



Original Article

Long-pulsed 1064 nm Nd: YAG laser in treatment of palmoplantar warts: A prospective study

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ABSTRACT

Objectives: Palmoplantar warts are a challenge to treat. Standard treatment methods include electrocautery, radiofrequency ablation and cryosurgery, carbon dioxide laser, and Erbium-doped Yttrium Aluminum Garnet laser, which are ablative, invasive, and have downtime. Non-ablative lasers like pulsed dye laser and long-pulsed Neodymium: Yttrium-Aluminum-Garnet (Nd: YAG) have been tried earlier for the treatment of warts to overcome these deficiencies. The aim of the study was to assess the efficacy and safety of long-pulsed 1064 nm Nd: YAG laser in the treatment of palmoplantar warts.

Material and Methods: Eleven adult subjects with a total of 58 hand and foot warts were enrolled in the clinical trial from January 2016 to January 2017 to receive treatment with long-pulsed 1064 nm Nd: YAG laser. The thick hyperkeratotic part of the wart was removed by paring and then the lesion was treated, at monthly intervals for four sessions or until the clearance of the warts. Response was assessed at the beginning, before each treatment session and after the final treatment.

Results: A total of 8 subjects with 52 warts completed the study. Forty (76.9%) warts showed complete clearance of lesion and 2 (3.8%) warts showed marked improvement. Ten (19.2%) warts did not get cleared. The average number of sessions was 2.2. Mild pain was noticed during the procedure. There was no wound, no infection and no bandages were required after the procedure. Post-inflammatory pigmentation or scarring was not observed in any case.

Conclusion: Long-pulsed 1064 nm Nd: YAG laser is safe, effective, non-destructive, and relatively painless for the treatment of palmoplantar warts.

Keywords: Warts, Laser, Neodymium: Yttrium-aluminum-garnet

INTRODUCTION

Warts are caused by human papillomavirus (HPV). Following infection, keratinocytes at the basal layer undergo epidermal thickening and hyperkeratinisation, which results in a visible wart.^[1] Common warts can arise on any part of the body and account for 70% of cases, while plantar and flat warts account for 24% and 3.5%, respectively. The remaining 2.5% includes anogenital warts and mucous membrane warts.^[2] Ablative lasers like carbon dioxide and Erbium-doped Yttrium Aluminium Garnet have been used to treat the warts. But ablative lasers are painful and have a prolonged healing time and high chance of scarring in the treated area.^[3-7] In warts, dilated blood vessels in papillary dermis are the characteristic feature, and targeting the blood vessels can result in ischemia and hence lead to resolution of the lesion.^[8,9] Non-ablative pulsed-dyed

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lasers 585–595 nm with chromophore as the oxyhemoglobin are most commonly used non-invasive laser for the treatment of wart.^[10] Hemoglobin has strongest absorption peak at 585–595 nm and a more modest absorption peak between 800 and 1100 nm. Long-pulsed 1064 Neodymium: Yttrium-Aluminum-Garnet (Nd: YAG) laser acts by targeting hemoglobin in the blood vessels. For this reason, we chose non ablativ long-pulsed 1064 Nd: YAG laser for the treatment of palmoplantar warts.

The objective of the present study was to determine the safety and efficacy of long pulsed 1064 nm Nd: YAG laser in the treatment of palmoplantar warts.

MATERIAL AND METHODS

This was a prospective and single center study of 58 palmar and plantar warts in 11 patients approved by the Institutional Ethical Committee. All the patients included in the study had not received any prior treatment for their warts. Pregnant or lactating females and patients on other modalities of treatment were excluded from the study. After obtaining a proper written and informed consent, digital single-lens reflex camera photographs were taken. Paring of the thick keratinous layer was done using a scalpel blade before the laser. 1064 long pulsed-Nd: YAG with a R33 hand piece as the probe with the following parameters was used: Spot size 3–6 mm depending on the size of the lesion; fluence 200–260 J/cm² according to tolerance of the patient and thickness of the lesion; pulse duration 5–15 ms depending on the thickness of the lesion; and 1 Hz repetition rate. The entire wart along with a 1–2-mm margin of the surrounding skin was then irradiated, with a 10–20% overlap of laser pulses. End point was greying or whitening of lesion. Cooling was done before, during, and after the procedure with a Zimmer Cryo6®I and ice pack. A total four sessions at monthly intervals or until complete clearance of the lesions were done. A smoke evacuator and a protective face mask was used by patient and treating physician to prevent inhalation of HPV. Mupirocin ointment was applied after the treatment. During this study, standardized photographs of each lesion were obtained at the baseline and each session thereafter. Improvement was assessed by clinical improvement score as follows:

