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# Correlation of Outcome of Scars with Comorbidities Following Er YAG Laser

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***Abstract***

*The scar is a sequela of any form of trauma. The abnormal scar can influence an individual's well beingness. The prevention, as well as treatment of scars, is important. The scar makes a good percentage of consultations in any Plastic Surgery department or dermatology department. There are many methods to manage a scar, Laser Therapy using Er YAG laser is one method of management of scars that are widely used. This study was conducted in a Tertiary care Institute in South India under the Department of plastic surgery, the aim of which was to find out if there is any correlation of comorbidities with their outcome of scars following Er YAG Laser therapy. Some studies evaluated the response of laser therapy based on the time of starting the therapy and location of the scar but the data based on the outcome of scars in comorbidity is few. A Total of 73 scars were included in the study with a follow-up period of 6 months.*

**Keywords:** Scar management, scar etiology, comorbidity, Er-YAG Laser

## INTRODUCTION

The prevention of abnormal scar formation or management of abnormal scars scar is a very common problem for which patients seek consultation from any plastic surgeon, [1]. The symptoms of scars are, disfigurement, pain, pruritis and restricted movement of joints, neck, eyelids, lips, fingers, The symptoms, and signs can differ based to their location, color, consistency, or size. And there many factors which can influence the scar formation, scar maturation. Though the scars are not completely avoidable, they can certainly be made better with good management [2]. There are many methods known for the prevention as well as management of scars and unfortunately there is no method as the single best method in managing the scars. Some of the commonly used methods for scar management are, scar massaging silicone gel or silicone sheet application pressure garments, medications for local application, intralesional steroids, surgical scar revision, and Laser Therapy [3].

Laser used initially in scar management were $CO_2$ and Pulsed-dye laser, which were known for adverse effects. Due to which there was always a search for newer lasers, equally effective and with

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lesser adverse.

In India Er YAG is more or less a newer addition in scar management, hence the data of the efficacy of the Er YAG in managing scars on Indian skin type is few. In this study, we have used the Er YAG for fractional ablative resurfacing of the post-trauma and burns scars and studied the effect of the Laser on each scar parameter also on the variables which can affect the outcome of the laser therapy. Especially any comorbid conditions which mat effect the outcome was studied [4].

