

The Role of Erbium Yttrium Aluminium Garnet Er YAG Laser in Reducing Height of The Scar

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Abstract

Scars is one of most important sequelae and also one of the most important reason for which patients consult a plastic surgeon or dermatologist in the post trauma or post-surgery period. Many treatments are available for the management of scar. Raised scars usually unsightly. Apart from the conventional treatment modalities Laser therapy is gaining popularity as a method to treat scars. Ablative fractional resurfacing (AFR) scars using a 2,940-nm erbium: yttrium aluminum garnet (Er:YAG) laser is relatively newer treatment modality in India. A study was conducted at a Tertiary care centre in southern part of India. A sample of 73 scars were enrolled, mainly in adults of age between 18 to 60 years. Er YAG Laser therapy was given for these scars in multiple sittings. The height of the scars was measured at the beginning and at the end of the treatment sessions. Vancouver scar scale scoring system was used to score the scars. Statistically significant improvement in the height of the scar was noticed after ablative fractional resurfacing of the scar using Er:YAG laser treatment without any significant side effects.

Keywords: Er YAG Laser; Raised Scar; Height of the Scar.

How to cite this article:

Nishad K, Ravi Kumar Chittoria, Padmalakshmi Bharathi Mohan, et al./The Role of Erbium Yttrium Aluminium Garnet Er YAG Laser in Reducing Height of The Scar.2021;9(1-2):29-32.

Introduction

Scars are one of the common causes of concern for any patient following trauma.¹ And that makes it one of the most common presenting complaints to nay dermatology or plastic surgery out patient department. The conventional treatments available for the management of scar are corticosteroid local application, scar revision, silicone sheet application, compression garments, derma abrasion etc. The Laser therapy has also gained popularity in the management of scars. Carbon dioxide (CO₂) Laser,

erbium: yttrium-aluminum-garnet (Er: YAG) Laser, and pulsed dye (PDL) lasers have all been used in the treatment of scars.² Ablative laser therapy and non- ablative laser therapy are two types of treatment methods scar management using Lasers. Side effects limit the use of ablative lasers like CO₂ and Er: YAG laser for skin resurfacing, non-ablative lasers were developed as a safe alternative to ablative laser resurfacing. However, results of using non-ablative are unsatisfactory.^{1,3} The exact mechanism by which a laser affects scar remodeling is not fully

understood. One view is that Lasers induce the secretion of cytokines and growth factors by stimulating a variety of cellular responses.¹ Other view is fractional photo thermolysis imparts controlled dermal heating which initiates a cascade of events which leads to normalization of the collagenesis - collagenolysis cycle 4 The use of ablative or non-ablative lasers based on the fractional approach is now emerging as a relatively newer and safer method of treatment of scars. This study was conducted in a Tertiary care center in South India using fractiona Er: YAG laser to resurface the scars and study the efficacy of in reducing the height of the scar.

Materials and Methods

The study was conducted in a Tertiary care center in South India from May 2020 to May 2021. Ethical committee clearance obtained before the starting of the. Total of 73 scars were enrolled randomly in healthy adults (age group 18 to 60 years). Informed consent was obtained from patients satisfying inclusion criteria. The digital Images of the scar was taken after getting consent using digital camera. The height of the scar was measured using calipers. Vancouver Scar Scale (VSS) score was calculated at baseline and 1 month after the completion of the treatment.

Each scar received four sessions of Laser using Er:YAG each at one month of interval. The laser used was Er:YAG both in ablative mode as well as thermal mode at wavelength 2,940nm, fluence 1J/cm², pulse width 0.3 ms using spot diameter of 4mm.

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) was performed on scars during each treatment session

Statistical analysis was performed 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. The Pearson product-moment correlation was used to determine the strength and direction of a linear relationship between two continuous variables. Pearson correlation coefficient, denoted as *r* (i.e., the italic lowercase letter *r*), measured the

strength and direction of a linear relationship between two continuous variables. Its value can range from -1 for a perfect negative linear relationship to +1 for a perfect positive linear relationship. A value of 0 (zero) indicates no relationship between two variables.

