as a score of less than 80%, and competent practice was defined as a score of equal or greater than 80%.

Methods:

Validity and reliability:

Five experts, two professors in medicine and three professors in the field of medical-surgical nursing, evaluated the content validity and made revisions to the instruments to improve their extensiveness, clarity, relevance, and applicability. The Cronbach's alpha coefficient test yielded the following results about the internal consistency's reliability: tool (I) was 0.932, and tool II was 0.93.

A pilot study

A pilot study was conducted on 10% (5 nurses) of the total sample to assess the clarity and feasibility of the data collection tools and produce the final form of the tools. No modifications were made. The pilot study was excluded from the total sample of the study.

Ethical considerations:

Before starting the study, the researchers had a meeting with the directors of the chosen setting to discuss the purpose of the study and secure their cooperation. Mansoura University's faculty of nursing's ethics committee gave its approval. To gain the cooperation of nurses, informed consent was obtained after they were informed of the study's objectives. The study's chosen participants were advised that their participation was completely voluntary and that they might leave the study at any moment, for any reason. Additionally, they were informed that their data would be protected and utilized exclusively for research purposes.

Field of work

The director of Mansoura University Hospital gave his approval. From the beginning of April 2024 until the end of July 2024, the study was carried out. The researchers welcomed each nurse, identified themselves, and gave an overview of the purpose and design of the study at the start of the interview.

Phases of the study: The investigation was carried out in the following four stages:

I-Assessment Phase

- A survey of the literature on the various aspects of the concerns from the past and the present, both locally and globally, was conducted using books, essays, periodicals, and magazines. Booklet was prepared in the Arabic language to cover many parts of the study topic created to close knowledge and practice gaps among nurses after examining pertinent contemporary Arabic and English literature.
- To gather information about the nurses' characteristics, Tool (I) part (1) was used to interview each nurse prior to the training.
- Tool (I) part (2) and tool II were used to evaluate the knowledge and practice of nurses regarding care of patients undergoing humeral fracture surgery.

II. Planning phase:

Based on the results of the previous phase, the objectives, priorities, and expected results were defined in order to address the practical requirements and knowledge gaps of the nurses when caring for patients undergoing humeral fracture surgery. The researchers scheduled five sessions for the nurses under study.

The simulation-based training:

The creation and revision of simulation-based training was done. It included lessons regarding care of patients undergoing humeral fracture surgery.

on humeral fracture surgery.

The general objective of simulation-based training sessions:

At the end of the sessions, the nurses were expected to acquire knowledge and practices that improve their performance regarding care of patients undergoing humeral fracture surgery.

Specific objectives of the training:

- Define humeral fracture surgery.
- List indications of humeral fracture surgery.
- Enumerate the types of humeral fracture surgery.
- Enumerate signs and symptoms of humeral fracture surgery.
- Identify the classification of humeral fracture surgery.
- Discuss post –surgery exercises of humeral fracture surgery.
- Apply the postoperative care of the humeral fracture surgery.
- List the most common complications of humeral fracture surgery
- Discuss how to prevent the complications of humeral fracture surgery.
- Perform dressing change
- Perform the appropriate documentation.

II: Implementation phase:

The researchers introduced themselves to start a conversation and went over the goals of the study during the first interview. Each participant in the study was completed the tools to assess the level of knowledge and practices regarding care of patients undergoing humeral fracture surgery.

Using five sessions—two theoretical and three practical—simulation-based training was intended to help nurses provide better care for patients having humeral fracture surgery. Each session lasted between thirty and forty-five minutes. After the theoretical sessions, skills training for simulation was conducted.

