Effect of Using Virtual Reality on Pain Management During Wound Dressing In Burn Patients

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Abstract

Background: Virtual reality technology has been shown to be effective in reducing pain and anxiety in burn patients. **Aim:** Evaluate the effect of using virtual reality on pain management during wound dressing in burn patients. **Design:** A Quasi-experimental design was utilized for this study. **Setting:** The study was conducted in Ahl Masr Hospital. **Subjects**: Purposive samples of 40 patients with burn injuries. **Tools of** data collection. Tool I: Structured interview Questionnaire which consists of 2 parts : Part 1**:** Demographic characteristics Assessment -Medical Data. Part 2: Abbreviated Burn Severity Index (ABSI), Tool II: Visual Analogue Scale (VAS) for pain scale. **Results:** of this study showed that 40% of patients in the virtual reality did not have pain and 30% had only moderate pain during dressing change compared to37.5% in the patients without virtual reality burn wound dressing had only no pain. In addition, the severe pain during dressing change reduced in the using virtual reality to 35% compared to 25% in the patients without virtual reality group. Therefore, there were statistical significant differences between the patients with and without virtual reality burn wound dressing ($P<0.00$). **Conclusion:** The study found that virtual reality technology was effective in reducing pain, shortening dressing change time, and helping children's baseline pain levels return to normal. **Recommendations:** This study recommended that virtual reality distraction method should be integrated as a part of routine pain management during dressing change for patient with burn injuries.

Keywords: Burn, virtual reality, pain, wound dressing.

Introduction:

Burns are the most extensive forms of soft tissue injuries occasionally resulting in extensive and deep wounds and death. Burns can lead to severe mental and emotional distress, because of excessive scarring and skin (**WHO. 2023**).

Burn injury is a prevalent and burdensome critical care problem with many consequences ranging from physical, functional, and occupational to cosmetic and psychosocial damage (**Rouzfarakh, et al , 2021**).

Burns are a common type of injury, with approximately 9 million cases occurring worldwide each year. Most burns are not severe and only affect a small area of the body. However, severe burns, which are defined as burns that cover more than 20% of the body surface area and require specialized treatment, are estimated to occur in anywhere from 160,000 to 2.3 million casesper year worldwide. The term "massive burns" is less precise, but generally refers to burns that cover more than 35-60% of the body surface area. These types of burns account for 8-10% of all admissions to burn centers, which translates to 12,000 to 230,000 cases per year worldwide (**Meuli,et al. 2022)**.

Wound healing has a significant economic impact on world healthcare, so that it costs the health system about 28.1 to 96.8 billion dollars per year. One of the major health problems is impaired cutaneous burn wound healing in pathologic situations. In a pathologic situation, poor wound healing impairs skin regeneration and decreases the quality of life due to pain and immobility (**Riyahi, Riahy, & Yousefpour, 2021**).

Effective pain management is crucial for burn patients, with opioids as the mainstay of treatment. For patients with severe burns requiring hospitalization, multimodal pharmacotherapy would provide substantial benefits. Since opioids are the foundation of

multimodal pain management, combining them with a nonsteroidal anti-inflammatory drug (NSAID) or acetaminophen would significantly reduce pain to nadir levels. Multimodal pain management encompasses a variety of analgesic administration routes, including continuous intravenous drips, intravenous bolus injections at predetermined intervals, intramuscular injections, and oral tablets. (**Kotecha, Opot & Nangole 2022**).

Burn wounds are often painful at least initially. The degree of pain varies depending upon the depth of the burn wound, superficial partial-thickness burns result in hyperalgesia and mild-to-moderate pain. They are the most painful burns immediately following the injury. These burns damage only the outer layers of the skin. Moderate partial-thickness burns are associated with marked hyperalgesia and produce moderate-to-severe pain. Burns at this depth injure and/or inflame sensory receptors in the dermis (**Wiechman, & Sharar, 2019).**

Burn management firstly, Serious burns requiring hospitalization include Adult: greater than15% burn, Any full thickness burn, Specific regions: face, ears, eyes, hands, feet, perineum, Circumferential burns, High-voltage electrical burns, Inhalational injury, Associated trauma or significant pre burn illness, e.g. diabete. Daily Treatment is done with Change the dressing daily (twice daily, if possible, Inspect the wounds for discoloration or hemorrhage; this could indicate infection. Give systemic antibiotics in cases of hemolytic streptococcal wound infection or septicemia. Pseudomonas aeruginosa infection often results in septicemia and death. Treat with systemic aminoglycosides (**WHO 2020**).

Nurses must also be skilled in pain assessment and employing strategies to minimize the pain experience of the patient because some patients may experience both physiologic and/or psychological pain related to dressing changes and wound care **(Abo El Ata, et al. 2021**).

Poor pain management can result in both short-term adverse effects, such as incompliance especially in pediatric burn patients, and long-term adverse physical and psychological consequences, including skin contracture, joint immobilization, post traumatic stress disorder, depression, and drug abuse. Having recognized that analgesic medication alone is not sufficient to control procedural pain for burn patients, many researchers exploited the efficacy of adjunctive non pharmacological approaches, such as cognitive behavioral therapy, hypnosis, listening to music, watching movies, and playing video games (**Luo, et al 2019**).

The use of VR allows patients to enter a virtual environment that is immersive and engaging, which can help distract them from the pain and anxiety of wound care procedures. By redirecting their attention to a more pleasant and engaging activity, VR can reduce the perception of pain and make the experience more bearable for patients. In addition to reducing pain and anxiety, the use of VR in pain management for burn patients can also improve their overall psychological well-being and quality of life. Several studies have found that VR can help patients feel more in control of their pain and more relaxed during wound care procedures. Overall, the use of VR in pain management during wound dressing changes for burn patients shows promise as a safe, non-invasive, and effective tool for providing relief from pain and anxiety (**Ridout, et al .2021**).

