

Effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopaedic patients with external fixation

Ola El-SebaieBadr¹, Yasmin Fathy Mohammed², Hend A. E. EL-shenawie³,
Yasmeen Mohamed Shehata⁴

^{1,4} Lecturer in Nursing Education Department, Faculty of Nursing, Alexandria University, Egypt

^{2,3} Lecturer in Medical Surgical Nursing Department, Faculty of Nursing, Alexandria University, Egypt

Abstract: Patient education and empowerment of nurse-patient interaction have been emphasized greatly in nursing. Infection in Pin site stays challenging issue facing providers of health care; therefore, nurse health education is greatly needed to decrease incidence of pin site infection, increase satisfaction, and lower anxiety level. So this study aims to determine the effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopaedic patients with external fixation. **Research hypothesis:** Patients who educated through safety measures program will have lower incidence of infection, higher satisfaction level, and low level of anxiety than those who cared through traditional hospital strategy. **Research design:** the current study utilized a quazi experimental research design. **Setting:** This study was conducted in patient wards and outpatient department of El Hadra Orthopedic and Traumatology University Hospital, Alexandria. Egypt. **Sample:** A convenient sample of 70 orthopaedic patients with external fixation was randomly divided into 2 equal groups, 35 patients in each group. **Tools:** Three tools were used for compilation of data. Tool (I): Orthopaedic Patient's External Fixation Assessment Sheet. Tool (II) Patients' Satisfaction Scale, Tool (III): Beck Anxiety Inventory. **Results:** Statistically significant difference was found between both groups regarding pin site infection where $\chi^2=5.820^{*MC}$ $p=0.046^{*}$. Also, statistical significant differences between both groups regarding satisfaction level of Neurovascular assessment, Pin site care, Exercise, Nutrition and smoking, Methods of device protection where $t=4.785^{*}$, $p<0.001$; $t=2.797^{*}$, $p<0.001$; $t=7.550^{*}$, $p<0.001$; $t=8.645^{*}$, $p<0.001$, $t=9.117^{*}$, $p<0.001$ respectively. There was statistical significant difference among both groups in relation to their level of anxiety where ($X^2=4.786^{*}$, $P=0.029^{*}$). **Conclusion:** Health educational program has a positive effect on the incidence of patients' pin site infection, satisfaction and lowering anxiety level among patients. **Recommendation:** The educational intervention and patient's psychosocial support should be included in routine nursing care as a protocol before and after external fixation surgery. Further research is to be carried out on new approaches around management of patients with external fixation and evaluate its effect on patients' quality of life.

Keywords: nurse-patient, health care, nurse health education.

1. INTRODUCTION

External fixator is one of the modalities used for fracture immobilization that allows stabilization of fracture without increasing soft tissue damage in which a system of percutaneous pins or wires are connected to an injury external frame. There are many types of external fixator such as "Illizarov" and "Hoffman". External fixator is specifically useful in the treatment of open or closed fracture, complex fracture associated with extensive injury of the soft tissue, adjustment of bony defects as well as for limb lengthening^(1,2)

In addition, external fixator has many advantages over other fracture management strategies. These advantages include; (1) minimal soft tissue trauma (2) provision of nursing care regarding the ability to observe soft tissue injury, dressing of the wound and ability to keep up motion of adjacent joints; (3) decrease of blood loss when used for pelvic fracture (4) fewer complications of immobility. In the other hand; External fixator has some disadvantages such as; the frighten appearance of the external fixator device, and complications related to the pin sites such as; pin loosening, varying degrees of stability which can result in malunion or non-union, and skin scratch, and finally pin site infection⁽³⁻⁵⁾.

Approximately 70% of patients with external fixing devices experience complications with high incidence rates⁽¹⁾, restrict patient operation, extended hospitalization, break up the healing process, and impact the quality of life (QOL). Furthermore, it places additional burden on the time and resources of the hospital and its medical and nursing personnel, as well as, it increases financial cost for both the patient and the hospital⁽⁶⁻⁹⁾.

One of the primary roles of the orthopaedic nurse is to prevent pin site infection. The nurse can reduce the presence of infection by following certain standards of practice and providing health teaching regarding external fixation devices and daily living activities⁽¹⁰⁻¹²⁾.