- Three days a week, from 9 a.m. to 1 p.m., the researchers were accessible in the study areas. Using the study instruments indicated earlier, each nurse was interviewed on an individual basis.
- Subgroups comprising six to eight nurses each were created from the study nurses.
- The investigators began every session by gathering input regarding the preceding one, and they concluded each one with a summary.
- After analyzing the relevant literature and taking into account the actual needs of the nurses under study, a simplified booklet was created and distributed to nurses in Arabic. It covered every topic pertaining to knowledge and practice relating humeral fracture surgery.
- Applying simulated-based training by utilizing a variety of teaching methods, such as lectures, brainstorming sessions, small-group discussions, demonstrations, and re-demonstration, using the necessary equipment and a simulation manikin that was available in a faculty clinical lab. The use of a range of teaching aids, such as figures, PowerPoint, handouts, flipcharts, and animated movies, enhanced nurses' performance regarding care of patients undergoing humeral fracture surgery.

Theoretical and practical sessions were as follows.

The first session (theoretical) began with the researchers introducing themselves, extending their gratitude to the nurses for participating in the study, and outlining the goals of these training sessions. The first session's topics included definitions, indications, causes, signs and symptoms, diagnosis, management &treatment modalities, post-surgical exercises, and consequences related to humeral fracture surgery.

The second session was theoretical in nature and addressed topics pertaining to the nurse's role in providing care for patients undergoing humeral fracture surgery as well as her role in preventing complications from the procedure.

Third (Practical) Session: During this session, the nurses under study received instruction on how to assess and

prepare patients before humeral fracture surgery and postoperative care.

The fourth session, titled "Practical," took place in the faculty clinical lab, where trained nurses were clinically demonstrated and re-demonstrated on the surgical process and how to care for patients undergoing humeral fracture surgery. These sessions were conducted using a simulated manikin. Following the faculty lab sessions, trainees moved to Mansoura University Hospitals, where they were supervised by researchers and practiced real-time re-demonstration. This increased their confidence and validated their competence in caring for their patients.

Fifth session (Practical): This session focused on educating nurses how to change dressings and keep wounds clean, as well as how to prepare for exercises after humeral fracture surgery. The researchers devised these exercises to address the nurses' lack of knowledge and expertise. The virtual manikin was again utilized in this session, then the researchers began by asking participants about their past experiences and answering any concerns they had about humeral fracture surgery. After that, she administered the post-test and thanked each participant's nurse for their participation in the study.

IV-Evaluation phase: The effectiveness of the simulated-based training was evaluated by reevaluating the nurses' performance using the aforementioned tools both immediately following the implementation of the training (posttest) and one month later (follow-up).

Statistical analysis:

Data was tallied, coded, and converted into a form that was specifically made to be input into a computer. The data were entered and assessed using SPSS version 22. The Excel program was used to produce the graphics. Quantitative data were reported as mean and SD and analyzed using a t-test for comparison of the same group on the pretest and posttest. Quantitative data was represented using numbers and percentages. Pearson correlation was used to explain the relationship between quantitative data that are regularly distributed. With a P-value of 0.05, the significance was ascertained as follows: a statistically significant P-value was one that was less than 0.05, and a highly statistically significant P-value was one that was less than or equal to 0.001.

Results:

According to **Table 1**, 72% of the nurses under study were females and 58% had ages over 25, with a mean age of **26.7 ± 5.9** years. Regarding the study's nurses' qualifications, 30% held a baccalaureate degree in nursing, while 70% had graduated from the technical institute of nursing. Of those with years of experience, 44% had five to fewer than ten years, and 32% had more than five years.

As seen in **Figure (1),** 96% of the nurses under study did not previously take part in training programs pertaining to simulation-based training on nurses' performance regarding care of patients undergoing humeral fracture surgery.

As seen in **Figure (2**), 58% of the nurses surveyed stated that physicians were their primary source of information regarding humeral fracture surgery.

Table (2) provided evidence of progress, showing a highly significant difference (P<0.001) in nurses' knowledge regarding care of patients undergoing humeral fracture surgery pre-, immediately post-, and one month after the introduction of simulation-based training.

