

## Original Article

# Paraffin wax bath therapy versus therapeutic ultrasound in management of post burn contractures of small joints of hand

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**Abstract:** Burn injury may result in psychological and physical disability. Post-burn contractures, a poor outcome of the wound healing process, may limit the movement at the joints and impair the quality of life of the survivors. To compare outcomes of paraffin wax bath therapy and therapeutic ultrasound in post-burn contractures of small joints of the hand; eighty patients with post-burn contractures were enrolled in this study. Patients were divided into two groups; group I (n=40) was treated with ultrasound therapy and group II (n=40) with paraffin wax bath therapy, while stretching exercises & protocols for massage of the burn scar contracture were the same for both groups. The study participants were assessed for passive range of motion (P-ROM) for the extension at inter-phalangeal (IP) joints of the involved finger at the first contact session and the end of the 8th week of the treatment. The mean age of the patients was 25.62 years in Group-I and 24.67 years in group II. Group-I had 29 (72.5%) males and 11 (27.5%) females and group-II had 37 (92.5%) males and 3 (7.5%) females. After 8 weeks of treatment, Group-I displayed improvement in range of motion with a mean increase of  $4.97 \pm SD 0.94$  degrees while Group-II showed a mean increase of  $9.37 \pm SD 4.41$  degrees with *P* value of  $<0.005$ . Paraffin wax therapy with stretching exercises and massage were more effective as compared to ultrasound therapy with stretching exercises and massage for the management of post-burn contractures of small joints of the hand.

**Keywords:** Paraffin Wax therapy, ultrasound therapy, post burn contractures, burn, physiotherapy

## Introduction

Burn injuries are quite common and especially in low-income countries [1]. Extensive burns may be fatal and life threatening while less severe injuries may lead to a lengthy hospital stay, prolonged illness, morbidity, deformity, various physical or psychological problems [2]. As superficial burn wounds are painful due to which patients prefer to keep the affected areas and the joints in a position where these are minimally aching. Usually, this is the position of rest but at the same time it is not the functional position. If the patient maintains this position during wound healing phase for prolonged period, it may result in contractures development that may become severe during the remodeling phase due to the organization of the scar. Even after the wound management

phase is over, these patients may suffer several post-burn complications.

Hands are mostly involved in burn injuries especially in electric and flame burn injuries as these are organs of action and these are involved in protecting the body from any trauma or insult [3]. Because hands play an active role in action and protection maneuvers in daily life and mostly come across post-burn contractures and other complications as well [4].

After acute burn injury, early assessment and treatment by a multidisciplinary team including a Physiotherapist is imperative to improve the quality of life of the individual affected with burn injury [5]. Physical therapist plays a vital role in the management of burn injuries as the role of physiotherapist starts quite early in the wound management phase and post burn com-

plications. Contractures are one of the common post-burn complications [6]. Different exercise regimen and therapeutic modalities are utilized to regain the functionality of hands after post-burn complications. Controlled stretching and strengthening exercise regimens also have a role in the burn rehabilitation [7]. Ultrasound therapy and paraffin wax therapy have long been utilized to restore the normal pliability of skin and range of movement at various joints. Therapeutic ultrasound has been found effective in restoring the extensibility of the scar tissue, thus assisting in the mobility of the involved area and joints [8]. Paraffin wax bath therapy mainly acts through moist heat which softens the skin and scar and thus increases the range of movement. Paraffin wax therapy, combined with exercises and the use of splints, has also been found helpful in restoring the range of movements [9, 10]. Therapeutic Exercises are widely included in the treatment of the burn patients [11]. The basic purpose of the Physical therapy is to promote the mobility by encouraging the exercise of extremities for ambulation and reduce the incidence or impact of the burn contracture [12]. However, not much comparative literature is available on the outcomes of therapeutic ultrasound and paraffin wax bath therapy combined with exercise. The present study is to compare the outcome of two modalities when applied for post-burn contractures of small joints of hands.

### **Material and methods**

#### *Study design and setting*

A quasi-experimental study was conducted at the Physical Therapy Department of Allied Burn & Reconstructive Surgery Centre, Faisalabad, from August 2020 to Jan 2021. All patients were met in the Outdoor Patient Department (OPD) of the Burn Centre.

#### *Inclusion criteria*

The study's inclusion criteria was age, limited from 18-44 years, with post-burn contractures of small joints of either hand with a restricted range of motion of finger's with a post-burn duration of more than three months. Patients having these contractures of more than six months were not included in the study.