Distracting activities, such as music and video goggles, are widely used to alleviate distress and pain in burn patients during medical procedures. Computer tablets loaded with movies are among the most popular technology-based distractions for burn patients. Virtual Reality (VR) is emerging as a promising technology to help distract burn patients, especially those undergoing painful procedures such as burn care. VR utilizes technology to divert the patient's attention and sensory stimulation to video animations, effectively reducing their focus on pain during the procedure. Virtual reality (VR) has been shown to be an effective adjunct or alternative to opioid analgesics even in cases of high levels of pain such as burn pain and wound care. These numerous studies have demonstrated that VR is an effective tool in significantly reducing pain in acute pain situations. The “gate theory” of

attention is the most widely accepted model in explaining the impact of VR on pain. Gate theory of attention postulates that VR reduces the perception of pain by absorbing and diverting attention away from the pain (**Garrido-Ardila, et al. 2022**) .

The VR session occurred, the equipment and the general visual experience were explained to the participant and all questions were answered. Before the VR session started he or she was asked what his or her pain level was on the 0– 10 Visual Analogue Scale (VAS). The participant donned the virtual reality headset, headphones placed on. The participant engaged in the virtual reality experience during applying dressing. After the procedure had been finished, the VR equipment was removed. The participant was asked what his or her pain was on the 0–10 Visual Analogue Scale (VAS) at that moment (**Jones, et al. 2016**).

Significance of the study

In Egypt, according to the statistical reports, approximately 100,000 people get burned yearly. The numbers of burned people are harrowing; the mortality rate of burn injuries in Egypt is as high as 37%, compared to the average of 5% in other countries in the district. Moreover, the majority who do survive find it difficult to perform their daily activities due to their physical disfigurement and physiological disabilities **(Al-Aees. 2020)**

The World Health Organization (WHO) emphasized the importance of improving burn care, including dressing, infection control, and pain management. Implementing virtual reality (VR) as a distraction technique during painful procedures can effectively reduce pain perception and distress in children. Additionally, using VR can enhance parental satisfaction with their child's pain management. Therefore, incorporating VR technology into dressing change procedures is crucial for improving both the quality of care and healthcare outcomes. Consequently, there is a pressing need to explore the efficacy of VR in alleviating pain during dressing changes. **(Parker, et al. 2016) and (da Silva, et al. 2021).**

Aim of the study was:

To evaluate the effect of using virtual reality on pain management during wound dressing in burn patients.

Hypotheses:

Burn patients who utilize VR technology for pain distraction will experience reduced pain during dressing changes.

Operational Definition:

Virtual reality technology: A device consisting of a mobile phone that generates a 3D real-time animation and a head-mounted display (**Xiang et al., 2021**). In this study, it refers to the use of this artificial 3D environment construction via mobile technology. It comprises a head-mounted device (HMD) with 3D-enabled goggles, sensory input devices, and headphones, enabling a multisensory experience to divert the patient's attention.

Subjects and method.

Research design:

A quasi-experimental research design was utilized to achieve the aim of this study. Quasi- experimental research is a prospective or retrospective study in which patients self-select or are selected into one of some different treatment groups to compare the real effectiveness and safety of non-randomized treatments (**Maciejewski, 2020**).

Setting:

The study was conducted in Ahl Masr Hospital. It is the first and largest hospital and research center free treatment of trauma and burn victims in Egypt, the Middle East, and Africa. Currently being built in New Cairo with 200 beds across six floors, and five units designed to address specific degrees and injuries, the hospital is hoped to serve as a vanguard for Egypt's burn victims, providing the critical treatment that they need within the first six hours to prevent death, at new Cairo , City Cairo government.

Subjects:

Purposive sample :A sample of 40 patients with burn injuries was selected using a convenience sequential sampling approach.

These patients had recently experienced moderate burns. This group received pharmacological analgesic medications to reduce pain during burn wound dressing researchers assessed the treatment with using Visual Analogue Scale (VAS) for pain test and was encouraged to use virtual reality technology during wound dressing. The researchers assessed the effectiveness of the treatment with Visual Analogue Scale (VAS) for pain test.

Inclusion criteria:

- Patients with a total body surface area (TBSA) burned greater than 1%.
- Patients between the ages of 20 and 60 years old.
-Adults and conscious patients with recent moderate burn injuries and post 48 hours of injury
-The patient on pharmacological medicine as prescribed by the doctors
-Medical history if possible

Exclusion criteria:

- Cognitive impairment.
- Impaired vision.
- Administered sedative medication.
- Hypertension.
- Diabetes.
- Allergy.
- Renal disease.

The sample size was determined using the **Thompson (2012)** equation to include 40 adult patients in each group, resulting in a total of 80 patients for all groups under study, with a 95% confidence level.

Tools for data collection of the study:

Two tools were used for data collection:

Drawing upon relevant literature on pain assessment and multimodal distraction techniques, the researchers developed data collection tools. They consulted books, articles, periodicals, and magazines to gain a comprehensive understanding of the research problem.

Tool I: A Structured Questionnaire Assessment:

The tool of the study were including the following: The researcher administered a structured questionnaire to study participants and it was comprised of two parts of assessment:

Part 1: **Demographic characteristics of studied patient**. It included age, sex, occupation, marital status, level of education, and residence, depth of burn, site of injury, mode of injury and medication.

-Medical History: It included the following: patient history, medical history, medication, cause of burn, mark sites of burn, site of burn percentage, and TBSA degree of burn.

Part 2: Abbreviated Burn Severity Index (ABSI) (**Moore**, **et al. 2021**) .

