

## Nurses Performance Regarding Orthopedic Patients with External Fixation at Zagazig University Hospitals

Nour Mansour Mohamady Mohamed, Nadia Mohamed Taha, Naglaa Abd Elkareem Moghazy  
Medical Surgical Nursing Department, Faculty of Nursing, Zagazig University, Egypt

### Abstract

**Background:** The external fixation device had been the gold standard for treatment of many types of fractures that cannot be treated by traction or cast. Orthopedic nurses increasingly play integral roles in all aspects of orthopedic care. **The study aimed to** assess nurses' performance regarding orthopedic patients with external fixation at Zagazig University Hospital. **Research design:** A descriptive design was used. **Tools of data collection:** A self-administered questionnaire and observational checklist were used to collect data. **Study subjects:** convenient sample of 55 nurses working at orthopedic department at Zagazig university hospitals. **Results:** Studied nurses' age ranged between 28 - 58 years and all of studied nurses were females. The majority of studied nurses had a diploma degree in nursing science and hadn't attended previous training about caring of the orthopedic patient with external fixation. About three quarter of studied nurses had unsatisfactory total knowledge and Almost half of studied nurses had inadequate total practice regarding care of patient with external fixation. The majority of the studied nurses' performance was affected by environmental factors. A statistically significant relation was found between factors affecting nurses' performance and their demographic characteristics at nursing qualification. Also there was a statistical relation between nurses' total knowledge regarding external fixation and nurses total practice at care of patients' positioning. **Conclusion:** Nurses had unsatisfactory level of knowledge and inadequate practice regarding care of orthopedic patient with external fixation and nurses reported that their performance was affected by environmental occupational, administrative, and psychological factors. **Recommendation:** Educational programs should be held periodically for such group of nurses to provide clear idea about the proper care of patient with external fixation, external fixation complications, pin site care, dressing and the factors affecting these performance.

**Key words:** External fixation, Fractures, Orthopedic nurses, Orthopedic care.

### Introduction

The musculoskeletal system consists of bones, joints, cartilages, ligaments, tendons and muscles a total of 206 bones make up the human skeleton providing shape to the body, supporting the internal organs, forming red, white blood cells and platelets, storing and releasing minerals. Many factors are affecting the musculoskeletal system: Disease, trauma, malnutrition and aging all contribute to musculoskeletal problems; the number of orthopedic surgeries performed

per year is expected to reach 6.6 million by 2020 [Stomberge et al., 2017].

Musculoskeletal diseases may be degenerative, traumatic, inflammatory, neuromuscular, congenital, or oncologic in nature. The most common cause of musculoskeletal injury is a traumatic event resulting in fracture, dislocation and \or soft tissue injury. A fracture is a break or disruption in the continuity of the structure of the bone. For a fracture to heal, it needs immobilization either by using casts, braces,

splints, immobilizers, internal and external fixation devices [Linton, 2016].

An external fixation device (EF) placed outside the human body is made of either carbon, stainless, titanium and aluminium alloys and consist from three-parts pin are inserted in bone, bars connect and joint to connect pin with bar. It is widely used for treating trauma, complicated or infected fractures, fixing long bones, pelvic bones and for orthopaedic procedures [Padoveca et al., 2017].

Around the world, 234 million surgical procedures are performed each year. Therefore, surgical site infection rate in orthopaedic surgery and its consequences still remain a major problem. Representing a heavy psychological and financial burden. [Tucci et al 2019]. One form of surgical site infection is pin tract infection the most common complication of external fixation accounting for 43% of complications. The presence of pin tract infection reduces the pin-bone interface strength, which leads to subsequent pin loosening [Mohammed, 2017].

Care of the patient with an external fixation device may appear difficult, time-intensive and both physically and emotionally draining for both the patient and careers. Pre-operative counselling, a well-structured teaching, intense psychological support and a good care plan will overcome many of the problems. The most important step is making a successful prognosis for the patient with an external fixation device [Walker, 2018].