Visual analog scale

- Complete clearance – 100%
- Marked improvement – 75–99%
- Moderate improvement – 50–74%
- Mild improvement – 49–25%
- Poor – <25%.

At each subsequent visit, the efficacy of the treatment was evaluated both subjectively and objectively. Adverse effects

such as hemorrhagic bulla, scarring, pigmentary alteration, and pain during the procedure were noted. Pain was evaluated by pain scale (0–10), where “0” represents no pain and “10” implies severe pain.

RESULTS

Out of 11 subjects, three subjects left the study. From the eight subjects that were included in the study, there were three male and five female patients. Mean age of patients was 31 years, with a range of 19–64 years. On completion of the study, the results were evaluated for 52 warts. Out of the total 52 warts, 50 warts were deep palmoplantar warts [Table 1]. The average duration of lesion was 9.8 months, with a range of 3–24 months. Complete clearance with appearance of normal dermatoglyphics [Figures 1 and 2] was seen in 76.9% (40/52) of warts which belonged to the deep palmoplantar (39) and verruca vulgaris (1) subtype, and marked clearance was seen in 3.8% (2/52) of the warts, which included one periungual and one deep palmar variety. About 19.2% (10/52) warts had mild improvement [Table 2].

Five patients showed complete clearance of their lesions. Among these five patients, four patients had palmoplantar warts and one patient was having verruca vulgaris. Patients with palmoplantar warts ($n = 4$) required a total of 10

Table 1: Distribution of warts according to subtype.

Sub type of warts	Number of warts
Deep palmoplantar	50
Periungual	1
Verruca vulgaris	1
Total	52



Figure 1: (a) Multiple plantar warts in a 28-year-old male patient at presentation. (b) Plantar warts after the treatment with four sessions. (c) Appearance of normal dermatoglyphics at 12-month follow-up.

sessions of treatment for complete clearance. The average number of sessions required for complete clearance was 2.5 (range 2–4). The patient with verruca vulgaris wart ($n = 1$) showed complete clearance in one session. Periungual warts showed marked clearance after two sessions. The average number of sessions required for complete clearance in these patients ($n = 5$) was 2.2 [Table 3].

All the treatment sessions were well tolerated, with 62.5% of subjects having no pain. Only mild transient pain was noted in 37.5% of patients during the procedure. There was no scarring, pigmentary alteration, and hemorrhagic bulla in any of the patients. Mild crusting was seen after each session which healed within 1 week with topical application



Figure 2: (a) Multiple palmar warts in a 34-year-old male patient involving his right middle and index fingers and thumb. (b) Resolution of warts after four sessions.

Table 2: Distribution of patients and number of warts according to response.

Response	No. of patients (%)	No. of warts (%)
Complete 100%	5 (62.5%)	40 (76.9%)
Marked 75–99%	2 (25%)	2 (3.8%)
Moderate 74–50%	0	0
Mild 25–50%	1 (12.5%)	10 (19.2%)
Poor <25%	0	0
Total	8	52

Table 3: Average number of treatments according to subtypes of warts.

Subtype of warts	Average number of sessions for complete clearance
Verruca vulgaris	1 (1/1)
Deep palmoplantar	2.5 (10/4)
Total	2.2 (11/5)

of mupirocin. Follow up was done for 12 months and no recurrences were seen.