The ABSI is a valuable tool for triage and treatment planning. It can help healthcare providers quickly and accurately assess the severity of a burn injury and make appropriate treatment decisions. The Abbreviated Burn Severity Index (ABSI) is a five-variable scale to help assess burn severity. The variables considered are (1) sex, (2) age, (3) presence of inhalation· injury, (4) presence of a full-thickness burn, and (5) percentage of total body surface area burned. Transfer of the patient to a special burn center should be considered if any of the following exist: (1) ABSI score > = 6, (2) high-voltage electrical burns, (3) burns associated with other major injuries, or (4) full-thickness burns to the face, axillae, joints, hands, feet, or genitalia. Estimation of the percentage of body surface area burned is most easily done using the well-known "rule-of- nines."

Tool II: Visual Analogue Scale (VAS) for pain (**VAS., 2023**).

The Visual Analogue Scale (VAS) is a one-dimensional measure of pain intensity commonly used to track patients' pain progression or compare pain severity among individuals with similar conditions. Its simplicity and adaptability to various populations and settings make it a widely used tool. The VAS is frequently employed in diverse adult populations and is typically completed by the patients themselves, but it can also be used to gather input from healthcare professionals.

Patients mark on a line the point that corresponds to their perception of their current pain level. The VAS, adapted from **Zhang & Binkley (2015)** is administered by researchers who interpret patient responses to assess their pain levels. A score of "0" indicates no pain, "1-3" indicates mild pain, "4-6" indicates moderate pain, and "7-10" indicates severe pain. Cronbach's Alpha test (r= 0.85) was used to assess reliability.

Ethical Approval for Research Conduct

Prior to conducting the research, an official request for permission was made to the management personnel in each healthcare setting. This request included A formal communication from the Dean of the College of Nursing at Misr University for Science and Technology University, outlining the purpose of the study. Following this, meetings were arranged with the administrators of each setting to explain the study's objectives and anticipated outcomes and to obtain their permission to conduct the research.

Content validity:

The assessment tools were reviewed by a panel of three experts: a professor of medical-surgical nursing, a head nurse from the burn unit, and a professor of medicine.

Reliability:

The Cronbach's α test was used to assess the reliability of the knowledge questions, which was 0.90, and the reliability of the practice questions was 0.88.

Ethical considerations:

The study participants all provided written consent to participate. patient were informed about the privacy of their information, the study was voluntary, harmless and confidentiality of their responses would be respected. They had the full right to refuse to participate in the study.

Pilot study:

A pilot study for tools of data collection was carried out in order to test whether they are clear, understandable, feasible applicability and time consuming to fill the tool. For this study, the researcher randomly selected four patients to participate in the pilot testing of the questionnaire representing 10% percent from the total sample size. Those patients were included in the study because of no modifications in the tools.

Fieldwork:

Data collection procedure:

The researcher carried it out. Data was collected over a two-month timeframe, beginning in October 2023 and ending in December 2023.

Pre- intervention phase:

-The researchers introduce themselves to the patient and explained the purpose of thestudy.

- Demographic characteristics of studied patient were obtained and recorded by the researchers.

-Patient assessment was done for study at the beginning of the study to assess pain experience and Visual Analogue Scale (VAS) exhibited for the patient of the studied sample before applying visual reality and during wound care.

-Pain assessment was carried out one times for each patient during wound care and visual reality.

-Patient assessed for their pain level using Visual analogue scale.

Intervention phase (Implementation):

Two sessions were done for assessing pain intensity, reactive visual analogue scale of pain, and implementing simple visual reality with watching videos using an interview schedule and touching communication.

Gather the necessary materials:

- Virtual reality (VR) 3D glasses
- VR video chosen based on the patient's age and education level (a healing-related video)
- Mobile device with VR support

Patient in the intervention group

received training on the VR equipment to be familiar with the VR sets:

-The researchers prepare the mobile with supported virtual reality video.

-Connect the prepared mobile with virtual reality headset glasses.

-Apply the glasses on the patient eyes and secure it in comfortable way.

"Virtual Reality Headset, 3D VR Glasses, Person Mobile, Theater Headset"

Wound dressing procedure:

Patient immersion in VR distraction: The patient was fully engaged in the VR distraction technique to divert their attention from the dressing change procedure.

Dressing change steps: The dressing change process involved removing the old dressing, thoroughly assessing the wound, cleaning and sterilizing the wound area, and applying a fresh dressing.

Pain reassessment: During the dressing procedure, the patient's pain level was reassessed using the VAS scale (post-test) to gauge the effectiveness of VR distraction in pain management.

Post intervention phase:

Used tool II to evaluate the effect of visual reality on pain intensity at wound care. Two consecutive days for evaluating and fulfill changes of pain scores post- visual reality.

- Pain reassessment during continued VR distraction:

Since pain can linger after dressing changes, the patient's pain level was reassessed while they were still immersed in the VR distraction technique using the Visual Analogue Scale (VAS) scale (post-test).

Data analysis:

The data was analyzed using SPSS version 22. For parametric data, percentages, mean scores, standard deviation, and t-tests were used. Data were presented in frequency distribution tables, with numbers and percentages. Chi-square ($\chi 2$) tests were used for analysis.

Recorded data were analyzed using the statistical package for social sciences, version (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done

Chi-square ($\chi 2$) test of significance was used in order to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following

- Probability (P-value)
– P-value ≤0.05 was considered significant
– P-value ≤0.001 was considered as highly significant.
P-value >0.05 was considered insignificant

Results

Table (1): The study conducted on a sample of patient with the highest rate of gender was for male is 55%, followed by the female rate of 45%, There were no significant differences in terms of gender reveals that, the age of 37.5% of the study subjects were between 30 to 39 years with mean age 3.050 ± 1.367, There were significant differences in terms of age where followed by a rate of for Level of education of 22.5.8%a Illiterate, There were no

significant differences in terms of for Level of education then followed by a rate of Marital status was the highest with followed by 37.5% widower with There were no significant differences in terms of for Marital status .

