

LOW LEVEL CO₂ LASER THERAPY IN BURN SCARS: WHICH PATIENTS BENEFIT MOST?

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ABSTRACT

Objective: To evaluate the influence of age of burn scars on the degree of responsiveness to low level CO₂ laser therapy.

Patients and Methods: Patients who had suffered from burn scars were allocated into three groups according to the age of their scars: 0 to 6 (n=120), 7 to 12 (n=100) and over 12 months (n=100). A single weekly CO₂ laser beam was applied at power scale of 4.5 of maximum possible of 30 which was increased by 0.5 degree to maximum power of 9 using a hand piece on LQ30 Slim Evolution CO₂ laser scanner.

Results: The results showed that younger scars responded more favorably than older ones. Seventy percent of the scars that aged less than 6 months completely disappeared compared with 12% in the second groups and none in the third group.

Conclusion: These findings suggest the early low level CO₂ laser therapy is an effective method for treatment of burn scars provided it is applied as early as possible.

KEY WORDS: Low Level CO₂ Laser Therapy, Burn scars, Age.

Pak J Med Sci April - June 2006 Vol. 22 No. 2 158 - 161

INTRODUCTION

Burn injuries not only heal with difficulty in majority of cases it leads to hypertrophic scars and contracture deformities. Currently there is no universally accepted method in the treatment or reduction of this phenomenon. Various experimental, constructive clinical and surgical attempts have been made but the problem still persists. Such attempts included surgical excision, dermabration, compression with silicon or JOBST dressings, and corticosteroids but none has proved to result in optimal cure.¹⁻⁴

Recently the use of laser therapy as a new surgical technique has found its useful

application in various clinical conditions. One of this is in variety of dermatological conditions such as acne deformities, removal of wrinkles, traumatic scars and other cosmetic treatments.^{5,6} However, to our knowledge, with exception to one publication, the use of low level laser therapy (LLLT) has not been used in the treatment of burn scars.⁷ In this aforementioned work, the effectiveness of LLLT, using red light source was assessed on a small number of patient with scar durations ranging from 1 to 194 months. Furthermore, the application of Low Level CO₂ Laser Therapy in the treatment of burn scars has not been tested previously. This study was conducted on a larger number of patients with a history of burn scars of different durations with two major aims: firstly to assess the effectiveness of CO₂ LLLT in the treatment of burn scars. Secondly, to evaluate the responsiveness to this treatment in relation to the degree of maturation of scars. In other words, does the age of burn scar influences in the degree responsiveness to LLLT with CO₂ laser? For this purpose, three groups of patients with different durations of burn scars were enrolled.

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- * Received for Publication: April 6, 2005
Accepted: October 16, 2005

PATIENTS AND METHODS

All patients, irrespective of their age or sex, who had developed hypertrophic scars during the period of the study (39 months), were included. The patients were allocated into one of three groups according to the age of their scars: the first group consisted of 120 patients with scars aged between 1 to 6 months; the second group was 100 patients with scars aged between 7 to 12 months and the third group was another 100 patients with scars aged more than 12 months, the oldest of which was 36 months old.

In each patient one burn scar area was selected as the lesion that should be irradiated and a similar one on the affected region or the corresponding opposite site, as the case may be, was used as control, which remained unexposed. None of the patients had previously undergone surgical grafting or received any drug treatment, including corticosteroid, for their burn scars. All the patients had variable degrees of pruritus, vascularity and pain before initiation of therapy.

Protocol for Laser Therapy: The laser type used in this study was LQ30 Slim Evolution CO₂ laser system (Lasering, s.r.l., Modena, Italy). The laser beams were applied by a hand piece scanner (ScanLas, Code A10525). The scanning mode selected was controlled by a control console which was set at 5, 4, 4 digital scales referring respectively to the shape (rectangular), size (approximately 10 mm, range 6 to 20 mm) and frequency (5000 Hz). The operation mode used was a continuous mode of exposure.

The starting power of exposure was set at 4.5, which was increased on weekly basis by 0.5 degrees for 10 weeks to a maximum of 9 (ranged from 0.5 to 30) on the power scale. This scale of power exposure was considered as low-level range for this instrument. The distance of exposure between the diode and the scar was maintained fixed with the aid of a backup pin located on the hand piece. A single exposure was made on each of the allocated areas.

Assessment Criteria: The degree of response to treatment was made by microscopic evaluation based partly on Vancouver Scar Scale (VSS).⁸ The height and pliability of the scars were assessed before and after the end of the treatment period of 10 weeks. The criteria were graded as complete flat, moderate reduction or no change in both the height and pliability of the scars. Further evaluations were made one and three years after the end of treatment schedule. Furthermore, changes in vascularity and pruritus were assessed by patients reporting and macroscopic evaluation respectively. The latter was assessed as change in the colour of the scar relative to the normal skin site. Improvement was considered with loss of pruritus and reduction in the redness and production of light to dark brown colour.

Statistical Analysis: The data was analyzed using X² test and the level of P < 0.05 was considered as the level of significance.

