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Effect of Virtual Reality on Pain Control during Burn Dressing

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Abstract: Background: Wound pain is unpleasant sensory and emotional experience for patients with burn during dressing and remains unacceptably high with the use of the pharmacological analgesics which associated with many adverse physical and psychological squeals which lead to patients' dissatisfaction with pain management. **Purpose**: to evaluate the effect of virtual reality application on pain control during burn dressing. **Design**: A quasi experimental research design was utilized. **Setting**: The study was conducted in the Plastic and Burn Surgery Department at Menoufia University Hospital (Emergency Hospital), Menoufia governorate, Egypt. **Sample**: A convenient sample of 90 adult patients were included. They were randomly assigned into two equal groups 45 patients each. **Instruments**: Two instruments were used in data collection: Structured Interviewing Questionnaire and the Visual Analogue Pain Scale (VAS). **Results**: The study results revealed a highly statistically significant decrease in mean pain scores among the study group at first and second dressing post intervention (2.91+1.70 VS 9.55+.81 and 2.7333+1.65694 VS 9.4222+1.23378 respectively as compared to control. **Conclusion**: Application of virtual reality intervention in patients with burn improves pain intensity during burn dressing.

Keywords: *virtual reality, pain control.*

Introduction

Burn is a disastrous trauma that can lead to lifelong and life threatening injuries which can be difficult to manage, treat and lead to serious psychological and economic impact. It affects negatively on person's life with short-term and long-term impacts on their physiological and psychological well-being (Yeşilyurt & Kendirkıran., 2024). The management of patients with burn depends on the degree and extent of the burn as most second and

third-degree burns require prolonged admission in a specialized center because it requires specialized care and multidisciplinary team to deal with these injuries (Davis et al., 2024). Patients with burn often experience severe pain during the management of burn such as when wound dressings are changed in addition to the background pain of tissue damage (Elsadek., 2024).

Opoids are routinely administered for burn pain management as it considered abroad spectrum analgesics agents affecting a wide number of organ systems and influencing a large number of body functions but the pain remains unacceptably high and its use associated with many common sides effects and adverse events such as sedation, dizziness, nausea, vomiting, constipation, physical dependence, addiction, tolerance, hallucinations and respiratory depression. Also opioids may cause less common sides effects as delayed gastric emptying, hyperalgesia, immunologic and hormonal dysfunction and muscles rigidity (Kostopanagiotou et al., 2024).

As a result, inadequate pain control which has detrimental effects on patient's confidence, compliance and also influencing on the physical and the psychological wellbeing (Yang et al., 2024). Also, pain theories highlight the importance of psychological determinants of the pain experience, including perception, attention and anxiety (Wilk et al.,2024).

In this regard, nurses should do their best to control pain through application of the non-pharmacological nursing interventions during burn dressing as hypnosis, cognitive behavioral techniques and relaxation techniques which address these determinants and have proved effective in distracting patients during procedural pain (Harorani et al.,2024).

Virtual reality (VR) as a distraction innovative technology and a non-pharmacological nursing intervention can also act upon pain perception. It is a safe and effective promising analgesic technique which uses an immersive visual and auditory experience usually delivered through a headset to distract a patient's attention from painful stimuli. It progressed significantly in the last decade with development of commercially available, low-cost, high-resolution, wide field-of-view, standalone VR devices that can be used in many clinical scenarios. It has demonstrated clinical benefit as an adjunctive analgesic during burn wound dressing and other painful medical procedures (Jeffs et al.,2024).

Therefore, application of virtual reality will be helpful to the current study and opens the door for evidence based practice to determine the effect of virtual reality application on pain control during burn dressing.

Significance of the Study:

Wound pain is unpleasant sensory and emotional experience for patients with burn during dressing. The most common strategy for pain management during dressing is the use of opoids but the pain remains unacceptably high and associated with adverse physical and psychological squeals (Thomas, et al.,2020). Virtual reality is one of the non-pharmacological interventions and distraction tool which distract the patient's attention away from pain

inducing procedures (Lauwens et al., 2020). Therefore, in this study, virtual reality could be effective in helping patients with burn to control their pain during dressing change, preventing the unacceptable consequences of poor pain management. So, this study is done to evaluate the effect of virtual reality application on pain control during burn dressing.