#### *Exclusion criteria*

Patients having any congenital or musculoskeletal or neurological disorder or with diabetes were not registered, also patients who underwent any treatment before enrollment in this study, e.g., surgery or physiotherapy previously, were excluded from the study.

#### *Ethical statement*

All the participants who agreed to participate were briefed about the purpose of this study, written informed consent was taken. This study was approved by the ethical committee of the concerned institution. This study followed the policy and rules and regulations and ethical standards of the institute and with the 1964 Helsinki Declaration and its later amendments. (Number for ERC acknowledgment is 2016-17/PHRC/PMC/110).

#### *Grouping method*

A manual lottery procedure was preferred to assign the subjects to two groups randomly. All patients in both groups were treated three days per week. All the patients attended all sessions till 8 weeks and followed the instructions.

*Group-I ultrasonic therapy group:* Group-I consisted of 40 patients and was treated with Ultrasonic Therapy along with stretching exercise and massage. Ultrasonic therapy treatment consisted of following parameters: frequency of 3 Mega-Hertz for 5 minutes with pulsed duty cycle and power of 0.50 to 0.80 W/CM<sup>2</sup> (watt/centimeter square) applied in a circular manner over the scar contracture with a 1-cm diameter probe.

*Group-II paraffin wax bath therapy group:* Group-II was treated with paraffin wax bath therapy with stretching exercise and massage. This therapy consisted of applying 10-14 layers of wax at a temperature of 42-44°C by brush paint method, and the area was covered with a glove for 20 minutes. When the glove was removed, used paraffin wax was discarded each time.

#### *Exercise and massage*

A total of 3 sets of the stretching exercise with 5 repetitions each were performed by the phys-

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**Table 1.** Characteristics of patients at initial assessment with comparison amongst both groups

	Group-I Ultrasound Therapy (n=40)	Group-II Paraffin Wax bath Therapy (n=40)
Age (years)	25.62	24.67
Male	29	37
Female	11	3
Right hand involved	28	27
Left hand involved	12	13

ical therapist to each patient of both groups individually on each visit. The lubricating agent was used for massage to counter the effects of dryness and prevent the breaking of the scar tissue which might have further complicated the scar otherwise. Deep tissue massage on the scar and the surrounding skin was applied for 4-6 minutes, 6-8 times daily by the patient himself or herself.

### Main outcome measure

Passive range of motion (PROM) for extension at inter-phalangeal (IP) joint of the involved fingers was assessed using a manual goniometer at the start of 1st session and the end of eight weeks.

### Statistical analysis

Descriptive statistics are explained as frequency and percentage while numerical variables are explained as mean  $\pm$  standard deviation; independent sample t-test was used for inter-group comparisons. Paired t-test was used within the groups for change in range of motion. SPSS version 17.0 was used for this purpose.

### Results

Demographics and main characteristics of the study participants are mentioned in **Table 1**. This study include 80 patients. Out of 80 patients, 66 (82.5%) were male, 14 (17.5%) were females. Group-I had 29 (72.5%) males and 11 (27.5%) females and group-II had 37 (92.5%) males and 3 (37.5%) females. The mean age of the patients was 25.62 years in Group-I and 24.67 years in group II. All patients reported movement limitation and some patients reported itching and dry skin.

### Cause of the injury

The cause of the burn injury was flame burn in 54 (67.5 %), electrical burn in 13 (16.3%), scalds in 11 (13.8%), and chemical burns in 2 (2.5%). A total of 55 cases (68.75%) had contractures of the right hand, 25 cases (31.3%) had involved the left hand (**Figures 1-3**).

### Normality of the data

The normality of data was checked by an independent sample test. There was no significant difference between the groups at the first evaluation ( $P > 0.05$ ). **Table 2**, while a comparison of the groups is described in **Table 3**.

### Main outcome measure at baseline and after 8 weeks

The average passive range of motion (P-ROM) in both groups at the time of 1<sup>st</sup> treatment was mean of  $28.18 \pm S.D 12.55$  degree and after the 8 weeks of treatment it was recorded as mean  $35.36 \pm S.D 13.16$  degree. Hence, the mean improvement in the passive range of motion (P-ROM) was 7.17 degrees ( $P < 0.005$ ) (95% confidence interval). The improvement in passive range of motion (P-ROM) for Group-I was  $4.97 \pm S.D 0.94$  degree while Group-II patients showed improvement of  $9.37 \pm S.D 4.41$  degrees ( $P < 0.005$ ) (**Table 4**).

