

## Correlation of Outcome of Scars with their Pathogenesis Following Er YAG Laser

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### Abstract

The scar is a sequela of trauma, burns or surgery. The abnormal scar can influence an individual's well beingness, so the prevention as well as treatment of scar is important. The concern for scar makes a good percentage of consultations in any Plastic Surgery out-patient department. There are many methods to manage a scar, laser Therapy using Er YAG laser is one method of management of scars that is widely used in western countries. In India, Er YAG laser therapy is relatively a recent addition, hence the data available on scar management using the same is few. This study was conducted in a Tertiary care Institute in South India under the Department of plastic surgery, aim of which was to find out if there is any relation of etiopathogenesis of scars with their outcome following Er YAG Laser Therapy or in other words to find out how different types of scars responds to the Er YAG Laser therapy. There are studies which 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 etiology 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; Scar Etiopathogenesis; Er-YAG Laser.

### Introduction

The concern of scar is a very common problem for which patients seek consultation from any plastic surgeon, either it is for preventing abnormal scar formation or for the management of abnormal scars. The symptoms of scars that brings a patient to any medical care facility is, disfigurement, pain, pruritis and disablement due to it in the form of restricted movement of joints, neck, eyelids, lips, finger etc. Scars can influence the symptoms and signs based to their location, color, consistency, or

size (height). There are many methods known for the prevention as well as management of scars. Though the scars are not completely avoidable, they can certainly be made better with meticulous initial management. In this study we give more importance to the management of scars and scar modulation. There is no method which can be cited as the single best method in managing the scars. Some of the commonly used methods are 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. Laser therapy can be low-level laser therapy or high-level laser therapy. In this study we are more focused on High-level laser therapy. Initial high-level lasers in use were CO<sub>2</sub> and Pulsed-dye laser, which were known for many adverse effects. Due to which there was always a search for newer lasers, equally effective, lesser adverse effects as well as lesser downtime to achieve the desired clinical effects like changes in size (height), consistency, color (pigmentation) or vascularity.

Though the Er-YAG laser was used in western countries for many years, in India Er YAG is a relatively newer addition to the armamentarium in scar management, hence the data of the efficacy of the Er YAG in managing unsightly scars in 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. The efficacy of the Laser on pigmentation is studied in special interest as pigmentation is one parameter that can attract a beholder's attention to any scar.

## Materials and Methods

**Table 1:** Scars Included in the Study and their Etiology.

Scar Type	(n %)
Post Burn Scar	18(24.7)
Post Traumatic Scar	8(11)
Amputation Stump Scar	5(6.8)
LSCS Scar	2(2.7)
Electrical Burn Scar	7(9.6)
ALT Flap	4(5.5)
STSG	7(9.6)
FTSG	3(4.1)
Fasciotomy Scar	4(5.5)
Healed Scar Face	5(6.8)
Venesection Scar	2(2.7)
Post-operative Scar	4(5.5)
Keystone Flap	1(1.4)
SFJ Ligation	1(1.4)
Ischial rotation	1(1.4)
PBC release scar	1(1.4)
Total	73(100)

This study was conducted in the Department of Plastic Surgery at a tertiary care center after getting the departmental ethical committee approval. Informed written consent was taken from each patient for Er YAG laser therapy and photography of the scars. Total 73 scars were enrolled into the

study randomly (Table 1) post-trauma, post-surgical and post burns scars were included. The scars were evaluated only 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, once pre-treatment and next one month after the completion of the laser therapy. The laser therapy was given for four sessions each at a one-month interval. Er: YAG Laser therapy using already existing equipment in the department, Twain 2940, Quanta System S.p.A., Italy, in ablative as well as thermal mode, at a wavelength of 2,940nm, fluence was set to 1 to 2 J/cm<sup>2</sup>, 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 performed. The types of scars and 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 there is any difference in response between scars of different etiologies to the Er YAG Laser.

## Result

**Table 2:** Preprocedural and Post Procedural Changes of Vancouver scar scale variables.

VSS Parameter	Pre Procedural	Post Procedural	P Value
Vascularity	2+0.8	1.3+0.7	0.001
Pigmentation	1.47+0.6	1.2+0.6	0.006
Pliability	2.1+0.8	1.5+0.7	0.001
Height	1.6+0.7	1+0.6	0.001
Total Score	6.6+1.6	3.2+1.9	0.001

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 1). 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).

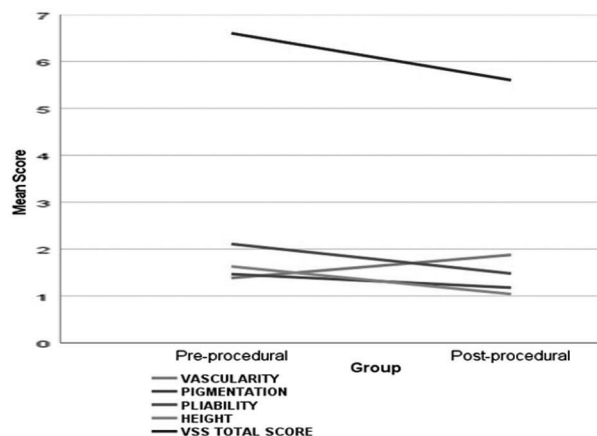


Fig. 1: Graph Showing the changes of VSS variables.

## Discussion

The scar is defined as fibrous tissue that replaces the wound<sup>2</sup> During the process of healing the wound develops a bridge of collagen fibers with a thin epithelium, forming an immature scar.<sup>3</sup> 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.<sup>4</sup> 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. Transforming growth factor- $\beta$  (TGF- $\beta$ ), connective tissue growth factor (CTGF), platelet-derived growth factor (PDGF), and insulin-like growth factor 1 (ILGF-1) are up-regulated, meanwhile interferon- $\alpha$  (IFN- $\alpha$ ) and interferon- $\gamma$  (IFN- $\gamma$ ) are down-regulated.<sup>5</sup>

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 the etiology. 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 etiology or the causative factors. Interestingly in our study we did not find any statistically significant difference.

## Conclusion

The study shows that Er -YAG Laser therapy is

an effective method in the management of post-trauma scar. All the scars in the study showed good response to the Er YAG Laser Therapy and there is no statistically significant relation of etiopathogenesis with outcome. No adverse effects were noted during the study. The limitation of the study is that 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-center study and longer duration of follow up to get a better picture of the effect of Er YAG laser.

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