Effect of Joint Motion Exercises in Reducing Pain and Joint Contractures among Burn Patient at Benha Teaching Hospital

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Abstract

Background: ***Context:*** Burns are a global health issue, causing over 300,000 deaths annually and millions of disabilities. Survivors often face stigma and discrimination due to their disability. Joint contractures, a prevalent complication, can limit joint mobility and adversely affect daily activities. Extreme burns, particularly dermal and full-thickness burns, can lead to deficiency in mobility and daily activities. Despite treatment progress, scar contracture remains a challenge, and patients should receive optimal care to minimize the risk of complications. ***Aim:*** Evaluate the effect of joint motion exercises in reducing pain and joint contractures among burn patient at Benha Teaching Hospital. ***Methods:*** A quasi-experimental research, specifically a one-group pre/post-test design, was employed in this study. The research was conducted in burn unit at Benha Teaching Hospital, Benha, Egypt. The study included a purposive sample of 60 patients of both genders over nine months. Five assessment tools were utilized: I-A structured interview questionnaire for gathering personal data, and medical history, II-Observational check list to assess joint motion, III-Contractures assessment questionnaire, IV-Visual Analog Scale (VAS), and V-Patients' verbal expression of the features of pain ***Results:*** The study found a statistically significant improvement in patients' joint mobility and strength after a joint motion exercise intervention. The percentage of patients reporting poor performance decreased from 88.3% pre-intervention to 1.7% post-intervention. The exercise also improved pain intensity from 43.30% severe pain pre-intervention to 13.30% severe pain post-intervention. The progression of contracture degree also improved from 75% moderate contractures pre intervention to 15% moderate contractures post-intervention. A highly significant positive correlation was found between joint motion exercises, pain intensity level, and joint contractures post-intervention. P=0.000**. ***Conclusion*:** Based on the findings of the current study, it can be concluded that joint motion exercises has proven to be effective in reducing pain intensity level and progression of contractures for second degree burn patients, which supports the study hypotheses. ***Recommendations:*** Simple instruction booklet should be provided for burn patients regarding joint motion exercises, in addition future research should focus on assessing factors that contribute to joint contractures in patients with severe burn injuries.

Keywords : Burn patients ,joint Contracture,Joint Motion exercises , Pain

Introduction

Burn injuries represent a major contributor to morbidity and mortality on a global scale. Individuals who have suffered from burn injuries may face lasting effects that impact their overall health and quality of life. Additionally, severe burns frequently require comprehensive physical and psychological rehabilitation, leading to substantial social and economic challenges for both the patients and their families. Patient-reported outcome measures (PROMs) have become essential tools in assessing the effectiveness of patient-focused care. Given the complex and diverse aspects of burn care, along with the various potential long-term consequences, integrating PROMs into burn quality enhancement initiatives is crucial **(Li et al., 2024)**

Burn injuries can arise from a variety of sources, including friction, extreme cold, heat, radiation, chemicals, or electrical currents. The predominant cause of such injuries is heat, which can emanate from hot liquids, solids, or

flames. Although all burn injuries result in tissue damage due to the transfer of energy, the specific cause can elicit distinct physiological and pathophysiological reactions. For instance, alkaline substances can induce colliquative necrosis, while burns from acidic agents result in coagulation necrosis. Furthermore, electrical injuries may inflict significant damage to deeper tissues that is not immediately apparent on the skin's surface. It is also important to note that thermal injuries can occur as a result of exposure to cold temperatures **(Jeschke et al., 2020) and (Nguyen et al., 2020).**

The duration of recovery from burn injuries is contingent upon their severity, classified as superficial, superficial partial, deep partial, or full thickness. Superficial burns, which impact only the epidermis and are classified as second-degree, generally heal within a few weeks and do not result in scarring, despite the associated pain. Conversely, deeper burns necessitate a more extended healing period due to damage to the extracellular matrix (ECM), the degradation of growth factors (GFs), a prolonged inflammatory response, elevated levels of pro-inflammatory cytokines, proteases, reactive oxygen species (ROS), and an increased risk of infection. Burns are categorized into four primary stages based on their depth, which is influenced by factors such as the temperature of exposure, duration of contact, source of exposure, and the thickness of the skin **(Radzikowska-Büchner, 2023).**

Burn pain is recognized as one of the most challenging types of pain to treat. It can be categorized into three distinct types: procedural pain, background pain, and breakthrough pain. Procedural pain occurs during dressing changes and is regarded as the most intense pain experienced in non-surgical procedures. Background pain, on the other hand, is the discomfort felt by patients while at rest, resulting from the thermal injury. Breakthrough pain is characterized by sudden episodes of pain that occur despite ongoing management of chronic pain with opioid medications. Initially, full-thickness skin burns may present with reduced pain sensation due to nerve ending damage. However, individuals with both partial- and full-thickness burns can experience significant pain when exposed nerve endings are stimulated by mechanical actions such as touching, rubbing, or cleaning during wound care **(Sahin & Sahin, 2023).**

The formation of contractures following a burn injury arises when the skin tightens over the wound, thereby reducing its surface area. Research indicates that the severity of contractures is primarily influenced by the extent of the burn and the duration of hospitalization. This complication is frequently observed in patients who have sustained burn injuries. The high incidence of contracture can be attributed to insufficient initial treatment of burn wounds, including the failure to promptly initiate necessary surgical procedures, physiotherapy, and the use of anti-deformity splints, all of which contribute to the early contracture development **(Ali & Ali, 2022).**

Burn pain treatment is particularly complex; it is multi-faceted and often changes as the patient progresses through a series of procedures that involve the manipulation of painful burn areas. When treating second-degree burns (both partial thickness and full partial thickness), the ROM exercise can help reduce pain, reduce dressing changes period, help control infection, speed up healing, help with long-term recovery, and reduce treatment expenses **(Blome-Eberwein et al., 2021).**