Purpose of the Study:

The purpose of the current study is to evaluate the effect of virtual reality application on pain control during burn dressing.

Research Hypotheses:

- Patients with 2nd degree burn who engage in virtual reality intervention will have less pain score during burn dressing than those who don't.

Methods

Research Design:

A Quasi-experimental research design was utilized in this study.

Setting:

The current study will be conducted in burn and a plastic surgery department in Menoufia University Hospital, Menoufia Governorate.

Sampling:

A convenient sample of 90 adult patients from both sexes who were admitted to the burn and a plastic surgery department and fulfill the inclusion criteria was included in the study for a period of eleven months. They were randomly assigned into two equal groups (study & control group) 45 patients for each.

The study sample was calculated based on review of past literature (Larsen, et al.,2019), at power 80% and confidence level 95%, with following equation:

N = 2 [Zα/2 + Zβ] 2 *P(1-P) / (P1-P2)2

N= $2(I.96+0.84)^2$ * 0.92* 0.08 /0.0256

N =45 per group

So calculated sample was 45 participants per group so total sample required is 90 participants.

Where: Zα/2 = 1.96 (From Z table) at type 1 error of 5% Zβ = 0.842 (From Z table) at 80% power p1−p2 = Difference in proportion of events in two groups P = Pooled prevalence = [prevalence in case group (p1) + prevalence in control group (p2)]/2.

Inclusion criteria:

Conscious patients with 2nd degree burn aged 18–50 years. More than 50 years old their sensation of pain decreased gradually or may have exposed to diabetes mellitus and they unable to score their pain correctly, willing to participate in the study and undergoing dressing change.

Exclusion criteria:

Patients who have burn injury in the face and neck as this site of burn interfere with the use of the virtual reality goggles, Patients who have significant cognitive impairment (intellectual disability) because they unable to score their own pain correctly, Diabetic patients as their sense of pain was diminished and Pregnant women because they aren't stable physically and emotionally.

Instruments of the study:

Instrument one: Structured interviewing questionnaire

It developed by the researcher through a review of literature (Abdeltwab et al., 2023) to assess socio-demographic and medical data which included two parts:

- **Part one: Socio-demographic data**: it was concerned with patient's characteristics as the age, gender, level of education, occupation and the place of residence.
- **Part two: Medical data**: it included three questions as the cause of burn, site of burn and the extent of burn.

Instrument two: Visual Analogue Pain Scale (VAS)

It was adopted from Bain, et al., (2005) to rate the patient's level of pain intensity.

Scoring system

The total score was from zero to ten, in which zero denoted no pain while a score from 1 to 3 denoted mild pain, a score from 4 to 6 denoted moderate pain, a score from 7 to 9 denoted sever pain and 10 denoted worst pain.

Validity of instrument: -

Face validity was done by seven academic expertes in the field of Medical Surgical Nursing (five professors, one lecturer from Faculty of Nursing, Menoufia university and one nursing staff in burn unit from Menoufia University Hospital). The expertes check the instruments for clarity, relevancy, comprehensiveness, simplicity and applicability. According to their opinion, final modifications were made and the final form was developed.

Reliability of the instruments: -

The reliability of the second instrument (Visual Analogue Pain Scale) was tested by Boonstra, et al., (2008) and it was found that the test retest reliability was r = 0.84.

Pilot study: -

Prior to data collection, pilot study was conducted on 10% of the study sample (10 patients) to test clarity, feasibility and applicability of the instruments then necessary modifications were made. Also the pilot study gave the researcher experience on how to deal with the included patients and used to estimate the time needed for each subject to fill in the questions. So these patients were excluded from the study sample.

Ethical Consideration

- A written approval was obtained from the Ethical and Research Committee Faculty of Nursing Menoufia University prior collecting the data (code 923 date 3-9-2023).
- The researcher clarified the purpose of the study to patients included in the study before data collection.
- formal written consent was obtained from the patients to participate in the study.
- The researcher assured the patients of the anonymity and confidentiality of their data.
- The patients were informed that participation in the study was voluntarily and they can withdraw at any time.