Table (3) indicated that prior to undergoing simulation-based training, 68% of nurses possessed poor knowledge regarding care of patients undergoing humeral fracture surgery. However, their level of knowledge increased to a good level (92.0%) immediately post, and (90.0%) one month after the implementation of simulation-based training. A statistically significant variation was seen in the knowledge level of nurses before, immediately after, and one month after the implementation of simulation-based training (P<0.001).

Table 4 demonstrated a statistically significant variation in the practice levels before, right after, and one month following the introduction of simulation-based training. With regard to assessment and preparation prior to humeral fracture surgery, it was clear from this table that 46% of the study's nurses inadequate level of practice pre to the training. In contrast, 100% and 96% of the nurses had adequate practice immediately following and one month following the implementation of simulation-based training. Additionally, it was shown that, in comparison to 94% of the nurses who immediately followed the training and 90% of them one month later, 64% of the nurses in the study had inadequate practice providing post-operative care before the training.

Figure (3) showed the distribution of the studied nurses' total practice level regarding care of patients undergoing the humeral fracture surgery procedure before, immediately post, and one month after the implementation of simulation-based training. It shows that 88% of the studied nurses had an incompetent practice level prior to the implementation of simulation-based training, although this percentage dropped to 12% post-education. After one month of simulation-based training, 86% of the studied nurses had a competent practice level.

Table (5) revealed that there was a statistically significant positive correlation between the total knowledge and total practice regarding care of patients undergoing the humeral fracture surgery pre- and post-simulation-based training.

Table (1): Demographic characteristics distribution of the studied nurses (n. =50)

Demographic characteristics	No.	%
Age (Years)		
18 ≤ 25	21	42
≥ 25 years	29	58
Mean ± SD	**26.7 ± 5.9**	
Gender:		
Male	14	28
Female	36	72
Qualifications:		
Technical Institute of nursing	35	70
Baccalaureate degree in nursing	15	30
Years of experience:		
< 5 years	16	32
5 – ≤10 years	22	44
10 - ≥15 years	12	24

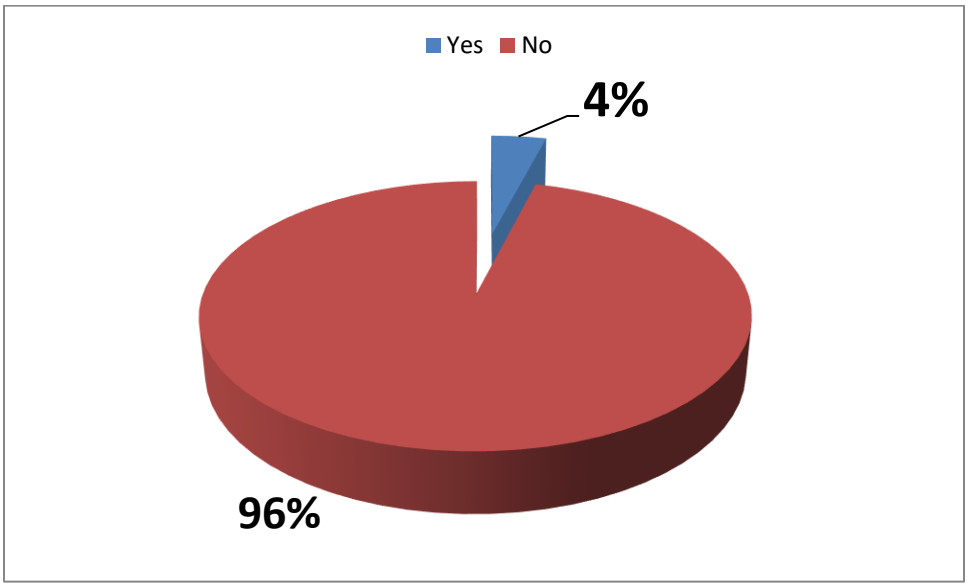

Figure (1): The studied nurses' distribution according to attending training programs on nurses' performance regarding care of patients undergoing the humeral fracture surgery (N=50).

