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Case Report

Hourly Supervised Physiotherapy Treatment and Dynamic Splinting of Elbow Contracture in A 30% Mixed Burn - A Case Report

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ABSTRACT

Background: There is enough evidence on role of Physiotherapy and splinting to prevent contractures in post-burn patients. However, timely intervention and frequent sessions along with splinting helped to achieve functional independence and full ROM in a patient with 90^0 fixed elbow contracture, in 30% mixed burns.

A 13 years old male was admitted to burn unit having sustained 30% mixed electrical burns over face, bilateral upper limb, left flank of abdomen and bilateral dorsum aspect of foot. He presented with inability to do all the functional movements of bilateral elbow joints and wrists.

On 3rd post admission day, Physiotherapy treatment was started with relaxed passive movement of elbow and wrist and active movements of shoulder and neck. Progressive hourly sessions with increased duration and hold time of the end range stretched position were planned. On 6 post admission day, dynamic splint was given. Patient received a total 42 Physiotherapy sessions during the in-patient phase and the patient achieved full ROM of bilateral Elbow joints and was functionally independent.

Conclusion: Frequent, every hourly Physiotherapy sessions in form of passive range of motion, sustained stretch, splinting and strengthening exercises gave excellent results in terms of full range of motion and complete functional independence in a 30% mixed burns with bilateral elbow contractures.

Key words: Splinting, Positioning, Passive movements, elbow Contracture, mixed Burns.

INTRODUCTION

Burn injury remains the common cause of trauma especially in low and middle-income countries. Burn constitutes the second highest incidence of trauma related deaths globally. [(1)] Burn, by definition, damage the skin and also may involve damage to the underlying soft tissues, muscles and bone. All of these factors contribute to contracture formation in burn injuries. [(2)]

Contractures are defined as an inability to perform full range of motion of joint. [(3)] If deep partial thickness and full – thickness burns which are not treated with excision and grafting can be disabling, as these deep injuries often lead to burn scar contractures unless provided with adequate positioning and splinting. Burn scar contractures are severely disfiguring, painful and itching. Patients with burn scar contractures which interfere with activities of daily living are often marginalized and experience difficulties in receiving education and securing work. [(4)] Burn contractures hinder joint mobility, resulting in functional impairment and reduced quality of life. [(5)]

Contractures result from a combination of possible factors - improper limb positioning, duration of immobilization and muscle, soft tissue. Burned areas should be positioned in an elongated state or neutral position of function.

Physiotherapy plays an important role in the reduction of contractures in burn cases. Commonly, physical therapy interventions are directed towards prevention of scar contracture, preservation of normal range of motion, maintenance or improvement in muscle strength, return to pre -burn function and performance of activities of daily living. The long term goals of burn rehabilitation aims at prevention or minimization of hypertrophic scar formation and cosmetic deformity which can be achieved by stretching programs and functional training. [(6)]

Positioning programme begins on the day of admission and focuses on maintenance of soft tissue in an elongated state, preserving function, preventing tissue destruction and minimizing oedema. Splinting of the involved joints can be viewed as an extension of a positioning programme in anti- deformity positions. Splinting is known for preventing contractures, reduction of developing contracture and reducing the overall pain experience. [(6)]

Most splints used for burn are static however dynamic splint also have been successfully used in the care of patient with a burn injury. These splints have moveable parts which allow movement of joint. At the same time, dynamic splint apply a low-load, prolonged stress that can be adjusted to a patient's tolerance. They offer great potential for correcting a developing contracture and the early return of active function in areas of extensive burn and grafting. [(6)]

Active-assisted and passive exercise should be initiated if a patient cannot fully achieve active ROM. Range of motion exercises with end range sustained stretch helps to elongate the immature scar and a developing contracture can be corrected.

CASE REPORT

A 13 years old male was admitted to burn unit having sustained 30% mixed burn over face , bilateral upper limb, left flank of abdomen and bilateral dorsum aspect of foot. It was the case of accidental burn due to electrocution while flying kite over the terrace at around 9am The patient was taken to a private hospital where initial treatment with wound dressing was given. The patient was then shifted to a Tertiary Health Care Centre at Hingna on the same day, where he was managed conservatively with appropriate medications, high protein diet and local wound dressing with collagen.

The patient was referred for Physiotherapy treatment on day-3 post burn injury after good uptake of collagen was confirmed. After the initial examination of depth of burns and percent of TBSA involved, the therapist examined the patient to determine the presence of impairments and activity limitations.

On observation with the patient in supine position, bilateral elbows were flexed, forearm mid-way between pronation and supination and placed over the abdomen, wrists were in flexion and neck flexed.

On examination, passive movements of bilateral elbow joints showed 10^0 of flexion and extension, from100^0 fixed elbow position, forearm fixed in mid-prone, bilateral wrist joints with 10^0 of flexion-extension and difficulty in taking neck into extension. The pain on Visual Analogue Scale was 0 for elbow movements with no degrees of movement. A Visual Analogue Scale rating is one of the main outcome measures and was recorded on a horizontal linear scale from 0 to 10; with 0 being no pain at all and 10 being the maximum pain imagined.