Preparatory phase

It included an extensive review of related recent literature, studies related to variables of the study and international resources to prepare the tools for data collection. During this phase, the researcher also visited the study setting to ecquainted with the personal setting.

Procedure

- A written official letter was submitted from the Dean of the Faculty of Nursing, Menoufia University to the director of burn and a plastic surgery department including the purpose and methods of data collection.
- The data was collected by the researcher for 11 months from beginning of September 2023 until the end of July 2024 during the morning shift through two consecutive days every week during the period of data collection.
- Patients who fulfill the inclusion criteria were assigned randomly and divided alternatively into two equal groups as the all even numbers (2, 4, 6, 8….) were considered the study group (I) and all the odd numbers (1, 3, 5, 7….) were considered the control group (II) for collecting data. The data collection was done through four phases: Assessment phase, planning phase, implementation phase and evaluation phase.

Assessment phase

- Once the researcher got the consent from the patients an interview started by assessing their sociodemographic characteristics and medical data using instrument one and pain intensity of patients was assessed using instrument two at the end of the two dressing sessions.

Planning phase:

The intervention was revised and made based on expertes's comments, in order to be implemented using handout illustrative booklet in a very simple Arabic language as well as supplemented by photo. The booklet contained the following:

- Information about burn injuries as, causes, degrees of burn and symptoms, prevention of burn injuries, first aids, management of different burn injuries and burn dressing
- Information about VR as definition, purpose of its use, benefits, uses of VR, different applications of VR and degrees of burn in which we can use VR intervention to control pain during dressing change, equipment's of VR, the type of the google used and the type of the mobile used in the google.

Implementation phase

- The intervention was implemented during dressing change in two sessions (in the first and second dressing change). The duration of each session was ranged from 15 - 35minutes. The VR equipment were disinfected before and after each session.

❖ **The first dressing change session**

- It was constructed to orient the patients by the intervention as explaining the purpose of VR, uses, equipment's, how to use the virtual reality for controlling pain during burn dressing, the type of the google and the mobile used by using the

informational booklet for each patient in the study group.

- The patients in the study group received both the VR intervention and routine hospital care and the patients in the control group received only the routine hospital care during dressing change.
- At first, the researcher assisted each patient of the study group in wearing the VR equipment's (3D Oculus Gear VR goggle connected to Samsung Galaxy S6 mobile based Gear VR and relaxation video as 'Calm on Oculus Go' was viewed through the mobile).
- Then, the researcher explained that each patient in the study group had the right to take off the VR google at any point of time during dressing change.
- After that, the researcher began the VR video 5min before dressing change and continued until the end of the dressing session.
- Finally, the researcher assisted every patient of the study group in removing the VR google at the end of the dressing.

❖ **The second dressing change session**

It was carried out at the next day following the first dressing change session to ascertain the effect of VR in controlling pain during burn dressing for the same patients and contained that;

- The patients in the study group engaged in the VR intervention with routine hospital care and the patients in the control group received only the routine hospital care during dressing change.
- The researcher assisted each patient of the study group in wearing the VR equipment's.
- Then, the researcher explained that each patient in the study group had the right to take off the VR google at any point of time during dressing change.
- After that, the researcher began the VR video 5minutes before dressing change and continued until the end of the dressing session.
- Finally, the researcher assisted every subject of the study group in removing the VR google at the end of the dressing session.

Evaluation phase

It was conducted immediately following the intervention as the researcher assessed the pain intensity at the end of the dressing change in the two sessions for each patient of both groups using instrument two (visual analogue pain scale).

Results:

Table 1 displays frequency distribution of the studied groups according to their sociodemographic characteristics. It clarifies that about half 51.1% of both groups were male regarding their gender. Also more than one third (37.8%,40%) of both groups had secondary education. Regarding occupation, more than half (51.1%) of the study group had not work/house wife compared to approximately less than half (48.9%) in the control group and more than third of the study group and control group had a manual work (40.1%, 37.8%) respectively. Regarding the residence, the majority of the study group and control group

were from rural area (77 %, 75%) respectively. There were no statistically significant differences between both studied groups according to the sociodemographic characteristics.