The nursing team is composed of skilled professionals who work at the forefront of healthcare delivery. Consequently, tasks such as planning, monitoring, and preventing complications related to burns are essential for sustaining vital functions, facilitating rehabilitation, improving quality of life, and enhancing clinical outcomes. Additionally, these professionals must work towards reducing hospital stays, complications, morbidity and mortality rates. Therefore, understanding the necessary nursing care for

adult burn patients is vital for developing strategies and restructuring nursing practices to minimize long-term effects. Inadequate and nonspecific care can lead to more complications and extended hospital stay **(Costa et al., 2023).**

Significance:

Burns are recognized as the fourth most common cause of injury worldwide, following motor vehicle accidents, falls, and acts of interpersonal violence. Within clinical environments, second-degree burns are the most frequently encountered type, comprising 85.4% of all burn incidents. Notably, 56.3% of these second-degree burns impact less than 10% of the total body surface area (TBSA). In the initial post-burn phase, second-degree burn wounds exhibit significant changes that are influenced not only by their pathophysiological characteristics but also by the interventions applied and various other factors. Timely and effective first aid in pre-hospital settings, along with prompt treatment upon hospital admission, is essential to prevent the progression of the wound **(Ji et al., 2024)**

Egypt faces a significant issue with a high number of deaths caused by burns, ranking among the highest globally. Approximately 250,000 individuals endure severe burns annually in the country. Sadly, around forty percent of individuals perish because they are not rescued within the initial six hours following the injury **(Mohamed et al., 2023)**

At Benha Teaching Hospital, the incidence of burn injuries was 71 cases by the end of 2023 **(Benha Teaching Hospital Statistical Office, 2023).** From the previous studies, we can ascertain the significance of this issue and its true magnitude. This study highlights the importance of range of motion exercises for the burn patients, which could help in reducing pain and progression of contractures among the burn patients

Aim of the reasrch :

The present research was conducted with the objective of evaluating the effect of joint motion exercises in reducing pain and joint contractures among burn patient at Benha Teaching Hospital.

Research Hypotheses

H1- Applying joint movement exercises will reduce pain among burn patients post-intervention compared to pre-intervention.

H2- Applying joint movement exercises will reduce joint contractures among burn patients post-intervention compared to pre-intervention.

H3- A significant correlation could exist between joint motion exercises, pain intensity level and joint contractures post-intervention.

Subjects & Method

Research Design

Aquasi-experimental research design employing a one-group pre-test and post-test methodology was implemented to achieve the objectives of this study. In such a design, researchers evaluate the causal impact of an intervention on a specific population without the use of random assignment **(Handley et al., 2018).**

Quasi-experimental designs provide a lower level of control compared to experimental designs in at least one of three key areas. These areas include the manipulation of treatment variables, the alteration of the setting, or the selection of subjects **(Foreman & Mateo, 2019).**-

Joint motion exercises applied by patients were the independent variable. The dependent variables, conversely, encompass patient contracture degree and pain intensity level of patients with burn.

Study setting

The study was carried out in in Burn unit at Benha Teaching Hospital (Ministry of health). It located at Shaheed Farid Nada, Banha, Banha, Al Qalyubia Governorate, Egypt. It is an educational hospital for training of medical and nursing students in all specialties. It was established since 1967. The burn unit located in the ground floor and has 4 rooms for inpatient, including 20 beds. All beds are occupied most of time. The cost of services provided is given for free .There is also a room

for dressing, a physician's office and nursing station.

Subjects

A purposive sample of 60 adult patients representing both genders and met the following

Sample size

The sample was calculated by the following equation using the Steven and Thompson equation to calculate the sample size from the next formula ***(Thompson, 2012)***:

$$n=\frac{N\times p(1-p)}{\left[\left[N-1\times\left(d^2\div z^2\right)\right]+p(1-p)\right]}$$

N= Population size
Z2= confidence level of 95%
P= probability
d2= margin of error
So, sample size (n)

The total number of adult patients diagnosed with second degree burn in one year, beginning in August 2023 and ending in September 2024, is 71 adult patients diagnosed with second degree burn in Benha Teaching Hospital (Ministry of health), so the target population of this study is 60 patients. The sample size calculation will be done using the following equation:

N= (71)

Z2= (1.96)

P= (0.05)

d2= (0.05)

n = 60

$$n=\frac{71\times 0.50\ (1-0.50)}{[71-1\times\ (0.052\div 1.962)]\ +0.50(1-0.50)}=60$$

Criteria:

Inclusion Criteria: patients diagnosed with second degree burn, aged from 20 to 60 years and burn percentage from 10 - 50% (TBSA), hemodynamically stable and able to communicate. Exclusion Criteria: Patients with severe consequences such severe infections, traumatic brain injuries, spinal cord injuries, significant fractures, or amputation, patients with serious damage to tendons, skeleton, and nerves. Also, patients with mental or psychological problems were excluded.

Tools of data collection

Tool 1: Structured Interview Questionnaire

It was adapted from **Beck & Clark (2023),** and **Smith & Turner (2024).** It consisted of the following two sections:

Section 1 This section addresses the personal data of patients and includes six inquiries regarding age, gender, marital status, place of residence, qualifications, and occupation.

Section 2 This section focuses on the medical history of patients. It comprised ten inquiries regarding length of hospital stay, the way the burning occurred, causes of burn, burn location, percentage of burn, presence of burn infection, signs of burn infection, presence of skin grafting and comorbid diseases.

Tool 2: Observational check list to assess joint motion

It was adapted from **Turner & Patel (2022), Karel & Roberts (2023), and Smith & Adams (2024).** The tool assessed the patient's ability to move joints **(**Joint motion exercise) including numerous joints as: neck joint, shoulder joint, elbow joint, forearm joint, wrist joint, thumb joint, fingers, hip, knee joint, ankle, toes and spine. Each step of observational checklist was assigned to score (1) if done and (0) if not done.