### Discussion

Hands are most commonly involved in burn injuries as these are organs of action and also these are involved in protecting the body from any trauma or insult. The study used the objective measure i.e., range of motion which was assessed by a manual goniometer for each patient by the same Physiotherapist. We compared the gain in the passive range of motion i-e extension, at proximal inter-phalangeal (PIP) joints of the hands treated with Ultrasound Therapy and Paraffin Wax Bath Therapy.

In a study, Holavanahalli and colleagues compared the effects of paraffin wax therapy and stretching exercise on 23 burn survivors with shoulder contracture and found that paraffin wax bath therapy with stretching exercise were proved to be more effective to improve the range of motion exercise. These patients

Group-I Ultrasound Group      Group-II Wax Bath Therapy Group

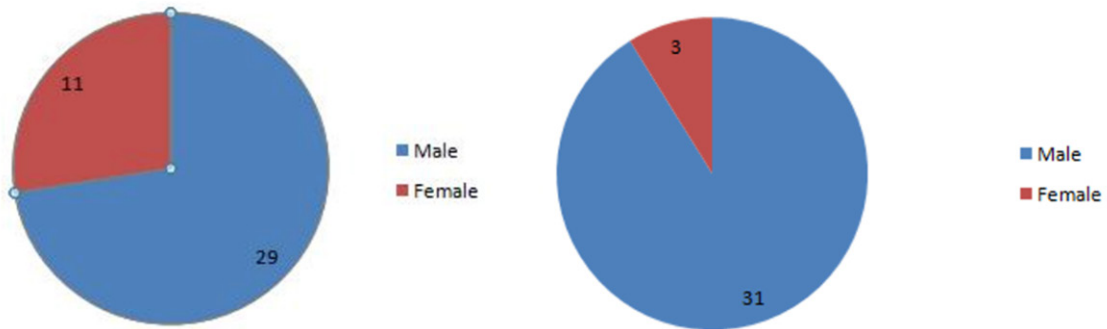


Figure 1. Graphic presentation of the participants of two groups.

Group-I Ultrasound Group      Group-II Wax Bath Therapy Group

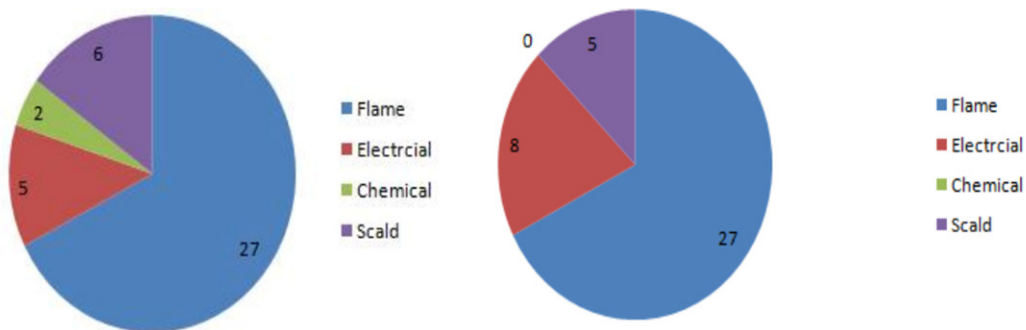


Figure 2. Graph is presentation of types of burns among the participants of two groups.

