

## Effect of Orthopedic Nursing Care Protocol on Nurses' Knowledge, Performance, and Patients' Outcomes among Patients with External Fixators

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**Abstract: Background:** An external fixator is a device used to stabilize a broken bone and facilitate deformity correction. Pin site infection is still a serious complication of external fixation. These patients also suffer from pain, discomfort, and anxiety due to any adjustment techniques and movement of pins through skin. **Purpose:** To assess effect of orthopedic nursing care protocol on nurses' knowledge, performance, and patients' outcomes among patients with external fixators. **Setting:** The study was conducted in Orthopedic Surgery Department, University hospital, Menoufia, Egypt. **Sampling:** Convenience sample of nurses working in orthopedic surgery department (32 nurses) and a purposive sample of 76 adult patients who were undergoing external fixation. They were divided into two equal groups (study and control). **Instruments:** Six instruments were used: Subjects' and Nurses' Interviewing Questionnaire; Nurses' Knowledge Assessment Questionnaire; Nurses' Observational Checklists; Checketts Otterburns Grading System for pin site infection; The Numeric Pain Rating Scale; and Beck Anxiety Inventory. **Results:** The study finding displayed a highly significant improvement in the nurses' knowledge and performance scores in the posttest compared to pretest with p-values <0.001. Concerning to the patients outcomes, the study results revealed statistically significant difference between the study and control groups regarding pain, anxiety levels and pin site infection in favor of study group when comparing the two groups, with p-values <0.05. **Conclusion:** The study findings concluded that the nursing protocol has positive effects in improving nurses' knowledge and performance related to care of orthopedic patient with external fixators and led to a lower levels of pain and anxiety and decrease in pin site infections among the subjects of the study group when compared to the control group. **Recommendations:** Orthopedic nurses should attend regular in-service training courses and workshops on external fixators, focusing on their weaknesses. This will improve their knowledge and practice, ultimately leading to better patient outcomes.

**Keywords:** External Fixators , Nursing care Protocol, patients' outcomes.

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## **Introduction**

Over 500 million individuals suffer injuries annually on a global scale, with over a quarter of them experiencing orthopedic injuries. A significant number of these individuals need hospitalization and surgical intervention. Orthopedic trauma surgery is linked to high levels of acute pain and infection rates (Edgley, et al., 2019). Egypt is among the nations with the highest rates of road traffic accidents worldwide (Abdelhady, et al., 2022).

As traction or casting cannot be used to cure specific types of fractures, external fixator devices have become the gold standard of therapy to stabilize complex fractures or abnormalities of the limbs without further harming soft tissue. An external fixator is utilized when other forms of immobilization would not be adequate, in which a steel frame is externally placed on the limb, and wires or pins are percutaneously inserted through the limb's muscle and skin into the bone. It optimizes pressure distribution on the fracture surface to promote normal healing (Xing et al., 2020; Lenza et al., 2019).

There are numerous subtypes of external fixators, such as uniplanar, multiplanar, unilateral, bilateral, and circular fixators. In this type of fixator, a scaffold system is formed by screw-type clamps, bolts, sockets, and circular rings which fix the pins. Depending on the patient's injury or wellness, external fixator devices may be left in place for a period of weeks or months. The Ilizarov fixator is the most frequently utilized example of a circular fixator (Hadeed et al., 2022;

Walker, 2018). It is broadly perceived that there are inherent risks for patients who have external fixators; these include pin site infection, increased length of hospitalization, pain, delayed fracture healing, and anxiety (Elhapashy et al., 2021).

Pin tract infection is a common complication of external fixation. Superficial pin site infections can progress to serious complications such as severe soft tissue infection, acute and chronic osteomyelitis, putting the patient at risk for morbidity and death (Bue et al., 2021). Checketts et al. (2000) developed a classification system for pin site infections to aid in treatment decisions. Pin site infections are categorized as minor infections (Grade 1-3) and major infections (Grade 4-6), with the latter involving bone tissue and potentially leading to pin loosening. The incidence rates of pin site infections range from 9 to 100% (Siddiqui et al., 2019).

Using external fixators on the skin for extended periods can cause discomfort and pain, leading to psychological distress for patients. Furthermore, external fixators can make patients feel unattractive, affecting their self-esteem, sleep, and overall psychological well-being. In addition to focusing on the physical healing process, it is essential to pay attention to the psychological health of fracture patients (Jia et al., 2024). The main duty of healthcare providers is to reduce the risk of infection and alleviate pain and anxiety (Shields et al., 2022).

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Nursing plays a crucial role in assessing the quality of hospital services as it provides continuous 24-hour care in accordance with healthcare standards. Within the healthcare system, nursing holds a well-established position, and the structure of nursing care organizations impacts both the delivery of care and patient outcomes (Liu, 2019).

The nursing staff members who start to provide orthopedic care require understanding the correct and efficient nursing skills to practice nursing correctly for themselves and for the patients. Nurses are ideally placed to support patients with external fixator devices, in particular helping them look after the pin sites (Walker, 2018). Providing verbal and written information will help patients understand the importance of caring for pin sites effectively, identifying infection quickly, reducing patients pain and anxiety (Badr et al., 2021; Lie et al., 2022). So the current study aim was to assess effect of orthopedic nursing care protocol on nurses' knowledge, performance, and patients' outcomes among patients with external fixators.