Items		Poor	Moderate	Good
		Less than 50%	50 to less than 75%	75% to more
Neck joint exercise	4	1	2	3-4
Shoulder joint exercise	8	4	5	6-8
Elbow joint exercise	2	0	1	2
Forearm joint exercise	3	1	More than 1 to 2	3
Wrist joint exercise	2	0	1	2
Thumb joint exercise	4	1	2	3-4
Fingers	2	0	1	2
Hip exercise	6	3	3 - 4	5-6
Knee joint exercise	2	0	1	2
Ankle exercise	3	1	1 - 2	3
Toes exercise	4	1	2	3-4
Spine exercise	3	1	1 - 2	3
Total	**43**	21	More than 21 to 32	32-43

Tool 3: Contractures assessment questionnaire:

It was adapted from **Herndon (2018).** It was designed to assess signs of contractures and included (9) physical assessment procedure or movements. Movements ranged from mild, moderate or severe contractures. It included physical movements steps about presence of changes in joint movement around the burn area, difficulty in extending or bending any part of the injured body, sensation of tightness or pain when trying to move the burned area, change in the shape or position of the skin around the burn area, the skin around the burns has become harder or more difficult to move, changes in the ability of the joints to move, awareness about the risk of contractures due to burns, receiving any physical therapy or exercises to improve joint movement, and presence of any other symptoms around the burn area (such as pain, swelling, numbness).

Scoring:

Total global score of 9 questions with 9 scores, were rated as (no= Zero & yes= 1). These scores were summed and converted into a percent score. It was classified into three categories according to the following:

- Mild contracture if total score < 50% (< 4.5 scores).

- Moderate contracture if total score from 50% - < 75% (4.5 -<6.75 scores).

- Severe contracture if total score from ≥ 75% (≥ 6.75 scores).

Tool 4: Visual Analog Scale (VAS):

It was adopted from **Kremer (2019).** The VAS is a tool used to measure the intensity of pain experienced by a person. It provides a way for healthcare providers to understand the level of discomfort a patient is experiencing and guide treatment decisions. The VAS is a linear measurement tool, generally extending 10 centimeters in length. One extremity signifies "no pain," while the opposite extremity indicates the "worst pain imaginable." Patients indicate their pain level by marking a point along the line. The resulting score is typically quantified in millimeters, with a range from 0 (indicating no pain) to 100 (representing the worst pain possible).

Scoring:

- 0 mm: No pain
- **1-3 cm (0-30 mm):** Mild pain
- **4-6 cm (31-60 mm):** Moderate pain

- **7-9 cm (61-90 mm):** Severe pain
- **10 cm (100 mm):** Worst possible pain

Tool 5: Patients' verbal expression of the features of pain:

It was adapted from **Dickson, Shokrollahi, & Whitaker, (2019).** It was designed to assess and understand patients' pain experience. The way pain is described can provide valuable information about its nature, intensity, and impact on daily life. It included (6) questions about the nature of this pain, type of pain, the most time feeling with pain, does pain awake the patient from sleep, effect of pain on patients' concentration, and methods of relieving pain.

Scoring system:

Each item of this tool had sub-items, the choice of each item was yes or no, yes was scored (1) and no was scored (0). The statistical display of this tool was limited to the number and percentage, because each point contains different choices other than the others.

Joint exercise Booklet

After a comprehensive review of the literature, the researchers developed joint motion exercise booklet based on **Dawson & Johnson (2023) and Miller & Davis (2023).** It consisted of two parts:

- The theoretical part encompassed the anatomy & physiology of the skin, definition of burn, causes, various types and associated symptoms, the percentage of body surface area affected, potential complications, first aid measures and rehabilitation, benefits of joint motion exercises after burn injury, contraindications for applying joint exercises, complications of exercises, how to prevent complications and joint contractures after burn injury.
- The practical part: It included applying joint motion exercises to many joints as: neck joint, shoulder joint, elbow joint, forearm joint, wrist joint, thumb joint, fingers, hip, knee joint, ankle, toes and spine.

Procedure

Approval to conduct the study was secured through the submission of an official correspondence from the Dean of the Faculty of Nursing at Benha University to the Director of Benha Teaching Hospital, which clarified the objectives and anticipated outcomes of the research.

In terms of ethical considerations, authorization was granted by the Scientific Research and Ethics Committee at the Faculty of Nursing, Benha University (**REC-MSN-P-38)** prior to the commencement of the study. Before the collection of data, the research team presented the participating patients with a detailed explanation of the study's aims. Verbal consent was obtained from the patients to affirm their voluntary involvement. The researchers guaranteed the confidentiality and anonymity of all data collected. Patients were informed of their right to choose whether to participate in the study and were free to withdraw at any time.

The preparatory phase included a thorough review of existing literature on various research aspects to create the necessary tools and a joint exercise booklet. The validity and reliability of these tools were meticulously evaluated by a panel consisting of five reviewers and experts in medical-surgical nursing, as well as staff members from the plastic surgery department. They assessed both the content and face validity of the tools and provided constructive feedback, which resulted in essential modifications.

Cronbach's alpha coefficient was calculated to gauge the reliability of the Contractures assessment questionnaire, resulting in a high score of 0.956. As for Joint motion exercises observational checklist, its reliability was determined to be 0.890, while for pain intensity scale, it was found to be 0.960 and patients' verbal expression of the features of pain was 0.790. These findings clearly indicate that these tools possess a high degree of reliability.

Pilot study:

A pilot study was conducted to enhance the clarity and usability of the study instruments, estimate the duration needed for data collection, identify possible challenges, and evaluate the overall feasibility of the research process. This pilot study involved 10% of the participants (6 patients) from the main study. Insights obtained from this pilot study led to essential modifications aimed at refining the data collection tools. Importantly, the patients

involved in the pilot study were excluded from the final group of study participants.

