

Effect of Age on Outcome of Low Level Laser Therapy (Lllt) Treated Post Burn Immature Scars

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Abstract:

Background: Burn is a major problem in low and middle income countries, with annual incidence of around 6-7 million per year in India. Post burn immature scars are reversible as well as preventable. Apart from conventional therapy various other measures exist for treatment of these scars, including Low level Laser Therapy (LLLT). No study has been reported from India on effect of age on LLLT treated post burn immature scars.

Methods: This is a prospective interventional study to see correlation of age with effect of LLLT on post burn immature scars. Study was done in single institute with 41 subjects of post burn scars with LLLT for 8 weeks. Effect of LLLT was observed with Vancouver scar sclae (VSS) score before and after intervention and observations were correlated with age of the subjects.

Results: On analysis it was found that improvement in mean VSS score was more in age group 0-10 years and 10-40 years. Further the improvement in mean VSS score was in younger patients (0-10 years) than middle aged (10-40 years). And no improvement was seen in age >40 years.

Conclusion: There is a positive effect of LLLT in younger age (0 to 40 years) compare to older population (>40 years) on immature post burn scars but large randomized multicentric trials are required to validate this study.

Key words: age; low level laser therapy (lllt); post burn immature scars

Introduction:

Burn is a major problem in low and middle income countries, with annual incidence of around 6-7 million per year in India. During rehabilitation phase, a burn survivor has to deal with multiple post burn problems, scar being one of them. Post burn scars have significant physical, psychosocial and socioeconomic impact on a burn survivor. A mature scar is flat, soft and supple with colour matching with that of the surrounding skin. An immature scar is a red, sometimes itchy or painful and slightly elevated scar in the process of remodeling. Immature scars undergo repeated scar breakdown. This is a major problem in the post burn patients. Post burn immature scars are reversible as well as preventable. Pressure therapy is the conventional treatment of post burn scars. Apart from conventional therapy various other measures exist for treatment of these scars, including Low level Laser Therapy (LLLT). Effect of various adjuvant therapy modalities has not been established for treatment of these scars, and it is important to assess their effectiveness and set standard treatment protocols for these modalities. No study has been reported from India on effect of age on LLLT treated post burn immature scars.^{1,2}

Materials and Methods

This study was done in the Department of Plastic Surgery, Jawaharlal Institute of Postgraduate Medical education and Research (JIPMER), Puducherry, India. Inclusion criteria was subjects with post burn immature (vascular, raised, non pliable or itchy) scars. Exclusion criteria were subjects with acute burn wounds (<1month old), age >65 years, with diabetes/ radiation exposure, scars near eyes or >4 square feet area and subjects not willing to participate in the study. Withdrawal criteria was, if patient is not willing to continue with the study. Prospectively post burn patients coming to the plastic surgery outpatient department (OPD) of our institute satisfying the inclusion criteria during August 2018 to October 2019 after obtaining informed written consent were treated with LLLT with following specifications: Gallium Arsenide (GaAs) Diode Red Laser of Wavelength 650 nm with Output power 100 mW, frequency 10 kHz for Duration 125 sec in Continuous beam mode at Interval of twice a week (not less than 3 days interval between two therapies) at a distance of non contact delivery (60cm distance between laser source and scar) (figure 1 and 2).



Figure 1: Low level Laser therapy (LLL) equipment

Figure 2: Treatment session

Outcome of LLLT treated patients were correlated using Vancouver Scar Scale (VSS) score before and after the treatment.

Results:

Total of 41 patients satisfied the inclusion criteria and were analysed (Table 1).

Age in Years	Number of subjects	Mean VSS score before treatment	Mean VSS score after treatment	Improvement in mean VSS Score
0-10	13	7.0	6.1	0.9
10-40	21	7.2	6.5	0.7
>40	7	7.5	7.5	0
Total	41			

Table-1: Age correlated with VSS score

On analysis it was found that improvement in mean VSS score was more in age group 0-10 years and 10-40 years. Further the improvement in mean VSS score was in younger patients (0-10 years) than middle aged (10-40 years). And no improvement was seen in age >40 years.

Discussion:

Burn is a major problem globally and has a significantly high incidence in low and middle income countries like India [1]. It is one of the major groups of trauma, second after road side accidents in terms of annual incidence. Estimated incidence of burn injuries in India is around 6-7 million per year.² Out of these around 0.15 million people require prolonged rehabilitation [2]. The natural history of burn is not over with wound healing, but it is the starting point of a new set of post burn problems. Post burn problems are local problems associated with scar hypertrophy, contracture, pruritis and disfigurement as well as systemic problems like hyper-metabolic state, nutritional deficiency and anemia. There is a significant psychosocial and socioeconomic impact of post burn problems over burn survivors [3]. Burn victims are in need of support from healthcare system during acute burn injury as well as post burn rehabilitation. Problem of burn rehabilitation is further important because most of the burn survivors are of age group 15 to 40 year, which is most productive age group of the society [2]. Scar is defined as replacement of normal tissue with fibrous tissue after injury or disease [4]. All wounds heal by scar formation; burn wound is not an exception to that. History of scars dates back to sixteenth century when Ambrose Pare first used pressure for the treatment of scars [5]. In 1678 Johnson has mentioned pressure for scar management in his notes [5]. Then in 1790 Petz has given first full medical description of scars [5]. During healing process the burn wound develops bridge of collagen fibers with a thin epithelium, forming an immature (active) scar [6]. An immature scar is characterized by its red, raised and rigid mass like appearance. Scar becomes flatter, less vascular and more pliable with maturation. Burn scars may take up to two years or longer to mature [6]. There are high chances of hypertrophic scarring in burn wounds. There are various factors contributing to the formation of hypertrophic scar: [6, 7].