Figure 1 displays the age of the studied groups and involves less than half (44.5%) of both groups their age was ranged from 36 to 50 years. And about the quarter (22.2%, 24.4%) of the study and control group respectively, their age ranged from 18 to 25. There were no statistically significant differences between both studied groups according to their age.

Table 2 displays the medical history of patients in the study and control groups. It shows, the hot fluids were the common cause of the majority of the study group and control group 51.1%, 46.7% respectively regarding the cause of the burn. Regarding the site of burn, anterior and posterior upper extremities was the common site of the majority of the study group and control group 35.6%, 28.9 % respectively. Regarding to the extent of burn, more than half (51.1%) of the study group was (15-25%), while around two thirds (62.2%) of the control group was (more than 25%). There were no statistically significant differences between the two studied groups according to patient's medical data except extent of burn.

Figure 2 displays the mean scores of pain among the studied groups during first and second dressing post intervention (reveals that the total Mean±S.D of the study group at the first dressing 2.91+1.70 and in the control group was 9.55+.813. While at the second dressing, the Mean±S.D of the study group 2.73+1.65 and the total Mean±S.D of the control group 9.42+1.23. So it is reflecting the highly statistically significant differences between the study group and control group after intervention as in the study group observed reduction in total mean scores of pain was reported.

Figure 3 displays frequency distribution of the studied subjects regarding their pain scores during first and second burn dressing shows that, at the first dressing, more than half of study group (53.3%) had mild level of pain, compared to no one in control group while more than one third (37.8%) of study group had moderate level of pain compared to (2.2%) in control group. Also, no one in study group had severe level of pain at the first session compared to the majority (97.8%) of the control group had severe level of pain.

At the second dressing, more than half of the study group (57.8%) had mild level of pain compared to no one in the control group while one third (33.3%) of study group had moderate level of pain compared to no one in control group. Additionally, (2.2%) of the control group had severe pain and the majority of control group (97.8%) had worst level of pain compared to no one in study group. There were highly statistically significant differences between the two studied groups toward the pain level of the studied sample at the first & second dressing with (p value =.000).

Table (1): frequency distribution of the studied groups according to their sociodemographic characteristics (N =90).

Demographic Characteristics	Study Group(N=45)		Control Group(N=45)		x^2	P
	No.	%	No.	%		
Gender						
Male	23	51.1	23	51.1	.000	1.000
Female	22	48.9	22	48.9		
Educational level						
Illiterate	5	11.1	10	22.2	2.703	.609
Read and write	8	17.8	6	13.3		
Basic education	5	11.1	3	6.7		
Secondary school	17	37.8	18	40.0		
High education	10	22.2	8	17.8		
Occupation						
Not Working/house wife	23	51.1	22	48.9	.044	.833
Employee	4	8.9	6	13.2	.451	.798
Manual work	18	40.1	17	37.8		
Residence						
Urban area	10	22.2	11	24.4	.062	.803
Rural area	35	77.8	34	75.6		

figure 1: the age of the studied groups (N =90).