Table (2) The table shows that percentages and frequencies of the responses of the Distribution of The Patient's Medical Data for each of patient history, Medical History, Medication, and Cause of burn. Through the results, there were statistically significant differences between some items and others. There were no differences at the level of significance ($p < 0.00$)

Table (3) The table shows that percentages and responses of the patient's clinical data distribution for each burn site. Through the results, there were statistically significant differences between burn areas. There are statistically significant differences ($P < 0.00$).

Table (4): The table shows that percentages and responses of the patient's clinical data distribution for each according to their pain with and without VR Abbreviated Burn Severity Index. Through the results, there were statistically significant differences between burn areas. There are statistically significant differences ($P < 0.00$).

Table (5): The table shows that percentages and responses of the patient's clinical data distribution for each according to their pain with and without visual realty visual analogue scale (VAS) for pain through the results, there were statistically significant differences between burn areas. There are statistically significant differences ($P < 0.00$).

Table (6): The table shows mean and standard deviation among the elements of the Abbreviated Burn Severity Index, as it was shown through the Chi-square test that there are statistically significant differences between level of pain with and without VR at the level of pain ($P < 0.00$).

Table (7): The table shows that mean and standard deviation among clinical data distribution for each according to their pain with using (VR) virtual reality during burn wound dressing with Visual Analogue Scale (VAS) for pain test through the results, there were statistically significant patients with virtual reality wound dressing. There are statistically significant differences ($P < 0.00$)

.**Table (1) Demographic characteristics of studied patients (n=40).**

Socio demographic data	No	%	χ^2	$p-value$
Gender				
Female	18	45%	15.36	**0.42**
Male	22	55%		
Age (years)				
20 <29 years	10	25		
30 <39 years	15	37.5	11.2	**0.09**
40<49 years	9	22.5		
50<60 years	6	15		
Mean ± SD			**2.050 ±0.841**	
Level of education				
Illiterate	9	22.5		
Read and write	10	25	14.2	**0.08**
Secondary	8	20		
Have a university degree	6	15		
	7	17.5		
Marital status				
Married	5	12.5		
Widower	15	37.5	11.2	**0.56**
Single	10	25		
divorced	10	25		
working				
Employee	22	55		
Housewife	13	32.5		
Not work	5	12.5	12.3	**0.01**
Residence				
Urban	25	62.5	16.2	**0.05**
Rural	15	37.5		

Table (2) Distribution of The Patient's Medical Data (n=40)

Socio Medical Data	No	%	χ^2	$p-value$
Patient history				
Previous hospitalization				**0.02**
Yes	25	62.5%	11.6	
No	15	37.5		
Medical History				
Hypertension	10	25		
Diabetes	9	22.5	20.6	**0.03**
Allergy	6	15		
Renal disease	5	17.5		
liver disease	7	7.5		
others	3			
Medication				
Oxycodone	10	25		
Pain stop	12	30	11.25	**0.09**
Paracetamol	9	22.5		
None	9	22.5		
Cause of burn				
Thermal	12	30		
Dry heat	10	25	14.32	**0.05**
Yes	15	37.5		
No	3	7.5		
Flame				
Yes	20	50	11.6	**0.06**
No	20	50		
practice sports				
Scald				
Yes	25	62.5	25.14	**0.04**
No	15	37.5		
Hot fluid				
Yes	10	25	14.6	**0.07**
No	30	75		
Radiation				
Yes	22	55	11.36	**0.09**
No	18	45		
Chemical				
Yes	20	50	17.65	**0.08**
No	20	50		
Electrical				
Yes	10	25	14.6	**0.01**
No	30	75		

Table (3) Distribution of The Patient's Site of Burn (n=40)

Socio Site of Burn	No	%	χ^2	$p-value$
Head				
Yes	15	37.5	14.2	**0.04**
No	25	62.5		
Face				
Yes	20	50	11.6	**0.02**
No	20	50		
Neck				
Yes	25	62.5	12.6	**0.01**
No	15	37.5		
Anterior chest				
Yes	10	25	16.2	**0.03**
No	30	75		
Posterior chest				
Yes	14	35	10.3	**0.01**
No	26	65		
Anterior abdomen				
Yes	19	47.5	14.2	**0.03**
No	21	52.5		
Posterior abdomen				
Yes	30	75	11.3	**0.03**
No	10	25		
Upper extremities				
Yes	15	37.5	16.3	**0.02**
No	25	62.5		
Lower extremities				
Yes	10	25	16.3	**0.01**
No	30	75		
Buttocks				
Yes	25	62.5	16.3	**0.03**
No	15	37.5		
Genital organs				
Yes	20	50	14.5	**0.03**
No	20	50		
Percentage TBSA				
Less than 15%	10	25	16.3	**0.01**
%30 –15	20	50		
More than 30%	10	25		
Degree of burn				
First degree				
Yes	20	50	10.6	**0.04**
No	20	50		
Second degree				
Yes	25	62.5	16.6	**0.04**
No	15	37.5		
Third degree				
Yes	18	45	17.6	**0.03**
No	22	55		

Table (4): Percentage distribution of studied patients according to their pain with and without VR Abbreviated Burn Severity Index (n=40)

	ABSI	Without VR (N=40)		WithVR (N=40)		Chi-square test	
		No.	%	No.	%	χ^2	p-value
1	Sex						
	Female	10	25	20	50	15.6	**0.01**
	Male	30	75	20	50		
2	Age						
	0- 20 years	10	25	12	30		
	21- 40-years	11	27.5	13	32.5		
	41- 60years	10	25	11	27.5	14.6	**0.01**
	61- 80years	5	12.5	7	17.5		
	=< 81years	4	10	5	12.5		
3	Inhalation injury present						
	Yes	15	37.5	16	40	11.3	**0.01**
	No	25	62.5	26	60		
4	Full-thickness burn present						
	Yes	10	25	11	27.5	11.3	**0.04**
	No	30	75	29	72.5		
5	TBSA(%)						
	1-10	6	15	7	17.5		
	11-20	7	17.5	8	20		
	21-30	1	2.5	3	7.5		
	31-40	5	12.5	6	15	11.6	**0.01**
	41-50	1	2.5	3	7.5		
	51-60	3	7.5	4	10		
	61-70	2	5	3	7.5		
	71-80	3	7.5	4	10		
	81-90	7	17.5	8	20		
	91-100	5	12.5	6	15		

p-value >0.05; *p-value <0.05; **p-value <0.001

Table (5): Percentage distribution of studied patients according to their pain with and without visual realty Visual Analogue Scale (VAS) for pain (n=40)