### **Significance of the study**

External fixation is a vital tool in modern orthopedic surgery, commonly used in traumatology and reconstructive procedures (Jin et al., 2022). Complications associated with external fixators are prevalent, affecting approximately 70% of patients. According to Badr et al. (2021), tendon inflammation and pin

site infections are the most frequent side effects of external fixation. Frank et al. (2024) reported a 30% incidence of pin site infections. However, there is limited data on the rate of orthopedic pin site infections in Egypt.

It has been observed that patients with external fixators had an increased risk of pin site infection and other complications during their clinical training at the orthopedic department. Higher rates of morbidity, longer hospital stays, and increased expenses are the consequences of these complications. Additionally, patients who develop a pin site infection may lack sufficient knowledge about maintaining a pin site. Moreover, there is significant disagreement regarding the best course of action despite multiple studies attempting to provide evidence-based recommendations for preventing pin site infections (Lie et al., 2022).

The goal of nursing care is to protect the patients from these possible complications and facilitating their recovery and return to normal function. In order to improve nurses' performance, lower occurrence of pin site infections and decrease pain, and anxiety among orthopedic patients with external fixators, the researchers decided to conduct the current study.

### **The purpose:**

To assess effect of orthopedic nursing care protocol on nurses' knowledge, performance, and patients' outcomes among patients with external fixators.

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**The research Hypotheses:**

In the current study, the following were hypothesized:

- **H1:** Orthopedic nurses who receive orthopedic nursing care protocol are expected to have higher level of knowledge on posttest than pretest.
- **H2:** Orthopedic nurses who receive orthopedic nursing care protocol are expected to have higher level of performance on posttest than pretest.
- **H3:** The patients who receive the protocol of care (study group I) are expected to have less pain than those who don't (control group II).
- **H4:** The patients who receive the protocol of care (study group I) are expected to have lower anxiety levels than those who don't (control group II).
- **H5:** The patients who receive the protocol of care (study group I) are expected to have fewer occurrence of pin sites infection than those who don't (control group II).

**Operational definitions:**

- **Orthopedic Nursing Care Protocol:** In the present study, it refers to a comprehensive set of nursing care components that were developed following thorough research and reviewed by experts. This protocol encompasses postoperative pin site care, non-pharmacological pain management, exercises, dietary guidance, and instructions. Nurses received this protocol to apply it during patient care.

- **Patients' outcomes:** In the current study, **outcomes** refer to experience of pain, anxiety and occurrence of pin site infection.

**Methods:**

**Research Design**

Quasi-experimental research design (study/ control) was used to fulfill the purpose of the study.

**Setting:**

The study was implemented at University Hospital's Orthopedic Surgical Department and outpatients clinic in Shebin El-Kom City, Menoufia Governorate, Egypt. There are five rooms in the department—three for men and two for women and can accommodate forty patients in total.

**Sampling:**

**Sample size for patients:**

Based on an analysis of earlier research on Morsy et al. (2021). It was discovered that only 9.1% of the participants had satisfactory knowledge about self-care during the pretest. However, 90.9% of the participants reported having satisfactory knowledge about self-care immediately after the guidelines were implemented, based on the assumption that 140 patients would be seen in a year. Using this data, the following formula was used to determine the sample size at 80% power and 95% confidence level:

$$\text{Sample Size } n = N * [Z^2 * p * (1-p)/e^2] / [N - 1 + (Z^2 * p * (1-p)/e^2)]$$

Where,

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- **N** = Population size,
- **Z** = Critical value of the normal distribution at the required confidence level,
- **p** = Sample proportion,
- **e** = Margin of error
- **n** =  $140 * [(1.95)^2 * 0.09 * 0.91 / (0.05)^2] / [140 + ((1.95)^2 * 0.09 * 0.91 / (0.05)^2)]$

Accordingly, the calculated sample size was 69 to avoid dropout sample was increased by 10% to become 76 participants

#### **Sample of Nurses:**

The available numbers of nurses who work at Orthopedic Surgical Department in Menoufia University Hospital and had the inclusion criteria (a convenience sample of 32 nurses) are chosen as a study sample:

#### **Sample of Patients**

Patients were divided into two equal groups. Each group contained thirty eight patients.

- **Study group (I)** comprised patients who received care according to the designed nursing care protocol.
- **Control group (II)** comprising patients who exposed to routine hospital care before conducting of nursing care protocol.

#### **Inclusion criteria for nurses**

- Over one year of clinical experience in the orthopedic department.
- Able to cooperate, communicate, and practice nursing.

#### **Exclusion criteria for nurses**

- Head nurses who were managers or supervisors (because they didn't share in the direct patient care).

#### **Inclusion criteria for the patients:**

- Hospitalized, above 18 years of age to 60 years, with external fixators, agree to participate in the study

#### **The patients were excluded based on the criteria listed below:**

- With pathological fractures due to tumors, osteomalacia
- With chronic diseases such as diabetes mellitus, immune suppressed disease or corticosteroid user.
- With psychological or mental problems that may increase anxiety.

#### **Instruments for data collection:**

The data was gathered using the following Instruments:

#### **Instrument one: Subjects'**

#### **Interviewing Questionnaire:**

It was developed by the researchers. It is composed of two sections.

- The first section focused on the demographic characteristics of the patients under study, as well as some medical data. This included age, gender, marital status, educational level, occupation, living status, residence, medical diagnosis, and site of external fixators.
- The second section focused on the characteristics of studied nurses, including age, gender, educational level, years of experience, and participation in training courses related to patient care with an external fixators..