Fieldwork:

The Director of Benha Teaching Hospital provided official approval for the study. The data collection process took place over a period of nine months, starting in February 2024 and concluding at the end of October 2024. During the assessment phase, which lasted for two months, each patient participated in a structured interview utilizing data collection tools to assess their initial needs. The planning phase, which also extended for two months, involved the creation, review, and modification of a booklet on joint motion exercises tailored to the specific requirements of the patients. The implementation phase lasted three months, during which the researchers conducted the joint motion exercises with the patients immediately following the baseline data collection. This intervention was carried out in five sessions, each lasting one hour and accommodating six patients.

-***Session one*** was constructed to orient the patient with the program sessions, elucidate its objectives, and provide an overview of the anatomy and physiology of the skin, definition of burn, causes, types & symptoms of each type.

-Session two was constructed to discuss knowledge related to burn percentage, complications, first aid and rehabilitation.

-Session three focused on benefits of joint motion exercises after burn injury and contraindications for applying joint exercises.

- ***Session four*** educates the patients about the complications of exercises, how to prevent complications and joint contractures after burn injury.

- ***Session five*** concerns practical parts which included applying stretching and joint motion exercises (flexion and extension) to many joints as: neck joint, shoulder joint, elbow joint, forearm joint, wrist joint, thumb joint, fingers, hip, knee joint, ankle, toes and spine.

Evaluation phase: Patients' joint motion, contracture degree, pain intensity level and verbal expression of the features of pain were evaluated after three months of applying joint motion exercises. This phase extended for two months.

Data analysis

The gathered data were meticulously organized and analyzed utilizing the IBM computer equipped with the Statistical Package for Social Science (SPSS), version 25. Descriptive statistics, including mean and standard deviation, were applied to numeric data, while qualitative data were expressed in terms of frequency and percentage. Chi-square tests were conducted to explore associations between qualitative variables. To assess relationships among numerical variables, Pearson correlation coefficients were employed. For quantitative data, a comparison of two variables was performed using a student's t-test. A paired t-test was implemented to evaluate the effectiveness of the intervention on the same group of patients both prior to and following the intervention. Statistical significance was established at $p \leq 0.05$, with a p-value of 0.001 regarded as highly significant.

Results

Table (1): presents the personal data of the study sample. The age distribution shows that, 38.3% of participants aged between 40 to 50 years old. The mean age of the participants was 41.28 years with a standard deviation of 10.83 years, indicating a relatively diverse age range. In terms of gender, females make up a slightly higher percentage (58.3%) compared to males (41.7%). The marital status data reveals that 80 % of participants are married. The residency data indicates that a significant portion of the sample (78.3%) resides in rural areas. Regarding qualifications, a considerable proportion of the participants have low educational attainment, with 41.7% unable to read or write. Regarding employment, 50% of patients do not work.

Table (2): provides insights about medical history of burn patients. The average length of hospital stay was 25.90 days with a standard deviation of 24.26 days. Regarding the cause of the burn, 60% of cases occurred due to accidents. When it comes to the specific cause of the burn, fire (flame) was the most common cause as reported by 50% of patients. The table also details the locations of burns upon admission. The highly affected visible area was the neck (35%), while, the most affected

invisible area was the abdomen (31.7%). The burn percentage, which measures the extent of the burn injury, has a mean of 43.80% with a standard deviation of 15.42%, suggesting a broad range of burn severity. In terms of wound infection, 80% of burn wounds exhibit no signs of infection. Additionally, 90% of patients didn't undergo skin grafting. The table also highlights that 78.3% of patients have no other associated diseases.

Table (3): demonstrates a significant improvement in the patients' joint mobility with the percentage of patients reporting poor performance decreasing from 88.3% pre-intervention to just 1.7% post 3 months of intervention. The overall p-value of 0.000** confirms the substantial effectiveness of the joint motion exercises across all joints.

Figure (1): clarifies change in pain intensity level among burn patients from 43.30% severe pain pre intervention to 13.30% severe pain post-3 months of intervention.

Figure (2): clarifies change in contracture degree among burn patients from 75% moderate contractures pre intervention to 15% moderate contractures post 3 months of intervention.

Table (4): shows that, the total score of patients' verbal expression of pain features had significantly improved between the pre intervention and post-3 months of intervention. The mean score decreased from 17.13 ± 2.32 pre intervention to 8.17 ± 3.13 post-3 months of intervention. This difference was statistically significant, as indicated by the t-test result ($t = 17.985$, $p = 0.000$), with a p-value less than 0.001, as well as an improvement in concentration and a reduction in the pain's impact on their sleep and daily life after the intervention.

Table (5) shows that: A highly statistically significant positive correlation was found between joint motion exercises, pain intensity level and joint contractures post 3 months of intervention as shown by the P-values indicating statistical significance. P=0.000**.

Table (1): Percentage distribution of studied patients regarding their personal data (n=60).

Personal data	No.	%
Age (years)		
20-< 30 years	8	13.3
30-< 40 years	11	18.3
40-< 50 years	23	**38.3**
≥50 years	18	30.0
Mean±SD	41.28±10.83 years	
Gender		
Male	25	41.7
Female	35	**58.3**
Marital status		
Single	8	13.3
Married	48	**80.0**
Divorced	4	6.7
Residence		
Rural	47	**78.3**
Urban	13	21.7
Qualifications		
Don't read and write	25	**41.7**
Read and write	11	18.3
Primary education	8	13.3
Intermediate education	4	6.7
University education	12	20.0
Occupation		
Doesn't work	30	**50.0**
Manual work (Hand work)	6	10.0
Employee	18	30.0
Housewife	6	10.0

Table (2): Percentage distribution of studied patients regarding their medical history (n=60).

patients' medical history	No.	%
Length of hospital stay		
Mean±SD	25.90±24.26 days	
The way the burning occurred		
Accident	36	**60.0**
Suicide	18	30.0
Assault	6	10.0
Cause of burn		
Fire (flame)	30	**50.0**
Boiling liquid (water)	6	10.0
Chemical liquid	24	40.0
Burn location upon admission to the hospital:		
A- Visible places:		
1- Face	17	28.3
2- Neck	21	**35.0**
3- Palms	16	26.7
4-Feet	6	10.0
B- Invisible places:		
1- Chest	12	20.0
2- Abdomen	19	**31.7**
3- Back	10	16.7
4- Thighs	2	3.3
5-The upper part of the arms.	9	15.0
6-The lower part of the legs	8	13.3
Burn percentage		
Mean±SD	43.80±15.42	
Is there infection in the burn wound?		