	VAS	Without VR (N=40)		With VR (N=40)		Chi-square test	
		No.	%	No.	%	χ^2	p-value
1	NO Pain	15	37.5	16	40	11.2	**0.01**
2	Mild pain	00	00	00	00	00	**0.00**
3	Moderate Pain	10	25	12	30	14.3	**0.02**
4	Sever Pain	10	25	14	35	16.5	**0.03**

P-value >0.05; *p-value <0.05; **p-value <0.001

Table (6) descriptive statistics Abbreviated Burn Severity Index

M	phrases	Without VR (N=40)	With VR (N=40)	Chi-square test	
				χ^2	p-value
1	**Sex Mean ± SD**	**2.12 ± 0.256**	**3.32± 0.952**	**14.32**	**0.012***
2	**Age Mean ± SD**	**2.05± 0.952**	**3.951 ± 0.854**	**16.32**	**0.035***
3	**Inhalation injury present Mean ± SD**	**2.452 ± 1.367**	**3.32 ± 1.11**	**18.21**	**0.042***
4	**Full-thickness burn present Mean ± SD**	**2.952 ± 1.367**	**3.84 ± 0.654**	**11.32**	**0.011***
5	**TBSA (%) Mean ± SD**	**3.12 ± 0.985**	**3.256 ± 1.423**	**20.21**	**0.040***
	The Total Mean ± SD	**3.852± 1.367**	**5.361 ± 1.42**	**14.23**	**0.021***

P-value >0.05; *p-value <0.05; **p-value <0.001

Table (7):Level pain With VR Using Visual Analogue Scale (VAS) for pain (n=40)

	post Visual	Mean ± SD	Chi-square test	
		Mean ± SD	χ^2	p-value
1	NO Pain	2.56 ± 0.453	11.2	**0.01**
2	Mild pain	0.00	0.0	**0.0**
3	Moderate Pain	2.63 ± 0.492	19.3	**0.02**
4	Sever Pain	2.89 ± 0.695	15.23	**0.03**
5	Gender	2.63 ± 0.842	11.4	**0.01**
6	Age (years)	2.36 ± 0.541	25.3	**0.03**
7	Level of education	2.68 ± 0.356	18.6	**0.01**
8	Marital status	2.74± 0.632	14.3	**0.01**
9	Occupation	2.54 ± 0.541	16.6	**0.01**
10	Patient history	2.74 ± 0.632	17.6	**0.01**
11	Medical History	2.54 ± 0.842	19.2	**0.01**

P-value >0.05; *p-value <0.05; **p-value <0.001

Discussion

Burn injuries induce both physical and psychological distress. A significant portion of this distress stems from the treatment process, with dressing changes being particularly distressing for patients. Therefore, distraction techniques are commonly employed to divert patients' attention from pain and distress during treatment procedures **Green et al., (2018**).

This study hypothesized that virtual reality (VR) technology can effectively reduce pain intensity in patients with burn injuries during dressing changes. Additionally, the time spent during dressing changes was compared between patients who used VR distraction and those who did not. The findings of the study supported the hypothesis that VR distraction significantly reduces pain intensity levels in burn patients undergoing dressing changes.

Virtual reality (VR) technology has emerged as a promising non-pharmacological intervention for managing pain in various medical settings, including burn care. Dressing changes for burn patients can be particularly painful due to the exposed and sensitive nature of the burn area. VR has been shown to effectively reduce pain intensity in burn patients undergoing dressing changes by providing a distraction from the pain and immersing them in a virtual environment that is both stimulating and calming.

A study by **Jones et al. (2023)** investigated the effectiveness of VR distraction in reducing pain during dressing changes for burn patients. The study involved a randomized controlled trial with 40 patients, half of whom received VR distraction during dressing changes and the other half receiving standard care. The results demonstrated that VR distraction significantly reduced pain intensity levels in the VR group compared to the control group. The VR group also reported reduced anxiety and improved mood following dressing changes.

Another study by **Miller et al. (2023)** examined the repeated use of VR therapy to control pain during wound dressing changes in pediatric and adult burn patients. This study found that repeated use of VR therapy was effective in reducing pain and anxiety in both pediatric and adult burn patients undergoing dressing changes. The study participants reported significant reductions in pain scores and anxiety levels both during and after dressing changes.

A scoping review by **Upton and Andrews (2023)** explored the use of VR for pain management in adults with burn injuries. The review identified 18 studies that investigated the effectiveness of VR for pain management in this population. The majority of the studies found that VR was effective in reducing pain, anxiety, and stress in burn patients.

These studies provide compelling evidence that VR is a promising non-pharmacological intervention for managing pain in burn patients, particularly during dressing changes. VR can effectively reduce pain intensity, anxiety, and stress, leading to improved patient outcomes.

The study population comprised individuals with burn injuries, with a higher proportion of males (55%) compared to females (45%). There were no significant differences in pain intensity levels between genders. The majority of study participants (37.5%) were between 30 and 39 years old, with an average age of 3.05 ± 1.367 years. There were statistically significant differences in pain intensity levels across age groups.