So, the concept of patient education is created and regarded as a basic task of nurses during health services provision. Education enhances a patient's capability for self-care and increasing the health status and the avoidance of the disease. Patient education is regarded as essential character and rule in healthcare services, a criterion for protecting patient's hospital rights, a ways to attain healthiness promotion, and a mixture of educational actions aimed to aid persons who are suffering a disease or its problems. Accordingly, it required to be done frequently and constantly at many organized levels to get the accepted result. Moreover, programs of patient education are energetic and motivating processes to enhance, preserve, and improve patient care; the carrying out of patient education inside a hospital is a problematical duty that plays a important role in enhancing and managing diseases and giving excellence healthcare services.^(13, 14)

Nurse's providing teaching should be planned with regard to different illness-specific results on the life quality of the patients. Identifying whether the patient understands the information and ensuring that she/he has learnt, evaluating the progress that the patient makes regarding health care objectives and picking up the teaching methods while performing these tasks are part of the nurse's role⁽¹⁵⁾

In fact, the role of the orthopaedic nurse in preparing the surgical patients preoperatively, beside supporting and caring for them postoperatively is paramount. So, the surgical wound care should start in the preoperative stage. The orthopaedic nurse in that stage has different areas of care that include: nutritional preparation, and encouraging smoking cessation, encourages performance of exercise and psychological care. Moreover, the nurse provides health education to the patient about personal hygiene, clothing and promoting a good blood supply to pin site wound which is greatly needed in the postoperative stage⁽¹⁶⁻¹⁹⁾.

Nursing staff should adopt a uniform patient care program that can be educated to each one involved in patient's care. The use of a reliable safety measures care program will aid to confirm that the patient is not receiving diverse knowledge from several memberships of the healthcare group, a familiar problem that can cause misunderstanding and deficiency of self-confidence. Giving patients information relating safety measures care program is an effective way allow for providing high-quality of patient's care^(20, 21)

Therefore, patients with lower limb external fixation had significant levels of wound infection and inflammation of tendon and had a greater require for further operations. In addition, patients with external fixation almost of the time experience anxiety, depression, and maladaptive coping due to, changes in body image, pain and lack in knowledge and skills to deal with the external fixation device⁽²²⁾. Moreover, patients with external fixation had self care deficits regarding performance of daily living activities and low satisfaction that contribute to decrease quality of life, increased morbidity and mortality post external fixation. Therefore, application of educational program for such group of patients is concept to empower the patient and family with the needed knowledge and skills necessary for optimal safe performance and enhancing their satisfaction. Hence, this paper intended to determine the effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopaedic patients with external fixation

Aim of the study**This study aims to:**

Determine effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopaedic patients with external fixation.

Research hypotheses

Patients who educated through safety educational measures program will have lower incidence of infection than those who cared through traditional hospital strategy

1. Patients who educated through safety measures educational program will show higher satisfaction level than those who cared through traditional hospital strategy.
2. Patients who educated through safety measures educational program will exhibit lower anxiety level than those who cared through traditional hospital strategy.

2. MATERIALS AND METHOD**I-Materials****Research design**

A quasi-experimental study was conducted.

Settings

This study was conducted in patient wards and outpatient department of El Hadra Orthopedic and Traumatology University Hospital, Alexandria, Egypt.

Subjects

A convenient sample composed of 70 patients was randomly selected and divided into 2 equal subgroups, 35 patients in each group.

Control group: 35 patients who received hospital traditional care.

Study group: 35 patients who received educational program beside traditional care. Patients were assigned according to the following criteria:

Inclusion criteria: Adult aged from 21 to 60 years of both sexes, External fixation applied for either upper or lower extremity, Free from any infection, and Free from any associated disorders e.g. diabetes mellitus, cancer.

Tools

Three tools were used to collect the data.

Tool I: Orthopaedic Patient's External Fixator Assessment Sheet.

Part I: Socio-demographic and clinical data such as; age, sex, marital status, level of education, occupation, Smoker or not, medical diagnosis, type of external fixator and site of external fixator

Part II : Checketts-Otterburns Grading System.

This tool was developed by Checketts- Otterburns⁽²²⁾. It was used to determine degree of infection whenever it occurs. It grades the infection from grade one to grade six using appearance changes and treatment needed to treat infection. The first grade involves minor discharge, redness around the pins, while the second grade represented as redness of the surrounding skin, pain and tenderness in the soft tissue, pus discharge. Regarding the third grade similar to the second grade in appearance but fails to improve with thorough local care and antibiotics. For the fourth grade includes severe soft tissue involvement distressing more than one pin, associated loosening of the pin, and the fifth grade look a lot like the fourth grade beside bone involvement, radiographs show osteomyelitis. Finally, the sixth grade in which infection occurs after fixator removal the pin tracks heals down and discharges in intervals.

Tool II: Patients' Satisfaction Scale

This tool was developed by researchers after thorough review of literatures.⁽²³⁻²⁶⁾ to determine the patients' satisfaction level regarding **safety measure educational program** items that include neurovascular assessment(4 statements) , pin site care(4 statements) ,exercise(4 statements), health teaching about nutrition and cessation of smoking(3 statements) and methods of device protection(3 statements). Each item was scored on a 3 likert-scale ranging from 1 (not satisfied), 2 (neutral satisfied) and 3 (satisfied).

Scoring system

The satisfaction score ranged from 18 to 72. Higher Scores indicate greater degree of satisfaction. Patients' Satisfaction was classified into not satisfied; neutral and satisfied as follows:

- < 18= Not satisfied

- 19-45= Moderate satisfied

- \geq 46= high Satisfied

Tool III: Beck Anxiety Inventory

This tool was developed by Beck⁽²⁷⁾. It was self –report measure of anxiety consisted of 21 items. Each item ranked as follow not at all=0,mildly but it did not bother me much =1,moderately it was not pleasant at times =2,severelyit bothered me a lot =3.The total score was calculated by the sum of the 21 items.