As the patient could not fully achieve active ROM, he was initially treated with gentle relaxed passive ROM exercises of elbow to achieve elbow extension, supination-pronation movements were initiated within pain limits and wrist and finger movements were started. Sustained stretch with hold of 10 second was given to elbow flexors to achieve elbow extension. Active neck movements were given and neck extension exercises were reinforced to prevent neck flexion contractures. Shoulder

free ROM movements were given for flexion-extension, abduction-adduction and shoulder elevation-bracing exercises. Proprioceptive neuromuscular facilitation using diagonal pattern strengthening for shoulders were started 2 days later. Lower limb ankle pump exercises with limb elevated on two pillows to reduce swelling, active range of motion exercises for hip-knee were also started. The burn wound of bilateral upper limb was treated with recommended positioning i.e. by keeping the shoulders in 90^0 abduction and external rotation with elbow positioned in available range of possible extension. A soft roll was placed at scapular region to maintain the neck in extension. Use of pillow was discouraged.

Patient was encouraged to perform all the shoulder and neck exercises in sitting position. Dynamic quadriceps training was initiated and patient was encouraged to ambulate from third post admission day.

A custom-made Dynamic elbow splint (fig.1) was given for right elbow on day-6 post burn injury, to stretch elbow flexors and gain elbow extension. A day later, the left elbow was positioned in another dynamic splint. The pain on VAS on 6^{th} day post-burn injury for elbow flexion-extension was 7. Active exercises in available ranges and passive movements with end range stretches were given followed by positioning in the Dynamic elbow splint. (fig.3) Hourly Physiotherapy sessions were continued to achieve progressive functional elbow joint flexion and extension. Four days after the Physiotherapy was started, we achieved 60^0 to 100^0 of elbow extension ROM and 0^0-20^0 of pronation and supination. We then aimed at improving elbow flexion ranges beyond 100^0. The patient was advised to moisturize the wound with coconut oil to improve the pliability of the soft tissues around elbow joint and to prevent dryness of skin.

The same protocol was given for left elbow. We focussed on passive stretches, functional activities such as self-care, strengthening of elbow flexors and extensors, scapular retractors - middle trapezius, rhomboids, pronator - supinator of forearm and wrist flexors – extensors and gripping exercises were also incorporated. Stretching for upper fibres of trapezius and sternocleidomastoid were initiated.

On day-9 post burn injury, patients has received (6 PT sessions per day for 7 days= 42 PT sessions), elbow flexion range was 60^0 -140^0 and elbow extension was 140^0-60^0, pronation and supination of 0^0-40^0 with pain on VAS reduced to 5.

On day -13 post burn injury, the patient achieved complete elbow flexion-extension range of motions for bilateral elbow joints and complete range of forearm pronation- supination. He was functionally independent with no difficulty in eating, grooming, toilet activities etc. Ambulation of 1000m was achieved on the day of discharge.

RESULTS

A 13 year old boy weighing 35 kgs, with 30% mixed burns of bilateral upper limb involving Bilateral Elbow joints showed progressive improvement in ROM, reduction in Pain and improvement in self-care and activities of daily living after 13 days of hospital stay and 11 days of Physiotherapy treatment.

After ensuring adequate analgesia, Physiotherapy sessions were given every hourly from 10am to 3pm (six sessions per day) for 11 days. The duration ranged from 10-15 minutes in the beginning to 45 minutes till the day of discharge. The data for ROM and Pain rating on Visual analogue scale is documented in the following table.

Burn Admission Day	PT Session Day	Pain On VAS	Joint	Range Of Motion	
3	1	9	Shoulder	Full	
			Elbow	Right	Left
			Flexion	Fixed 100^0	Fixed 100^0
			Extension	Fixed 100^0	Fixed 100^0
			Forearm		
			Pronation	Fixed mid-way between supination & pronation	Fixed mid-way between supination & pronation
			Supination	Fixed mid-way between supination & pronation	Fixed mid-way between supination & pronation
			Wrist		
			Flexion	0^0-10^0	0^0-10^0
			Extension	0^0-10^0	0^0-10^0
6	4 (Dynamic elbow splint was given to right elbow first and a day later for left elbow)	7	Elbow		
			Flexion	80^0-120^0	60^0-140^0
			Extension	120^0-80^0	140^0-60^0
			Forearm		
			Pronation	0^0-20^0	0^0-20^0
			Supination	0-20^0	0^0-20^0
			Wrist		
			Flexion	0^0-20^0	0^0-20^0
			Extension	0^0-20^0	0^0-20^0
9	7	5	Elbow		
			Flexion	60^0-140^0	Full
			Extension	140^0-60^0	Full
			Forearm		
			Pronation	0^0-40^0	0^0-40^0
			Supination	0^0-40^0	0^0-40^0
			Wrist		
			Flexion	0^0-40^0	0^0-40^0
			Extension	0^0-40^0	0^0-40^0
13	11	0	Elbow		
			Flexion	Full	Full
			Extension	Full	Full
			Forearm		
			Pronation	Full	Full
			Supination	Full	Full
			Wrist		
			Flexion	Full	Full
			Extension	Full	Full

There was a progressive decrease in the pain and improvement in elbow, forearm and wrist movements over a period of 11 days. At the time of discharge the patient was completely independent in activities such as self-dressing, combing, and eating and toilet activity.

