

Management of Hypertrophic Burn Scar: A Comparison between the Efficacy of Exercise-Physiotherapy and Pressure Garment-Silicone on Hypertrophic Scar

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Abstract

Purpose: Our study aims to investigate the effectiveness of other treatment methods for burn related scarring and to determine the possibility of their routine administration in similar clinical settings.

Methods: Through a prospective study, 66 patients were enrolled to receive either the conventional pressure garment therapy (PGT) and Silicone (control group) or exercise and physiotherapy (case group). Patients were visited regularly to be examined for the status of their scars' regression, limbs' dysfunction, and joint motion. Then, these two groups were compared to determine the efficacy of exercise and physiotherapy as an alternative to the conventional treatment with PGT.

Results: After about 20 months follow-up, decreased articular range of motion (ROM) was: 16 (51.5%) cases compared to 5 (15%) of controls had mild, 11 (35.5%) of the cases compared to 13 (39.5%) of the controls had moderate; and 4 (13%) of the cases compared to 15 (45.5%) of the controls had severe decreased ROM which revealed statistically significant difference ($P<0.01$). At the same time, Vancouver Scar Scale score was: 15 (48%) of the cases and 6 (18%) of the controls had mild Scar Scale, 12 (39%) of the cases and 14 (42.5%) of the controls had moderate score and 4 (3%) of the cases and 13 (39.5%) of the controls had severe score which revealed a statistically significant difference ($P<0.05$).

Conclusion: Our study showed that physical therapy and exercise are more effective than PGT, in management of burn hypertrophic scar, hence could be an alternative in cases that conventional therapy cannot be used for any reason.

Key Words: Silicone Gels; Burn Exercise; Physiotherapy; Hypertrophic Scars

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INTRODUCTION

Despite advances that have emerged in the management of burn injury, it still occurs with an annual incidence of 1 case per 3000 persons in the northern US which leaves abnormal scars as the most common and frustrating complication [1-3]. Either as hypertrophic or keloid types, burn scarring occurs in up to 70% of burn patients [4,5] depending on the patient's age, socioeconomic status, types and severity of the injury [5,6]. Development of scars not only faces

patients with cosmetic issues; but it also may result in limb dysfunction, particularly when it is adjacent to the joint [7,8].

Since 1970s, pressure garment has been the mainstay of treatment for hypertrophic scars in burn injuries [9]. Despite extensive evidence in favor of its use, the effectiveness of this modality has never been proven scientifically [10]. Nevertheless, pressure garment is not the only available option and local application of silicone gel is another alternative [11]. High costs and physical discomfort are among the

disadvantages of this method of burn scar treatment [12]. Since in some countries, insurance companies do not pay for pressure garment and silicone; plus, many patients can't afford its expenses; therefore, we conducted this study to evaluate the efficacy of these two commonly used treatment options.

METHODS AND SUBJECTS

Through this prospective study, 66 admitted patients in our tertiary burn care center entered the study. Burn patients aged between 12 and 60 years and had developed a burn scar after performing allograft. In addition, those who had a history of organic dysfunction that was caused by chemical or electrical burns or those who healed spontaneously were excluded from this study. Patients were considered in either of the two groups of treatment; one group treated with pressure garment and Silicone as the control group and the other group with who were treated with exercise and physiotherapy as the case group. Based on the process of treatment they followed within the study period; all the subjects were matched in terms of age and sex.

During the first session of the treatment, all the patients were advised to adhere to the pressure garment therapy as the mainstay of treatment. After two weeks, those patients who could not tolerate pressure garment were treated by physiotherapy and exercise.

Patients in the case group underwent physiotherapy during their hospitalization and then continued their sessions after discharge along with routine daily

exercises at home. Physical therapy consisted of active and passive movements of joints, manual massage over the scar area and strengthening exercises. Exercises, based on patient's tolerance, were performed daily from 10 minutes to two hours, in 30-minute sessions at home and twice or three times a week at clinic. Exercise in hospital generally includes passive motions such as posing pressure on the finger joints and wrist in the flexion and extension zones of hand joints and also for increasing range of motion and for 30 to 40 minutes in each session. Required trainings for home exercises were taught to the patients. These included aerobic and active exercises which were beneficial for fine hand motions, fingers apposition and also for coordinating fingers movements. The patients were asked to hold different objects in different sizes in his/her hand and repeat this action several times. Also, we used special tools, digit-flex and digit-ext or putty paste in order to reinforce digital muscles.

Patients in control group also attended physiotherapeutic sessions at the hospital but they did not remain on the program after discharge and hence were considered to use only pressure garment as treatment. Patients' correct adherence to the use of pressure garment was controlled by phone call, periodic and verbal follow ups.