1. Duration for which wound remains open
2. Depth of burn injury
3. Wound infection
4. Age
5. Location of injury
6. Tension on the scar
7. Chronic inflammatory process
8. Altered ground substance
9. Immunological factors
10. Genetic factors

An immature scar should physiologically remodel and mature over time and become more similar to normal skin. Hypertrophic scar (HTS) represents abnormal healing in which scar is stuck in the immature phase [8]. HTS also undergo some amount of remodeling and maturation over time [8]. Clinical spectrum of immature scars include vascular scars (pink, red or purple coloured scars which blanches on pressure), hypertrophic scars (raised from the normal surrounding skin level), inelastic scars (non pliable) and hyper-pigmented or hypo-pigmented scars. Immature scars may be associated with itching and discomfort to the patient. If these scars are across the joint it may lead to contracture formation. If these scars are near any natural opening it may cause narrowing of that opening like microstomia, ectropion or nostril contracture. These scars are also cause of various deformities.

This study shows that subjects enrolled in the study are of a wide age range (3 years to 62 years); Mean age being 24.2 ± 17 years. When divid There are certain differences between immature scar / HTS and normal skin / scar in terms of composition and architecture of their extracellular matrix. Type-III collagen appears during proliferation phase of normal wound healing and then it is replaced with type-I collagen during remodeling phase. Thus collagen composition of normal scar is 80% type-I collagen with 10-15% type-III and minimal amount of type-V collagen. In contrast to normal scar, the immature scar / HTS have increased ratio of type-III to type-I collagen. Immature scar / HTS have around 33% type-III, 10% type-V and only around 60% type-I collagen. The type-III collagen is not replaced with type-I collagen in hypertrophic scar, that indicates biological immaturity of the scar [8, 9, 10] Architecture of collagen fibrils in the immature scar / HTS is thinner and disorganized with whorls and nodules formation. The interfibrillar space is filled with proteoglycans and glycoproteins. This space is also irregular and increased in amount in immature scar / HTS. These scars are in a hyper-hydrated state, owing to greatly increased amounts of glycoaminoglycans. Composition of proteoglycans is also altered with decreased amounts of 'Decorin' and increased amounts of 'Biglycan' and 'Versican' [8, 10]. Similarly composition of glycoproteins is also altered with increased amount of 'Fibronectin' in immature scar / HTS [8].

Cellular function of fibroblasts and keratinocytes is also altered in immature scar / HTS making them pro-fibrotic. There are two types of dermal fibroblasts: (1) Deep dermal (Reticular) fibroblasts and (2) Superficial dermal (Papillary) fibroblasts [11]. During wound healing role of deep dermal fibroblasts is to close the wound while superficial dermal fibroblasts are responsible for scar remodeling. Fibroblasts in immature scar / HTS are similar to deep dermal fibroblasts. There is lack of superficial dermal fibroblasts in these scars. Thus there is lack of remodeling in these scars, rendering them in an immature state [12]. This also correlates to the fact that deep burns are more prone for developing immature scar / HTS for a long time. Myofibroblasts activity is increased in these scars making them more prone for development of contractures [8]. Behaviour of keratinocytes is also abnormal in immature scar / HTS. Keratinocytes of immature scar / HTS are profibrotic, similar to that of proliferative phase of wound healing. The altered keratinocytes and fibroblasts have positive reinforcement on each other, representing dermal-epidermal interaction [8, 10].

Expression of cytokines is also altered in immature scar / HTS. The balance between matrix metalloproteinase (MMPs) and Tissue inhibitors of metalloproteinase (TIMPs) is altered towards pro-fibrotic side. Transforming growth factor- β (TGF- β), connective tissue growth factor (CTGF), platelet derived growth factor (PDGF) and insulin like growth factor 1 (IGF-1) are up-regulated, while interferon- α (IFN- α) and interferon- γ (IFN- γ) are down-regulated [8, 10].

ed into decade wise age groups, maximum subjects (31.7%) are of age group younger than 10 years. Around half (46.3%) of the subjects are younger than 20 years. Thus it can be said that majority of subjects coming to plastic surgery out-patient department (OPD) for complaint of problematic post burn scars are of young age. All scars included in present study showed either improvement or no change in VSS score after starting of therapy. No scar worsened after starting of therapy. In present study we did not find any side effect of LLLT on scars. Neither any systemic side effect was observed during study period. LLLT is a safe laser, considered to be a non heat producing laser. It is classified as laser safety class IIIB. Shortcomings of present study are that we did not consider categorization of scars based on location of scar, extent of original burn injury, previous operative wound management, and presence of skin graft over the scars. These may be confounding factors contributing to errors.

We used scanning mode laser machine, which has advantage of covering large surface area in one sweep. Problem with scanning mode is it decreases power density of the laser due to scattering effect. Also the power density is variable based on area covered. There is no study correlating age with outcome of LLLT treated immature scars. This study may give clinicians an idea about effect of LLLT while treating different age groups in their practice.

The limitation of the study include single center, small sample size & no statistical analysis done.

Conclusion

There is a positive effect of LLLT in younger age (0 to 40 years) compare to older population (>40 years) on immature post burn scars but large randomized multicentric trials are required to validate this study.

Conflicts of interest -none

Disclosures -none.

Financial support-none

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