**Instrument two: Nurses' Knowledge Assessment Questionnaire:**

It was used to assess nurses' knowledge about external skeletal fixation. It was developed by the researchers after conducting a thorough review of the relevant literature (Canberra Hospital and Health Services, 2021; Morsy et al., 2021; Xing et al., 2020). It addressed the following topics: pin site care, neurovascular integrity, pain management techniques, nutrition, range of motion, and physical exercises; external fixation device (definition, indications, purpose, advantages and disadvantages, complications, and related warning signs and symptoms). Each question was scored on a scale of 0 to 2, with 0 indicating an incorrect answer, 1 for a partially correct answer, and 2 for a fully correct answer. The total knowledge score was determined by summing up the scores for all questions. Subsequently, an overall score out of 100 was calculated. The nurses' knowledge level was then categorized as follows: A satisfactory level was considered to be  $\geq 60\%$ , while an unsatisfactory level was  $< 60\%$ .

**Instrument three: The Observational Checklist for Nurses:**

It consisted of two parts:

- **Part one:** Checklist for pin site care. It was adapted by the researchers after extensive reviewing of literature such as the Orthopedic Institute of North of Texas, (2021); Royal College of Nursing U.K. (2010);

Trigg and Mohammed (2006). It was employed to evaluate the pin site care practices of for patients with external fixators.

- **Part two:** Checklist for progressive relaxation with deep breathing. It is adapted from Perry, et al., (2022). It was used in the management of pain and anxiety.
- The total score for all steps in each area of the practice was then calculated.

**Scoring system:**

Every step has a value between 0 and 2, with 0 representing not performing the step, 1 representing performing the step incorrectly, and 2 representing performing the step correctly. The scores of the items in each area were collected, converted to a percentage, and categorized as follows in order to get the performance score in each area: A total score of less than 75% indicates incompetent performance, whereas a score of 75% or higher indicates competent performance.

**Instrument four: The Numeric Pain Rating Scale (NPRS):**

It was adopted from Benjamin and Charles (2019) and is a unidimensional method. It was used assess the pain experienced by patients with external skeletal fixation. It is considered the most accurate measure of a patient's pain level. The standard format for NPRS is a horizontal line or bar with eleven-point scales ranging from zero (indicating no pain) to ten (expressive the pain in the highest level).

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**Instrument five: The Beck Anxiety Inventory (BAI):**

It was developed by (Beck and Steer, (1993). The BAI assesses the level of anxiety and typically takes five to ten minutes to complete. It is designed for individuals aged seventeen and older. The BAI comprises 21 questions, each scored on a scale of 0 (not at all), 1 (mildly), 2 (moderately), and 3 (severely). Higher scores indicate more severe anxiety symptoms. The scoring ranges are as follows: 0-9: normal; 10-18: mild; 19-29: moderate; 30-63: severe.

**Instrument six: Checketts Otterburns Grading System for pin site infection:**

It was developed by Checketts et al. (2000), It is a clinical assessment instrument that was validated for use in consistently defining and classifying pin site infection. It has good reliability with Cronbach's alpha equal to 0.71.

**Scoring of this scale:**

There are six grades on this scale; a minor infection is considered from grade 1 to grade 4, but grade 5 and 6 are considered major infections.

**Ethical considerations**

For the protection of participants' rights, the nurses and patients provided verbal and written consent indicating their willingness to participate in the study after being informed about the study's purpose. Confidentiality and privacy were ensured, and participation was voluntary. Approval for the study was obtained from the Ethical and Research Committee of the Faculty of

Nursing, Menoufia University, Menoufia Governorate, Egypt (Approval number 911, Date: 19/1/2022). All participants, including nurses and patients, signed a written consent form after understanding the study's purpose. They were informed that declining to participate would not affect their care.

**Methods**

following the explanation of the study's purpose, Permission was granted by the hospital director and the head nurses of the orthopedic department and orthopedic outpatients clinic in the above-mentioned setting

**Validity:**

A panel of 5 experts from the medical surgical nursing and orthopedic departments at Menoufia University, including three professors and two assistant professors, evaluated the validity of the instruments. They assessed them for comprehensiveness, relevance, simplicity, clarity, and ambiguity. Additionally, the experts reviewed and made recommendations for modifications based on the latest literature. All experts' recommendation were done.

**Reliability:**

The researchers assessed the reliability of the instruments one, two and three using a test-retest method and the Pearson correlation coefficient formula to determine the relevance and consistency of the tools in measuring their items. The values obtained were  $r = 0.81, 0.79, \text{ and } 0.78$ , respectively. Alghadir et al. (2018) evaluated the reliability of instrument four and

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concluded that it is an excellent and reliable tool for measuring pain in knee osteoarthritis, with intraclass correlation coefficients of 0.95. In terms of reliability, Osman et al. (2002) examined instrument five and reported high internal consistency (Cronbach's alpha = 0.94). The reliability of instrument six was assessed by Checketts et al. (2000), who demonstrated that it is a reliable clinical assessment tool for defining and categorizing pin site infections, with a Cronbach's alpha coefficient of 0.71.

**Pilot study**

A pilot study was conducted on three nurses and seven patients, representing nearly 10% of the subjects, to evaluate the feasibility and applicability of the constructed instruments. Any necessary modifications were made based on the findings of the pilot study. The results of the pilot study were not included in the final study.

**Procedure:**

Data were collected from March 1, 2022, to February 28, 2023. Prior to implementing the nursing care protocol, the researchers began collecting data from the control group. Each patient in the control group completed socio-demographic data. The researchers also assessed pain levels, and anxiety levels and the occurrence of pin site infection for patients in the control group using instruments four, five, and six. These measurements were considered as a pretest results for patients' outcomes before conducting the nursing care protocol..