Score of 0-21=Low anxiety

Score of 22-35 = Moderate anxiety

Score of 36 and above = potentially concerning levels of anxiety

II- Method

The study was conducted through the following steps: -

1. Written approval to carry out the study was obtained from the administrative authorities after declaring the aim of the study.
2. Orthopedic Patient's External Fixator Assessment Sheet, as well as education booklet was developed by the researchers after review of the related literature^(16-21, 28).
3. The developed tools and educational booklet were revised by five experts in the field of nursing and orthopedic specialists to ascertain its content validity and clarity of the items.
4. The content validity was revised by 3 experts from the Medical Surgical Nursing Department, 2 experts from Orthopedic Surgery Specialty. Some modifications were done. Tool III was translated to Arabic .the accuracy of its translation was reviewed and validated by a jury of five expertise in nursing psychology
5. Reliability of the developed tools were estimated by correlation coefficient(70.0)
6. A pilot study was conducted on 10 % of subjects (7 patients) to test feasibility and applicability of the developed tools. Those subjects were excluded from the study sample.
7. A convenient sample of 70 adult patients who fulfilled the inclusion criteria was assigned randomly and equally divided into two equal groups. Patients of both groups were assessed immediately on admission within 24 hours using tool I. Tool III used to determine patient level of anxiety pre and post safety measures educational program.
8. **The study was implemented through four phases: -**

Assessment phase: assessment of patients' needs and problems facing the patient with external fixator device through meticulous review of literature.

- **Planning phase:** an educational booklet was developed by the researchers based on review of relevant literature^(16-21, 28).in Arabic language. It involves items related to the following:

- Preoperative preparation as deep breathing and coughing exercises and psychological preparation
- Postoperative nursing care related to pin site care, neurovascular assessment, performance of exercises in addition to health teaching about importance of smoking cessation, nutrition, methods of device protection
- **Implementation phase:** The Control group who comprised of 35patients received hospital routine care. While, study group who comprised of 35 patients received educational program in addition to hospital traditional care .The educational program provided only to the study group in 3 sessions as follows:

The first session: includes preoperative patient preparations:

Preoperatively, patients in the study group was interviewed individually and received education about performing deep breathing and coughing exercises before and after the operation and training how to perform it before the operation .Psychological preparation through providing patient with photos about external fixators.

The second session consisted of post operatively safety measures education:

Patients were educated about steps of pin site care and signs and symptoms of pin site infection. Neurovascular assessment. Also, performance of isotonic and isometric exercises for affected and non-affected extremities .

The third session:

It included items concerned with health teaching about importance of nutrition, smoking cessation, and methods of device protection.

Evaluation phase: Evaluation was done for both groups weekly for six weeks during the period of hospitalization and in outpatient clinic. Comparison was done between two groups in order to determine the effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopedic patients with external fixation.

Data collection extended from June 2019 to January 2020.

Ethical considerations.

- Informed consent was taken from each participant of the study after explanation of the purpose of the study. Confidentiality and privacy was assumed to each patient.
- The patient has the right to leave the study at any time without providing any reasons.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent Quantitative data were described using mean and standard deviation, Significance of the obtained results was judged at the 5% level.

The used tests were

1. **Chi-square test:** For categorical variables, to compare between different groups
2. **Monte Carlo correction: Correction** for chi-square when more than 20% of the cells have expected count less than 5
3. **Student t-test :**For normally distributed quantitative variables, to compare between two studied

3. RESULTS

Table I: illustrates distribution of patients' socio-demographic characteristics in both study and control group .In relation to the patient's age: The highest percentage (45.7%) of patients in the study group were in the age group of 30 to less than 40 years, while in the control group the highest percentage (34.3%) were in the age group of 40 to less than 50 years.

Regarding the patient's sex: The majority of the participants (65.7% and 71.4%) were male in both study and control group respectively. As regards marital status: Married patients represented the highest percentage 71.4% and 80.0% in both study and control group respectively .

As for the level of education: More than one third (34.3%-40.0%) of study and control group respectively were Illiterate patients, while the lowest percentage in both study group and control group (17.1%- 8.6%) of patients had university education. Concerning occupation: Patients who were employed represented more than half (57.1%, 51.4%) of patients in both the study group and control group

In respect to smoking habit: more than half (57.1%) of the patients in the study group were non - smoker, and (54.3%) of the patients in the control group were smoker.

Table1: Distribution of patients’ socio-demographic characteristics in both study and control group.