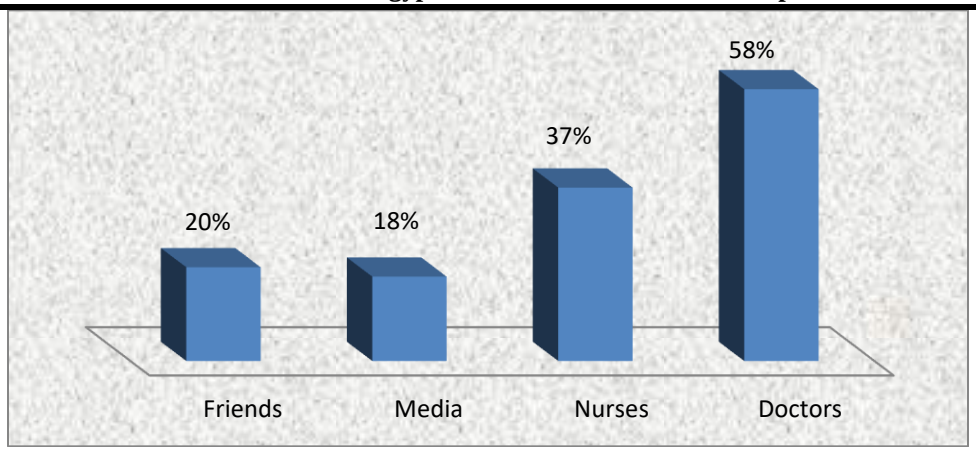

Figure (2): Nurses' source of knowledge regarding care of patients undergoing the humeral fracture surgery.

Table (2): The studied nurses' knowledge distribution regarding care of patients undergoing humeral fracture surgery pre, immediately post, and one-month post- simulation-based training implementation (n. =50)

Nurses' knowledge	Pre- simulation -based training implementation		Immediately Post-simulation -based training implementation		One month Post-simulation -based training implementation		F	P-value
	No	%	No	%	No	%		
Definition								
Correct	29	58.0	50	100	48	96.0	112.5	<0.001**
Incorrect	21	42.0	0	0.0	2	4.0		
Indications								<0.001**
Correct	22	44.0	48	96.0	48	96.0	132.6	
Incorrect	28	56.0	2	4.0	2	4.0		
Causes								<0.001**
Correct	27	54.0	46	92.0	42	84.0	145.8	
-Incorrect	23	46.0	4	8.0	8	16.0		
Signs and symptoms								<0.001**
Correct	22	44.0	48	96.0	47	94.0	112.4	
-Incorrect	28	56.0	2	4.0	3	6.0		
Types								<0.001**
Correct	19	38.0	48	96.0	46	92.0	99.9	
Incorrect	31	62.0	2	4.0	4	8.0		
Management and treatment								<0.001**
Correct	19	38.0	48	96.0	46	92.0	87.9	
Incorrect	31	62.0	2	4.0	4	8.0		
Prevention of complications								<0.001**
Correct	26	52.0	47	94.0	48	96.0	96.6	
Incorrect	24	48.0	3	6.0	2	4.0		
Preparation and assessment								<0.001**
Correct	22	44.0	46	92.0	47	94.0	107.4	
Incorrect	28	56.0	4	8.0	3	4.0		
The role of the nurse is to prevent complications								<0.001**
Correct	30	70.0	50	100.0	48	96.0	87.6	
Incorrect	20	30.0	0	2.0	2	4.0		

(**) highly statistical significance at p < 0.001

Table (3): The studied nurses' total knowledge level regarding care of patients undergoing the humeral fracture surgery pre, immediately post, and one month post- simulation-based training implementation (n. =50)