The nursing care protocol was conducted for nurses in four phases: assessment, planning, implementation, and evaluation.

**Assessment phase:**

Researchers established therapeutic communication with nurses to secure their cooperation after explaining the study's purpose. The socio-demographic data of the nurses were collected by the second part of instrument one. Then a pretest was administered to nurses during the initial assessment to assess their knowledge about external fixators, using instrument two. This process took around 15-20 minutes. Subsequently, the researchers individually observed the nurses' practice while caring for patients with external fixators using instruments three. This phase spanned 4 weeks.

**Planning phase:**

Based on the assessment findings and a review of relevant literature, the researchers developed the orthopedic nursing care protocol for nurses in the orthopedic department. The protocol was developed based on studies by Gulanick et al. (2021), Hadeed, Werntz, & Varacallo (2019) and Sud & Ranjan (2018), to enhance understanding and application of external fixator care.

The nursing care protocol included the following components; introduction to external fixators, indications, advantages, disadvantages, potential complications of external fixators, nursing care for patients with external fixators, including pin site care, non-pharmacological pain management



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techniques such as progressive relaxation with deep breathing, dietary guidance, and exercise recommendations.

Additionally, it also included pre-discharge nursing instructions for patients, covering pin site care, exercise, medication management, and scheduling follow-up visits. The training sessions utilized group discussions, demonstrations, and interactive discussions. Teaching aids such as PowerPoint slides, handouts, and an illustrated booklet were used to enhance learning.

#### **Implementation Phase**

The nursing care protocol was conducted with nurses in the orthopedic department seminar room during the morning shift from 12:30 to 1:30 PM. Nurses were divided into three groups, with 10 nurses in each group. The nursing care protocol was implemented in three sessions held twice a week for 6 weeks. Each group attended three 60-minute sessions, starting with a discussion of objectives and content, followed by interactive activities. A 15-minute summary of external fixator knowledge and practices was presented in each session using various instructional methods and teaching aids. At the end of the sessions the nurses received booklet contain all information which included in the nursing care protocol

▪ **The first session** covered the theory of external fixators, including an introduction, types, indications, advantages, disadvantages, complications and demonstration of isometric and isotonic exercises to the nurses.

▪ **The second session** covered procedures pin site care and non-pharmacological pain management, and neurovascular assessments.

▪ **Third session:** The session provided instructions to patients before discharge, covering pin site care, nutrition, exercises, medication, and follow-up visits.

#### **Evaluation phase:**

Following the completion of the nursing care protocol, the researchers conducted a posttest to assess the nurses' knowledge using instrument two. The nurses' performance was also evaluated using instrument three.

Subsequently, the researchers collected data from the study group subjects. An interview was conducted to gather socio-demographic information from the study group subjects, then, pain, anxiety levels and the pin site infection of these patients were assessed using instruments four, five, and six. The measurements of the study group were considered as posttest results for patients' outcomes after conducting the nursing care protocol.

A comparison of pre- and posttest results for nurses' knowledge and performance was conducted using suitable statistical analysis to assess the effect of the nursing care protocol on nurses' knowledge and performance.

The comparison between the study group and control group was also conducted to assess the differences between the two groups in the pain, anxiety and occurrence of pin site infection to determine the effect of the nursing care protocol on the study group in relation to these variables.

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### **Statistical Analysis**

The data was analyzed with SPSS software version twenty-five. The mean and standard deviation of quantitative data were computed. The Chi-square test (X<sup>2</sup>) was used to compare two groups for qualitative data, which present a categorical dataset through frequency, percentage, or proportion of each category. The Student's t-test was employed to compare between the means of two sets of parametric data from separate samples. A significance level of  $p \leq 0.05$  was chosen for interpreting the test results (Dawson and Trapp, 2001).

### **Results:**

**Table 1** shows that the study included mostly female nurses (84.37%) with an average age of  $29.5 \pm 8.05$ . The majority of the nurses were married. Approximately two-thirds of the participants were graduated from a Technical Nursing Institute, and 62.5% had 3–5 years of experience.

**Table 2** clarifies that there was an increase in the mean scores of nurses' knowledge in the posttest compared to the pretest. This increase was highly statistically significant with  $P=0.000$ .

**Figure 1** illustrates that the nurses' knowledge levels in the pretest were 53.13% unsatisfactory and 46.87% satisfactory. In the posttest, these levels changed to 90.63% satisfactory and 9.37% unsatisfactory.

**Table 3** reveals that there were increases in the mean nurses' performance scores of pin site care and progressive relaxation with deep breathing in the posttest compared to the pretest. These increases were

highly statistically significant, with  $p \leq 0.001$ .

**Figure 2** displays improvements in the nurses' performance level regarding pin site care in the posttest than pretest. The percentage of competent performance among the studied nurses changed from 9.37% in the pretest to 87.5% in the posttest.

**Figure 3** demonstrates an increase in the nurses' Performance level regarding progressive relaxation with deep breathing in the posttest than pretest where, the competent level changed from 3.13% to 93.57%.

**Table 4** provides detailed information on the demographic and medical characteristics of patients in the study and control groups. It is evident that the majority of the sample (63.16% of the study group and 52.63% of the control group) were males. The means and standard deviations of age for the study and control groups were  $34.67 \pm 7.38$  and  $33.70 \pm 8.32$ , respectively. Around half of the patient in both groups had elementary education. Most of them in both groups didn't work (65.79% of the study group and 60.53% of the control group). The common medical diagnosis in both groups was open fracture grade II, found in 52.64% of the study group and 50% of the control group. The common site of the external fixator among study participants was the lower extremities (57.89% of the study group and 60.53% of the control group).