Personal characteristics	study (N=35)		control (N=35)		Test of significance	p
	No.	%	No.	%		
Age (years)					$\chi^2=1.926$	0.588
• 20-	5	14.3	5	14.3		
• 30-	16	45.7	11	31.4		
• 40-	10	28.6	12	34.3		
• 50-60	4	11.4	7	20.0		
Sex					$\chi^2= 0.265$	0.607
• Male	23	65.7	25	71.4		
• Female	12	34.3	10	28.6		
Marital status					$\chi^2=0.699$	0.403
• Single	10	28.6	7	20.0		
• Married	25	71.4	28	80.0		
Level of education					$\chi^2=2.572$	^{MC} p = 0.492
• Illiterate	12	34.3	14	40.0		
• Basic education	10	28.6	7	20.0		
• Secondary	7	20.0	11	31.4		
• University	6	17.1	3	8.6		
Occupation					$\chi^2=0.230$	0.631
• Not employed	15	42.9	17	48.6		
• Employed	20	57.1	18	51.4		
Smoking habit					$\chi^2=0.915$	0.339
• Smoker	15	42.9	19	54.3		
• Non-smoker	20	57.1	16	45.7		

χ^2 : Chi square test, MC: Monte Carlo

p: p value for comparing between the two groups

Table 2: Shows distribution of patients in the study and control group according to clinical data. Concerning medical diagnosis: Patients who had fracture grade II represented the highest percentage in both groups (51.4%) of the study group and (57.1%) of the control group, while, deformity represented the lowest percentage (5.7% , 8.6%) of patients in both groups study and control respectively

Concerning type of external fixator Illizarov represented the highest percentage (48.6%, 40%) in both group study and control respectively. In relation to site of external fixator application: The table reveals that the majority (57.1%) of patients of the study group had fixator in their lower extremities. While, the majority (51.4%) of patients of the control group had fixator in their upper extremities

Table 2: Distribution of patients in the study and control group according to clinical data .

Clinical data	Group study (N=35)		Group control (N=35)		Test of significance	p
	No.	%	No.	%		
Medical diagnosis					$\chi^2=0.639$	MC p=0.753
• open grade I Fracture	15	42.9	12	34.3		
• open grade II Fracture	18	51.4	20	57.1		
• Deformity	2	5.7	3	8.6		
Type of external fixator					$\chi^2=0.616$	0.735
• Illizarov	17	48.6	14	40.0		
• Uni-lateral	6	17.1	8	22.9		
• Bi-lateral	12	34.3	13	37.1		
Site of external fixator					$\chi^2=0.516$	0.473
• Upper extremities	15	42.9	18	51.4		
• Lower extremities	20	57.1	17	48.6		

χ^2 : Chi square test, MC: Monte Carlo

p: p value for comparing between the two groups

. **Table 3:** explains distribution of patients in the study and control group according to their infection grades. A according to Checketts- Otterburns Grading System for pin site infection: 88.6%, 65.7% of patient in both study and control group respectively had no infection. Equal percentage 5.7% of patients in study group had grade 1 and grade 2 infections. While 25.7% of patient in control group had grade 1 infection and only 8.6% had grade 2. Statistically significant difference was found between both groups where $\chi^2=5.820^*$ MC p=0.046*

Table 3: Distribution of patients in the study and control group according to Checketts- Otterburns Grading System for pin site infection

Infection grades	Study (n=35)		Control (n=35)		χ^2	MC p
	No.	%	No.	%		
Grade 0	31	88.6	23	65.7	5.820*	0.046*
Grade 1	2	5.7	9	25.7		
Grade 2	2	5.7	3	8.6		

χ^2 : Chi square test MC: Monte Carlo

p: p value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

Table 4: demonstrates distribution of patients according to their level of satisfaction .The study group had the highest satisfaction Mean \pm SD. 14.63 \pm 3.06, 14.17 \pm 2.63, 15.89 \pm 0.68, 11.49 \pm 1.15, 11.74 \pm 0.85 regarding Neurovascular assessment, Pin site care, Exercise, Nutrition and smoking, Methods of device protection respectively compared to those of control group 9.71 \pm 5.25, 11.89 \pm 4.06, 10.74 \pm 3.97, 6.94 \pm 2.89, 7.97 \pm 2.29 .with a statistical significant differences between both groups regarding Neurovascular assessment, Pin site care, Exercise, Nutrition and smoking, Methods of device protection where $t=4.785^*$, $p<0.001$; $t=2.797^*$, $p<0.001$; $t=7.550^*$, $p<0.001$; $t=8.645^*$, $p<0.001$, $t=9.117^*$, $p<0.001$

Table 4: Distribution of patient’s study and control group according to their level of satisfaction .