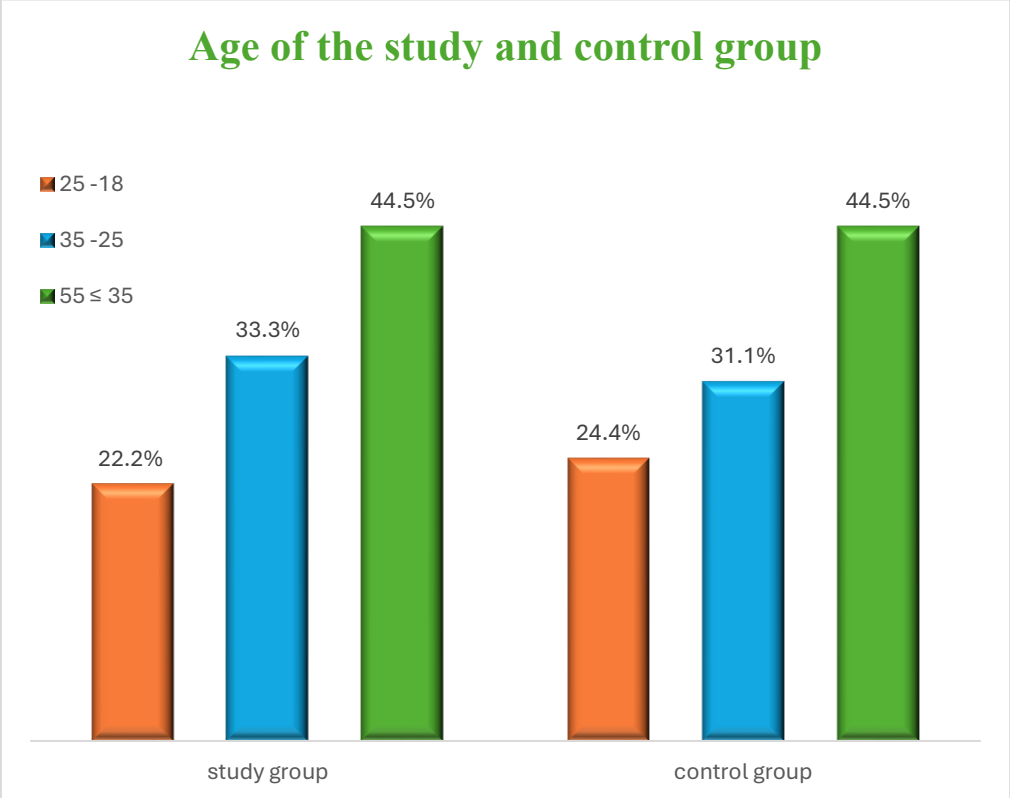
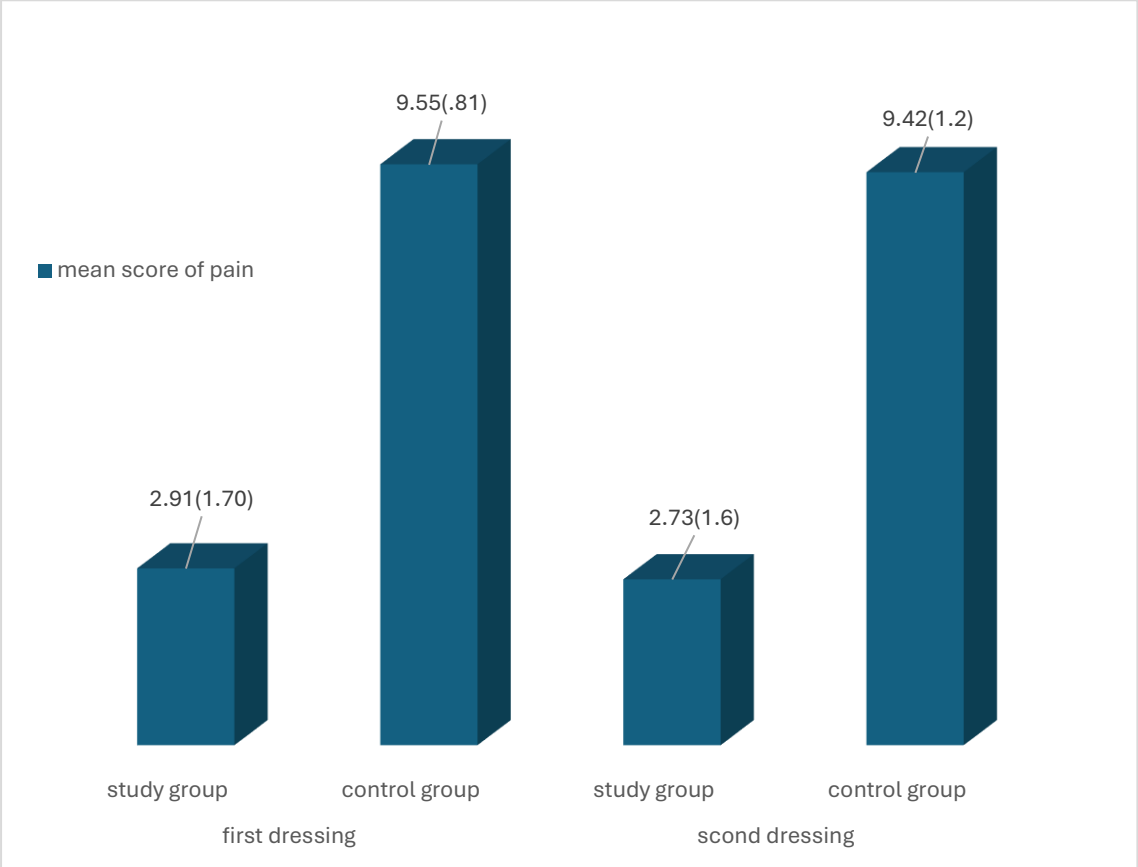


