

ORIGINAL ARTICLE

Efficacy and Safety of Long Pulsed Nd:YAG Laser in the Management of Hypertrophic Scars and Keloids

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Abstract

Introduction

Keloid scars have always been a therapeutic challenge. Lasers due to their versatile action are being tried in the management of hypertrophic scars and keloid. Use of Nd:YAG laser especially in dark skin types is justifiable but sufficient data is not available.

Methods

30 clinically diagnosed cases of keloids and hypertrophic scars were enrolled and treated by 1064nm long pulsed Nd:YAG laser for 3 sessions at 4 weekly interval. Therapeutic effectiveness was evaluated at baseline, during each visit and one month after the last session using Vancouver Scar Scale (VSS). Photographs were taken during each visit.

Results

A total of 26 patients with keloid and four patients with hypertrophic scar were included in the study. Common age group encountered was 21 – 30 years with M:F ratio of 2:1. Chest was the commonest site involved as noticed in 13 (43.3%) patients. Altogether, 15.7% improvement was evidenced in the VSS from baseline to post-treatment with response being documented in 13 (43.3%) of the 30 patients. Clinical response was seen in 13 patients of whom 5 patients showed < 25% improvement and the remaining 8 patients showed 25 – 75% improvement. Statistically significant improvement was recorded in pliability ($p= 0.00$) parameter of the VSS. Side effects were minimal like pruritis and pain seen in 30% patients.

Conclusion

1064nm long pulsed Nd:YAG laser has limited efficacy as monotherapy in the treatment of keloid and hypertrophic scar. Nevertheless, it is a safe and well-tolerated procedure.

Key words: 1064nm Nd:YAG laser, keloid, hypertrophic scar

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Introduction

Keloid and hypertrophic scar represent an inadvertent aftermath of the normal wound healing process characterized by overgrowth of fibrotic tissue. The trending therapeutic modalities in the management of these scars involve intralesional corticosteroids, silicone gel sheets, mechanical pressure dressings, 5-fluorouracil, bleomycin, verapamil and laser therapy.¹ Despite extensive research, no treatment modality has proved effective in the permanent removal of keloid.

Currently, the focus is on techniques that are

minimally invasive, which calls for laser based treatment. Apfelberg et al first reported the use of lasers on keloid by irradiation with CO₂ and argon lasers.²

Long-pulse Nd:YAG laser has caught the attention in the management of scars due to its multi-potential action on dermal vasculature and matrix metalloproteinase (MMP).³ The mechanism of action is based on the principle of heat generation leading to an increase in vascular permeability, increased MMP production and decomposition of collagen fibers.⁴ Nd:YAG laser is capable of generating changes in the collagen bearing tissue at depths of 500 to 1000µ.⁵ The heat attained reaches a depth of mid-dermis which correlates well with the level from where keloids generate. Furthermore, the energy is only weakly absorbed by melanin and better absorbed by blood vessels making it safer for the Indian skin.³

Materials and Methods

The study was carried out in a tertiary care hospital, Mandya. Study protocol was approved from the institutional ethics committee. A detailed history of each patient was obtained and a thorough cutaneous examination was done with additional focus on patient’s skin type. Clinically diagnosed cases of keloids and hypertrophic scars fulfilling the inclusion and exclusion criteria were enrolled for the study. Written informed consent was procured from the participants.

Inclusion criteria

Patients with clinical diagnosis of hypertrophic scar and keloid.

Exclusion criteria

1. Scar on the face
2. Size of the scar > 5cm at presentation
3. Age < 12 years
4. Pregnant and lactating females
5. Active infections in the area to be treated
6. History of any topical or intralesional treatment for the scar 4 weeks prior to the initiation of therapy
7. History of malignancy or radiation therapy
8. Patients with unrealistic expectations

Procedure

Each of the participants were treated by 1064 nm long pulse Nd:YAG laser. The area to be treated was cooled with ice packs and protective eyewear was provided to the patient as well as the treating

doctor. Topical anesthetic cream was avoided. Nd:YAG laser (Celphia, Dermaindia) was delivered at a fluence of 25 J/cm² with a spot size 7 mm. After the procedure, the treated area was again cooled. A total of 3 sessions were given for each patient at 4 weekly intervals.

Therapeutic effectiveness was evaluated at baseline, during each visit and one month after the last session using Vancouver Scar Scale (VSS). Photographs were taken during each visit to monitor the clinical improvement.