Satisfaction level	Study (n=35)	Control (n=35)	t	p
Neurovascular assessment	14.63±3.06	9.71 ± 5.25	4.785*	<0.001*
Pin site care	14.17±2.63	11.89±4.06	2.797*	0.007*
Exercise	15.89± 0.68	10.74±3.97	7.550*	<0.001*
Nutrition and smoking	11.49±1.15	6.94±2.89	8.645*	<0.001*
Methods of device protection	11.74± 0.85	7.97±2.29	9.117*	<0.001*
Overall	67.91±4.72	47.26±8.23	12.875*	<0.001*

t: Student t-test

p: p value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

Table 5: illustrates Comparison between the study and control group according to their level of anxiety. During pre safety educational program, it was found that the highest percent of patients (57.1%in the study and 51.4 in the control group experiencing moderate anxiety level. There was no statistical significant differences among both groups in relation to their level of anxiety where($X^2=0.230, P=0.631$).whereas, during post safety measure educational program, it was noticed that the majority of patients 85.7% in the study group experiencing less anxiety level compared to 62.9% in control group . There was statistical significant difference among both groups in relation to their level of anxiety where($X^2=4.786^*, P=0.029^*$).

Table 5: Comparison between the study and control group according to their level of anxiety .

Level of anxiety	Pre safety measures educational program				Post safety measure educational program			
	Study (n=35)		Control (n=35)		Study (n=35)		Control (n=35)	
	No.	%	No.	%	No.	%	No.	%
Less anxiety	15	42.9	17	48.6	30	85.7	22	62.9
Moderate anxiety	20	57.1	18	51.4	5	14.3	13	37.1
$\chi^2(p)$	0.230 (0.631)				4.786* (0.029*)			

χ^2 : Chi square test

p: p value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

4. DISCUSSION

External fixation is essential aspect of complicated fracture managing; External fixation used for limb restoration and correction of deformity. As, the external fixation can remain in place for several months and patients will require to deal with the device and show an understanding of the standard of pin site care . Moreover, psychosocial support needs to be considered. In addition, patients always fight to adapt with the external fixation device and need a comprehensive evaluation and support to enhance their quality of life ⁽²⁹⁾ .

The quality of patient health education programs considered to be one of the most important priorities in health care systems. Therefore, it is necessary to measure the outcomes and contribution of nursing educational programs on the incidence of pin site infection. So, a well-structured teaching program and care plan can promote maximum self- care for the patients with external fixation devices and will decrease incidence of pin site infection ⁽²²⁾ . The study was designed to determine effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopaedic patients with external fixation.

Based on the results, it was observed that the highest percentage (45.7%) of patients in the study group were in the age group of 30 to less than 40 years, while in the control group the highest percentage (34.3%) were in the age group of 40 to less than 50 years. From the researchers' point of view, this result may be regarded to the fact that this age group spent most of their time out of homes. Also, they characterized by high level of activity and therefore they are vulnerable to risky behaviours and accidents. The previously discussed finding was in the same line with a study conducted by Khorais et al., (2018) entitled " Self-Care Program: Quality of Life and Satisfaction among Patients with External Skeletal Fixation " which revealed that the mean age of the patients was thirty years ⁽³⁰⁾.

Like this study findings, a study performed by Mohamed et al., (2017) who carried out a study about "pin tract infection after uniplanar external fixation of open fractures at a national, teaching and referral hospital", stated that the median age of the patients with external fixation was thirty-two years ⁽³¹⁾. While this finding is not in agreement with a study done by Mohamed, et. al, (2015) entitled: "Outcome of illizarov fixator in tibial non-union" who found that the mean age of the patients with external fixation was (40 ± 13.89) ⁽³²⁾.

Regarding the patient's sex, the present study showed that; The majority of the participants were male in both study and control group .This may be due to rush behaviours in men are more than in women, which leads to more risk for accidents. This study finding was supported by Moneur (2013) who implemented a study titled " Overview of the musculoskeletal system: Rheumatology organization" found that the higher incidence of fracture was among males than female⁽³³⁾.

In addition to Babis et al., (2011), who conducted a study about "High energy tibial plateau fractures treated with hybrid external fixation", they found that males represented extra half of the studied patients ⁽³⁴⁾

As regards marital status: Most of the study patients were married; this finding may be related to majority of patients' age in both groups ranged from 30 -50 years and patients in this age group are expected to be married .Beside decreasing the married age in our society. In directly this phenomenon may increase the risk of fractures and accidents due to the married men will be more preoccupied with thinking about the pressures of daily life, and therefore more prone to accidents. Also, it could be added that males are more liable to road traffic accidents and work accidents due to their nature of work and activities than females.

In relation to educational level, the current study illustrated that about one third of the studied patients were Illiterate, while the other two thirds of them had a different level of education. This may be due to the study was conducted in the governmental hospital which put up many numbers of patients with low socio economic levels ⁽²⁹⁾

As regards to occupation, it was found that Patients who were employed represented by too much patients in both the study group and control group .This finding was congruent with Khorais et al., (2018) " Self-Care Program: Quality of Life and Satisfaction among Patients with External Skeletal Fixation" which showed manual workers represented more than half of the studied patients too⁽³⁰⁾.