**Table 5** shows a significant statistical difference in the mean pain scores, favoring the study group with a p-value of  $< 0.001$ . The mean  $\pm$  standard

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deviation was  $4.58 \pm 1.13$  for the study group and  $6.29 \pm 1.64$  for the control group.

**Figure 4** displays that severe pain was found in only 2.63% of the study group, while 50% of the patients in the control group experienced severe pain.

**Table 6** displays a significant difference in anxiety levels between the study and control groups, with a p-value of 0.002. Furthermore, it indicates lower anxiety in the study group, with 15.79% and 2.63% experiencing moderate and severe

anxiety, respectively. In contrast, 42.11% and 5.26% of the control group exhibited moderate and severe anxiety.

**Table 7** shows a statistically significant difference between the two groups in terms of pin site infection grades, with a p-value of 0.006. The data reveals a lower incidence of infection in the study group, where grades III and IV were present in 21.05% and 2.63% of the control group, respectively, as opposed to 2.63% and 0% in the study group.

**Table 1: Distribution of Nurses According to Their Demographic Characteristics (N=32).**

Variables	n	%
Age		
• < 25	10	31.25
• 25-30	18	56.25
• > 30	4	12.5
$\bar{x} \pm SD$	29.5 $\pm$ 8.05	
Gender		
• Male	5	15.63
• female	27	84.37
Marital status		
• Single	8	25
• Married	22	68.75
• widow	2	6.25
Educational attainment:		
• Nursing school	8	25
• Technical institute	20	62.5
• Bachelor's degree in nursing	4	12.5
Years of experience:		
• 1 to < 3	5	15.63
• 3-5	20	62.5
• > 5	7	21.87

(\*) Statistically significant at  $P \leq 0.05$ .

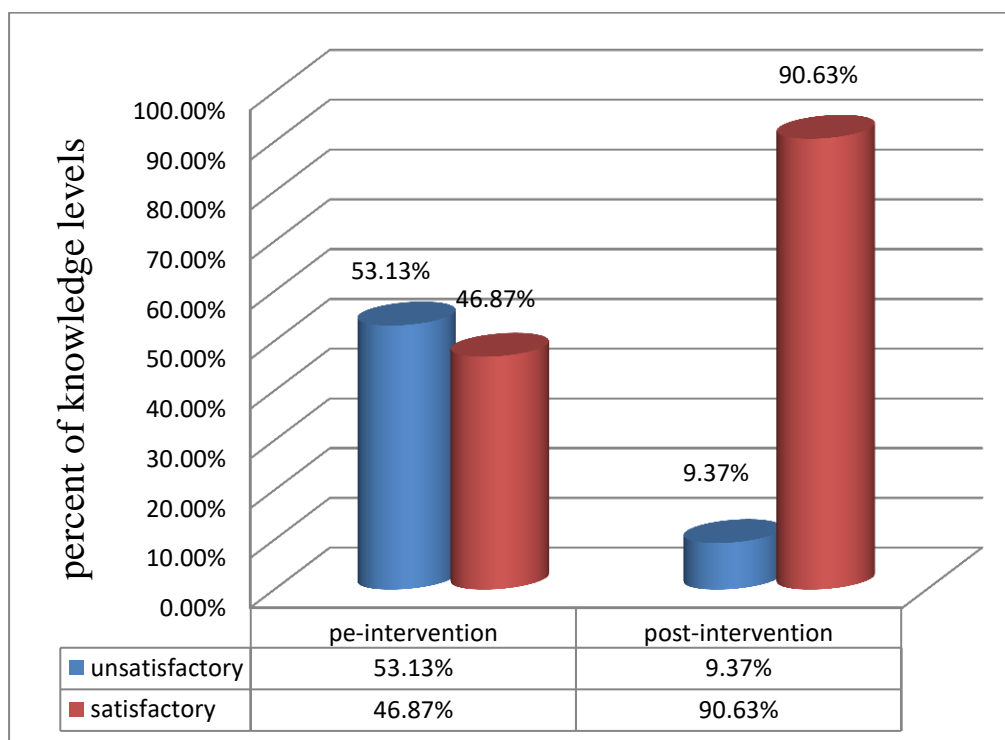
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**Table 2: Mean Nurses' Knowledge Scores in Pre and Posttest (N=32)**

variable	Max. score	Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	Paired t-test & p value
Nurses' knowledge score	22	13.85 $\pm$ 1.71	17.50 $\pm$ 1.73	t= 6.83 P= 0.000 *

(\*) Statistically significant at  $P \leq 0.05$ .

