

## Role of Er-YAG Laser in Post Electrical Burn Scar

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**How to cite this article:**

Kada Sri Vidhul, Ravi Kumar Chittoria, Barath Kumar Singh. P/Role of Er-YAG Laser in Post Electrical Burn Scar/International Physiology.2023;11(1):23-26.

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**Received on:** 28.12.2022

**Accepted on:** 31.01.2023

### Abstract

The scar is a general sequela of any burns. If the scar becomes unsightly it influences the psychological or physical well-beingness of the patient. The pigmentation difference of the scar with the surrounding skin is one factor that can make the scar unsightly. There are many methods of scar management. Laser Therapy using Er-YAG laser is one method of management of scars that are widely used in western countries. In India, the data on scar management using Er YAG laser and the effect of Er YAG laser on the management of the scar is few. In this article, we highlight the role of Er-YAG laser in post electrical burn scar resurfacing.

**Keywords:** Er-YAG Laser; Electrical Burnscar; Scar Management; Laser Therapy.

### INTRODUCTION

Scar management is a very common problem for which patients seek consultation from any plastic surgeon. Abnormal scars can be painful, itchy and it can disable the patient as scars it can prevent the movement of the joint, neck eyelid, or lips. Scars can become unsightly due to their location, color, consistency, or size (height). There are many methods for the prevention and management of scars. Though the scars are not completely avoidable, they can certainly be made better with meticulous management of the wounds.<sup>1</sup> There is no single best method to manage the scar.

Some of the commonly used methods of scar management are scar massage with emollients, compressions garments, intralesional steroids, surgical scar revision, and Laser Therapy. Laser therapy can be low-level Laser Therapy as well as high level Laser therapy. High level laser therapy is in use for many years, initial lasers in use were CO<sub>2</sub> and Pulsed dyelaser.<sup>1,2</sup> Due to the adverse effects, there is always a quest for newer and newer lasers that are equally effective and with lesser adverse effects and lesser down time to achieve the desired clinical change. The desired clinical changes that can make a scar less unsightly are changes in size (height),

consistency, color (pigmentation), 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-burns scars and studied the effect of the Laser on each scar parameter. In our study we discuss role of Er-YAG Laser in post electrical burn scar.

## MATERIALS AND METHODS

This study was conducted in the Department of Plastic Surgery at a tertiary care centre after getting the departmental ethical committee approval. Informed written consent was taken from the patients for Er-YAG therapy as well as the clinical photography. This is a prospective descriptive non randomised case study about a 35 year old male sustained electrical burn injuries while working at construction building. He sustained electrocution by contact with electric wire as it fell on patient body. Patient initially went to local hospital, then arrived to our emergency department with an electrical burn in the anterior aspect of the chest (entry zone) and the left foot (exit zone). The chest had a contact with a 220 V of alternating current. It was presumed that the current entered his chest and

exited through his left thigh. The other external skin injury to abdomen and both thighs and arm. Multiple second degree superficial burns involving chest and abdomen (anterior aspect), bilateral arms (anterior aspect), bilateral thighs, multiple blisters over thigh, legs. The serum electrolytes, urea and creatinine, urine analysis, electrocardiogram, chest x-ray were normal, urine myoglobin negative. He was resuscitated with the standard WHO burn protocol. The patient was extubated after three days of intensive care. Initially, the patient is treated on conservative management and the patient developed raw area on right sided chest wall, abdomen, thigh for which Split skin grafting is applied which is taken from both thighs. After 3 weeks patient developed scar over chest, abdomen, both thighs (Fig. 1). The scars were evaluated twice using the Vancouver scar scale scoring system and clinical photography twice once pre-treatment and next 3 months after the completion of the laser therapy. The Vancouver scar scale score pre-treatment was assessed as 10/13. The laser therapy was given for four sessions each at a 3-weekly interval. The laser used was Er:YAG Laser, 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. Laser is applied (Fig. 2 & 3) to the scar over the chest, abdomen, thigh.



Fig. 1: Post electrical burn scar over the chest, abdomen and thigh



Fig. 2: Application of Er-YAG Laser



Fig. 3: Er-YAG laser Fractional resurfacing immediately after laser therapy

## **RESULTS**

In our study after application of Er-YAG Laser in post electrical burn scar, Vancouver scar scale improved to 6/13 and scar is improved clinically. (Table 1)

Table 1: Preprocedural and Post Procedural Changes of Vancouver scar scale variables.

Components	Before application	After Application
Vascularity	2	1
Pigmentation	2	2
Pliability	3	1
Height	3	2
Total Score	10	6

## **DISCUSSION**

The scar is defined as fibrous tissue that replaces the wound after injury or disease. During the process of healing the wound develops a bridge of collagen fibres with a thin epithelium, forming an immature scar.<sup>3</sup> An immature scar is red, raised, rigid, and hypopigmented. During the process of maturation the scar becomes more pliable, flatter, less vascular colour 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 remodelling phase.<sup>4</sup> 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 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.

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.<sup>5</sup> 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.<sup>6,7</sup> 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 remodelling 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.<sup>7</sup>

## CONCLUSION

The case report shows that Er-YAG Laser therapy is an effective method in the management of post-electric burn scar and it showed significant improvement after the application of the Er YAG Laser. No adverse effects were noted during the study.

**Conflicts of interest:** None

**Authors' contributions:** All authors made contributions to the research, is putatively expected to be useful article.

**Availability of data and materials:** Not applicable.

**Financial support and sponsorship:** None.

**Consent for publication:** Not applicable.

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