Trauma and orthopaedic care in hospitals is delivered by a multidisciplinary team called the Trauma and Orthopaedic Services Team (TOST). Orthopedic nursing focuses on musculoskeletal diseases, injuries and disorders. An orthopedic nurse is well prepared for orthopedic conditions and caring for patients experiencing these difficulties. Orthopedic nurse works closely with the

orthopedic team, the patient and his family to ensure clear client education, a smooth recovery, and minimal complications [National Association of Orthopedic Nurses, 2018].

### **Significance of the study**

---

Most bone fractures heal spontaneously over the course of several months following standard fracture care. Still, approximately 5% to 10% of all fractures have delayed healing; resulting in continued morbidity and increased utilization of health care services [Buza& Einhorn, 2016]. About 7.9 million fractures occur annually in the United States. Moreover, in Egypt fractures was the second cause of injuries by 28.7% incident [Fawzy et al., 2015], and it is associated with 12-20% increase in morbidity and disability rates [Zakzouk, 2013].

### **Aim of the study**

---

The current study aimed to assess nurses' performance regarding orthopedic patients with external fixation at Zagazig University Hospitals.

### **Methodology**

#### **Research questions:**

- 1.What is the level of nurses' knowledge regarding orthopedic patients with external fixation at Zagazig University Hospitals?
- 2.What is the level of nurses' practices regarding orthopedic patients with external fixation at Zagazig University Hospitals?
- 3.What are the factors affecting nurses' performance regarding orthopedic patients with external fixation at Zagazig University Hospitals?

**Design:**

Descriptive design was used to conduct the current study.

**Setting:**

The present study was conducted in all orthopedic departments at Zagazig University Hospitals the first department present in the third floor in emergency hospital which consists of 4 wards (male and female), number of beds is 38, and number of nurses is 25. The second department present in the fifth floor in orthopedic surgery department at surgical hospital; it is divided into 2 wards (male and female), number of beds is 80, and number of nurses is 30.

**Sample:**

Convenient sample of all available nurses working in orthopedic departments at Zagazig University Hospitals during the study period. Their total number was 55 nurses.

**Tools of Data Collection:** Two tools were used to collect the necessary data:

Tool (I): **Self-administered questionnaire:** 1- **Nurses' demographic data** to assess the personal characteristic of the nurses including: Age, gender, marital status, education level, area of residence ears of experience and attending training about external fixation.

2- **Nurses' knowledge questionnaire regarding external fixation** [Brown et al., 2015] to assess nurses' knowledge regarding orthopedic external fixation It includes 58 items distributed on five categories (anatomy and physiology of musculoskeletal system, nurses' knowledge regarding fracture, nurses' knowledge regarding external fixation devices, nurses' knowledge regarding pin site infection and nurses' knowledge regarding

caring for patients with external fixation.). Those scored as follows: a correct answer was scored one and the incorrect zero. For each area of knowledge. The knowledge was considered satisfactory if the percent score was 70% or more

3- **The factors affecting nurses' performance in dealing with orthopedic patients with external fixation.** [Basavanthappa, 2014]. It included four sets of factors, namely psychological, administrative, professional, and environmental. Those scored as follows: Each factor considered by the nurse as influencing her performance was scored one and the not influencing zero. The scores of the four factors were summed-up and the total divided by the number of the items, giving a mean score for the total factors. This was converted into a percent score. The factor was considered to have a high influence if the percent score was 70% or more and low influence if less than 70%.

Tool (II): **Observation checklist:** adapted from [Speigelberg, 2010 & Haeleema, 2012] **it consists of six parts:** (pin site care, care of patients, positioning, care of injured and health extremities, care of the nutritional status of the patient, care of patients, hygiene and care of patients, environment) Each practice item observed to be done was scored one and the not-done zero. For each area of practice, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the area. These scores were converted into percent scores. The practice was considered satisfactory if the percent score was 70% or more and unsatisfactory if less than 70%.

**Validity and reliability of the tool**

The data collection tools were presented to a panel of five experts this include three professors of medical surgical

nursing from faculty of Nursing Zagazig University, the dean of faculty of medicine and the head of orthopedic department faculty of Nursing Zagazig University. The reliability of tools (Cronbach's Alpha =0.711) acceptable.