The present study revealed that; the highest percentage of studied patients were non smoker compared to(54.3%) of the patients in the control group were smoker.. This study finding was in line with a study carried out by Milenkovic and Mitkovic (2020) who conducted a study about " External fixation of segmental tibial shaft fractures" which revealed that; over half of studied patients were smokers ⁽³⁵⁾. This study finding was congruent with Ring J et al (2016) in study entitled" Smoking cessation advice in limb reconstruction: An opportunity not to be missed" reported that more than half of the study sample were smokers. Also, confirmed that guidance concerning smoking cessation during treatment can potentially have a positive effect on patients smoking habits and smoking effect should be connected to the patient pathology and considered during taking the consent of operation. ⁽³⁶⁾.

According to sites and grades of fracture the present study revealed that; the highest proportion of patients had fracture II . This study finding was agreeing with a study done by Mohammed et al., (2017) entitled, "Pin tract infection after uniplanar external fixation of open fractures at national teaching and referral hospital". Which revealed that the most common diagnoses of patients recruited was open tibia-fibular fracture ⁽³¹⁾.

The results of the present study revealed that the highest percentage of patients had fixator in their lower extremities .This study finding was in agreement with Mahdian et al., (2017) who concluded in their study " Epidemiological profile of extremity fractures and dislocations in road traffic accidents in Kashan, Iran: a glance at the related disabilities" that lower extremity fractures were the most common fracture among motorcyclists ⁽³⁷⁾.

Similar to the present study Amanti et al., (2010) who revealed that; the majority of patients' fractures in their study titled "Randomized prospective study on the use of Eufiss in the prevention of infections in patients treated with external fixation" were in the lower limb⁽³⁸⁾.

The findings of the current study revealed that both groups were homogenous. This could be attributed by selection criteria tend to make patients of both groups similar to each other concerning their socio-demographic characteristics and clinical data. Thus there were no differences affecting patients' results in both groups. So, differences between two groups regarding pin site infection incidence, satisfaction and low anxiety level may be due to the effect of safety measures educational program on the incidence of infection, satisfaction, and anxiety level among orthopaedic patients with external fixation.

Regarding to pin site infection according to grading system the present study revealed that there was statistically significant difference was found among both groups. This positive outcome may be due to the effective usage of health education program for the study group, where the health education program made a great emphasis on how to keep pin site clean and keep it away from infection. Additionally, it focused on the importance of healthy diet, exercise, cessation of smoking and follow methods to keep device protected.

The most important study results are in line with our hypothesis that supposed the group of patients who will receive the safety measure educational program have less incidence of pin site infection than those who exposed to the traditional hospital care

Concerning the satisfactory level among studied patients, it was noticed that almost patients were satisfied regarding neurovascular assessment, pin site care, exercise, nutrition and smoking, and methods of device protection. This result can reflect the success of the health educational program on improvement of pin site-care practices of studied patients. Pertaining the satisfaction with the health educational program from the subjects' perspectives in the current study, most of the studied subjects were satisfied with the educational program and its activities, such as knowledge and skills needed for the care of external fixation device, the educational booklet, educational methods. This findings were similar to the studies of Awad and Chung (2010); Ahmed and Abd-El Mohsen (2018) who mentioned that the implementation of a structured educational program increased the patients' satisfaction level^(39, 40).

On the other hand, most of the studied patients had limited educational level which in turn results in some difficulties to looking for and understanding the required care so that they are willing to enhance their knowledge and skills to maintain a better quality of life. This finding agrees with a study conducted by Sayed et al., (2019) entitled "Effect of Nursing Management on Pin Site Infection Among Incidence Patients with External Fixators" who confirmed that patients with external fixation improved their skills regarding pin site care after education⁽⁴¹⁾.

The study results illustrated that there was statistically significant difference among study and control group regarding level of anxiety. This could be related to effect of safety measure educational program in reducing anxiety level through preoperative preparation using booklet with colour pictures and simple written language that could be effective methods of preparation in low educated patient. In addition to, researchers answered all patient question related to external fixation devices that may reduce patients anxiety and enhance their coping strategies. This result is in harmony with Dheensa and Thomas(2012) in a study entitled "Investigating the relationship between coping, quality of life and depression/anxiety in patients with external fixation devices" emphasised the value of supporting patients with external fixation in increasing adaptation in the period of application, but also post, fixation.⁽⁴²⁾

5. CONCLUSION

Congruent with the study hypotheses, health educational program has a positive effect on the incidence of patients' pin site infection. Satisfaction and lowering anxiety level.

6. RECOMMENDATIONS

The results of this study projected the following recommendations: The educational intervention and patient's psychosocial support should be included in routine nursing care as a protocol before and after external fixation surgery. Further research is to be carried out on new approaches around management of patients with external fixation and

evaluate its effect on patients' quality of life. Studying factors affecting patients' satisfaction with the therapeutic regimen post external fixation surgery . Follow up care for patients with external fixation through phone calls, and clinical visits that would help to pinpoint patients' health education needs.