All patients were visited at an outpatient clinic every four to six weeks for an average of 20 months. In each visit, scar changes were measured by the Vancouver Scar Scale (appendix 1), changes in limb function were assessed by physical examination, and hand span (defined as the distance between the first and the fifth finger, in a condition that all the fingers are quite open, and range of motion (ROM) of the joints was determined by goniometry (Table 1).

Table 1: Range of motion of joints in degrees (contraction)

Joint	Motion	Mild	Moderate	Sever
Wrist	Flexion	40-58	20-39	0-19
	Extension	40-58	20-39	0-19
	Radial deviation	13-19	7-12	0-6
	Ulnar deviation	19-28	9-18	0-8
Hand span (14.3-25.3) cm		21-25	16-20	Less 16 cm
Elbow	Extension	170	100-170	Less 100
Knee	Flexion	170	120-169	120
Ankle	Dorsi flexion	87	84-86	Less 83

Table 2: Demographics and primary characteristics of patients

Feature		Case (N=31)	Control (N=33)	P. value
Age (years)		29.58(12.01)	32.24(13.51)	0.5
Gender	Male	22 (71%)	24 (72.7%)	0.5
	Female	9 (29%)	9 (27.3%)	
Site of Scar	Elbow	7 (23.3%)	4 (11.8%)	0.06
	Wrist and Fingers	10 (30%)	20 (61.8%)	
	Knee	6 (20%)	2 (5.9%)	
	Ankle and Toes	8 (26.7%)	7 (20.6%)	
Severity of Scar Formation	Mild	9 (29%)	12 (36.4%)	0.3
	Moderate	9 (29%)	13 (39.4%)	
	Severe	13 (41.9%)	8 (24.2%)	

The massage was done as retrograde massage from distal fingers toward proximal limbs for edema control and improving perfusion in hand and also friction massage was done around the wound as rotational movements for 10 to 15 minutes in each session to prevent adhesion.

The research ethics committee of Tehran University of Medical Sciences approved the study protocol. Patients signed an informative consent before entering the study. Data were analyzed using Statistical Package for Social Sciences (SPSS version 14, Chicago, Inc). Student t- test for numeric and Chi square test for categorical variables were applied and the values were considered statistically significant at $p < 0.05$.

RESULTS

A total of 66 patients entered the study; but two of them were lost during follow up. The rest of them (64 patients) completed the study at the outpatient visits. About half of them (31 of 64) were young people for whom a functioning hand was of utmost importance.

Thirty three patients completed the recommended duration of pressure garment therapy (case group) while the other 31 patients did not afford this treatment option and hence were considered as the control group i.e. received only physical therapy and exercise.

Mean \pm SD of age was 29.58 ± 12.01 in cases compared to 32.24 ± 15.21 in controls which was not significantly different ($P > 0.05$); gender did not differ significantly between the two groups neither ($P > 0.05$). Patients' demographics and burn related features are summarized in table 2. In addition, no statistically significant difference was observed between two groups in terms of primary burn features ($P > 0.05$).

In the last visit, patients' status of decreased ROM was as follows: 16 (51.5%) cases compared to five (15%) patients of control group as mild, 11 (35.5%) cases compared to 13 (39.5%) of patients in control group as moderate, and four (13%) of the cases compared to 15 (45.5%) of controls as severe which did reveal statistically significant difference ($P < 0.01$) (Table 3).

At the same time, Scar Scale Vancouver was measured as follows: 15 (48%) of the cases and six (18%) of the controls had mild Scar Scale; 12 (39%) of the cases and 14 (42.5%) patients of the control group had moderate Scale; four (13%) of the cases and 13

Table 3: Severity of decreased ROM of the joints after two methods of treatment

Severity	Case (n)	Control (n)	P. Value
Mild	16 (51.5%)	5 (15%)	<0.01
Moderate	11 (35.5%)	13 (39.5%)	<0.01
Severe	4 (13%)	15 (45.5%)	<0.01

Table 4: Comparison of Vancouver Scar Scale between groups after two methods of treatment

Scale	Case (n)	Control (n)	P. Value
Mild	15 (48%)	6 (18%)	<0.05
Moderate	12 (39%)	14 (42.5%)	<0.05
Severe	4 (13%)	13 (39.5%)	<0.05

(39.5%) of the controls showed severe scale all of which revealed a statistically significant difference ($P < 0.05$) (Table 4).