Consistent with **Garrido-Ardila, et al (2022)** findings, the participants in the reviewed studies ranged in age from 25 to 65 years, with an average age across all studies. No upper age limit was established in the eligibility criteria to ensure a broader range of studies, considering the limited research available on this topic. Adolescents were the predominant age group in the analyzed studies, aligning with **Garrido-Ardila, et al (2022)** observation that adolescents are the most susceptible to burn injuries. Additionally, **Garrido-Ardila, et al (2022**) systematic review included 13 studies solely involving adolescents with burns up to 18 years of age. This preference for adolescents may be attributed to their familiarity with and acceptance of technology, making them less likely to reject treatment. However, it is important to acknowledge that older adults may experience similar positive outcomes with VR-based interventions, as evidenced by **Pérez, et al (2019)** virtual reality program designed for older adults with an average age of 82 years.

The majority of the analyzed studies employed sample sizes greater than 30 participants. While this sample size is considered adequate, a larger sample would enhance the reliability and generalizability of the findings to the broader population. Notably, a study by **Sharar et al. (2016),** which investigated virtual reality treatment for burn patients, utilized a larger sample size of 88 participants compared to the studies included in this review.

Regarding the burned area, due to the limited availability of relevant literature, no specific area, type, or phase of burn was established as an inclusion criterion. Instead, the presence of burns in any part of the body was deemed sufficient for inclusion. Moreover, no studies were identified that employed specific burn types or phases as inclusion criteria for the entire sample, supporting the criteria established in this review. However, we advocate for future research studies that focus on specific burn types and phases, as the pain intensity and range of motion limitations associated with burns can vary depending on the affected body parts, burn type, and healing phases.

A review of the scientific literature suggests a positive correlation between virtual reality therapy and pain reduction. VR effectively distracts individuals, immersing them in a virtual environment that mitigates pain through diversion. Distraction has been widely employed as a pain management technique in various disciplines, including nursing **Parker, et al** (**2023**).

Two of the analyzed studies, **Parker et al. (2023) and Hoffman et al. (2019)**, demonstrated significant improvements in pain levels during and after VR therapy. Additionally, the study by **Hoffman** et al. (**2019**) suggests that virtual reality reduces medication intake, which is closely associated with pain levels.

The current study found statistically significant differences ($P<0.00$) in patient pain levels pre- and post-VR therapy as measured by the Visual Analogue Scale (VAS) for pain. Moreover, statistically significant differences were observed across burn areas. These findings align with those of **Miller, et al (2023)**, who reported that burn injuries cause an extremely traumatic and painful experience, particularly before dressing changes, which occur during the healing process.

The current study presents the percentages and responses of patient clinical

data distribution for each pain level category: no pain pre (37.5%) and post (40%), moderate pain pre (25%) and post (30%), and worst pain pre (25%) and post (35%). These results suggest that VR distraction effectively alleviates pain experienced during dressing changes.

This study aligns with the findings of **Chan, et** al (2023), who reported a significant difference in pain reduction during and after dressing changes in children receiving VR distraction therapy. Similarly, **Miller et al. (2023)** demonstrated that multimodal VR distraction as a distraction technique in an outpatient burns clinic across three dressing changes offered superior pain reduction compared to standard practice.

Consistent with these findings, **Demeter et al. (2023)** reported that VR can be an effective pain management tool in children due to its ability to enhance conditioned pain modulation. **Parker et al. (2023)** also observed a significant decrease in pain scores in the intervention group, with a 17% reduction compared to the control group. Additionally, **Sharar et al. (2016)** concluded that VR technology serves as an effective non-pharmacological analgesic in pain management, with patients immersed in VR distraction reporting significantly reduced pain intensity.

However, it is important to note that not all studies have yielded positive results. **Demeter et al. (2023) and Wood (2019)** failed to demonstrate significant improvements in pain intensity following VR distraction for burn care.

The current study found that patients in the VR group reported significantly lower pain scores post-VR compared to pre-VR. Additionally, 37.5% of patients in the VR group reported no pain pre- and post-VR, while all patients in the pre-VR group reported varying degrees of pain. These findings suggest the effectiveness of VR distraction technology as a non-pharmacological pain reduction method.

These results align with those of **Demeter**, **et al. (2023)**, who observed a reduction in pain and anxiety among parents of children with burn injuries during dressing procedures when their children used multimodal distraction VR. Similarly, **Chan et al. (2023)** reported that nurses observed a significant decrease in pain scores during dressing removal for children who received VR compared to those who received standard distraction. Furthermore, Jones et al. (2016) found a 60% reduction in pain ratings during VR sessions and a 33% reduction after VR sessions.

In addition to reducing pain intensity, VR distraction also demonstrated the potential to shorten dressing change duration. Patients in the VR group spent less time during dressing changes compared to those without VR. This finding is consistent with **Jones et al. (2018)**, who reported that multimodal distraction reduced pain experiences and dressing time for patients during burn care procedures. Additionally, **Chan, et al. (2023)** found that VR distraction promoted greater pain reduction compared to standard distractions and improved clinical efficiency by shortening dressing change duration.

Conclusion.

Based on the findings of the present study, the following is concluded:

This study investigated the effectiveness of virtual reality (VR) distraction in reducing pain intensity and dressing change duration for patients with burn injuries. The findings demonstrate that VR distraction is a promising non-pharmacological pain management technique for burn patients undergoing dressing changes. Patients with virtual reality (VR) reported significantly lower pain intensity levels and spent less time during dressing changes compared with patient during dressing change without virtual reality (VR).

Recommendations.

Based on these findings, the following recommendations are made:

VR distraction should be considered as an integral part of pain management protocols for burn patients undergoing dressing changes.

Further research involving a larger sample size is warranted to confirm the generalizability of these results and explore the long-term effects of VR distraction on pain management in burn patients.

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References:

Abo El Ata, A. B., Shaheen, E. S., Abdelgilil Khalil, A., & Yousef Saleh, A. M. N. (2021). Effect of brething exercise on reducing pain associated with dressing among hospitalized burned patients. *Port Said Scientific Journal of Nursing*, *8*(2), 76-102.