REFERENCES

- [1] Tawfiq, N. B. & Radhi, T. A. (2016). Assessment of postoperative nurses' practices concerning care of fracture treated by external fixation. *kufa Journal for Nursing sciences*, 6(1), 24-32.
- [2] Dan, D., Kemper, M.D., (2014). Principles of external fixation. Orthopaedic Trauma Service, Walnut Creek, California. Retrieved from <https://ota.org/sites/files/2018-06/G11-Principles%20of%20External%20Fixation.pdf>. Retrieved on 22/4/2020.
- [3] Touissaint, J., Gitajn, L., & Kwon, J. (2013). Measuring boehler's angle with oblique lateral radiographs: implications for management of calcaneal fractures. *The Harvard Orthopaedic Journal*, 15(December 2013), 7-12 .
- [4] McDonald, C., Firoozabadi, R., Routt, L., & Kleweno, C. (2017). Complications associated with pelvic external fixation. *Orthopedics*, 40(6), 959-963
- [5] Dancer, S. J., Stewart, M., Coulombe, C., Gregori, A., & Viridi, M. (2012). Surgical site infections linked to contaminated surgical instruments. *Journal of Hospital Infection*, 81(4), 231-238.
- [6] Mohamed, M., Mansour, N., Mohamed Taha, N., & Moghazy, A. (2020). Nurses performance regarding orthopedic patients with external fixation at Zagazig University Hospitals. *Egyptian Journal of Health Care*, 11(1), 115-126
- [7] Timby, B. and Smith, N. (2014): *Introductory to Medical-Surgical Nursing*, 11th ed., Lippincott Williams & Wilkins, China, pp. 969-990
- [8] Moyle, S. (2017): *Nursing Care of External Fixation Devices*. Available at <https://www.asumed.com/articles/external-fixation-devices>
- [9] Mulhim, F.; Baragbah, A.; Ali, M.; Alomran, A.; Azam, Q.: Prevalence Of Surgical Site Infection In Orthopaedic Surgery: A 5 Years Analysis, *Int Surgery*, 2014, Vol. 99, No. 3, Pp 260-270
- [10] Xiujuan G., Yonghong Z., Pengcui L., and Jinli G. Experimental study on the effects of different disinfectants in preventing pin-site infection after using Ilizarov circular external fixators. (2020) *European Journal of Inflammation* Volume 18: 1–8 DOI: 10.1177/2058739220942647 journals.sagepub.com/home/eji
- [11] Manggala Y, Anghong C, Primadhi A et al. (2017) The deformity correction and fixator-assisted treatment using Ilizarov versus Taylor spatial frame in the foot and ankle *Orthopedic Reviews* 9: 7337.
- [12] Walker J. Assessing and managing pin sites in patients with external fixation. *Nursing Times* 2018 :114(1):18-21
- [13] *Teaching of nursing . a guide for faculty fifth edition* Billings D.M. Halstead J.A. Elsevier Inc. 2016 p. 35-4c.
- [14] Gay, C.; Chabaud, A.; Guilley, E. and Coudeyre, E. (2016): Educating patients about the benefits of physical activity and exercise for their hip and knee osteoarthritis, systematic literature review, *Annals of Physical and Rehabilitation Medicine*, 59: pp. 174–183
- [15] Said D, Elbana H, ELAbasi E, Abd El-aziz T, Mohamed Z. (2020) . Nurses` safety practices provided for patients undergoing external fixation surgeries . *Journal of Novel Research in Healthcare and Nursing* Vol. 7, Issue 3, , Available at: www.noveltyjournals.com pp. 493-523
- [16] Suliman, M., & Aljezawi, M. (2018). Nurses' work environment: indicators of satisfaction. *Journal of nursing management*, 26(5), 525-530
- [17] Swenson, D. (2020). Review of current practice in preventing health care associated infections. In *Assurance of Sterility for Sensitive Combination Products and Materials E-book* (pp.135-164). Academic Press, Elsevier, United States of America. Retrieved. from <https://www.sciencedirect.com/science/article/pii/B9780128050828000062>. Retrieved on 3/6/2020.