Nurses' knowledge level	Poor		Average		Good		F	P-value
	No.	%	No	%	No	%	134.7	0.000**
Pre-simulation based training implementation	34	68.0	14	28.0	2	4.0		
Immediately post simulation based training implementation	0	0.0	4	8.0	46	92.0		
One month Post- simulation based training implementation	0	0.0	5	10.0	45	90.0		

(**) Highly significant at P<0.001

Table (4): The studied nurses' practice scores regarding care of patients undergoing the humeral fracture surgery pre, immediately post, and one-month post- simulation-based training implementation (n. =50)

Nurses' practice	**Pre-** simulation -based training implementation				**Immediately Post-** simulation -based training implementation				**One month Post-** simulation based training implementation				F	P
	Incompetent		Competent		Incompetent		Competent		Incompetent		Competent			
	No	%	No	%	No	%	No	%	No	%	No	%		
Assessment and preparation	23	46.0	27	54.0	0	0	50	100	2	4.0	48	96.0	143.2	0.000**
Dressing change	29	58.0	21	42.0	4	8.0	46	92.00	2	4.0	48	96.0	144.2	0.000**
Post-operative care	32	64.0	18	36.0	3	6.0	47	94.0	5	10.0	45	90.0	135.6	0.000**
Post- surgery exercises and medications	36	68.0	14	32.0	4	8.0	46	92.0	6	14.0	46	92.0	89.41	0.000**

(**) Highly significant at P<0.001

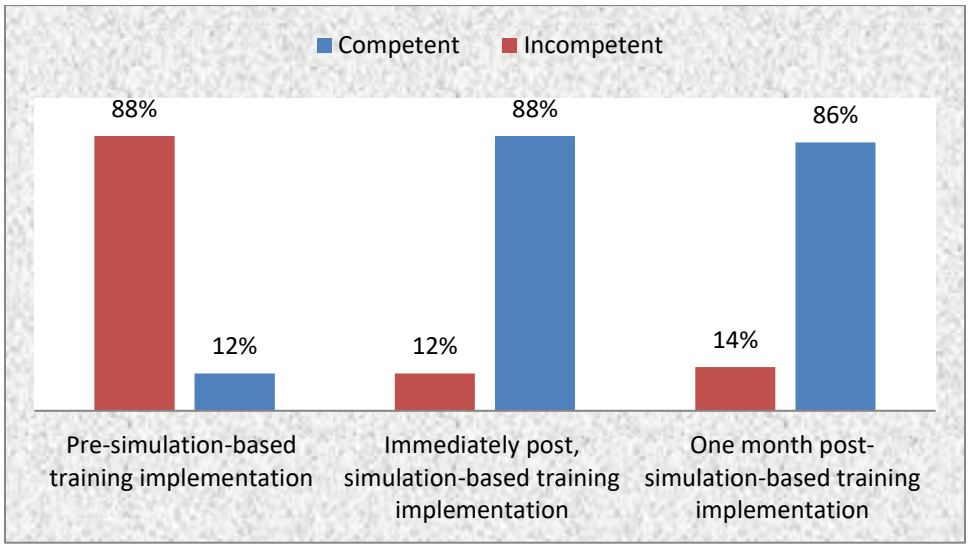

Figure (3): The studied nurses' total practice level regarding care of patients undergoing the humeral fracture surgery pre, immediately post, and one month post- simulation-based training implementation (n. =50).

Table (5): Correlation between total knowledge and practice regarding care of patients undergoing the humeral fracture surgery pre, immediately post, and one month post- simulation-based training implementation (n. =50)

Items	Total knowledge Scores					
	Pre-simulation-based training		Immediately Post-simulation-based training		One month post-simulation-based training	
	R	P	R	P	R	P
Total practice Scores	0.106	0.534	0.366	0.021*	0.308	0.047*

*** Statistically significant (P ≤ 0.05).**

Discussion:

After fractures of the hip and distal radius, humeral fractures rank third in frequency of fractures. About 5% of all fractures are caused by them, and their frequency is rising **(Jo et al., 2021)**. Simulation, as an evidence-based educational technique and process, firstly appeared when it became difficult for nurses working in a hospital to acquire clinical experiences. Simulation helps to address any limitations related to the clinical setting (including availability of patients, security issues etc.), promote teamwork and solidarity among students, and implementation of a protocol for the attainment of a skill. It is based on a scenario, where learning becomes interactive, allows feedback between the educator and the other members of the team, and promotes clinical reasoning and critical thinking in the team **(Koukourikos et al., 2021).**

The findings of the current study revealed that three-fifths of the nurses were females and older than 25 years old, with a mean age of 26.7 ± 5.9 years. The high percentage of female participants in this study could be attributed to the fact that, up until a few years ago, only girls were allowed to pursue nursing degrees in Egyptian institutions. These findings support those of **Tag Mohamed Mohamed Aboelnasr et al. (2024),** who reported that nearly two-fifths of the nurses were between the ages of 25 and 30, with a mean age of 26.33 ± 3.11. The majority of the nurses were females.

Regarding qualifications, more than three quarter of them had graduated from a technical institute. These findings are in line with those of **Abolwafa & Hossein, (2018),** who discovered that most of the nurses undergoing understudy had educational backgrounds comparable to those of technical colleges. While the majority of the study participants had a bachelor's degree in nursing, according to **Abd Elhy & Kasemy, (2017**).

About half of nurses under study had five to fewer than ten years of experience. This result contradicts **Mohammed & Abdel Fattah, (2018)** findings, which indicated that over half of the participants had one to five years of experience. **Abolwafa & Hossein, (2018)** also demonstrated that more than fifty percent of nurses had one to five years of experience**.**

The present study's results indicate that nearly all of the nurses were not enrolled in any courses that addressed simulation-based training and its effects on nurses' performance during humeral fracture surgery. This confirmed, according to the researchers, that the nurses in the study need simulation-based training to raise their degree of proficiency. In contrast, the results of **Almarhomy et al., (2021)** showed that more than two thirds of the nurses included in the study had received on-the-job training. Furthermore, according to **Chaghari et al., (2017),** two thirds of Tehran's nursing staff participated in in-service training sessions that were conducted at their place of employment. In-service training is a vital component in improving the standard of care given by nurses.

Based on their information sources, the results of the current study showed that nurses were mostly informed about humeral fracture surgery by physicians. The study's nurses, according to the researchers, depended on medical specialists to provide them with comprehensive information about patients' situations. This showed even further that the people who were the subject of the study looked for the right treatment for their medical issues. **Alduraywish et al., (2020)** found that while courses and campaigns were the least popular sources of health information, doctors were the most often used source, followed by internet searches. Surprisingly, social media was the least trusted source, and doctors were the most trusted.

The results of this study showed that nurses' knowledge of humeral fracture surgery increased with the introduction of simulation-based training. The knowledge of nurses prior to, immediately post, and one month after the implementation of simulation-based training differed significantly (P<0.001). The experts said that this proved how effectively the simulation-based training was executed. This demonstrated how crucial it was to comprehend the reasons behind the gain in knowledge brought about by simulation-based training.

The results of the current study showed that nearly two thirds of nurses had insufficient knowledge of humeral fracture surgery prior to obtaining simulation-based training. However, a month after simulation-based training was implemented, their level of knowledge significantly increased. The nurses' knowledge levels prior to, immediately post, and one month after the introduction of simulation-based training varied in a statistically significant way. Support for this conclusion comes from the research "Effects of high-fidelity simulation-based on life-threatening clinical condition scenarios on learning outcomes of undergraduate and postgraduate nursing students" by **La Cerra et al., (2019),** who discovered that simulation training enhanced nursing students' performance and knowledge. Furthermore, simulation-based training improved nursing students' clinical reasoning skills, knowledge, and capacities, as demonstrated repeatedly by **Abdalla Jarelnape & Idris Sagiron (2023).**