### **Field work**

After necessary permission was obtained. The researcher then met with the nurses individually, explained to them the aim of the study and the process of collection of the data, and invited to participate. Those who gave their consent were given the self-administered questionnaire, and were instructed in how to fill it. This took 30 minutes from each nurse.. The data collection process of this study was carried out through six months in the period from the beginning of September 2018 to end of February 2019. The researcher collected data from two shifts, the morning and the afternoon shifts, three days per week.

### **Pilot study**

A pilot study was conducted on five nurses representing 10% of the main study sample. Since no modifications were done in the tool, those who shared in the pilot study were included in the main study sample.

### **Ethical consideration**

---

The study protocol was approved by the research ethics committee at the Faculty of Nursing, Zagazig University. Each

potential subject was informed about the nature, purpose, and benefits of the study, and informed that her participation is voluntary before giving her verbal consent to participate. Anonymity of the subjects was also assured.

### **Statistical analysis**

The collected data were organized, tabulated and statistically analyzed using SPSS software. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians for quantitative variables. Qualitative categorical variables were compared using chi-square test. When the expected values in one of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones.

### **Administrative design**

The necessary approval was obtained from the Head of the Orthopedic Department, the Directors of the Surgery and Emergency hospitals, the Dean of faculty of medicine and from the General Director of Zagazig University Hospitals. Letters were issued to them from the Dean of the Faculty of Nursing, Zagazig University.

**Results:****Table (1):** Frequency and percentage distribution of demographic characteristics of studied nurses.

Demographic Characteristics	No	%
Age:		
<30	28	50.9
≥ 30	27	49.1
Range	28.0-58.0	
Mean±SD	41.1±7.8	
Median	39	
Gender:		
Female	55	100.0
Marital status:		
Single	7	12.7
Married	48	87.3
Residence		
Rural	29	52.7
Urban	26	47.3
Nursing qualification:		
Diploma	50	90.9
Bachelor	5	9.1
Nurses' total experience years:		
<20	25	45.5
≥ 20	30	54.5
Range	1-40	
Mean±SD	21.4±8.2	
Median	21	
Nurses' experience years in orthopedic department:		
<10	23	41.8
≥10	32	58.2
Range	1-40	
Mean±SD	12.3±9	
Median	10	
Attended training about external fixation:		
No	50	90.9
Yes	5	9.1

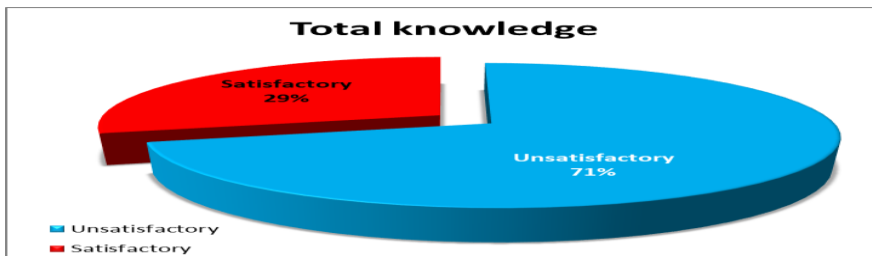
**Table (1):** illustrates the demographic characteristics of the studied nurses (n=55). The table shows that, the age of study subjects ranged from 28 - 58 years with median 39 years; also 100% of the study subjects were female. 87.3% of nurses were married, and 90.9% had a nursing diploma. While 52.7% were residing in rural areas. This table also clarifies that, the median years of nurses' experience in hospital and in orthopedic ward were 21 and 10 years, and 90.9% of the studied nurses hadn't attended previous training course about caring of orthopedic patients with external fixation.

**Table (2):** Satisfactory knowledge regarding external fixation among studied nurses (n=55).

Satisfactory knowledge (70%+)	No	%
Musculoskeletal anatomy & physiology	14	25.5
Bones fractures	39	70.9
Orthopedic external fixation	28	50.9
Pin site infection	2	3.6
Methods of care of patients with external fixation	27	49.1

**Table (2):** shows the satisfactory knowledge of studied nurses regarding external fixation. The table indicates that 70.9 % of studied nurses had a satisfactory knowledge regarding Bones fractures, while only 3.6% of studied nurses had a satisfactory knowledge regarding pin site infection.