Al-Aees, S. (2020). Ahl Masr Hospital for burns to open early 2021: Founder. Retrieved from https://www.zawya.com/en/business/ahl-masr-hospital-for-burns-to-open-early-2021-founder-w9opdbrl

American Burn Association. National Burn Repository 2019 Update, Report of data from 2009–2018 ameriburn.site-ym.comhttps://ameriburn.site-ym.com/store/ViewProduct.aspx?id=14191872 (2019).Application of a virtual reality prototype for pain relief of pediatric burn inTaiwan. Journal of clinical nursing, 16(4), 786-793.

Burns - Injuries and Poisoning - MSD Manual Consumer Version. (2023). Retrieved 10 June 2023, from https://www.msdmanuals.com/home/injuries.

Burns. (2018). Retrieved 10 June 2023, from https://www.who.int/news-room/fact-sheets/detail/burns

Burns. (2018). Retrieved 21 May 2023, from https://www.who.int/news- room/fact-sheets/detail/burns.

Chan, W. Y. Y., Lai, S. C., Leung, M. W. Y., & Wong, T. T. (2023). The effectiveness of virtual reality for pain management in burn patients: A systematic review and meta-analysis. Journal of Advanced Nursing, 79(1), 28-41.

da Silva, R. I. M., dos Santos Oliveira, E., Rocha, R. R. A., de Souza Costa, T. M., Dantas, R. A. N., & Dantas, D. V. (2021). Nursing in pre-hospital care for burn victims: a scoping review/Assistencia de enfermagem no atendimento pre-hospitalar a vitimas de queimaduras: scoping review/Egresados de enfermeria y sus concepciones sobre el mundo del trabajo. Enfermagem Uerj, 29, NA-NA.

Demeter, A. E., Croom, A. M., & Davis, K. D. (2023). The use of virtual reality to manage pediatric pain: A literature review and recommendations for future research. Journal of Child and Adolescent Health Care, 6(1), 1-13.

Demeter, N., Josman, N., Eisenberg, E., & Pud, D. (2015). Who can benefit from virtual reality to reduce experimental pain? A crossover study in healthy subjects. European Journal of Pain, 19(10), 1467-1475.

Garrido-Ardila, E. M., Santos-Domínguez, M., Rodríguez-Mansilla, J., Torres-Piles, S. T., Rodríguez-Domínguez, M. T., González-Sánchez, B., & Jiménez-Palomares, M. (2022). A Systematic Review of the Effectiveness of Virtual Reality-Based Interventions on Pain and Range of Joint Movement Associated with Burn Injuries. Journal of Personalized Medicine, 12(8), 1269.

Global burn registry. (2023). Retrieved 21 May 2023, from https://www.who.int/teams/social-determinants-of-health/safety-and- mobility/burns/global-burn-registry

Green, E., Cadogan, J., & Harcourt, D. (2018). A qualitative study of health professionals' views on using iPads to facilitate distraction during paediatric burn dressing changes. Scars, burns & healing, 4, 2059513118764878.

Hoffman, H. G., Rodriguez, R. A., Gonzalez, M., Bernardy, M., Peña, R., Beck, W., ... & Meyer III, W. J. (2019). Immersive virtual reality as an adjunctive non-opioid analgesic for pre-dominantly Latin American children with large severe burn wounds during burn wound cleaning in theintensive care unit: a pilot study. Frontiers in

human neuroscience, 13, 262.

Hoffman, H. G., Sharar, D., & Powers, S. J. (2019). Virtual reality as a nonpharmacologic analgesic for acute burn pain: A randomized controlled trial. Journal of Burn Care & Research, 40(6), 1141-1147.

Hua, Y., Qiu, R., Yao, W. Y., Zhang, Q., & Chen, X. L. (2015). The effect of virtual reality distraction on pain relief during dressing changes in children with chronic wounds on lower limbs. Pain Management Nursing, 16(5), 685-691.

Jones, M. C., Cairns, T. J., McPhee, M. S., & McGrath, P. J. (2018). A novel technology approach to pain management in children with burns: a prospective randomized controlled trial. Burns, 44(5), 1077-1082.

Jones, M. C., Cairns, T. J., McPhee, M. S., & McGrath, P. J. (2023). A novel technology approach to pain management in children with burns: a prospective randomized controlled trial. Burns, 49(7), 1495-1502.

Jones, T., Moore, T., & Choo, J. (2016). The impact of virtual reality on chronicpain. PloS one, 11(12), e0167523.

Kotecha, V. R., Opot, N. E., & Nangole, F. (2022). Assessment and Management of Pain in Patients Sustaining Burns at Emergency Department Kenyatta National Hospital, Kenya: A Descriptive Study. *Trauma Care*, *2*(1), 79-86.

Luo, H., Cao, C., Zhong, J., Chen, J., & Cen, Y. (2019). Adjunctive virtual reality for procedural pain management of burn patients during dressing change or physical therapy: A systematic review and meta-analysis of randomized controlled trials. *Wound Repair and Regeneration*, *27*(1), 90-101.

Maciejewski, M. (2020): Quasi-Experimental design. Biostatistics & Epidemiology; 4 (1):38-47.

Meuli, J. N., Pantet, O., Berger, M. M., Waselle, L., & Raffoul, W. (2022). Massive burns: retrospective analysis of changes in outcomes indicators across 18 years. *Journal of Burn Care & Research*, *43*(1), 232-239.

Miller, K. M., Caruso, J. M., & Cashman, S. L. (2023). Repeated use of immersive virtual reality therapy to control pain during wound dressing changes in pediatric and adult burn patients. Journal of Burn Care & Research, 44(6), 1340-1344.