**Figure 1: Distribution of Nurses According to Their Knowledge Levels on the Pre and Posttest (N=32).**



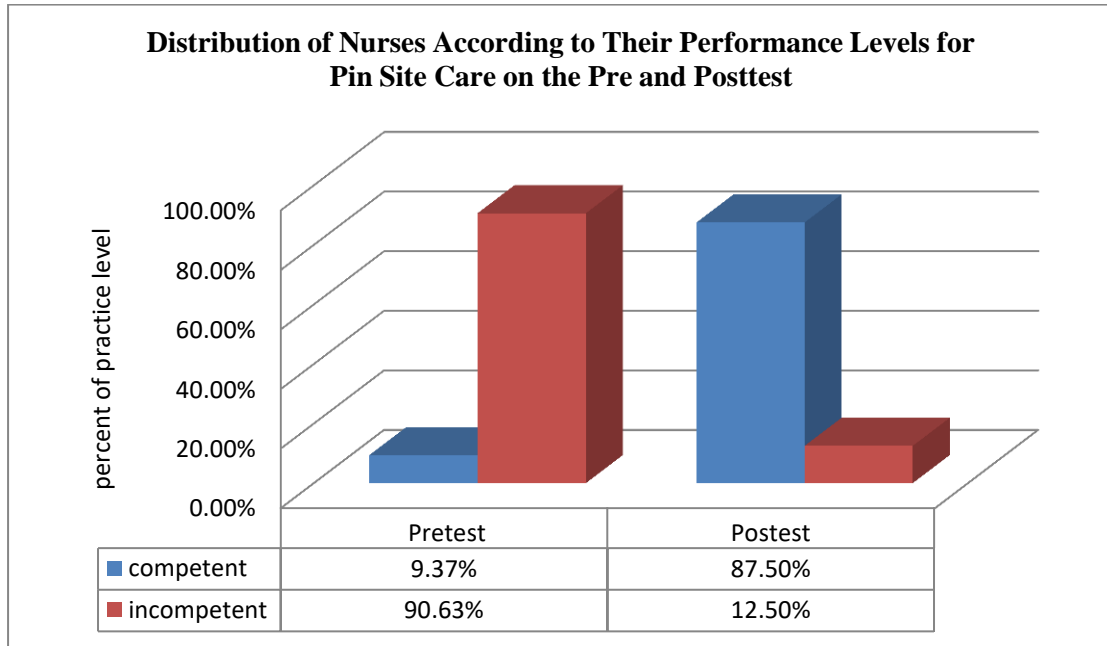
**Table 3: Mean Nurses' Performance Scores for the Procedures of Pin Site Care and Progressive Relaxation with Deep Breathing in the Pre and Posttest (N = 32).**

Elements of performance	Max. score	Assessment		Paired t-test p value
		Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	
Pin site care	32	19.56 $\pm$ 2.08	25.66 $\pm$ 2.87	t = 10.49 P=0.000**
Progressive relaxation with deep breathing	32	18.78 $\pm$ 2.27	24.20 $\pm$ 3.04	t=7.09 P=0.000**

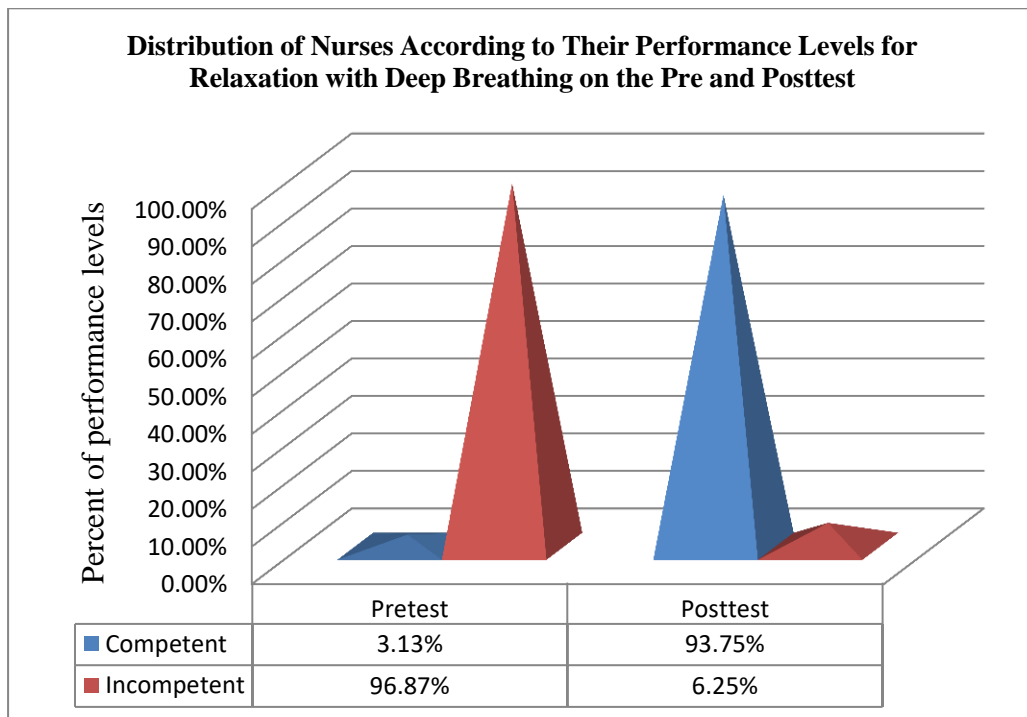
(\*) Statistically significant at  $P \leq 0.05$     (\*\*) Highly statistically significant

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**Figure 2: Distribution of Nurses According to Their Performance Levels for Pin Site Care on the Pre and Posttest (N=32).**



**Figure 3: Distribution of Nurses According to Their Performance Levels for Relaxation with Deep Breathing on the Pre and Posttest (N=32).**



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**Table 4: Distribution of Patients According to Demographic Characteristics and Medical Data of in the Study and Control Groups (N=76).**