Fig 1 showing Dynamic Elbow Splint

Fig 2 shows developing contractures of right and left elbow joints

Fig 3 shows patient wearing bilateral dynamic elbow splint

Fig 4 shows lateral aspect of elbow with dynamic splint

DISCUSSION

Contractures are one of the common complications of burns. A significant number of contractures occur despite receiving treatment at a major burn centre that provides specialized occupational and physical therapy services for all burn patients. There are multiple reasons why burn survivors develop contractures despite receiving specialized care at a burn centre.

Those patients with longer length of stays, higher TBSA and inhalation injury confer a greater risk of contracture development. [(7)] Also, burn injuries that cross a major joint likely results in a greater risk of contracture development at that joint. The timing of surgical interventions and postoperative healing may result in a period of mandatory immobilization that puts patients at risk for contracture development. Additional contributing factors include patients who do not cooperate with therapy and positioning interventions and those who refuse therapy treatment altogether. [(8)]

The position of comfort after burn injury is typically the position that promotes deformity and therefore should be avoided. Common anti-contracture position are:- neck extension, shoulder abducted to 90^0 - 110^0 and horizontally adducted $15^0 – 20^0$ or the position of scaption, [(9-11)] elbow extension, forearm supination, wrist extension of 15^0 - 25^0 with neutral deviation,

MCP joints in 60^0-70^0 flexion with inter-phalangeal joints in extension, thumb in palmar abduction. There is however no universal position, to prevent all contractures [(12)] hence burn depth and location must be considered when determining optimal anti-contracture position [(13)] and is monitored regularly for effectiveness.

Splints are used through all phases of burn rehabilitation [(13,14-17)] with indications being soft tissue or skin graft protection, anti-deformity positioning, lengthening or tissue length preservation. [(13,18)] A preliminary report showed that splinting interventions can reverse scar contractures more rapidly compared with routine interventions, including exercise, massage and pressure in the long term rehabilitation phase. [(19)] There are 3 types of splints routinely used for burn patients: static splints, static progressive splints and dynamic splints. [(13)]

In this case, dynamic elbow splint was used and the angle for extension was set every hourly after improvement was gained with passive ROM exercises which was maintained by the splint till next PT session. A 10^0- 20^0 progression in the splint angle was made daily. Dynamic splint provides a continual stress to tissue over time. [(13,18)] Advantages of custom fabricated splints are that they can accommodate to a patients unique size and profile can be adjusted as oedema fluctuates or bandage thickness changes. [(20)]

Exercises play a very important role to improve the strength of muscle and stretch the skin around the burn area over the involved joints. It is a known fact that exercises prevents contractures, reduces soft tissue and muscle tightness and helps to restore full ROM around the involved joint. It is recommended that exercises should be regularly performed throughout the day, ideally every hour. A minimum of 4-5 session throughout the day are recommended. [(21)]

Active assisted exercises, passive exercises with end range stretches and strengthening with weights and therabands were incorporated in the present protocol. With our physiotherapy sessions gains in range of motion was achieved with tissue lengthening using the principles of stress relaxation [(19)] or tissue creep. [(12)] The combination of active assisted and passive movements along with low-load force and long-duration hold provided by the splint helped in scar tissue lengthening and minimised the likelihood of developing underlying joint capsular tightness. Thus, effective every hourly range of motion exercises, positioning in dynamic splint and movements within the dynamic splint between the sessions was effective in gaining complete range of bilateral elbow movements and translating it into effective functional outcome.

Schneider et al. concluded the importance of therapeutic positioning and intensive therapy intervention in contracture prevention. [(22)] Also, Celis et al. showed that patients receiving additional, supportive physiotherapy required less surgery for burn contracture than a group receiving basic support. [(23)]

Inadequate Physical therapy and inappropriate initial burn management has been listed as the main causes of joint contractures. Early aggressive physical therapy and splinting were the fundamental parts of our protocol. This is very well supported in literature that early physical therapy and splinting has been shown as an effective method to decrease the incident of burn contracture. [(24)]

CONCLUSION

We propose that appropriate positioning, early splinting and regular Physiotherapy sessions during the in-patient burn rehabilitation phase helps to gain mobility and functional outcomes in mixed burn.

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