Table (2): Medical History of Patients in the study and control groups (N =90).

Medical Data	Study Group(N=45)		Control Group(N=45)		x^2	P
	No.	%	No.	%		
Causes of burn						
Flame	7	15.6	8	17.7	1.324	.857
Hot fluids	23	51.1	21	46.7		
Electrical	3	6.7	3	6.7		
Chemical	11	24.4	13	28.9		
Other	1	2.2	0	0		
Site of burn						
Anterior and posterior upper extremities	16	35.6	13	28.9	1.358	.851
Anterior and posterior lower extremities	6	13.3	10	22.2		
Anterior chest, posterior chest	11	22.2	10	22.2		
Anterior and posterior abdomen	2	4.5	2	4.5		
Others	10	22.2	10	22.2		
Extent of burn						
Less than 15%	8	17.8	4	8.9	8.778	.012*
15-25%	23	51.1	13	28.9		
More than 25%	14	31.1	28	62.2		

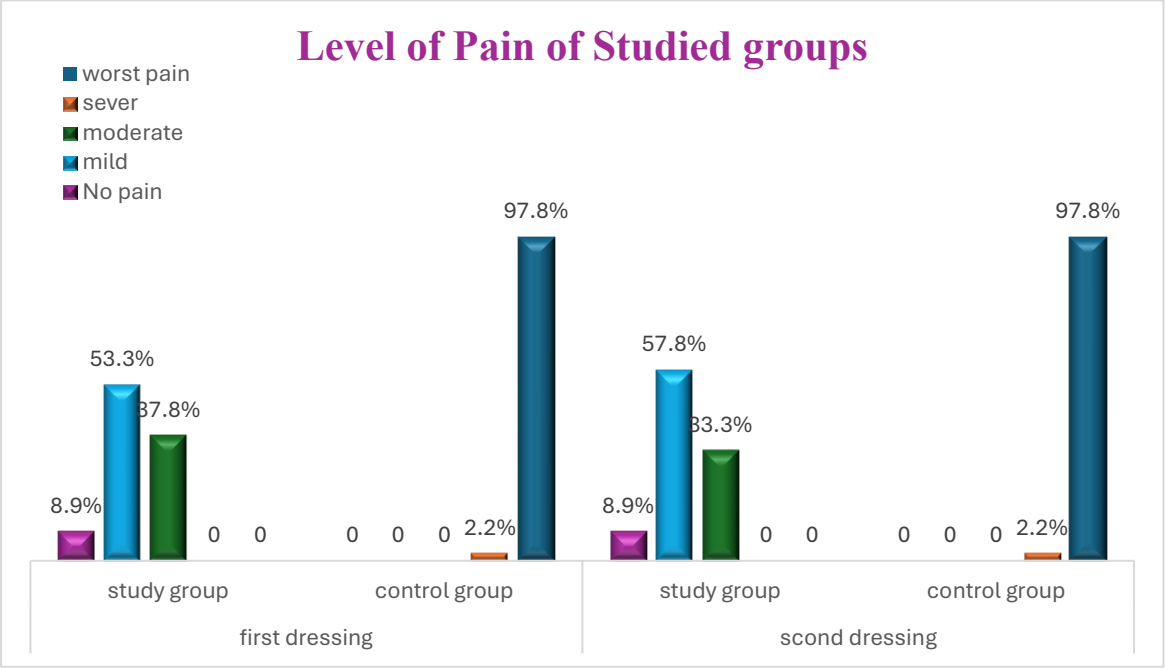
***Significant** ****High significant**

Figure (2) : mean scores of pain among the studied groups during first and second dressing post intervention (N=90).