No	48	**80.0**
Yes	12	20.0
Is there a skin grafting procedure?		
No	54	**90.0**
Yes	6	10.0
The signs of infection		
No signs	48	**80.0**
High temperature	12	20.0
Associated diseases with burn		
None	47	**78.3**
DM	6	10.0
HTN	7	11.7

Table (3): Comparison of studied patients' ability to move joints pre and post 3 months of exercises (n=60).

Joint Motion Exercises	Pre intervention						Mean±SD	Post 3 months of intervention						Mean±SD	X^2 (p-value)
	Poor		Average		Good			Poor		Average		Good			
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%		
Neck joint exercise	34	56.7	16	26.7	10	16.7	1.62±0.86	6	10.0	5	8.3	49	81.7	3.37±1.02	5.051 (0.025*)
Shoulder joint exercise	36	60.0	20	33.3	4	6.7	3.52±1.20	6	10.0	12	20.0	42	70.0	6.42±2.42	12.923 (0.000**)
Elbow joint exercise	29	48.3	30	50.0	1	1.7	0.53±0.54	8	13.3	6	10.0	46	76.7	1.63±0.71	10.302 (0.001**)
Forearm joint exercise	36	60.0	15	25.0	9	15.0	1.32±0.99	12	20.0	4	6.7	44	73.3	2.40±1.09	6.857 (0.009**)
Wrist joint exercise	32	53.3	17	28.3	11	18.3	0.65±0.78	4	6.7	8	13.3	48	80.0	1.73±0.58	4.865 (0.027*)
Thumb joint exercise	30	50.0	23	38.3	7	11.7	1.58±0.87	10	16.7	7	11.7	43	71.7	3.10±1.48	12.361 (0.000**)
Fingers	33	55.0	24	40.0	3	5.0	0.50±0.59	9	15.0	10	16.7	41	68.3	1.53±0.75	7.275 (0.001**)
Hip exercise	39	65.0	13	21.7	8	13.3	2.57±1.25	11	18.3	9	15.0	40	66.7	4.65±2.04	7.582 (0.010**)
Knee joint exercise	40	66.7	11	18.3	9	15.0	0.48±0.75	7	11.7	8	13.3	45	75.0	1.63±0.69	8.852 (0.000**)
Ankle exercise	37	61.7	10	16.7	13	21.7	1.40±1.05	13	21.7	11	18.3	36	60.0	2.28±1.03	6.900 (0.000**)
Toes exercise	33	55.0	18	30.0	9	15.0	1.57±0.85	5	8.3	10	16.7	45	75.0	3.38±1.09	8.934 (0.000**)
Spine exercise	47	78.3	12	20.0	1	1.7	1.05±0.67	14	23.3	13	21.7	33	55.0	2.28±0.90	10.111 (0.000**)
Total	53	88.3	7	11.7	0	0.0	16.78±3.84	1	1.7	16	26.7	43	71.7	34.42±5.50	12.642 (0.000**)

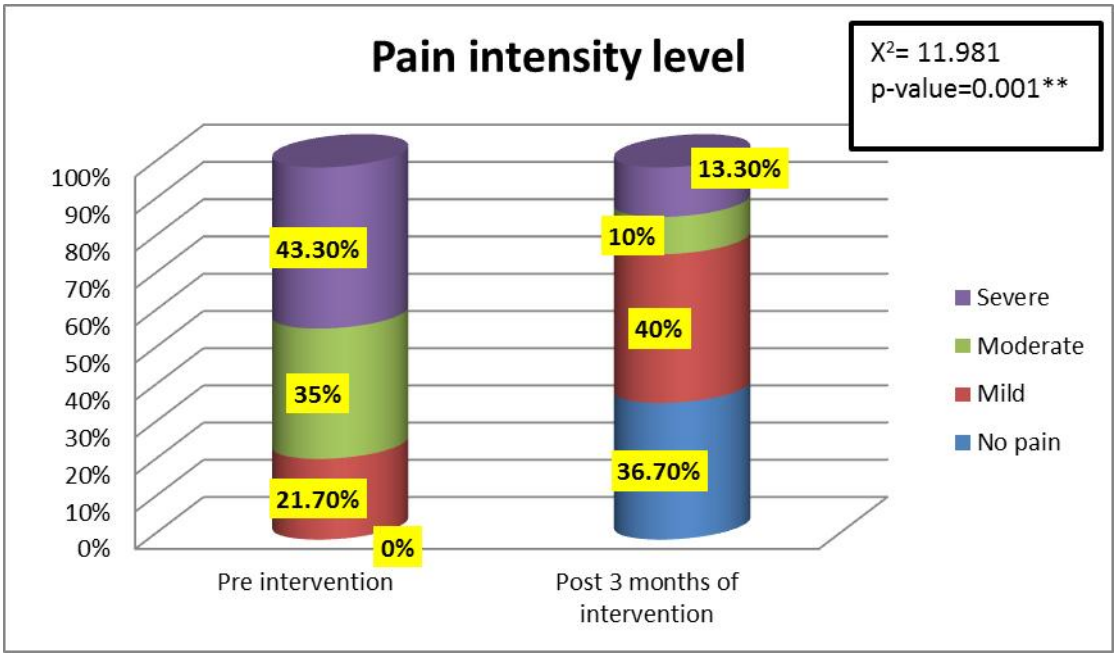

Figure (1): Comparison of Pain intensity level among burn patients pre and post 3 months of intervention (n=60).