Vancouver Scar Scale

PIGMENTATION: 0 - Normal colour 1 - Hypopigmented 2 - Hyperpigmented	VASCULARITY: 0 - Normal 1 - Pink 2 - Red 3 - Purple
PLIABILITY: 0 - Normal 1 - Supple (flexible with minimum resistance) 2 - Yielding (giving way to pressure) 3 - Firm (solid/inflexible, not easily moved) 4 - Banding (rope like) 5 - Contracture present	HEIGHT: 0 - Normal (flat) 1 - <2mm 2 - >2mm and <5mm 3 - >5mm

Statistical Analysis

Data was analyzed with the help of the One-way ANNOVA and other relevant tests using SPSS version 20 software.

RESULTS

The basic demographic characteristics of the study participants are tabulated in **Table 1**. The most common age group affected was 21 to 30 years (n=15, 50) and the M:F ratio = 2:1. Of the 30 study subjects, 26 (86.7%) were found to have keloid and 4 (13.3%) had hypertrophic scar.

Table 1: Demographic characteristics of 30 study subjects

Characteristics		
Mean age (years)	29.87 years	
Sex	Male	20 (66.7%)
	Female	10 (33.3%)
Fitzpatrick skin type	Type IV	20 (66.7%)
	Type V	10 (33.3%)

Upon probing the history of inciting event, 15 (50%) patients gave history of trauma, surgical scar or pre-existing lesions like pyoderma, acne, burns or varicella, while 11 (36.7%) patients claimed to have developed keloid spontaneously. All the 4 cases of hypertrophic scar gave history of trauma or surgery.

Out of a total of 30 study subjects, 6 patients (20%) were asymptomatic and 24 patients had associated symptoms. Pruritis was the most common symptom seen in 20 patients (66.7%) followed by pain seen in 8 patients (26.7%).

The duration of onset ranged from 2 to 12 months for hypertrophic scar and 1 - 16 years for keloid. The duration was arbitrarily divided into early onset and late onset; lesions less than or equal to 1 year old were classified as early and lesions older than 1 year were classified as late [Table 2]. However, duration had no statistically significant bearing on the outcome of the laser treatment ($p= 0.765$).

Table 2. Comparison of duration of the scar with response to treatment

DURATION	n=30	RESPONSE TO TREATMENT	
		Absent n=18	Present n=12
Early	14	8	6
Late	16	10	6

Chest was the most common site involved, recorded in 13 patients (43.3%). There was no statistically significant correlation ($p=0.40$) between site involved and response to treatment [Table 3].

Table 3. Comparison of site of the lesions with response to treatment

SITE	n=30	RESPONSE TO TREATMENT	
		Absent n=18	Present n=12
Abdomen	2	0	2
Back	3	2	1
Chest	13	7	6
Upper limbs	9	7	2
Lower limbs	2	2	1

Out of the 30 cases, response to treatment as assessed by VSS was seen in only 13 (43.3%) while the remaining 17 (56.7%) cases did not show any response [Table 4]. The overall improvement in VSS from baseline to post-treatment session was 15.7%.

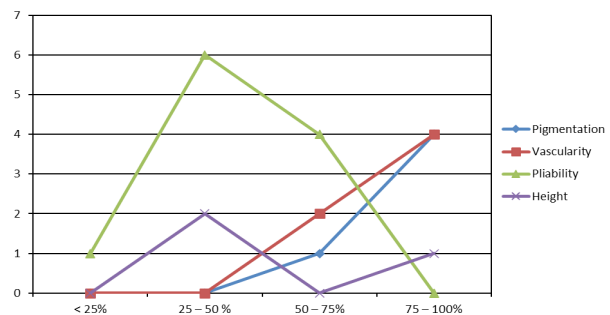
At the end of study, response with respect to various components of the VSS was analysed. Maximal response was seen in pliability where 10 (33.3%) patients showed improvement compared to baseline score. Response pertaining to pigmentation, vascularity and height were documented in 5 (16.7%), 6 (20%) and 3 (10%) patients respectively

Table 4. The analysis of response before and after treatment based on total Vancouver Scar Scale

RESPONSE	n=30	Percent (%)
0	17	56.7
< 25%	5	16.7
25 – 50 %	4	13.3
50 – 75%	4	13.3
75 – 100%	0	0

[Graph 1]. On comparing the means of individual parameters with the mean improvement in VSS, statistically significant improvement was recorded in pliability ($p= 0.00$) parameters.

Graph 1. Response seen in individual parameters of the Vancouver Scar Scale at the end of study



Patients included in the study experienced negligible side effects, none of them severe enough to warrant discontinuation of treatment. Of the 30, only 9 patients complained of pruritis and pain in the lesions post treatment and it was more commonly encountered in the first session.