According to **Fahajan et al., (2023),** the use of simulation-based training improved the nurses' knowledge. These results are in line with research on undergraduate nursing students in Thailand, which found that the training significantly and immediately improved the participants' knowledge, self-efficacy, and ability to perform chest compressions **(Partiprajak & Thongpo, 2016).** A different study comparing the knowledge and abilities of staff nurses with undergraduate nurses revealed that both groups' knowledge and abilities increased with training **(Sankar et al., 2013).**

The study's findings about nurses' practices showed a highly significant shift in practice levels prior to, immediately post, and one-month post-simulation-based training was implemented. This aligned with the findings of **Tag Mohamed Mohamed Aboelnasr et al., (2024),** who reported a highly statistically significant difference and improvement in nurses' competent practices when compared to pre-simulation-based training intervention. Similarly, with **Nuraini et al., (2015),** who investigated how simulation-based learning affected nursing students' practical accomplishments and found that it improved their performance, Moreover, **Beal et al., (2017**) also found that clinical simulation was a useful strategy for increasing studies.

The results of the study showed that the majority of the nurses under scrutiny practiced at an inadequate level prior to the implementation of simulation-based training. After a month of simulation-based training, the majority of the nurses in the study were able to perform at a competent level of practice. Simulation has emerged as an essential teaching tactic in this environment **(Wheeler & Dippenaar, 2020).** The current study's findings were consistent with those of **Sankar et al., (2013),** who noted increases in skill scores immediately following training, and **Alalhareth & Howarth, (2020),** who reported improvements in the simulation instruction group's post-test scores and an increase in research participants' competence scores.

The mean score of nurses' simulation-based training practices before and after the intervention differed statistically significantly. Simulation offers the opportunity to learn and practice in an environment that is similar to a real-world clinical situation, which is essential for assisting students in applying their newly learned skills and knowledge **(Wheeler & Dippenaar, 2020)**. Repeated practice of the skill provided by the simulation may also be beneficial for knowledge and skill learning (**Akhu-Zaheya et al., 2019**). By taking part in simulation teaching, an interactive process that correlates actual clinical occurrences in a safe environment, nurses can improve their knowledge and motor skills. This outcome is in line with research by **Koukourikos et al., (2021),** which found that applying simulation to students aids in the development of clinical skills. This result is in line with the findings of (**Alalade & Sekar, 2023),** who assert that nurses participating in simulation groups perform noticeably better as a result of simulation-based teaching-learning techniques.

A statistically significant positive correlation was discovered between the total knowledge and total practice scores for humeral fracture surgery before and after simulation-based training. The researchers found that after undergoing simulation-based training, the study's nurses showed an improvement in their understanding of humeral fracture surgery, which is usually associated with an improvement in practice scores. Our results were corroborated by **Wahba et al., (2017),** who reported a statistically significant positive correlation between the nurses' overall knowledge and their practice, supported our result. These results are consistent with those of **Shahin et al., (2012)** &**Mohammed & Weheida (2015),** who also discovered a statistically significant correlation between nurses' knowledge and their practice. Furthermore, **Encan & Akin (2019)** asserted that evidence-based professional knowledge and skills are necessary for nurses to advance in competence.

Conclusion:

Based on the findings of the current study, the results of this study suggest that using simulation-based training improved nurses' performance in terms of caring for patients after humeral fracture surgery. There was a correlation found between knowledge and practice scores obtained by nurses receiving simulation- based training.

Recommendations:

The results of this study included the following recommendations for nurses learning about humeral fracture surgery:

- Simulation-based training should be included as an efficient teaching tool.
- Preoperative nursing education for patients undergoing surgery for a humeral fracture should incorporate awareness initiatives.
- Using simulator manikins, which allow users to interact with the scenario and think through the consequences of their choices, is one way to use educational tools.
- Reapplication of the current investigation with larger sample sizes is necessary to generalize the results.

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