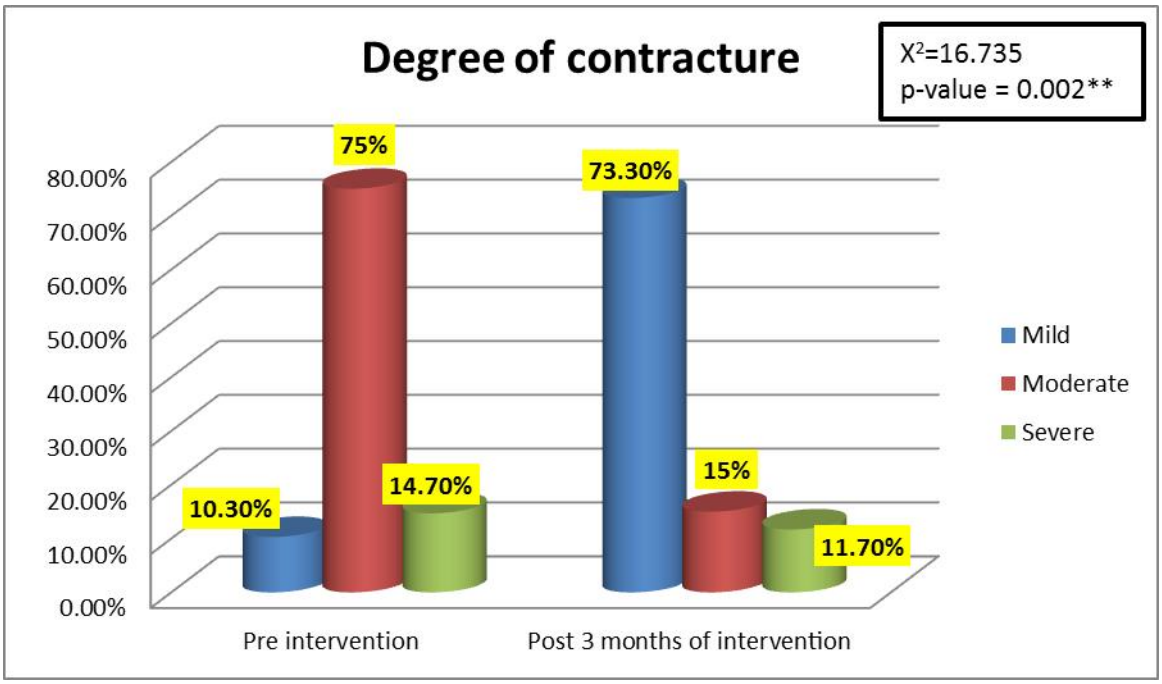

Figure (2): Comparison of contracture degree among burn patients pre and post 3 months of intervention (n=60).

Table (4): Comparison of studied patients regarding their verbal expression of the features of pain pre and post 3 months of intervention (n=60).

Items	Pre intervention		Post 3 months of intervention		X^2	p-value
	No.	%	No.	%		
***The nature of pain**						
-No pain	0	0.0	22	36.7		
-Intermittent	18	30.0	31	51.7	32.605	0.037*
-Continuous	42	70.0	7	11.7		
***Type of pain**						
-No pain	0	0.0	22	36.7		
-I can't specify	4	6.7	11	18.3		
-Burning	14	23.3	10	16.7	35.810	0.011*
-Stabbing/sharp	18	30.0	1	1.7		
-Tingling	9	15.0	2	3.3		
-Heaviness	8	13.3	14	23.3		
-Pressure	7	11.7	0	0.0		
***The most time feeling with pain**						
-No pain	0	0.0	22	36.7		
-In the morning after waking up	4	6.7	17	28.3		
-In the evening	6	10.0	12	20.0	38.584	0.000**
-After engaging in any activity	12	20.0	9	15.0		
-No difference from one time to another	38	63.3	0	0.0		
***Does pain awake the patient from sleep**						
-Never	10	16.7	39	65.0		

-It's bearable while sleeping and I don't wake up	12	20.0	9	15.0	34.925	0.014*
-Sometimes	14	23.3	10	16.7		
-Always	24	40.0	2	3.3		
***Effect of pain on patients' concentration**						
-Able to concentrate fully	5	8.3	40	66.7		
-Somewhat able to concentrate	10	16.7	15	25.0	33..422	0.030*
-Confused concentration	13	21.7	5	8.3		
-Unable to concentrate fully	32	53.3	0	0.0		
***Methods of relieving pain**						
-No pain	0	0.0	22	36.7		
-Take pain relief medication and try to move the painful area	19	31.7	15	25.0		
-Massage and apply pressure to the pain area	6	10.0	10	16.7	36.037	0.000**
-Apply warm compresses	17	28.3	2	3.3		
-I don't do anything that will make the pain go away on its own	18	30.0	11	18.3		
Total	**17.13±2.32**		**8.17±3.13**		**t-test (17.985)**	**0.000****

Table (5): Correlation between joint motion exercises, contracture degree and pain intensity level pre and post 3 months of intervention (n=60).

Variables		Joint Motion exercises		Contracture degree		Pain intensity level	
		Pre intervention	Post 3 months of intervention	Pre intervention	Post 3 months of intervention	Pre intervention	Post 3 months of intervention
Joint Motion exercises	r						
	P value						
Contracture degree	r	.069	.978				
	P value	0.598	0.000**				
Pain intensity level	r	.109	.826	.065	0.230		
	P value	0.408	0.000**	0.621	.038*		

Discussion:

A burn constitutes an injury to bodily tissues resulting from exposure to heat, chemicals, electrical currents, or radiation. The impact of a burn is determined by several factors, including the temperature of the source of the burn, the duration of exposure, and the specific type of tissue affected. The treatment approach is significantly shaped by the burn's depth and the necessity for surgical intervention. Presently, deep partial thickness and full thickness burn injuries are managed through prompt excision and skin grafting. The primary objective of this early intervention is to reduce the likelihood of complications such as scar formation and contracture **(Ahmed et al., 2019)**. The current study aims to evaluate the effect of joint motion exercises in reducing pain and joint contractures among burn patient at Benha Teaching Hospital.

