

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

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ABSTRACT

Background: Burn is an injury which affects approximately all systems of body and is very common among accidental injuries which causes burden on hospitals. A lot of treatment interventions are introduced until now for the management of burn to lessen complications and increase quality of life in survivors.

Methodology: Forty-eight patients who complete selection criteria were included in this study. Written informed consent was obtained from every participant in this study before starting any physical examination. Participants was allocated into two groups randomly. On 1st day range of motion at involved joints was assessed using goniometry. Group A is treated with stretching techniques, while group B is treated with Range of Motion exercises. Conventional treatment for both groups' participants includes isometrics exercise and anti-contracture positioning. Treatment frequency was 3 times a week.

Results: Comparison of all upper extremity joint movements at baseline and 4th week has shown that there was a significant difference between post treatment range of motion with p value of less than 0.05 showing that group A is more effective in improving shoulder flexion after burn injury. Comparison of mean of all measured range of motions in group A and B was 57.08 degree \pm 28.29 and 59.25 degree \pm 33.52 in pre-treatment and 96.66 degree \pm 36.35 and 81.49 degree \pm 33.10 post-treatment.

Conclusion: Stretching techniques are more effective in the prevention of post burn contractures than Range of Motion exercises, as more improvement was noted in range of motion at joints of upper limb in patients after stretching.

Keywords: ROM (Range of motion), RCT (randomized controlled trail)

INTRODUCTION

A significant burn is a serious damage which affect approximately every organ system of body of patients, their mental status and relationships with the others too¹. Burn causes death of a large number of affected persons which has been reduced in recent years due to critical burn care but disease, deformity and deaths due to major burn is a serious problem for clinical staff of hospital². In spite of decrease in burn accidents, they are among the common cases of injury in accident and emergency department of hospitals throughout the world causing significant disease and deaths³.

Pathophysiological changes which occur due to burn included inflammatory and metabolic lasts for a long period of time after injury⁴. Pathophysiological manifestation of thermal burn injury includes local and systemic changes. Local changes include coagulation, stasis and hyperemia in which inflammatory processes occurs. Systemic inflammatory and metabolic changes affect approximately all major systems throughout the body⁵.

Burns occur due to coming in contact with the hot objects and most often is due to hot liquids or steam causing scald burn; hot surfaces; fire flames; high voltage electric current; infrared radiations and certain chemicals⁶. There are many types of burn on the basis of source of injury such as flame burn, electrical burn, acid burn, alkali burn, scald burn, flash burn, sun burn, thermal burn, radiation burn, friction burn⁷.

Burns are more common in populations of low socioeconomic status and underdeveloped nations. 40% affected individual die due to burn in Southeast Asia and in Pakistan estimated occurrence of burn is 1388/100,000 annually as reported by World Health Organization⁸.

Burn contractures are defined as loss of ability to perform complete range of motion at joint after burn injury due to decrease in flexibility of soft tissue⁹. It is a very notorious problem after burn which develops due to formation of excessive scar tissue mostly at deep burned areas causing impairment in range of motion at involved joints resulting in disability¹⁰.

Contractures are prevented by physical therapy just after burn injury in acute phase, proper anti-contracture splints, anti-contracture positioning, stretching, range of motion exercise, scar massage and by performing activities of daily livings^{11,12}.

Physical therapy rehabilitation after burn is very important to restore normal functions, decrease disability, promote self-acceptance and family restoring. There are two main goals of physical therapy of burn patients (i) maintain mobility at involved body segments and (ii) prevent contractures which require prolong stretch and proper positioning¹.

Rehabilitation of burn survivors initiate after the day of accident and continue for months to years involving physical, psychological, occupational rehabilitation. Without any rehabilitation procedure of burn, every passing day will cause decrease in recovery and poor prognosis and difficult treatment¹¹. Along with contracture prevention and management Physical therapist manage posture for chest clearance, chest physiotherapy, elevate limbs to prevent edema, patient educations, promote activities of daily livings, patient education regarding rehabilitation and management of hypertrophic scar¹³.

In physical therapy, soft tissue structures are stretched for the sustain or increase extensibility and relief of spasm after injury. Stretching increases the range of motion at joints after burn injury and also to treat burn associated contractures¹⁴. Passive range of motion exercises are helpful to decrease soft tissue resistance when muscle strength is reduced and also in painful condition to gain range of motion at joints. Patient should also maintain proper anti-contracture positioning to prevent contracture which should begin early after the injury and maintain most of the time. Range of motion exercises should be in cooperated with positioning, because a static position for long period of time cause decrease in range of motion^{14,15}.

Up till now, the treatment methods of stretching and range of motion exercises are used effectively in the management of burn contractures and are evidence based by literature separately. The accessible literature demonstrates that there is very little evidence that compares the effects of stretching techniques versus range of motion exercises in the prevention of burn contractures.