**Figure (1):** Total knowledge regarding orthopedic external fixation among studied nurses (n=55).



**Figure (1):** show that 71% of studied nurses had unsatisfactory total knowledge regarding orthopedic external fixation.

**Table (3):** Satisfactory practice of studied nurses regarding caring of orthopedic patients with external fixation (n=55).

Satisfactory practice (70%+)	No	%
Pin site care	38	69.1
Care of patients' positioning	33	60.0
Care of injured and healthy extremities of the patient	0	0.0
Care of the nutritional status of the patient	18	32.7
Care of patients' hygiene	13	23.6
Care of patients' environment	50	90.9

**Table (3):** illustrates the total satisfactory practices of nurses regarding caring of orthopedic patients with external fixation. The table clarifies that, the highest percentage 90.9% of studied nurses had a satisfactory practice regarding care of patients' environment, while the lowest percentage 23.6% of the nurses had a satisfactory practice regarding care of patients' hygiene. On the other hand, none of the nurses performed the step of care of injured and healthy extremities of the patient.

**Figure(2):** Total practice regarding orthopedic patients with external fixation among studied nurses (n=55).



**Figure (2):** show that 51% of studied nurses had unsatisfactory total practice regarding orthopedic patients with external fixation

**Table (4):** Factors affecting nurses' performance regarding orthopedic patients with external fixation as reported by nurses in the study group (n=55).

Factors affecting nurses' performance	No	%
Psychological factors	16	29.1
Administrative factors	10	18.2
Occupational factors	8	14.5
Environmental factors	44	80.0

**Table (4):** shows the factors affecting nurses' performance regarding orthopedic patients with external fixation. The table indicates that 80.0 % of the studied nurses were affected by environmental factors, while only 14.5 % of the studied nurses were affected by occupational factors.

**Table (5):** Relations between nurses' total practice and their total knowledge regarding orthopedic external fixation.

Total practice	Total knowledge				X2 test	p-value
	Satisfactory No.=16		Unsatisfactory No.=39			
	No.	%	No.	%		
Pin site care:						
Satisfactory	13	81.3	25	64.1	1.562	0.211
Unsatisfactory	3	18.8	14	35.9		
Care of Patient positioning:						
Satisfactory	13	81.8	20	51.3	4.245	0.039*
Unsatisfactory	3	18.8	19	48.7		
Care of Exercises :						
Satisfactory	0	0.0	0	0.0	-----	-----
Unsatisfactory	16	100.0	39	100.0		
Care of the nutritional status:						
Satisfactory	5	31.3	13	33.3	0.022	0.881
Unsatisfactory	11	68.8	26	66.7		
Care of patient hygiene:						
Satisfactory	4	25.0	9	23.1	0.023	0.879
Unsatisfactory	12	75.0	30	76.9		
Care of Patients' Environment:						
Satisfactory	15	93.8	35	89.7	0.22	0.639
Unsatisfactory	1	6.3	4	10.3		
Total satisfactory practice						
Satisfactory	9	56.3	18	46.2	0.463	0.496
Unsatisfactory	7	43.8	21	53.8		

(\*) Statistically significant at  $p < 0.05$

**Table (5):** reveals the relations between nurses' total practice areas and their total knowledge regarding orthopedic external fixation. The table indicates a statistically significant relation between nurses' total knowledge of external fixation and their total practice at care of patient positioning as  $p$  value=0.03 .

**Table (6):** Relations between nurses' demographic characteristics and the factors affecting their performance.

Demographic Characteristics	Factors affecting nurses' performance				X2 test	p-value
	Affected No.=9		Not affected No.=46			
	No.	%	No.	%		
Age:						
<40	3	33.3	25	54.3	1.33	0.249
≥ 40	6	66.7	21	45.7		
Gender:						
Male	0	0	0	0	-----	-----
Female	9	100.0	46	100.0		
Marital status:						
Single	0	0	7	15.2	1.569	0.21
Married	9	100.0	39	84.8		
Residence						
Rural	6	66.7	23	50.0	0.839	0.36
Urban	3	33.3	23	50.0		
Nursing qualification:						
Diploma	6	66.7	44	95.7	7.652	0.006*
Bachelor	3	33.3	2	4.3		
Nurses' total experience years:						
<20	4	44.4	21	45.7	0.004	0.947
≥20	5	55.6	25	54.3		
Nurses' experience years in orthopedic department:						
<10	3	33.5	20	43.5	0.318	0.573
≥10	6	66.7	26	56.5		
Attended training in external fixation:						
No	7	77.8	43	93.5	2.245	0.134
Yes	2	22.2	3	6.5		