Figure 5

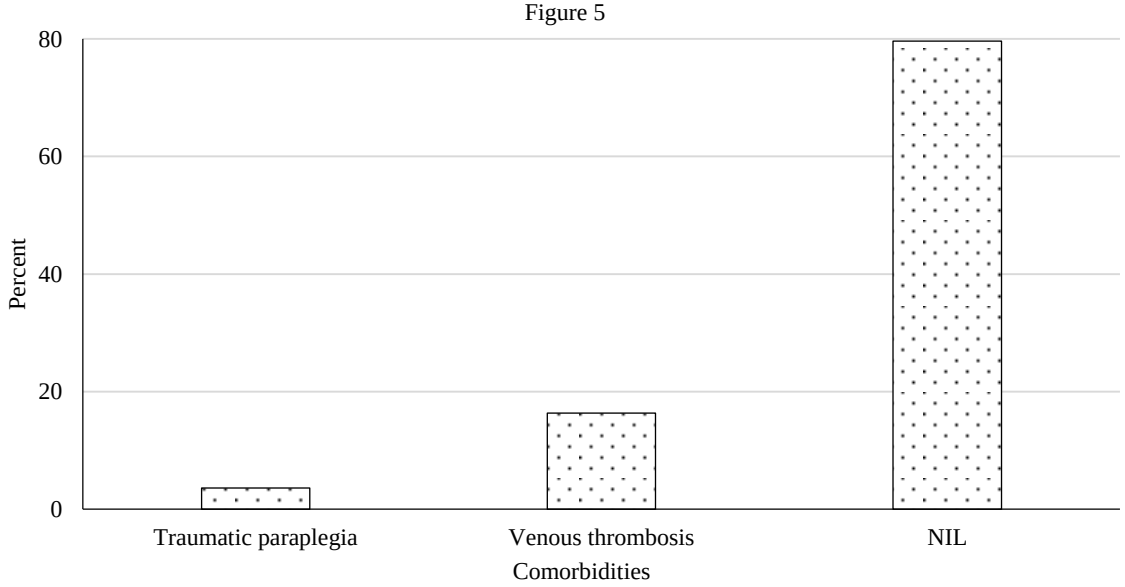


**Figure 1.** Different Comorbidities included in the study.

## MATERIALS AND METHODS

This study was conducted in the Department of Plastic Surgery at a tertiary care center. The departmental ethical committee approval as well as informed written consent was obtained from each patient for Er YAG laser therapy and clinical photography. Sample included a total 73 scars enrolled randomly, which included post-trauma, post-surgical and post burns scars. All the data related to the patient and scars were collected [5]. The scars were evaluated twice during the study using the Vancouver scar scale scoring system, which included the following parameters and scores; vascularity (normal=0, pink=1, red=2, purple=3), pigmentation (normal=0, hypopigmentation= 1, hyperpigmentation=2), pliability (normal= 0, supple=1, yielding=2, firm=3, banding=4, contracture= 5), and height (normal=0, <2 mm=1, 2~5 mm=2, >5 mm=3) and clinical photography. First assessment was done pre-treatment and next one month after the completion of the laser therapy. The laser therapy was given for four sessions each at one-month interval. Er: YAG Laser therapy using Twain 2940, Quanta System, Italy, in ablative as well as thermal mode, at a wavelength of 2,940nm, fluence was set to 1 to 2 J/cm2, pulse width used was 300 microseconds using spot diameter of 4mm. During each session, two laser passes of 400 mJ in short pulse mode (pulse duration 0.30ms) and one pass of 800 mJ in long pulse mode (pulse duration 1 ms) were given [6].

The response of each scar after the completion of the fourth sitting of the Er YAG were compared and statistical analysis was done using IBM statistical software, SPSS Statistics version 27 (IBM Inc.). Normally distributed data were expressed as mean ±SD. Data were expressed as median (interquartile range, IQR), when the assumption of normality was violated (Shapiro Wilk test, $P<0.001$). Paired T-Test was used and wherever needed one-way repeated measure ANOVA was done to determine whether there are any statistically significant differences between the means of

 

three or more levels of a within-subjects factor over time. A P value<0.05 was considered statistically significant. And it was noted if scars over any patients with co-morbidities (Traumatic paraplegia and Venous thrombosis) responded different to the Er YAG Laser (Table 1) [7].

**Table 1.** List of comorbidities included in the study.

| **Comorbidity** | **(n, %)** |
|---|---|
| Traumatic paraplegia | 3(4.1) |
| Venous Thrombosis | 12(16.4) |
| Nil | 58(79.5) |
| Total | 73(100) |

## RESULT

The mean age of patients was 35.2±7.8 (range, 18-50 years). The preprocedural and postprocedural Vancouver scar scale parameters are compared (Table 2) and the response is plotted as graph (Figure 3). There was a significant difference in vascularity, pigmentation, pliability, and height after laser application (paired t-test, P=0.001, 0.006, 0.001, 0.001 and 0.001, respectively). All the scars responded well to the Er YAG therapy including the scars on patients with comorbidities (Figure 2) [8].