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So, the rationale of this study is to introduce awareness in the general public regarding the importance of physical therapy in the prevention of burn contractures.

MATERIALS AND METHODS:

This study was conducted in Department of Burn and Plastic surgery, Mayo Hospital Lahore after approval of institutional ethical committee. A clear explanation about the study was given to all the patients and they were included in study after obtaining written informed consent following suitable inclusion and exclusion criteria. Subjects who were included in the study were of age group between 15 to 40 years irrelevant of their side and sex, with clinical diagnosis of 2nd and 3rd degree burns of more than 48 hours duration and patients of skin grafts after 10 days of grafting. Subjects were divided into 2 groups, with 24 subjects in each group.

Selection of patients into two equal groups was random selection as Department of Burn and Plastic Surgery is divided into 3 bays, 2 for males and 1 for females. Patients of 1st male bay were included in group A and of 2nd male bay in group B. Patients of half of the beds of female's bay were included in group A and another half in group B. The treatment was followed for period of four weeks consisting of 12 sessions. Prevention of contractures was evaluated by minimizing effect of burn on upper limb range of motion using goniometry. Joints of shoulder, elbow and wrist were considered in study and active range of motion was measured at every joint by universal goniometer with a standardized technique. In case of bilateral burn, data of more dependent limb was noted. All the relevant data was noted on patient demographic and assessment performa at day 1 after 2 weeks of treatment and then after 4 weeks of treatment. Before starting stretching techniques or range of motion exercises patients were provided with pain relieving medicines such as NSAIDs or Morphine by nurse.



Group A: 24 subjects have been received conventional treatment of 10 repetition of isometric exercises of shoulder flexors, abductors, adductors, medial and lateral rotators, elbow flexors and extensors and wrist flexors and extensors applied manually with a holding time of 5 seconds. anti-contracture positioning was maintained at shoulder in lying and sitting, arm into 90-degree abduction, elbow into extension and wrist into 30-40-degree extension, metacarpophalangeal into 60-70-degree flexion most of the time (except for carrying out exercise treatment and functional activities). Patients who were unable to maintained anti-contracture positioning splints were applied to them

Table 2: Mean values of ROM of the shoulder joint of the intervention group and the control group

ROM	Intervention Group		Control Group		P value
	After 4 weeks	At baseline	After 4 weeks	At baseline	
Flexion	95.0 ±10.0	164.16 ±8.612	120.0± 35.5	145.0 ± 19.57	0.00
Extension	37.50± 9.354	63.33± 6.055	47.5 ±14.4	66.2± 7.50	0.00
Abduction	104.16± 7.359	168.33± 4.08	110.0 ±25.4	143.7 ±8.53	0.00
Internal Rotation	50.83± 11.14	81.66± 4.08	71.2 ±10.3	77.5 ±8.66	0.00
External Rotation	40.83± 9.17	68.33 ±9.30	50.0 ±13.5	65.0± 9.12	0.00

Table 3: Mean values of ROM of the elbow & wrist joint of the intervention group and the control group

ROM	Intervention Group		Control Group		P value
	After 4 weeks	At baseline	After 4 weeks	At baseline	
Elbow Flexion	102.5±12.07	139.0±5.67	109.2±13.67	130.7 ± 8.38	0.00
Wrist flexion	45.9 ± 9.59	82.9 ±9.83	48.5 ±11.5	69.2 ±13.3	0.00
Wrist Extension	35.9± 8.94	74.0 ±9.71	32.0±10.3	58.5± 11.0	0.00



Group B: Passive range of motion exercise was applied at involved shoulder, elbow and wrist joints of 10 repetition during 3 alternate days of a week for 2 weeks and 20 repetition during 3 alternate days of next 2 weeks same as group A within the available range of motion before point of tissue resistance. Range of motion of involved shoulder, elbow and wrist was measured which affect more after burn at 1st day and after 2 weeks of treatment and after 4 weeks of treatment by goniometry. A total of 12 treatment sessions have been taken by the subjects and one session was lasted for 20 minutes. During rest of the days, patient was asked to do active range of motion exercises and isometric exercise.