RESULTS

Microscopic observation of the scars younger than 6 months showed favorable response to laser treatment and 84 patients out of 120 (70 %) the scars became flat and completely disappeared leaving a dark pigmentation area at the site of burn. These results were found highly significant compared with other treatment groups (p < 0.001) (Table-I). Furthermore, 25 (approximately 21%) patients in the first group showed moderate response, producing pliable scars with lower height than before treatment. Twelve scars aged between 7 to 12 months showed complete disappearance in contrast to none in the scars older than 12 months (p < 0.001) (Table-I). Only three scars aged over 12 months showed moderate responsiveness to laser therapy, giving a failure rate of 97%.

No recurrence of the scars regeneration in the responded scars occurred on the follow up for up to 39 months. However, five patients in the first group and two patients in the second group who were among the no change group improved slightly which were considered moderate on our scale of evaluation. While none in the third group improved after three

Table-I: The outcome of weekly low level CO₂ laser therapy over 10 weeks on burn scars of different durations.

<i>Duration of burn scars (months)</i>	<i>Completely disappeared</i>	<i>Moderately reduced</i>	<i>No change</i>	<i>Total number of patients</i>
1-6	84 ^{***}	25 ⁺⁺⁺	11 ^{***}	120
7-12	12	28	48	100
>12	0	3	93	100

^{***}P<0.001 between scars aged 1-6 months and the other two groups, and

⁺⁺⁺P<0.001 between scars aged 1-6 months and those aged more than 12 months.

years of follow up and no regeneration was observed.

Seventy six per cent of the scars in the 1 to 6 months old group showed resolution in both pruritus and pain, which was highly significantly different from the other two groups (p<0.001). While this was observed in 39 and 5 % of scars in the 7 to 12 months and older than 12 months respectively, showing a high significant difference between them (p<0.001). Improvement in vascularity was found to be closely correlated with similar percentages as those found for resolutions in both pruritus and pain.

DISCUSSION

Despite the contradictory results reported for various animal studies,⁹⁻¹² this study clearly demonstrated that CO₂ LLT has beneficial effects on human scars. Furthermore, the findings from this study are in contrast to those conducted on human subjects reported by Gaida et al,⁷ in which no complete flatness of the scars were observed following the use of red laser light. In their study, they exposed the scars twice a week for 8 weeks and showed that scars aged less than 12 months old responded better and became more pliable, which corresponded to moderate response to our study. The reasons for these different findings could be due to differences in the protocols adopted between our study and theirs: Firstly they used a different type of laser source, suggesting that the laser type has a detrimental role in the extent of outcome. We had complete disappearance of scars in 70% of the scars younger than 6 months following a weekly pass while they had none following

twice weekly exposure. Therefore, if both treatment protocols were equally effective then we would have expected at least 7 cases of complete flatness out of 11 recruited in their study which aged less than 6 months but such observation was not reported, suggesting that low level CO₂ laser therapy is a more effective method than the red light source. Secondly the total number of subjects enrolled in their study was 19, while our study had a total of 320 cases with 120 scars younger than 6 months, suggesting that, possibly, with this lower number of cases it was not sufficient to detect the possible wider benefits anticipated. They further failed to report the number of scars younger than 6 months which improved, but instead gave an overall results of the effects of LLLT of scars aged less than 12 months, on Vancouver scale.⁷

The range of power employed in present study was in the lower one third of the power range that this instrument was capable of and was considered the low level range. Since the introduction of this laser in our burn hospital 4 years ago, we employed this technique on various patients with different degrees of scars on an out-patient and on weekly basis. There were no morbidities or major side effects in all patient groups. Almost all the patients were relatively satisfied with the results, although it is a general trend that patients expectations of complete normalization is never achieved following the acute phase of burn care.

Various mechanisms have been proposed to underline the effectiveness of laser therapy proposed which ranged from activation of respiratory chain by photo-biological mechanisms, activation of other redox chains within

the cells or secondary messengers released from activated cells.¹³ Whatever underlying mechanisms may be, the overall results suggest the laser therapy ultimately brings normalization in the balance between the collagen production either by reducing collagen synthesis or increase in collagenase activity.¹

CONCLUSION

The favorable cumulative results of complete flatness to moderate response obtained for scars younger than 6 months were over 90%, this was reduced to 40% in scars aged between seven to twelve months and to a mere 3% in scars older than 12 months. These results suggest almost an inverse exponential relationship between the age of the scars and the responsiveness to laser treatment. Put in simple mathematical terminology, for each month of delay in laser treatment, the rate of failure increases by 5%. Therefore, for better beneficial outcome of these types of patient, it is recommended that burn scars be treated as soon as possible. Furthermore, since scar development is one of the major factors in causing morbidity in the unfortunate persons who had experienced the trauma of an accidental burn this study had clearly demonstrated that early low level CO₂ laser therapy can ameliorate some unwanted side effects of these consequences. The findings from this prospective clinical study are merely a small step forward to better care in burn patients.

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