Result

The preprocedural and postprocedural Vancouver scar scale parameters are compared in Figure 4. There was a significant difference in height after Er : YAG laser application (paired t-test, P= 0.001)

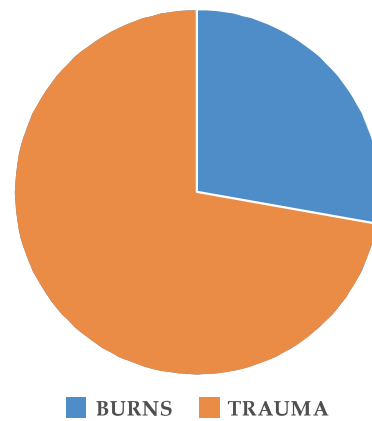


Fig. 1: Mode of Injury.

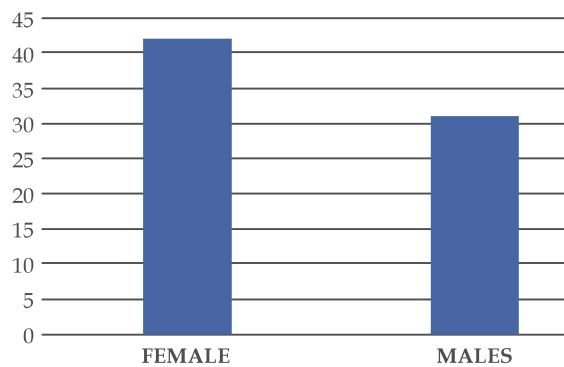


Fig. 2: Gender.

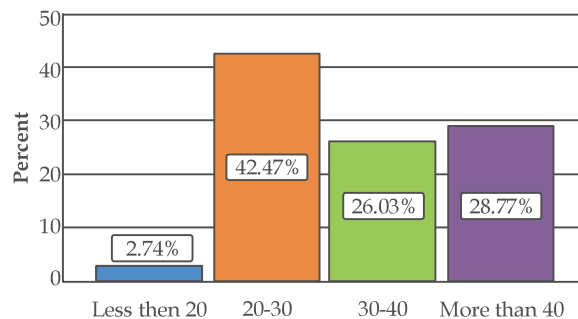


Fig. 3: Age of the Patients.

Table 1: Vancouver scar scale scoring Pre and Post Treatment.

VSS Parameter	Pre-Proicedural	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

Discussion

The scar is defined as fibrous tissue that replaces the wound after injury or disease² During the process of healing the wound develops a bridge of collagen fibers with a thin epithelium, forming an immature scar.³ An immature scar is red, raised, rigid, and hypopigmented, During the process of maturation the scar becomes more pliable, flatter, less vascular color is normalized. Any aberration of these makes the scar abnormal or unsightly. The difference between the normal scar, immature scar hypertrophic scar lies in the difference in the extracellular matrix composition, Type-III is the predominant type of collagen during the proliferation phase of normal wound healing and which eventually gets replaced with type-I collagen during the remodeling phase. 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. The 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 profibrotic. 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- β (TGF- β), connective tissue growth factor (CTGF), platelet derived growth factor (PDGF), and insulin like growth factor α (ILGF- α) are up-regulated, meanwhile interferon α (IFN α) and interferon- γ (IFN- γ) are down-regulated.^{4,5}

The first LASER machine was devised in 1960 by Maimon, which was a Ruby laser. Dr. Leon Goldman a dermatologist is considered to be 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 a lot 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 normalization of the collagenesis collagenolysis cycle occurs.

Conclusion

The fractional resurfacing using Er:YAG Laser is an effective method in the management of post-trauma scar especially raised scars. The height of the scar showed improvement after the application of the Er YAG Laser. No significant adverse effects were noted during the study. The limitation of the study is that the scars were not uniform and there was no control group. We suggest a large volume and multi-center study may give a better picture of the effect of Er YAG laser on reducing the height of the scar.

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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