Patient's demographic Characteristics	Study group (N=38)		Control group (N=38)		$\chi^2$ p value
	n	%	n	%	
Age / years ( $\bar{X} \pm SD$ )	34.67±7.38		33.70±8.32		t = 0.476 p = 0.636
Gender					
• female	14	36.84	18	47.37	0.864
• male	24	63.16	20	52.63	0.353
Educational Levels:					
• Illiterate	9	23.68	6	15.79	2.929 0.570
• Elementary education	18	47.37	21	55.26	
• moderate education	7	18.42	9	23.68	
• Higher education	4	10.53	2	5.27	
Marital state:					
• Single	6	15.79	9	23.68	2.887 0.409
• Married	22	57.89	24	63.16	
• Widowed	6	15.79	4	10.53	
• Divorced	4	10.53	1	2.63	
Occupation					
• Work	13	34.21	15	39.47	1.943 0.163
• Not work	25	65.79	23	60.53	
Medical Diagnosis					
• Open Fracture Grade I	15	39.47	17	44.74	0.482 0.488
• Open Fracture Grade II	20	52.64	19	50	
• Deformity	3	7.89	2	5.56	
Site of external fixator					
• Upper extremities	16	42.11	15	39.47	0.516 0.473
• Lower extremities	22	57.89	23	60.53	

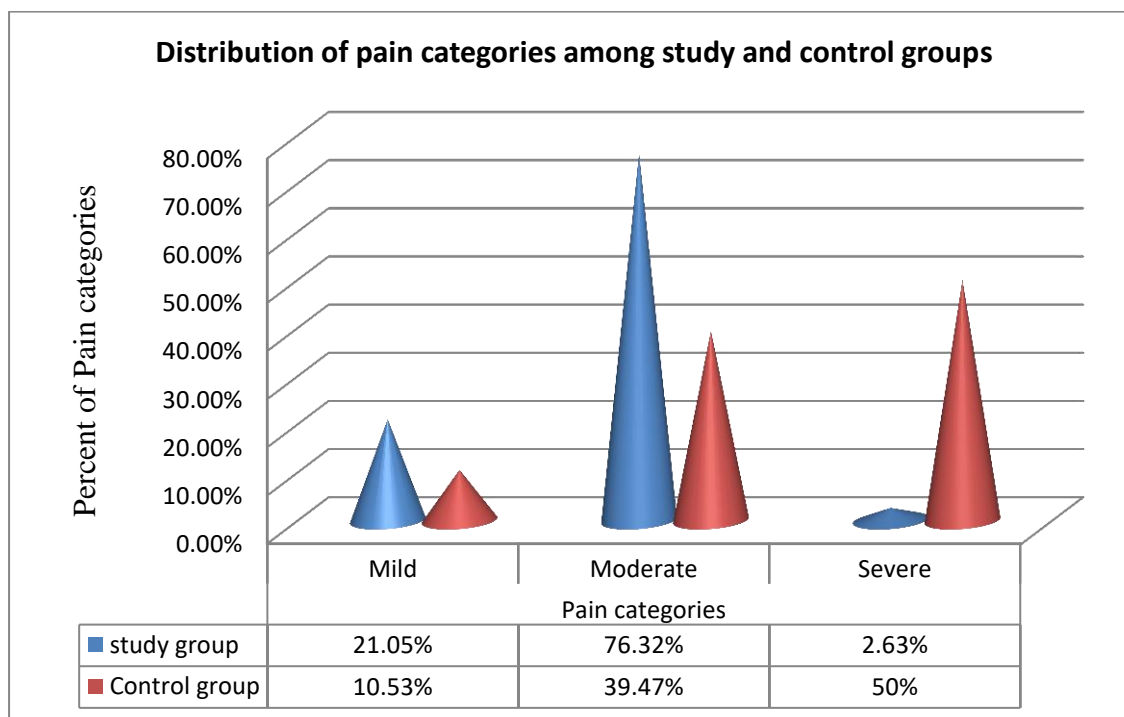
**Table (5): The Difference between Study and Control Groups As Regards Mean Pain Score (N=76).**

Variable	Study group (N=38) $\bar{X} \pm SD$	Control group (N=38) $\bar{X} \pm SD$	t-test	p value
Pain score	4.58 ± 1.13	6.29 ± 1.64	6.04	0.000**

(\*) Statistically significant at P≤0.05      (\*\*) Highly statistically significant

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**Figure (4): Distribution of Pain Categories among the Patients in the Study and Control Groups (N=76).**



**Table (6): Distribution of Patients According to Their Anxiety levels in the Study and Control Groups (N=76).**

Variable	Study group (N=38)		Control group (N=38)		Chi Square X <sup>2</sup>	p value
	n	%	n	%		
Anxiety Levels					12.66	0.002*
• Mild anxiety	31	81.58	20	52.63		
• Moderate anxiety	6	15.79	16	42.11		
• Severe anxiety	1	2.63	2	5.26		

(\*) Statistically significant at P≤0.05

**Table 7: Distribution of Patients In the Study and Control Groups According to the Grades of Pin Site Infection (N=76).**

Variable	Study group (N=38)		Control group (N=38)		Chi Square X <sup>2</sup>	p value
	n	%	n	%		
Grades of infection					12.50	0.006*
• Grade I	30	78.95	16	42.11		
• Grade II	7	18.42	13	34.21		
• Grade III	1	2.63	8	21.05		
• Grade IV	0	0	1	2.63		

(\*) Statistically significant at P≤0.05

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## **Discussion**

Orthopedic devices known as external fixators are utilized to realign bone segments without the need for surgery. Nurses should be equipped with the knowledge and skills to offer effective postoperative care for these patients, along with specialized care for the affected side to minimize the risk of serious complications. This involves checking the pin site for any signs and symptoms of infection, tending to the wound, and ensuring comfort to alleviate pain and anxiety (Widanage et al., 2023). The aim of the current study was to assess effect of orthopedic nursing care protocol on nurses' knowledge, performance, and patients' outcomes among patients with external fixators.