Discussion

With a growing knowledge regarding the basic anatomy and physiology of wound healing, tremendous advances have been made in the management of keloid and hypertrophic scar. The high recurrence rate has always been and still continues to be the major limiting factor and so far, there is no one gold standard treatment available for permanent keloid removal.³

In the last two decades, pulsed dye laser (PDL) and CO₂ laser have been given more emphasis in the management of keloid. Keeping in view of the depth of keloid scars, we can expect better penetration and action with lasers of longer wavelength like Nd:YAG (1064nm) than PDL (585nm) . The ample studies available on the use of long-pulsed Nd:YAG lasers as monotherapy for keloid treatment on Indian skin is the basis for undertaking this study.

In the present study, response was seen in only 43.3% while the remaining 56.7% cases did not show any response with an overall improvement of 15.7% in the VSS analysed one month after the treatment session [Figure 1-3]. On the other hand, study conducted by Venkataram Mysore et al showed total improvement of 29.6% in the VSS at the end of their study.³ Another study conducted by Shady Mahmoud Ibrahim et al reported a significant improvement of 65.44% ($p < 0.001$) in the final VSS.⁶ In a study done by Kumar et al, of the 17 keloids treated with Nd:YAG laser, 10 lesions (58.8%) completely resolved and 7 lesions (41.2%) showed only partial resolution.⁷ The low response rate documented in our study may be due to the use of lower fluence and lesser sessions compared to the aforementioned studies.

Figure 1. Female patient with keloid over the chest before treatment (A) and one month after treatment (B) showing response with respect to pigmentation, vascularity and height.



Figure 2. Male patient with hypertrophic scar over his right knee before treatment (A) and after treatment (B) showing improvement in pliability of the scar

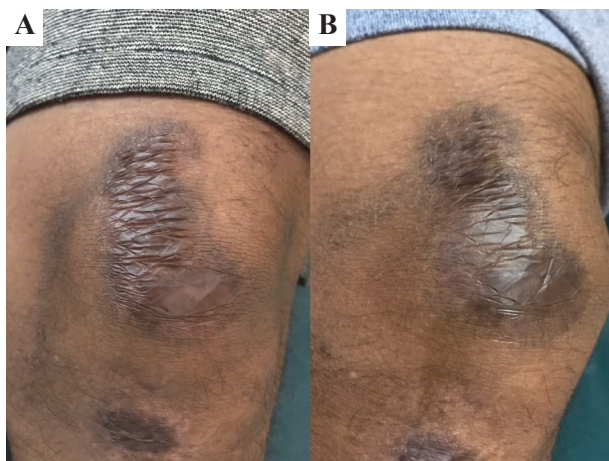


Figure 3. Male patient with keloid over his upper chest before treatment (A) and after treatment (B) showing response pertaining to pigmentation and pliability.



In our study, 17 patients did not show any improvement, 5 patients showed less than 25% improvement, 25 – 50% and 50 – 75% improvement were seen in 4 patients each. These findings are, to some degree, comparable with the study done by Ashwini Annabathula et al who combined patients fractional CO₂ laser, PDL and long pulse Nd:YAG laser. Of the 11 patients enrolled in their study, 1 patient had excellent improvement, 1 had good improvement, 4 patients had moderate improvement, 2 patients had mild improvement and 3 had no improvement.⁸

Assessing the improvement in the individual parameters of the VSS, our study revealed statistically significant response with respect to pliability. This is consistent with the study done by Shady Mahmoud Ibrahim et al who also reported a significant reduction in the pliability of the scar.⁶

Venkataram Mysore et al reported that lesions of less than 6 months duration showed statistically significant improvement in terms of vascularity, pliability, height and total VSS; on the other hand, keloids of more than 6 months duration showed statistically significant improvement in terms of vascularity, pliability and total score.³ On the contrary, no statistically significant correlation was seen with treatment response and duration of the lesion in the current study. Neither did we document any correlation with the treatment response and site of the lesions.

Furthermore, patients experienced negligible side effects like pain and pruritis reported in 30% patients, none of them severe enough to warrant

discontinuation of treatment. This finding was consistent with other studies who also reported minimal adverse effects.^{6,7,8} Lower incidence of adverse effects can be attributed to the use of lower fluence in our study as a precaution to the high melanin content of the patients' skin type.

Limitation

The small sample size, short duration of the study and lack of adequate follow-up period are the limitations of this study. For further research on this topic, large scale studies combining other modalities with laser therapy may be required.

Conclusion

To conclude, 1064nm long pulsed ND:YAG laser is safe but less effective as monotherapy in the management of keloid and hypertrophic scar. On the other hand, considering the simplicity, non-invasiveness and safety profile, it may be explored as an adjuvant to other modalities which can be directed at different components of the keloid. However, it must be borne in mind that laser therapy can be time-consuming and most definitely bears a financial burden on the patient.

Conflict of Interest Declaration

The authors have no conflict of interest to declare.

Acknowledgement

Nil

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