Group-I Ultrasound Group      Group-II Wax Bath Therapy Group

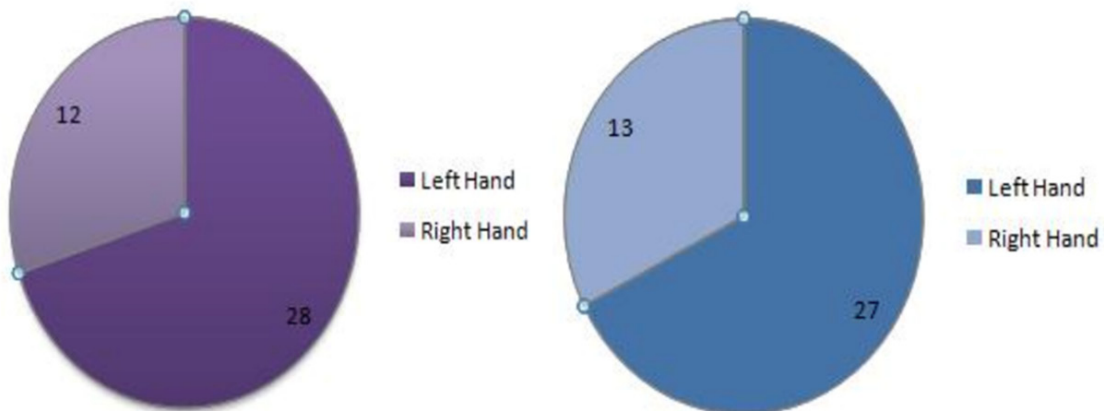


Figure 3. Involvement of right or left hand in both groups.

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**Table 2.** Age and clinical features of patients with test of similarity at initial assessment

	Group-I Ultrasound Therapy (n=40)	Group-II Paraffin Wax bath Therapy (n=40)	P-value
Age (years)	25.62	24.67	0.773*
Pre-treatment ROM**	27.75 ± 13.81	28.62 ± 11.32	0.216*

\*Independent samples t-test, values are represented as mean (standard deviation). \*\*ROM, range of motion.

**Table 3.** Comparison of change in range of motion between the groups

	Group-I Ultrasound Therapy (n=40)	Group-II Paraffin Wax bath (n=40)
ROM before initial treatment (in Degree)	27.75 ± 13.81	28.62 ± 11.32
ROM after the 8 weeks of treatment (in Degree)	32.75 ± 13.72	38.00 ± 12.18

**Table 4.** Improvement in range of motion between the groups

Groups	Mean ± Sd. Deviation
Ultrasound therapy (n=40)	4.97 (0.94)
Paraffin Wax bath (n=40)	9.37 (4.41)

**Table 5.** Gender based improvement in the range of motion overall

	ROM before initial Treatment (in Degree)	ROM after 8 weeks of Treatment (in Degree)
Male	27.87 ± 1.29	35.06 ± 1.29
Female	29.64 ± 1.32	36.78 ± 1.47

received 6 sessions for two weeks [13]. While in our study both groups received the treatment for 8 weeks. The population in this study was patients of above 14 years and in our study only adults' up to 44 years were included.

In another study carried out by Zübeyir and colleagues effectiveness of matrix rhythm therapy (MRT), ultrasound treatment (UT), laser treatment (LT) in patients with second or third-degree injuries involving the upper limb [14]. They combined these three therapies with whirlpool and exercise in 45 burn victims. The variables studied included intensity of pain, range of motion, muscle power, skin elasticity, etc. The active range at the joint was increased in all groups. But they found that there was no important alteration in skin pliability in all these groups.

Ward et al. studied the effect of ultrasound therapy on reduction in scar tightness and pain in post-burn cases. They applied the ultrasound therapy for 10 minutes for 2 weeks along with stretching exercises before they concluded that

ultrasound therapy in patients with post-burn contracture did not improve the range or reduce pain. Also, they declared that stretching exercises of 10 minutes may not be sufficient for the sustained effect of the treatment. Now it is a proven fact that exercise has to be continued for a considerable time before the pressure effect on a scar may help reorganize the collagen and reduce the hypertrophy of the skin [15].

Head and colleagues studied the effects of Paraffin Wax bath and stretching exercises for contracture management on 20 subjects and found that 2-20-degree range was improved after several weeks and skin was softer and its pliability was much increased [16].

Dilek et al. studied the effects of Paraffin Wax therapy on hand stiffness On 56 patients and found that range of movement was increased and the pain was much decreased after 12 weeks and concluded that it was an effective treatment for hand stiffness and reducing pain [17].

Results of the present study also show that there was a definite increase in the range of movements at small joints of hand after the use of both of these therapies but these were significantly marked with paraffin wax bath therapy. The average gain in the range of motion in males of both groups was 7.19 degrees as compared to the 7.14 degrees in female participants of both groups (Table 5). The gain in the range of movement was about double of that gained with ultrasound therapy. This difference might have been due to the effect of the moist heat of paraffin. This is supported by the finding that skin was softer at the end of the treatment with wax therapy and this effect faded away with the passage of time.

As shown in this study, paraffin wax therapy was significantly found effective to improve the range of motion when compared with ultrasound therapy. However, both of these therapies were utilized with stretching exercises and massage in post-burn contractures of small joints of the hand.

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### Disclosure of conflict of interest

None.

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