It was hypothesized that orthopedic nurses who receive orthopedic nursing care protocol are expected to have higher level of knowledge on posttest than pretest (hypothesis 1), the current research revealed that more than half of the nurses had unsatisfactory knowledge prior to the implementation of the nursing care protocol. This was in line with a study by Mohamed et al. (2020) on "Nurses' Knowledge of Orthopedic Patients with External Fixation," which found that nurses had unsatisfactory knowledge regarding the care of patients with external fixators. However, the majority of nurses in the current study demonstrated a satisfactory level of knowledge, with a significant increase in mean knowledge scores in the posttest compared to the

pretest ( $P=0.000$ ). This was also supported by Abdelhady et al. (2022) and Konda (2020), who noted a notable improvement in knowledge levels after structured interventions, indicating that most nurses had adequate knowledge about external fixation following the distribution of information booklets. These studies highlight the importance of ongoing learning and education for nurses to enhance their understanding of external fixator care.

Also, it was hypothesized Orthopedic nurses who receive orthopedic nursing care protocol are expected to have higher level of performance on posttest than pretest (hypothesis 2). The present research showed that the mean performance scores for pin site care and the technique of progressive relaxation were higher on posttest compared to the pretest. There was an improvement in the levels of performance for the two procedures in the posttest, with more than 90% of the studied nurses reaching an competent performance after the intervention. This result aligns with the study by Nour et al. (2020) on "Nurses' performance regarding orthopedic patients with external fixation at Zagazig University Hospitals." The study found that nearly half of the examined nurses had inadequate performance in pin site care and the progressive relaxation technique before the intervention. However, all nurses demonstrated adequate overall practice



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in pin site care and the progressive relaxation technique after the intervention.

The present study hypothesized that the patients who receive the protocol of care (study group I) are expected to have less pain than those who don't (control group II) (hypothesis 3). The current study revealed that there was a highly statistically significant difference in the mean score of pain found in favor of the study group. From the researchers' point of view, these outcomes may be attributed to the use of non-pharmacological pain management and progressive muscle relaxation techniques included in the nursing care protocol, which were provided to the study group. These techniques help reduce sympathetic activity, increase parasympathetic activity, dilate peripheral vessels, improve blood flow within them, and reduce muscle tension and pain perception (Loh et al., 2022). This finding is consistent with the study by Rowan et al. (2021) on the effectiveness of nursing guidelines for self-care strategies in patients with external skeletal fixation. The study found statistically significant differences in pain assessment between pre- and post-guidelines implementation, highlighting the importance of following the guidelines. The result also in line with the results of a study by Kodama et al. (2018) on joint distraction and early mobilization using a dynamic external finger fixator for treating fracture-dislocations of the

proximal interphalangeal joint. The study demonstrated significant differences in pain levels before and after adhering to the guidelines.

It was hypothesized that the patients who receive the protocol of care (study group I) are expected to have lower anxiety levels than those who don't (control group II) (hypothesis 4). The study findings showed a statistically significant difference in anxiety levels between the study group and the control group. The positive outcome for the study group could be attributed to the preoperative preparation and implementation of progressive muscle relaxation techniques as outlined in the Nursing care protocol. Furthermore, nurses answered patients questions about external fixation devices, which may have helped reduce anxiety and improve coping mechanisms. This finding aligns with a study by Badr et al., (2021) on the impact of an educational program on safety measures for orthopedic patients with external fixation, which also reported a significant difference in anxiety levels between the study and control groups in favor of the study group.

Moreover patients who received the protocol of care (study group) are expected to have fewer occurrences of pin site infections than those who don't (control group) (hypothesis 5). The current study found a statistically significant difference in the occurrence of pin site infection rate between the two groups, with the study group demonstrating a lower occurrence of

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pin site infection. The successful result can be credited to the efficient execution of a nursing protocol for the study group, which placed great emphasis on pin site care and maintaining cleanliness to prevent infection. The results of the current study are consistent with Badr et al. (2021), who investigated “the impact of a safety measures educational program on infection rates, satisfaction levels, and anxiety among orthopedic patients with external fixation”. In this study a statistically significant difference was observed between the groups in favor of the study group, attributed to the successful implementation of safety measures in the study group. The study group placed a strong emphasis on cleanliness and infection prevention at the pin site. Furthermore, the education program highlighted the significance of maintaining a healthy diet, engaging in regular exercise, quitting smoking, and adhering to device protection protocols.

In end, we can say that the study showed that the nursing care protocol has a beneficial effect on improving nurses' knowledge and performance in caring of orthopedic patients with external fixators. The training and information provided to the nurses were evident in the patients' outcomes, resulting in decreased pin site infections and enhanced levels of pain and anxiety management among subjects of the study group compared to the control group.

**Conclusion:**

The study findings concluded that the orthopedic nursing care protocol has positive effects on improving nurses' knowledge and performance related to the care of external fixators. The patients who received the orthopedic nursing care protocol (study group) had lower levels of pain, and anxiety and fewer pin site infection compared to those who did not receive it (the control group).

**Recommendations**

- Orthopedic nurses should attend regular in-service training courses and workshops on external fixators, focusing on their weaknesses. This will improve their knowledge and practice, ultimately leading to better patient outcomes.
- Provide orthopedic nurses with relevant magazines and educational booklets to promote ongoing education in the field.
- The study should be replicated with a larger sample size to achieve generalization.

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