(\*) Statistically significant at  $p < 0.05$

**Table (6):** demonstrates the relation between nurses' demographic characteristics and the factors affecting their performance. The table indicates a statistically significant relation between factors affecting nurse performance and their demographic characteristics at nursing qualification as  $p$  value<0.05.

## Discussion

Regarding the age of studied nurses, the result of present study showed that the majority of studied nurses' age ranged between 28-58 years old. This result is in

agreement with [El sharkawy, 2016 in the master thesis in Alexandria, who found that 50% of the nursing staff in orthopedic ward within age group (40-60) years. Also this was supported by [Haleim et al., 2010], who stated in a study in Egypt that the mean age of nurses was 35 years with range (40-60



years). While these findings were in disagreement with [Radhi & Tawfiq, 2016], who indicated in his study at Baghdad city that more than three fourth of studied sample within age group (20-39) years. It is also in disagreement with [Bader& Kadhim, 2012], who reported in his thesis at Baghdad, that the highest proportion 30.8% of nurses was 41-45 years old.

Finding of the present study revealed that, all the subjects in the study were females. This findings is in agreement with [Sickder, 2011], who reported that the majority of orthopaedic nurses in orthopaedic wards were females. But, this result is in disagreement with [Bader& Atiyah, 2017], who reported in his thesis at Al-Emam Al-Khadam that large proportion of sample were orthopedic male nurses.

As regarding to marital status the current results showed that; the majority of the studied nurses were married. This finding in the same line with [Bader& Atiyah, 2017 and Bader& Kadhim, 2012] in studies performed at Baghdad, who reported that the majority of the sample were married.

Regarding to educational level this study showed that the majority of nurses were diploma degree in nursing science. This finding is in the same line with [Bader& Atiyah, 2017; El sharkawy, 2016; Elreefay, 2012], who mentioned in studies performed at Baghdad and Alexandria that the majority of nurses were diploma degree, while this result is in disagreement with [Radhi & Tawfiq, 2016; Bader & Kadhim, 2012], who reported in studies performed at Baghdad that the majority of nurses had bachelor degree in nursing science.

Regarding to the nurses' experience years in nursing field as general the current study showed that more than half of studied nurses had more than 20 years of experience. This finding is in agreement with [Bader&

Kadhim, 2012], who found in study at Baghdad that more than half of the study sample had 21 years and more of employment in nursing field. But this result is in disagreement with [Abdalrahim, 2009], who said in a thesis in Jordin that, more than half of study sample had (1-5) years of employment in nursing field..

Concerning nurses' experience years in orthopedic ward, more than half of the study subjects had more than 10 years of experience in orthopedic ward. This is in agreement with [El sharkawy, 2016] in a study performed in Alexandria, who reported that the majority of nurses had equal or more than 10 years of experience. But this result is in disagreement with [Radhi & Tawfiq, 2016;], who reported in his study at Baghdad that years of experience in orthopedic ward for the majority of the sample was (1-5) years.

Also on the same context, noticeable finding of the study was that the majority of nurses never had training about external fixation. This result is in agreement with [Al-Barwari et al., 2006], who found in his thesis in Kurdistan that the majority of nurses didn't have training session. While the result is in disagreement with [Radhi & Tawfiq, 2016], who found in a stud at Baghdad that 54%, of the study sample sharing in training session.

In relation to studied nurses' total knowledge scores, the result of the present study revealed that, nearly two thirds of the studied nurses were having unsatisfactory total knowledge about orthopedic external fixation. This finding is in agreement with [Bader& Atiyah, 2017], who reported in a study performed in Baghdad that nurses knowledge regarding orthopedic external fixation was poor among the nurses under the study. On the other hand, this results are in disagreement with [Hassan et al., 2013], who reported in a study in Egypt at Assuit

university hospital that more than two thirds of nurses had good level of knowledge regarding external fixation.