RESULTS

Comparison of shoulder movements (Flexion, extension, abduction, internal and external rotation) at baseline and 4th week has shown that there was a significant difference between post treatment range of motion with mean values of these movements in group A at baseline are follows 95.00±10.00(F), 37.50±9.35(E), 104.16±7.35(ABD), 50.83±11.14 (I.R), 40.83±9.17(E.R) and in group B were 120.00±35.59(F), 47.50±14.43(E), 110.00±25.49 (ABD), 71.25±10.30 (I.R), 50.00±13.54(E.R) respectively. After 4 weeks of rehabilitation protocol the means values were 164.16±8.61(F), 63.33±6.05(E), 110.00±25.49(ABD), 71.25±10.30 (I.R), 50.00±13.54 (E.R), in group A and in group B were 145.00±19.57(F), 66.25±7.50(E), 143.75±8.5(ABD), 77.50±8.66 (I.R), 65.00±9.12(E.R) with p value of less than 0.05 showing that group A is more effective in improving shoulder flexion after burn injury. Comparison of mean of all measured range of motions in group A and B was 57.08 degree ±28.29 and 59.25 degree±33.52 in pre-treatment and 96.66 degree ±36.35 and 81.49 degree±33.10 post-treatment. Showing that group A improved more range of motion than group B. Comparison of elbow flexion, extension with wrist flexion, extension in pre and post treatment scores in group A and B show significant difference as value of p is less than 0.05, in pair wise comparison also there is significant difference in baseline, after 2 weeks and then after 4 weeks in improving wrist flexion after burn injury.

Table 1: Descriptive statistical analysis Intervention group and control group (n=48)

	Intervention Group	Control Group
Gender	19/5	18/6
Age	25.375 ± (8.7318)	29.583 ± (9.8153)
BMI	22.56±(3.35)	22.84 ± (3.08)

DISCUSSION

The study was conducted to find out the effectiveness of Range of Motion exercises in comparison with Stretching techniques in the prevention of burn contractures of upper extremity involving shoulder, elbow or wrist joint. 48 patients were included in this study equally divided into two groups of A and B having 24 participants in each group. Group A receives stretching techniques along with anti-contracture positioning and isometric strengthening exercises. Group B receives range of motion exercises along with anti-contracture positioning and isometric exercises.

Sixty nine joints were treated in 48 patients of which 42 were wrist joints, 17 were elbow joints and 10 shoulder joints. This study showed that both these interventions are effective in contracture prevention by gaining range of motion at joints after burn injury but stretching techniques are more effective than range of motion exercises in improving range of motion at joints after burn injury. Previous studies were conducted for shoulder joints and joints of hands after burn injury to prevent and manage contractures but none of these showed effect of stretching technique and range of motion exercise on elbow and wrist joints. Those studies also do not incorporate anti-contracture positioning and isometric exercises to maintain joint range of motion and reduce effect of deconditioning on muscles.

Passive stretching exercise was used for burn patients in a study conducted at Salt Lake City, Utah by R. Scot Ward, PT 14 burned limbs were studied in 9 male patients with 14 joints were involved and 10 minutes of passive stretching maneuver was used along with ultrasound. As both groups receive same stretching technique so no significant difference was noted¹⁶. Bharat Bhushan Dogra in his study conducted in burn patients of 2nd and 3rd degree burns as these cause significant contracture formation and then cause deformity of limbs, emphasis was placed on burns of upper limb as it effects daily task performance than lower limb as in this study, prevention of contractures is recommended by splintage and physical therapy exercises¹⁷. In a study conducted by Vinita Puri at KEM hospital, Mumbai, India 90 joints of the 42 patients studied for contracture treatment by serial splintage, they conducted study on upper extremity as it is most common burned area and have tendency to undergo contracture formation. The key elements for contracture prevention are splintage and physical therapy exercise. They used the passive stretching technique for contracture treatment along with splintage and scar massage. Their results showed that contractures can be prevented and treated by physical therapy efficiently so lesser surgical interventions was required¹⁸.

A study was conducted by Yoon Soo Cho in Korea in 2013 on burn patients for hypertrophic scar management, they used the treatment of range of motion exercises along with massage techniques for scar management. Their results showed significant improvement¹⁹. In an observational study done by Akash Gupta in India on burn patients, prevention of burn contracture is called to be best for burn victims, prevention is advised by positioning, splintage, scar excision and through physical therapy²⁰. Nadia Mohammad Taha in a study in Egypt stretching, range of motion exercises and other preventive measures are discussed for the prevention of burn contractures, these also assist in the management of pain, according to guidelines it is advised that these physical therapy interventions should start soon after injury to prevent disability²¹.

CONCLUSION

Both the Stretching techniques and Range of Motion exercises are useful in prevention of burn contractures are non-invasive and cost effective but as noted in this study, Stretching is more Effective in improving range of motion at joints so it is recommended to use this technique clinically in prevention of contractures. Further research on large scale is recommended.

Ethics approval and consent to participateThe study's goals were explained to the participants, and written informed consent was obtained. The Research Center King Edward Medical University Lahore's Committee of Institutional Review Board (IBR) approved the work.

Competing interestsThere was no competing interest among authors. All results of this study are presented honestly, clearly without any false or in appropriate data manipulation.

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