The current study reveals that, more than one third of the studied patients their age group was 40 to 50 years old with mean age 41.28 ± 10.83 years, indicating a relatively diverse age range. This age group representing the reproductive age group. This study was on the same line with **Mohammed et al., (2022),** who conducted a study entitled "Impact of active and passive range of motion exercises on contracture severity among burn patients" and mentioned that less than one quarter of the studied patients their age group was 40-≤50 years old. Also this finding was agreed with **Abd Elaal et al., (2022),** who carried out a study entitled "Effect of physical rehabilitation program based on range of motion exercise on hand joints function among patients with thermal burn" and found that the mean age of the studied patients was 41.3 ± 13.1 years.

In terms of gender, the present study reports that, females make up a slightly higher

percentage (more than half of the studied patients) and most of them were married. This could be referred to unsafe kitchen and cooking activities requested by the female housewives. This result was in accordance with **Ahmed et al., (2019),** who studied "Effect of range of motion exercise program on improving upper-arm region joints function for burned patients" and revealed that more than half of the studied patients were married. Contrariwise, this study was disagreed with **Seyyah and Topuz, (2021),** who studied "The effect of physiotherapy and rehabilitation on pain, kinesiophobia and functionality in upper extremity burns" and mentioned that majority of the studied patients were males.

The current study finds that, more than three quarters of the studied patients were from rural areas that might be due to the area served by the current study setting. This study was supported by **Ghasemi et al., (2024),** in their study entitled "The effect of an exercise program on the quality of life in burn patients" and reported that more than half of the studied patients were from suburban areas.

Regarding qualifications, a considerable proportion of the participants have low educational attainment, with less than half of the studied patients were unable to read or write and half of them weren't work, as the lowest level of education does not have sufficient information about burn prevention and the use of flammable tools carefully due to lack of education, knowledge and reliance on life experience. This study finding was in agreement with **Najafi et al., (2019),** who conducted a study entitled "The Effect of Range of Motion Exercises on Activity of Daily Living and Quality of Life in Patients with Burn" and mentioned that less than one quarter of the studied patients were illiterate. Contrariwise, this result was in disagreement with **Mohammed et al., (2022),** who reported that more than one quarter of them were not work.

The average length of hospital stay was 25.90 days with a standard deviation of 24.26 days, indicating significant variability in the duration of treatment, as length of hospital stay improve patient care and increase service efficiency. This study was on the same line with **Ahmed et al., (2019),** who represented that the mean length of hospital stay was 25.8±15.4 days. Otherwise, this finding was in disagreement with **Zhou et al., (2023)** in their study entitled "Risk factors and pathogens of wound infection in burn inpatients from east China" and found that the length of hospital stay of the studied patients ranged from 7 to 22 days.

Regarding the cause of the burn, three fifths of the studied patients occurred due to accidents. When it comes to the specific cause of the burn, fire (flame) is the most common cause as reported by half of patients, because the burn is trauma accident can occurred anywhere and anytime. This finding was in accordance with **Kara, (2023),** who carried out a study entitled "Effectiveness of early rehabilitation in hand burns" and found that most of the studied patients were exposed to accidental hand burn. Otherwise, this study was in congruence with **Seyyah and Topuz, (2021),** who mentioned that more than three quarters of the studied patients were exposed to flame burn.

The results also detail the locations of burns upon admission. The highly affected visible area was the neck (more than one third of the studied patients), while, the most affected invisible area was the abdomen (less than one third of the studied patients). This could be explained as visible sites are the most common and serious sites of burn injury because their significant functions in the activity of daily living. This finding was supported by **Zakeria et al., (2022),** who conducted a study entitled "Biosychosocial and educational needs of patients with burn injuries" and found that less than half of the

studied patients had neck burn and less than one quarter of them had trunk burn. Contrariwise, this study was disagreed with **Tibebu et al., (2021),** who carried out a study entitled "Health-related quality of life and its associated factors among burn patients at governmental referral hospitals of Amhara regional state, northwest Ethiopia" reported that more than two thirds of the studied patients had unexposed body part burn.

Burn percentage which measures the extent of the burn injury, has a mean of 43.80 with a standard deviation of 15.42, suggesting a broad range of burn severity, this could be due to the delay in transferring the patient. This includes the time taken to transport the patient to the burn center immediately following the burn injury, as well as the potential use of certain substances that may impede the care administered to the patient. Additionally, delays in providing first aid or the application of inappropriate treatment methods can exacerbate a minor burn injury, escalating it to a moderate or severe level. This finding was disagreed with **Schouten et al., (2022),** in their study entitled "The degree of joint range of motion limitations after burn injuries during recovery" and found that the mean percent of burn was 14.0±15.6 with range 50-92%.

In terms of wound infection, most of the studied patients their burn wounds exhibit no signs of infection. Additionally, the majority of them didn't undergone skin grafting. This might be due to their second degree burn with no infection guarantee a good healing process that requires no grafting. This study was in agreement with **AbdElaal et al., (2022),** who reported that most of the studied patients weren't undergone skin graft. Also, this study finding was on the same line with **Mulatu et al., (2022),** who carried out a study entitled "Outcome of burn injury and associated factor among patient visited at Addis Ababa burn, emergency and trauma hospital" and mentioned that more than two thirds of the studied patients had no infection in burn sites.

The results also highlight associated diseases. More than three quarters of patients have no other associated diseases as diabetes, hypertension, heart disease or kidney diseases. This result was supported by **Haddadi et al., (2020),** who conducted a study entitled "Baseline Characteristics and Outcomes of Patients with Head and Neck Burn Injuries" and mentioned that more than two thirds of the studied patients haven't any other comorbidities.