***Significant** ****High significant**

Figure3: frequency distribution of the studied subjects regarding their pain scores during first and second burn dressing (N=90).



Discussion:

Patients with burn experience one of the most severe and excruciating types of pain especially during the frequent and repeated dressing change procedures. Burn pain during dressing change is often extremely unbearable even with the application of analgesic medication and remains unacceptably high (Weber et al., 2024). So It continues to be a major clinical problem with signifies a serious prognosis. So non pharmacological nursing intervention as virtual reality application for patients with burn is particularly important to control pain during burn dressing (Jeffs et al.,2024). Therefore, the present study was undertaken to evaluate the effect of virtual reality application on pain control during burn dressing.

Concerning the pain assessment of the studied subjects; The findings of the present study confirmed the hypothesis number (1) which revealed that more than half of study group had mild pain in the first and second dressing but approximately all the control group had worst pain in both the first and second dressing. From the researcher's point of view, this because application of virtual reality technology as a distraction technique inhibit pain by gate-control block of sensory fibers and stimulating endorphin secretion and improve relaxation during dressing changes. Also the virtual reality technology diverts and distracts the patient's attention from the painful stimuli during burn dressing as the patient completely immersed in the virtual reality environment seen through the virtual reality google.

It was supported by Lou et al., (2024). who studied that "Effects of Virtual Reality on Analgesia in Wound Care and Physical Therapy for Burn Patients: At burn department, at Ningbo Hospital, Zhejiang Province, China,

and illustrated that The application of VR intervention in pain management for burn patients has demonstrated promising results, notably in reducing pain and discomfort during dressing changes.

In the same line Abdeltwab et al., (2023). who studied that "Effect of virtual reality on wound care related pain among patients with burn. " At burn department at Cairo University Hospital and the Governmental Hospital affiliated to ministry of health in Egypt, and found that there were high statistically significant differences between Visual Analog Scale (VAS) in the 2nd wound care without using VR and 3rd and 4th wound care with VR.

These results also agreed with Ismail & Mohamed., (2023) who studied that " Effect of Using Virtual Reality on Pain Management During Wound Dressing in Burn Patients". at Medical Surgical Nursing Department, Mansoura University, Egypt and found that there were statistically significant differences between level of pain with and without VR.

Moreover, Armstrong et al., (2023) who studied that "Pilot randomized clinical trial of virtual reality pain management during adult burn dressing changes." At Injury Research and Policy department at Nationwide Columbus Hospital in Ohio in the United States of America and illustrated that self-reported overall pain was lowest among participants in the active VR and highest among participants in the passive VR and control group across all three dressing changes. Also reported that he VR is a useful non-pharmacological tool for pain distraction.

But the current study was in contrast with Blokzijl et al., (2023) who studied that "Virtual Reality as Pain Relief in Burn Care: A Pilot Randomized Controlled Trial on the Effectiveness on Pain During Multiple Dressing Changes." At the Department of Medical Psychology of the Martini Hospital in Groningen, and explained that there were no statistically significant differences between the control group who received the standard wound care with pain medication and the study group who received the standard wound care with pain medication and additionally the VR distraction on pain intensity.

Additionally, Ebrahimi et al., (2017) who studied "Effect of virtual reality method and multimedia system on burn patients' pain during dressing". At Department of Psychiatric Nursing, Faculty of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran and reported That there was no significant difference between the virtual reality group and control groups regarding pain score with $p>0.05$.

Also, Jeffs et al., (2024). who studied "Comparing novel virtual reality and nursing standard care on burn wound care pain in adolescents" found that there was no statistically significant difference in burn wound care procedural pain was noted between the VR and standard care groups.

Conclusions

Application of virtual reality as anon pharmacological nursing intervention during burn dressing had a significant effect on reducing pain scores among patients with second degree burn.

Recommendations

Training and continuous education of nurses and health care providers to facilitate the use of virtual reality during dressing change for patients with 2nd degree burn. Then integration of the virtual reality into the standard burn dressing to reduce pain level among patients with 2nd degree burn. Also a similar study can be replicated at different settings and greater sample to allow for greater generalization of the findings.

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