On the other hand, the area of highest knowledge deficiency among studied nurses was related to the pin site infection. This result is in agreement with [Atiyah, 2018], who found in a stud at Baghdad that nurses' knowledge was poor related to pin site infection.

As regard to total score for the studied nurses' practice, the result of the present study revealed that almost half of the studied nurses were having inadequate total practice regarding care of patient with external fixation. This result is in agreement with [Bader& Kadhim, 2012], who stated in study performed at Baghdad that the majority of nurses have a poor practice related to orthopedic patients with external fixation. But this result disagrees with [Hassan et al., 2013], who revealed in her stud at Assuit that the majority of nurses had adequate practice regarding care of the patient with external fixation.

The current results revealed that the second lowest area of practice was care of patient hygiene; only one quarter of nurses performed this step. This result is in agreement with [El Sharkawy, 2016], who found in her study at Alexandria that nurses had low level of practice in showering and bathing.

The current study revealed that only less than one fifth of the studied nurses were identifying the factors affecting nurses' performance regarding orthopedic patients with external fixation. This result is in disagreement with [Gouda et al., 2019], in a study at Benha university hospitals who mentioned that (84%) of the studied nurses reported that factors had affected their performance.

The results of the current study revealed a statistically significant association between certain areas of knowledge and certain areas of practice. Thus, more nurses with satisfactory knowledge had adequate practice of care of patient positioning. In this context. [Kopfer & McGovern, 2008] emphasized that, nurses' level of education was a potential means for implementing preventive strategies and has a great impact on their knowledge and practice while caring for the patient.

### **Conclusion**

---

In the light of the main study findings, it can be concluded that the majority of the studied nurses had unsatisfactory knowledge, and slightly more than half of studied nurses had unsatisfactory practice level regarding care of orthopedic patient with external fixation. Furthermore, most of the studied nurses reported that their performance was affected by environmental, occupational, administrative, and psychological factors. Also it was concluded that nurses' knowledge has a positive influence on their practice at care of patient positioning and nursing qualification has a positive influence on their perception of the factors affecting their performance.

### **Recommendations**

---

- The nurses working in the study settings need more training to improve and refresh their knowledge about orthopedic external fixation.
- Educational programs and workshops are highly recommended to improve orthopedic nurses' deficiencies in the practices related to: care of patient positioning, care of injured and healthy extremities, care for the nutritional status of the patient and care of patient hygiene.

- The factors affecting nurses' performance should be addressed by the nursing management and the hospital administration
- Further studies should be carried out on a large number of nurses for evidence of the result.

**Financial support:**

No funding was received.

**Conflict of interest:**

No yes

**References**

- Abdallah M., (2009):** "Postoperative Pain Assessment and Management the Effects of an Educational program on Jordanian nurses' practice, knowledge, and attitudes". Göteborg 2009. Available on [www.CutePDF.com](http://www.CutePDF.com) Accessed on 28/9/2017 at 10:00 Pm.
- Al-Barwari R H., Al-Attar W M. and Sae'ed O A. (2006):** " Evaluation of Nursing Knowledge and Practices Concerning Nursing Care of Patient with Skin Traction in Orthopedic Units in Kurdistan Region". Sci. J. Nursing / Baghdad; 19 (2), 24.
- Atiyah H H., (2018):** "effectiveness of an educational Program on nurses' Knowledge Concerning nursing Management for Patients with Compound Fracture at orthopedic Wards in Medical City Directorate". Indian Journal of Public Health Research & Development; 9 (8), 322-327.
- Bader T R. and Atiyah H H., (2017):** "Nurses' knowledge toward Dressing Pin Track External Fixation in Orthopedic Ward at Al-Emamin Al-Khadamin Teaching City". IOSR Journal of Nursing and Health Science (IOSR-JNHS); 6(5), 8-14.
- Bader T. and Kadhim H., (2012):** "Evaluation of nurses' practices toward orthopaedic wound infection" Iraqi National Journal of Nursing Specialties; 25, p58-70.
- Basavanthappa B T., (2014):** "nursing administration". 3rd edition. Jaypee Brothers, Medical Publishers. India, p85-100.
- Brown D., Edward H. Seaton L. Buckley T., Lewis S., Dirksen S R., Hietkemper M M. and Bucher L (2015):** "Lewis's medical surgical nursing assessment and management of clinical problems". Fourth edition. Elsevier Mosby, Australia and new zealand. P 1578.
- Buza III J A., Einhorn T., (2016):** "Bone healing in 2016" .Clinical Cases in Mineral and Bone Metabolism; 13(2), 101-105.
- Elreefae N., (2012):** "Assessment of nurses' practices related to safety of intraoperative surgical patients undergoing general anesthesia". Published Master thesis. Faculty of Nursing, Alexandria University.P28..
- El-sharkawy S., (2016):** "Nursing practice toward prevention of pin site infection among orthopedic patient with external fixation" Unpublished master thesis. Faculty of Nursing, Alexandria University. PP 53-70.
- Fawzy E., Barakat A., Ibrahim H., and Mohamed A., (2015):** "Epidemiology of non -fatal injuries among Egyptian children: A community based cross-sectional survey", BMC public health; 15(1), 1248.