Figure 2

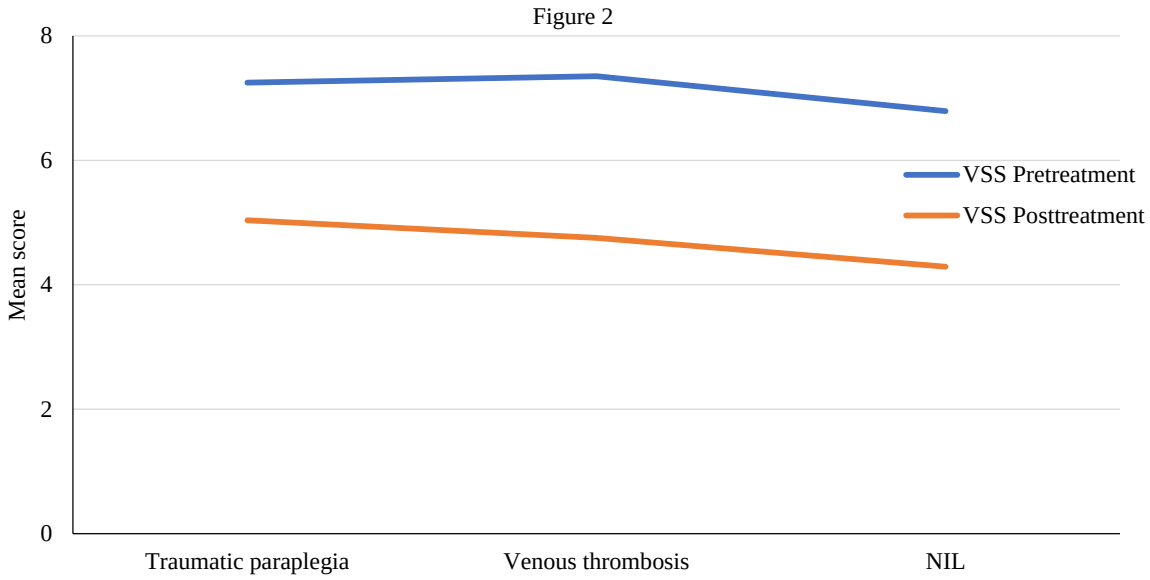


**Figure 2.** Graph Er YAG Laser Therapy in patients with Co-morbidities.

 

Figure 6

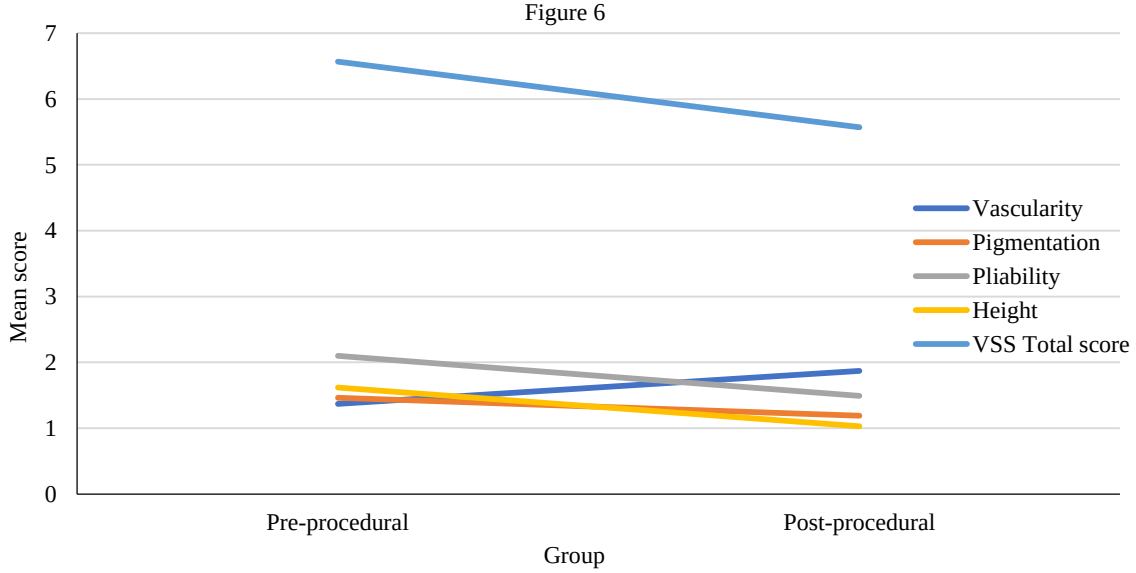


**Figure 3.** Graph of All participants of Pre and Post Er YAG laser

**Table 2.** Pre and Post Er YAG Laser Scar assessment of patients with traumatic paraplegia and venous Thrombosis Using VSS.

| Comorbidity | Preprocedural VSS | P value | Post procedural VSS | P value |
|---|---|---|---|---|
| Traumatic paraplegia | 7±2 | 0.369 | 4±1 | 0.028 |
| Venous Thrombosis | 7.2±1.5 | | 3.7±0.5 | |

