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Role of Pulsed Dye Laser in Management of Keloids: Review Article

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ABSTRACT

Background: Hyperproliferation of collagen in the dermis, caused by an aberrant healing response to injury, causes a keloidal scar that extends beyond the original lesion and grows in a pseudotumor pattern, with tissue deformation and a high recurrence rate following excision. The lasing medium of a pulsed dye laser (PDL) is an organic dye dissolved in a solvent. This list includes some of the most often used laser dyes: rhodamine, fluorescein, coumarin, stilbene and umbelliferone. Ethanol, Water, methanol, hexane, glycol and cyclodextrin, as well as cyclohexane are some of the solvents that are employed. Fast discharge flashlamp or external laser with high energy output. The PDL is hypothesized to improve keloids and hypertrophic scars by causing capillary breakdown, which leads to hypoxia and, in turn, changes the production of local collagen.

Objective: This review article aimed to assess the possible efficacy of pulsed dye laser in managing keloids.

Methods: Pulsed dye, laser, and keloids were all looked for in PubMed, Google scholar, and Science direct. References from relevant literature were also evaluated by the authors, but only the most recent or complete study from June 2008 to May 2021 was included. Due to the lack of sources for translation, documents in languages other than English have been ruled out. Papers that did not fall under the purview of major scientific investigations, such as unpublished manuscripts, oral presentations, conference abstracts, and dissertations, were omitted.

Conclusion: One of the most promising laser treatments for younger hypertrophic scars and keloids has been the 585-nm pulsed dye laser (PDL), which has shown positive outcomes in numerous trials.

Keywords: Pulsed dye laser, Keloids, Zagazig University Hospital.

INTRODUCTION

Humans are the only species known to have keloids, which are benign tumors of the skin. Patients with darker skin pigmentation are more likely to develop keloids than those with lighter skin pigmentation. Contractures, discomfort, itching, paresthesia, and psychological issues can all be side effects of excessive or abnormal scar development [(1)].

To repair a wound, the body uses a complicated set of cellular and humoral activities to bring the damaged skin back into proper function. There are three stages of healing: inflammation, proliferation, and maturity, which can be interpreted in terms of the three classic phases [(2)].

There is a higher prevalence of keloids during pregnancy and puberty, which has been linked to the hormone profile, but alternative causes, such as enhanced neo-angiogenesis during pregnancy, are also likely. More research is required to confirm a link between the formation of keloid scars and hormone levels [(3)].

Keloids don't stop growing, unlike hypertrophic scars, which tend to stabilize or recede once they've reached a particular size. To distinguish between keloids and hypertrophic scars, there are strict clinical and histological criteria [(3)].

Unexplained causes of keloids are more common on the chest and shoulders than on the upper back, neck, or ear lobes. The site of vaccination was the site of a large keloid weighing 1.8 kg in one example. Keloids have been debated extensively as to whether they are more likely to form in places of high tension [(4)].

Keloids can be treated with a pulsed dye laser:

It is possible to employ LASERs or light amplification by stimulated emission of radiation, to treat a wide range of dermatological problems, depending on the laser's wavelength, pulse characteristics, and fluence (energy output) as well as the condition being treated [(5)].

Lasers come in a variety of shapes and sizes, and they are distinguished by the medium used to generate the beam. Depending on the wavelength and penetration, each type of laser has a distinct spectrum of applications [(5)].

Pulsed dye laser:

A dye laser emits light by irradiating a target material with an organic dye and solvent. In the laser dye arsenal are rhodamine, fluorescein and malachite green in addition to fluorescein and stilbene. These include Ethanol (water), Water (methanol), Hexane, Glycol (cyclodextrin), and Cyclohexane. Fast discharge flashlamp or external laser with high energy output (as an external laser, ruby laser, or ND: YAG laser, or a quick discharge flashlamp) is required [(6)].

High-speed circulation of the dye solution helps to prevent triplet absorption and reduces dye degradation. Fluorescent dye molecules are excited and ready to generate stimulated radiation when light from an external source strikes them. Pulsed dye lasers emit pulses of visible light with pulse durations ranging from 0.45–40 ms at a wavelength of 585 or 595 nm. Radiofrequency can be used in conjunction with pulsed dye laser treatment to improve results and minimize side effects by allowing lower PDL dosages [(7)].

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Pulsed dye laser mechanism:

Pulsed dye lasers are commonly used by dermatologists for localized thermolysis during skin treatments. Target structures (also known as chromophores) absorb more of the laser light at the particular wavelength relative to the surrounding tissue. After irradiation, the target structure must cool by half its peak temperature, the thermal relaxation period of the target must be less than the pulse duration of laser energy [(8)].

Using this method ensures that the thermal energy has a restricted impact on the target structure and does not affect the surrounding tissue. When a pulsed dye laser's light hits the skin, it's either absorbed, scattered, or reflected back at the source of illumination. It is the absorption of energy, which is then transformed to thermal energy (heat) by the designated targets (chromophores), that is primarily responsible for the therapeutic effect [(8)].

Pulsed dye lasers often target haemoglobin in blood as a skin chromophores. Disadvantages arise when non-target tissues and structures absorb energy meant for the target chromophore [(6)].

Laser treatments for hypertrophic scars and keloids have been tested during the past few decades. Due to differences in laser settings, current data cannot be compared. One of the most promising laser treatments for younger hypertrophic scars and keloids has been the 585-nm pulsed dye laser (PDL), which has shown positive outcomes in numerous trials [(9)].

Hypoxia and altered local collagen formation are hypothesised to be the mechanisms through which the Keloids and hypertrophic scars can be improved by PDL since it causes capillary breakdown. PDL therapy has also been linked to an increase in MMP (e.g. collagenase) synthesis [(10)].