DISCUSSION

Scar formation is the most common complication of burn injuries that leads to functional and aesthetic impairments [9]. Age, genes, ethnicity, site and depth of burn influence and characterize the process of scar formation as intrinsic factors while infections, the process of wound healing (based on collagen deposition and release of interleukins/ cytokines); and applying pressure affect this process as controllable parameters. [12, 13]. Applying local pressure on the site of scarring has shown promising effects in healing and in some cases in scar formation cure. Although the history of the application of local pressure goes back to nearly 200 years ago [14], the pressure garment therapy (PGT) has been given-birth only since 1970s [12,15].

Although current evidence that supports benefits of PGT are anecdotal instead of being scientific [16,17], this method has been the mainstay in managing burn related scars for a long time [9-11,20]. Inhibition of collagen production and realignment of previously synthesized collagen bundles have been suggested as a possible mechanism for this local pressure to stop scar formation [21,22]. Nevertheless, there is no consensus about the exact amount of effective pressure on different parts of a human's body.

In addition to these uncertainties in the management of burn scars, the use of PGT has been questioned again by its further complications such as undesired appearance [19], discoloration of the area [21], discomfort due to excessive heat and sweating, dermatological reactions such as eczema, rashes, or ulcerated blisters

[18,19], organic deformity [23] and imposing tension on the affected region which causes concomitant inconvenience among patients [9,15]. Such factors eventually result in low adherence to PGT [24].

Among methods of local pressure application, Silicone is an option; however, due to the reported disadvantages of this modality from low efficacy in large scars to skin maceration, this material has been contained within other pressure garment materials [25].

Scar formation after burn injuries will cause destruction in dermal components which results in joint dysfunction and movement restriction in the affected region [21,26,27]. Reduction in range of motion (ROM) and organ dysfunction are among the most important concerns of physicians.

Maintaining natural appearance and resolving the disturbing effects of scars in dermal and articular structures are the main aims in post-burn rehabilitations. Physical therapy either as a passive motion of the joints or as an active and purposed motility should begin on the first day of hospitalization if the patient is otherwise healthy and does not present contraindicating manifestations [27,28].

Physiotherapy and exercise, via releasing produced tensions made by scar tissue and also by improving tissue perfusion results in relieving articular contractures.

Many of our patients in the study group could not afford PGT; moreover, because of financial needs, they had to turn back to their jobs as soon as possible so they chose to be treated by physiotherapy and exercise. Having this in mind, interpretation of our data may be a little difficult since the net effect of routine recommended physiotherapy could not be exclusive. Our understanding of the role of physical therapy in comparison to the conventional PGT in our patients would remain unchanged.

On the other hand, some other patients who used PGT and silicone were also able to perform

physiotherapy; but, because of using PGT and silicone, none of the patients in the control group followed up physiotherapy and exercises regularly. After all, results of the recovery process in the control group were not better.

Butz et al. have documented the effects of exercise and physiotherapy along with PGT in improvement of joint motion [3]. However, the active feature of exercise as a requirement has been emphasized by them. We should note that patients suffering from hypertrophic scars may ultimately become candidates for surgical correction procedures. On the other hand, Celis and colleagues have showed that adding exercise to the conventional physical therapy could reduce the amount of surgical intervention required to release burn scar contractures in children [2]. Our patients were also recommended to pursue such active exercises in consulting sessions they had with their physiotherapists., in contrast to the study of Celis, we did not put our patients under supervision to assure adherence to this individualized program. Another point which should be noted is that the age group of patients in the study of Celis which were younger than 12 year-old compared to our study group who were mostly about 20 to 40 year-old. Thereby, conducting similar studies among adult age group is recommended.

Adherence to the sessions of physical therapy and even individual exercising could be achieved more easily by controlling the patients' pain and performing such rehabilitation under sufficient analgesics. Proper pain control and also final satisfactory results can assure patients and keep them adherent to pursuing offered program [26].

Moreover, in order to encourage patients to do exercises at home, we taught them to hold different objects in different sizes from big to small. Additionally, performing all exercises in the warm water not only raises the energy spent by patients but also hastens the improvement of hand function. It is obvious that such exercises were not possible to be performed by patients who wore PGT gloves and used silicone sheets.

Our study showed that exercise and physiotherapy could be an effective strategy in the management of burn scars in patients and may be considered as an appropriate alternative under this circumstance. However, further studies are required to support our findings. This investigation is better to be implemented in double-blinded controlled clinical trials in order to achieve more valid results.

CONCLUSION

Our study showed that physiotherapy and exercise in comparison with PGT and silicone is more effective in management of burn hypertrophic scar, and it can be used in cases in which using PGT and silicone is not possible for any reason.

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Conflict of interests: None

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