## DISCUSSION

The scar is defined as fibrous tissue that replaces the wound[2] During the process of healing the wound develops a bridge of collagen fibers with a thin epithelium, forming an immature scar [9]. The process of wound healing comprises three phases, the inflammation phase which lasts for a few days, the proliferation phase lasting for weeks, and the maturation phase takes several months or years. Hypertrophic scars begin to develop 6 to 8 weeks after wound healing, it grows for 3 to 6 months, and then regress after 6 months. An immature scar is red, raised, rigid, and hypopigmented, During the process of maturation the scar becomes pliable, flatter, less vascular and color is normalized. The difference between the normal scar, immature scar lies in the difference in their extracellular matrix composition. A normal scar when mature consists of 80% type-I collagen with 10-15% type-III and a minimal amount of type-V collagen. This composition is altered in an abnormal scar with an increased ratio of type-III to type-I collagen and abnormal scar consists of around 33% type-III, 10% type-V, and around 60% type-I collagen. Apart from the composition of the collagen, the arrangement of fibrils and interfibrillar space also is different in an abnormal scar compared to the normal mature scar. The cellular function of fibroblasts and keratinocytes is also altered in an abnormal scar making them pro-fibrotic. The expression of cytokines is also altered in an abnormal scar. The balance between matrix metalloproteinase (MMPs) and tissue inhibitors of metalloproteinase (TIMPs) is altered and is moved towards the pro-fibrotic side [10]. Transforming growth factor-β (TGF-β), connective tissue growth factor (CTGF), platelet-derived growth factor (PDGF), and insulin-like growth factor 1 (ILGF-1) are up-regulated, meanwhile interferon-α (IFN-α) and interferon-γ (IFN-γ) are down-regulated.

There are many methods known for management of scars like scar massage, silicone gel or silicone sheet application pressure garments, medications for local application containing allantoin, heparin etc., intralesional steroids, surgical scar revision, and Laser Therapy. The first LASER machine was devised in 1960 by Maimon, which was a Ruby laser. Dr. Leon Goldman a dermatologist is the father of laser medicine. The first laser that was specifically designed for use in a medical condition was

 

Pulsed Dye Laser (PDL), which was used for port-wine stains. Since then, laser technology has evolved with newer concepts of pulsed therapy, fractionated laser therapy, Q-switched mode, etc. being added to the list. The principle of any laser is photo thermolysis, which was proposed first by Anderson. Each laser has a specific target on which it acts, known as chromatophore. The laser selectively acts on its chromatophore and produces thermal ablation of the target tissue. Fluence, pulse width, spot size, and stacking are variables that are to be adjusted according to the individual requirements The mechanism by which a laser affects scar remodeling is not fully known, but ablative fractional resurfacing may lead to the production of various cytokines and growth factors by stimulating a variety of not fully known cellular responses Fractional photo-thermolysis produces controlled and limited dermal heating which triggers a cascade of events in which leads to normalization of the collagenesis-collagenolysis cycle.

The present study was designed to find out if there is any difference in response to Er YAG Laser based on comorbidities. There are studies which found factors that influence the response to the Laser based on location and the time on initiating the Laser therapy. But aim of the study was to find out if there is any difference based on comorbidity in the particpants. Interestingly in our study we did not find any statistically significant difference.

## CONCLUSION

The study shows that Er -YAG Laser therapy is an effective in the management of scars. All the scars in the study showed good response to the Er YAG Laser Therapy (Figure 3) and there is no statistically significant relation of comorbidities with outcome of scar following Er YAG Laser Therapy. No adverse effects were noted during the study. The limitation of the study is that the percentage of comorbidities were less, most of the scars were of maturation phase, many scars on the same individual were enrolled into the study, laser was given by a single specialist and follow up was for 6 months. We suggest large volume and multi-centre study and longer duration of follow up to get a better picture of the effect of Er YAG laser.

**Competing interest**

None

**Declarations**

***Author's contributions***

All authors made contributions to the article

**Availability of data and materials**

Not applicable

**Financial support and sponsorship**

None

**Consent for publication**

Not applicable

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