Keratosis and hypertrophic scarring are best treated with non-overlapping laser pulses at fluences of 6–7.5 J/cm^2 (7–mm spot) or 4.5–5.5 J/cm^2 (10–mm spot) fluences. To effectively enhance scar colour, height, pliability, and texture, two to six therapy sessions are required [(10)].

To put it another way, the vast majority of published studies are deficient in evidence because they lack untreated controls, have too few cases and follow-up periods that are either too short or don't distinguish between hypertrophic scars and keloids. Usually lasts one to two weeks, the most prevalent adverse effect is purpura [(9)].

Vesicles and crusts may form depending on the amount of energy being used. Darker skin types are more likely to have hyperpigmentation that lasts longer and is less likely to occur when the wavelength 595 nm is used instead of the 585 nm. Reactivation of younger keloids has been witnessed on rare occasions, both by ourselves and by others in our everyday praxis. Because of this, the first step in treating keloids is typically a mix of cryotherapy and TAC, with PDL being used to reduce erythema [(11)]

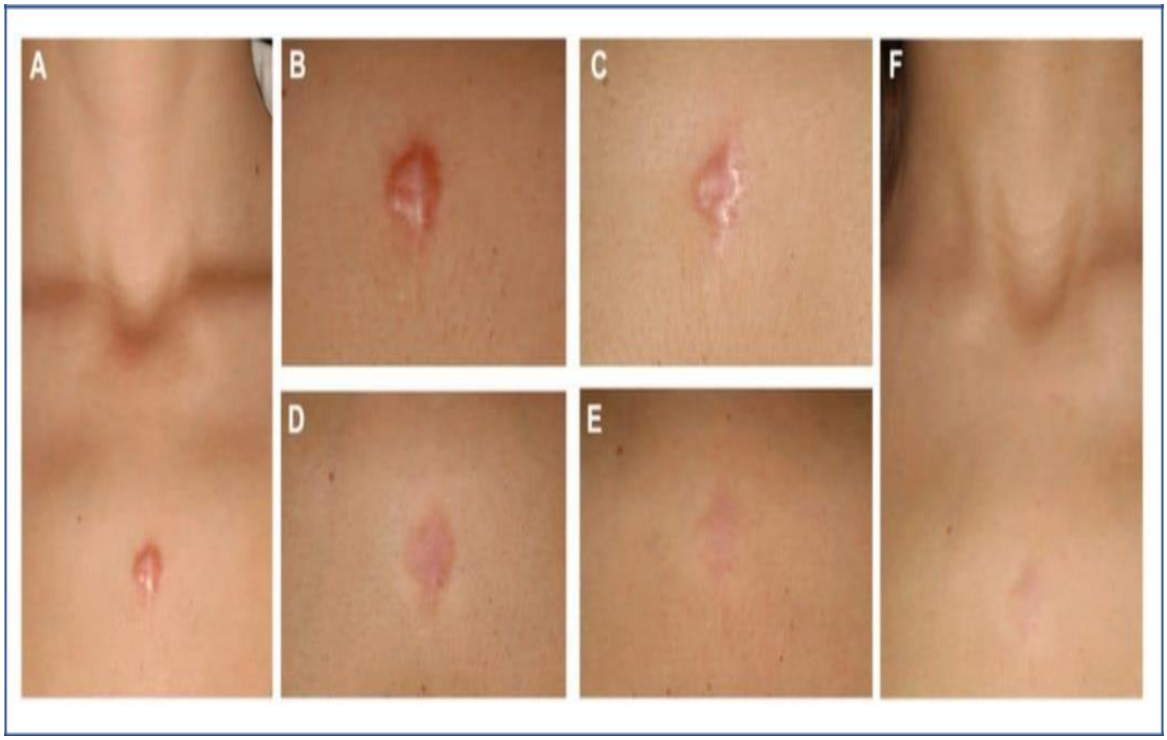

Figure (1): Before beginning the combining cryotherapy and intralesional TAC (10 mg/mL), this is the baseline photograph (A and B). Three rounds of cryo/intralesional triamcinolone acetonide therapy combined with the results before beginning PDL(C). After four PDL applications (D). Six months following the final laser treatment, there was no evidence of recurrence or reactivation. (E and F) [(9)].

Keloids and hypertrophic scars may benefit from the 1064-nm Neodym: YAG laser, which has been indicated as a promising treatment option. The Nd: YAG therapy may have comparable underlying mechanisms of action to PDL therapy, but it penetrates further into the body. Efficacy declines with the thickness of the scar, making it ineffective for treating thick keloids [10].

Cho *et al.* [12] reported that patients with hypertrophic scars who had five to 10 low-fluence treatments over the course of one to two weeks saw significant changes in pigmentation, skin elasticity, and scar height. There were only minor side effects, such as a stinging sensation during treatment and erythema following treatment. Nd: YAG laser treatment for hypertrophic scars and keloids still needs further research to fully understand its effects.

Following German standards for the treatment of excessive scarring, PDL is largely indicated for the decrease of erythema, such as in newly formed red scars with a high vascularization and can also be considered for the relief of severe pruritus. It is possible that conventional CO_2 or Erbium: YAG lasers can be advised for the ablation of latent hypertrophic scars. However, their utilization as monotherapy to eliminate keloid is not indicated due to recurrence rates similar to those after excision of keloid, as per these guidelines [13].

However, it appears that 6 months of post-CO_2-laser steroid treatments spaced 3–4 weeks apart will produce significant improvements. Because there aren't any controlled research, it's impossible to say whether fractional CO lasers can be used to treat hypertrophic scars [9].

CONCLUSION

One of the most promising laser treatments for younger hypertrophic scars and keloids has been the 585-nm pulsed dye laser (PDL), which has shown positive outcomes in numerous trials.

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