- [18] Kazmers NH et al (2016) Prevention of pin site infection in external fixation: a review of the literature. *Strategies in Trauma and Limb Reconstruction*; 11: 2, 75-85.
- [19] Mahdi, Z. S., & Ahmed, S. A. (2018). Effectiveness of an education program on nurses' knowledge toward prevention of orthopedic wound infection in Baghdad Teaching Hospitals. *Indian Journal of Public Health Research & Development*, 9(8), 1123-1128.
- [20] Bader, R. T. & Atiyah, H. H. (2017). Nurses' knowledge toward Dressing Pin Track External Fixation in Orthopedic Ward at Al-Emamin Al-Khadamin Teaching City. *Journal of Nursing and Health Science*, 6(5), 8-14.
- [21] El-sharkawy, S.A.(2016). Nursing practices toward prevention of pin site infection among orthopedic patients with external fixator.(Un Published Master Thesis) , Faculty of Nursing, Alexandria University, Alexandria,Egypt.
- [22] Checketts R., Otterburn M., & MacEachern G., (1993): Pin track infection: definition, incidence and prevention. *Int J Orthop Trauma*, 16-18
- [23] AbulaitiA, Yilihamu Y, Yasheng T, Alike Y, YusufuA.The psychological impact of external fixation using the Ilizarov or Orthofix LRS method to treat tibial osteomyelitis with a bone defect,*InjuryJournal*.Vol 48, (12)2017, 2842-2846,
- [24] Schreiber, M. L. (2016). Neurovascular assessment: an essential nursing focus. *MedSurg Nursing*, 25(1), 55-58
- [25] Nikolas H., Kazmers, Austin T., Fragomen &RozbruchS.,(2016): Prevention of pin site infection in external fixation: a review of the literature. *Strategies in Trauma and Limb Reconstruction*, Volume 11, Issue (2), 75-85.
- [26] Kazmers, N. H., Fragomen, A. T., &Rozbruch, S. R. (2016). Prevention of pin site infection in external fixation: a review of the literature. *Strategies in Trauma and Limb Reconstruction*, 11(2), 75-85.
- [27] Beck, A.T., Epstein, N., Brown, G., & Steer, R.A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology*, 56, 893-897.
- [28] Nam ,S.: Evidence –Based Clinical Practice Guidelines For Care Of Pin Site Care In Orthopaedic Patient ,university of Hong Kong ,college of nursing ,2010,p.55
- [29] Gouda, A. K. (2017). Nurses' performance for orthopaedic patients with traction or internal fixation. *Port Said Scientific Journal of Nursing*, 4(2), 193-7.
- [30] Khorais, A., Ebraheim, M., Barakat, A., (2018): Self-Care Program: Quality of Life and Satisfaction among Patients with External Skeletal Fixation. *IOSR Journal of Nursing and Health Science*, 7(4), 71-83.
- [31] Mohammed, R., Atinga, E., Sitati, F., &Gakuya, E., (2017): Pin tract infection after uniplanar external fixation of open fractures at a national, teaching and referral hospital. *East and Central African Journal of Surgery*, 22(1), 4248
- [32] Mohamed, I.; Saeed, M.; Durrani, A.; AbdulSatar, M. and Arif, M. (2015): Outcome of ilizarov fixator in tibial non-union, Department of Orthopedics and Spine Surgery, Hayatabad Medical Complex
- [33] Moneur, C., (2013): Overview of the musculoskeletal system: Rheumatology organization, Chapter 2,Section A: Clinical foundation. Available at: http://my.clevelandclinic.org/health/diseases_conditions/hic_musculoskeletal_pain/hic_Normal_Structure_and_function_of_the_Musculoskeletal_System.
- [34] Babis, G. C., Evangelopoulos, D. S., Kontovazenitis, P., Nikolopoulos, K., &Soucacos, P., (2011): High energy tibial plateau fractures treated with hybrid external fixation. *Journal of orthopaedic surgery and research*, 6(1), 35.
- [35] Milenkovic S, Mitkovic M. External fixation of segmental tibial shaft fractures. *European Journal of Trauma and Emergency Surgery* (2020) 46:1123–1127
- [36] Ring J., Shoaib A, Shariff R.Smoking cessation advice in limb reconstruction: An opportunity not to be missed VOLUME 48, ISSUE 2, P345-348, 2016DOI:<https://doi.org/10.1016/j.injury.2016.12.004>

- [37] Mahdian, M., Fazel, M., Sehat, M., Khosravi, G., & Mohammadzadeh, M., (2017): Epidemiological profile of extremity fractures and dislocations in road traffic accidents in Kashan, Iran: a glance at the related disabilities. Archives of bone and joint surgery, Vol.5, no.3, Pp. 186.
- [38] Amanti, A., Potalivo, G., Pelosi, F., Rende, R., & Cerulli, G., (2010): Randomized prospective study on the use of Eufiss in the prevention of infections in patients treated with external fixation. European inflammation, 8(3), 189-192
- [39] Awad, T. and Chung, F. (2010): Factors affecting recovery and discharge following ambulatory surgery, Canadian Journal of Anesthesia; 53: 858-872
- [40] Ahmed, M.N. and Abd-El mohsen, A.S. (2018): Effect of compliance to the discharge instructions among patients with internal fixation for hip fracture, Journal of Nursing Education and Practice, 8 (4): 112-117
- [41] Sayed, M., Mohammed, M., Mostafa, K., Desouky, A. Effect of Nursing Management on Pin Site Infection Among Incidence Patients with External Fixators. Assiut Scientific Nursing Journal, 2019; 7(16): 148-156.
- [42] Dheensa s, Thomas s. Investigating the relationship between coping, quality of life and depression/anxiety in patients with external fixation devices International Journal of Orthopaedic and Trauma Nursing 16:30 – 38 .2012 DOI: 10.1016/j.ijotn.2011.06.00.