- Gouda A H., Mohammed E T. and Ameen D A., (2019):** "Factors Affecting Postoperative Nursing Performance in The Surgical Units". Original Article Egyptian Journal of Health Care; 10 (1), 50- 6
- Haeleema Y., (2012):** "Nurses practices toward orthopedic wound infection", Iraqi National journal of Nursing; 25(1), 58-70.
- Haleim K., (2010):** "surgical site infection and associated risk factors in Egyptian orthopedic patients". Journal of American science, 2010; 6, (7).
- Hassan S A., (2013):** "standards of nursing care for patients undergoing external fixation in trauma unit at Assuit University hospital". Unpublished master thesis. Faculty of Nursing. Assuit University. P 88.
- Kopfer M. and McGovern M., (2008):** "Transmission of infection via a needle stick injury". American association for occupational health nurse journal. 2008.41.
- Linton D., (2016):** "Introduction to Medical Surgical Nursing E-Book". 6th edition, Elsevier, Canda, p 939-974.
- Mohammed M.R., (2017):** "pin tract infection after uniplanarexternal fixator of open fracturesat Kenyatta national hospital". A master thesis. College of health science –school of medicine-departement of orthopedic surgery.
- National Association of Orthopedic Nurses (2018):**  
Available at <http://www.orthonurse.org>.  
Accessed on 5\4\2019 at 11:50 pm.
- Padoveca Z., Radek S., Ruzicka P. and Ruzicka M., (2017):** "Design, analysis and testing of an external fixation device manufactured from composite materials". Applied and Computational Mechanics.11 (2017), 145–154.
- Radhi T A. and Tawfiq N B., (2016):** "Assessment of Postoperative Nurses' practices Concerning Care of Fracture Treated by External Fixation". Journal for nursing sciences; 6 (1), 24-32.
- Sickder H., (2011):** "Nurses' knowledge and Practices Regarding Prevention of Surgical Site Infection". (Thesis) prince of Songkla University. P.60. Available at: <http://www.UO.Prince songkla.com>.
- Speigelberg B., (2010):** "Ilizarov principles of deformity correction of the royal college", Annals journal of surgeons in England; 92 (2), 101-05.
- Stromberg H., Dallred C. and Dewit S C., (2017):** "Medical surgical nursing E book concepts and practice". 3rd edition, Elsevier, USA, P 719-743.
- Tucci G., Romanini E., Zanolli G., Pavan L., Fantoni M. and Venditti M., (2019):**"Prevention of surgical site infections in orthopaedic surgery: a synthesis of current recommendations" European Review for Medical and Pharmacological Sciences 2019; 23(2), 224-239.
- Walker J., (2018):** "Assessing and managing pin sites in patients with external fixation. Nursing Times [online]; 114: (1), 18-21.
- Zakzouk S., (2013):** "Assessment of time factor in managing femoral neck fractures by internal fixation in patients above 55 years", The Egyptian orthopedic journal; 48(2), 180-189.