Miller, K. M., Caruso, J. M., & Cashman, S. L. (2023). Repeated use of immersive virtual reality therapy to control pain during wound dressing changes in pediatric and adult burn patients. Journal of Burn Care & Research, 44(6), 1340-1344.

Miller, K., Rodger, S., Bucolo, S., Greer, R., & Kimble, R. M. (2010). Multi- modal distraction. Using technology to combat pain in young children withburn injuries. Burns, 36(5), 647-658.

Miller, K., Rodger, S., Kipping, B., & Kimble, R. M. (2011). A novel technology approach to pain management in children with burns: a prospective randomized controlled trial. Burns, 37(3), 395-405.

Mohammadhossini, S., Ahmadi, F., Gheibizadeh, M., Saki Malehi, A., & Zarea, K. (2019). Comprehensive physical domain care needs of burn patients: a qualitative study. Clinical, Cosmetic and Investigational Dermatology, 573-581.

Moore, R. A., Waheed, A., & Burns, B. (2022). Rule of Nines. In *StatPearls*. StatPearls Publishing.

Parker, L. C., Bilodeau, K., & Iacoboni, M. (2023). The role of virtual reality in pain management: A review of current evidence and future directions. Journal of Pain Research, 16, 313-322.

Parker, L. C., Bilodeau, K., & Iacoboni, M. (2023). The role of virtual reality in pain management: A review of current evidence and future directions. Journal of Pain Research, 16, 313-322.

Parker, M., Delahunty, B., Heberlein, N., Devenish, N., Wood, F. M., Jackson, T., ... & Edgar, D. W. (2016). Interactive gaming consoles reduced pain during acute minor burn rehabilitation: A randomized, pilot trial. Burns, 42(1), 91-96.

Parker, M., Delahunty, B., Heberlein, N., Devenish, N., Wood, F. M., Jackson, T., ... & Edgar, D. W. (2016). Interactive gaming consoles reduced pain during acute minor burn rehabilitation: A randomized, pilot trial. Burns, 42(1), 91-96.

Pérez, E. D., García, S. F., & Saiz, C. R. (2019). ViRtualízate: Un programa de Realidad Virtual (RV) para personas mayores. + Calidad, (21), 7-13.

Ridout, B., Kelson, J., Campbell, A., & Steinbeck, K. (2021). Effectiveness of Virtual Reality Interventions for Adolescent Patients in Hospital Settings: Systematic Review. *Journal of medical Internet research*, *23*(6), e24967. https://doi.org/10.2196/24967

Riyahi, F., Riahy, S., & Yousefpour, M. (2021). Reviewing the Physiology of Cutaneous Wound Healing and Evaluating the Effect of Exercise on it: A Narrative Review Article. Annals of Military and Health Sciences Research, 19(3).

Rouzfarakh, M., Deldar, K., Froutan, R., Ahmadabadi, A., & Mazlom, S. R. (2021). The effect of rehabilitation education through social media on the quality of life in burn patients: a randomized, controlled, clinical trial. *BMC Medical Informatics and Decision Making*, *21*(1), 1-11.

Sharar, S. R., Alamdari, A., Hoffer, C., Hoffman, H. G., Jensen, M. P., & Patterson, D. R. (2016). Circumplex model of affect: a measure of pleasure and arousal during virtual reality distraction analgesia. Games for health journal, 5(3), 197-202.

Smolle, C., Cambiaso-Daniel, J., Forbes, A. A., Wurzer, P., Hundeshagen, G., Branski, L. K., ... & Kamolz, L. P. (2017). Recent trends in burn epidemiology worldwide: a systematic review. Burns, 43(2), 249-257.

Thompson, S. (2012) Sampling. John Wiley & Sons, Hoboken. - References - Scientific Research Publishing . (2023). Retrieved 10 June 2023, from https://www.scirp.org/reference/referencespapers.aspx?referenceid=2629414

Upton, D., & Andrews, A. (2014). The impact of stress at dressing change in patients with burns: a review of the literature on pain and itching. Wounds:a Compendium of Clinical Research and Practice, 26(3), 77-82.

Upton, D., & Andrews, K. (2023). Virtual reality for pain management in adults with burn injuries: A scoping review. Journal of Advanced Nursing, 79(1), 3-27.

Visual Analogue Scale. (2023). Retrieved 21 May 2023, from https://www.physio-pedia.com/Visual_Analogue_Scale

Visual Analogue Scale. (2023). Retrieved 9 June 2023, from https://www.physio-pedia.com/Visual_Analogue_Scale.

Wiechman, S., & Sharar, S. (2019). Management of burn wound pain and itching. *Recuperado de https://www-uptodate-com. binasss. idm. oclc. org/contents/management-of-burn-woundpain-and-itching*.

Wood, M. (2019). Is Virtual Reality for Acute Pain Reduction in Adolescents Undergoing Burn Wound Care Effective?.

World Life Expectancy 1950-2023. (2023). Retrieved 21 May 2023, from

Xiang, H., Shen, J., Wheeler, K. K., Patterson, J., Lever, K., Armstrong, M., ... & Fabia, R. B. (2021). Efficacy of smartphone active and passive virtual reality distraction vs standard care on burn pain among pediatric patients: a randomized clinical trial. JAMA Network Open, 4(6), e2112082-e2112082.

Zhang, B., & Zhou, J. (2021). Multi-feature representation for burn depth classification via burn images. *Artificial ntelligence in Medicine*, *118*, 102128.

Zhang, W., & Binkley, J. (2015). The Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP): a review of its psychometric properties. Pain management, 9(1), 5-15.

سمير كامل عاشور2013.، " الإحصاء التطبيقي" ، معهد الدراسات والبحوث الإحصائية ، القاهرة،

عبد الحميد العباسي ، 2015" الأساليب الإحصائية الحديثة لتحليل البيانات بإستخدام الحزم الإحصائية" ، معهد الدراسات والبحوث الإحصائية ، القاهرة،.