The results of the present study demonstrates a significant improvement in the patients' joint mobility with the percentage of patients reporting poor performance decreasing from the majority pre-intervention to minority post-intervention. This confirms the substantial effectiveness of the range of motion exercises across all joints. From researchers' point of view, practicing physical exercises; and patients' participation in functional activities played an important active role in improving patients' joint mobility and strength.

This result was in agreement with **Palackic et al., (2021),** who reported in their study about "Rehabilitation exercise training for burn injury" that, Rehabilitation exercise training (RET) has been demonstrated to be an effective intervention for enhancing lean body mass, glucose and protein metabolism, cardiorespiratory fitness, and muscle strength in individuals who have survived burns. Furthermore, RET is recognized as a safe and effective approach that aids in restoring functionality and minimizing post-burn complications. It is also recommended that a long-term exercise prescription plan be implemented for all patients who have experienced severe burns.

On contrary, **Lensing et al., (2020)**, reported in their study about "Demographic

and Burn Injury-Specific Variables Associated with Limited Joint Mobility at Discharge in a Multicenter Study" that, majority of their patients had limited ROM at discharge. This was because patients had larger burns, skin grafting and prolonged bed rest which led to increase in length of stay, weight gain, poor compliance with rehabilitation therapy and limited ROM on the joint motion level.

The results of the present study reveals a relatively noticeable improvement in pain intensity level was observed from less than half of patients expressed severe pain pre intervention to less than one fifth of patients expressed severe pain post 3 months of intervention. From researchers' point of view, this result may be due to effectiveness of joint motion exercise program in decreasing pain among burn patients. **This supports the 1st research hypothesis.**

This result comes in agreement with **Dewi et al., (2023),** who stated in their study about "effect of stretching exercise to increase joint range of motion and functional ability in post-burn shoulder contracture patients: a case report" that, after 3 times of physiotherapy, the results showed a decrease in silent and movement pain. As well as increased range of motion. In contrary, the results of **Dewanti et al., (2022),** who studied "Physical Therapy Rehabilitation Management on Burn Injury: A Case Report" showed that, following one week of physical therapy management, the outcomes indicated a notable improvement in range of motion, muscle strength, skin integrity, and overall functional status. In contrast, there was a reduction in the levels of silent pain and tenderness. Nevertheless, no alterations were noted in motion-related pain.

This study reveals a relatively noticeable improvement in the progression of contracture degree from three quarters of patients with moderate contractures pre intervention to less than one fifth of patients with moderate contractures post intervention. From the researchers' perspective, these findings can be explained that engaging in joint motion exercises during burn care sessions enhances blood circulation to the muscles being exercised. This increased blood flow results in a larger open capillary surface area within the active muscles, which subsequently improves functional capacity, reduces the risk of contractures, and contributes to both psychological and physical comfort. **This supports the 2nd research hypothesis.**

This result was disagreed with **Ashraf et al., (2022),** who conducted study about "Comparison of the effect of Range of Motion exercises versus stretching techniques in prevention of burn contractures of upper limb; RCT- A Randomized clinical trial" and concluded that, stretching techniques proved to be more effective in preventing post-burn contractures compared to Range of Motion exercises, as patients exhibited greater improvements in the range of motion at the joints of the upper limb following stretching.

On contrary, Mohammed et al., (2020), studied "Low Load Prolonged Stretch vs. High Load Brief Stretch in Treatment of Knee Contracture after Burn" and concluded that A low-load prolonged stretch is more effective than a high-load brief stretch in the treatment of knee contracture following a burn injury.

The results of the current study reveal that total score for patients' verbal expression of pain characteristics significantly improved between the pre intervention and post intervention. From researchers' point of view, this marked reduction in the total score suggests that the joint motion exercise had a substantial effect on enhancing patients' ability to express and describe the nature of their pain, as well as an improvement in concentration and a reduction in the pain's impact on their sleep and daily life after the intervention.

This result was in the same line with **Lerman et al., (2022),** who studied "sleep after burn injuries: a systematic review and meta-analysis" and found that, sleep following burn injuries is adversely affected during both the acute and chronic phases of recovery. Insufficient sleep is linked to detrimental physical and emotional consequences, including pain, emotional distress, and a decline in quality of life.

The results of the current study reveal that, a highly statistically significant positive correlation was found between range of motion exercises, pain intensity level and joint contractures post intervention. From researchers' point of view, these results may be attributed to the fact that, joint motion exercises were effective and had a significant impact on reducing pain intensity and improving contracture degree, with these effects becoming particularly evident after the exercises implementation. **This supports the 3rd research hypothesis.**

These results comes in agreement with **Sherif et al., (2022),** who reported in their study about "Impact of Active and Passive Range of Motion Exercises on Contracture Severity among Burn Patients" that, A highly statistically significant correlation existed between both active and passive range of motion and joint contractures within the study group.

In addition, these results are in the same line with **Madian et al.,(2024),** who studied "Effect of Range of Motion Exercise Program on Pain Level among Patients with Second Degree Burn at Mansoura University Hospitals" and found that, there were high statistically significant – association regarding Range of motion and pain level in the post-test, and added that, a significant improvement of pain level was found after implementation of the ROM program.

Conclusion

The results of the present study indicated that implementation of joint motion exercises has proven to be effective in alleviating pain intensity level and progression of contractures for second degree burn patients, which supports the study hypotheses.

Recommendations

In light of the results obtained from the present study, the following recommendations are suggested:

1- Emphasizing the importance of promptly commencing range of motion exercises as an essential strategy to mitigate the risk of contractures in individuals suffering from severe burns.
2- Simple instruction booklet should be provided for burn patients regarding joint motion exercises.
3- Future research should focus on assessing the factors that contribute to joint contractures in patients with second degree burn injuries.
4- Furthermore, it is essential to conduct studies involving larger patient populations and long-term evaluations to determine the safety and effectiveness of physical therapy exercise programs for patients with burn injuries.

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