DISCUSSION

Warts are difficult to treat and multiple treatment options are available. The goal of the therapy is to achieve complete resolution of the lesions with minimum number of sessions, and minimal risk of pain, dyschromia, and scarring. The absorbed light energy is converted to thermal energy and causing coagulation (photodermal effect) or blasting (photomechanical effect). This process may obliterate nutrient supply to the wart and destroy the rapidly dividing epidermal cells containing HPV. It has longer wavelength with lower absorption coefficient for oxyhemoglobin and melanin that allows laser light energy to penetrate deeper into the tissue with less damage to surrounding tissue and destroying heat sensitive HPV by hyperthermia.^[6,11,12]

Studies have shown that diseased tissue is more sensitive to higher temperatures compared to normal tissue and hence are more prone to being permanently damaged.^[11–13] There is no scarring, pigmentary changes, and hemorrhagic bulla following the laser treatment as compared to ablative ones. For this reason, we chose non-ablative long-pulsed 1064 Nd: YAG laser for the treatment of palmoplantar warts.

We found that 76.9% ($n = 40$) of the lesions warts showed complete clearance which were of deep palmoplantar ($n = 39$) and verruca vulgaris ($n = 1$) subtype all had a duration of equal or less than a year. The average number of sessions required for complete clearance was 2.2 and marked clearance was seen in 3.8% ($n = 2$) warts one periungual and one deep palmar wart, mild improvement was seen in 19.2% ($n = 10$) warts all are deep palmoplantar wart and duration of warts was 2 years. Patients with warts of verruca vulgaris subtype and lesion of less than a year duration responded best to the treatment.

We did cooling by Zimmer Cryo6[®]i (forced refrigerated air) throughout the procedure. It is a non-contact surface cooling that cools the epidermis 15°C in 8 s and ensures delivery of high fluence of laser beam. This decreases the chances of collateral thermal damage to the tissue, thereby reducing the edema and pain during the procedure. This is the reason for which our patients were able to tolerate higher fluence without any adverse effect.^[14]

Han *et al.* achieved a higher clearance rate (96%) compared to our study (76.9%). Long-pulsed Nd: YAG was used in 396 patients with parameters 5 mm spot size; 20 ms pulse duration and fluence of 200 j/cm². The average number of sessions was 1.49. Median follow-up period was 2.24 months and relapse was seen in 11 patients with a recurrence rate of 3.27%.^[8] In our study, we followed up each patient for a period of 12 months and no recurrences were observed. In

the study by Kimura *et al.*, 20 patients with 34 refractory warts using 5 mm spot size pulse duration 15 ms and fluence 150–185 j/cm² were treated. About 56% of the patients had complete clearance with an average session of 3.8 with minimal discomfort and no side effects.^[6] As they had used less fluence, the clearance rate was lower, a greater number of sessions were needed and minimal discomfort was observed as compared to our study.

Goldberg *et al.* in their study have used low-energy (200 mJ) pulse duration 1 ms Nd: YAG with no cooling in 25 patients with 63 hand warts, a complete response was seen in 19 subjects and 41 warts. No adverse events were seen.^[15] Bingol *et al.*, treated 51 patients with 146 recalcitrant hand warts using spot size 3 mm pulse duration 23 ms; 180–200 j/cm². They observed 88.4% of warts clearing with a single treatment session, and 100% clearance after two sessions using a novel technique of alignment of intersection point of the circles of three laser pulses per session.^[16] El-Mohamady *et al.* compared the efficacy of pulsed dye laser (PDL) versus Nd: YAG in the treatment of plantar warts in 46 patients. Clearance rate was not significantly different in the two groups, PDL (74%) and Nd: YAG (78%). Complications such as hematoma (28%), secondary bacterial infection (10%), and severe pain were more commonly seen in Nd: YAG group but more number of sessions were required in the PDL group compared to the Nd: YAG group to achieve a similar clearance rate. There was no statistically significant difference in relapse in either group. Therefore, the authors concluded that PDL may be a preferred treatment option due to its more manageable adverse effect profile.^[17] However, PDL has limited role in refractory deep seated warts due to its shorter wavelength (585 nm), lesser tissue penetration, and required more number of sessions for wart clearance.^[17] None of these studies compared duration of the warts and their response to treatment.

Different studies have shown variations in their results as there are no fixed parameters and protocol, but these studies have unanimously suggested that long pulse Nd: YAG is safe and effective for the treatment of palmoplantar warts. The number of sessions needed are less, compliance is better with higher clearance rates and less recurrence compared to other treatment modalities. Difficult location warts could be easily treated as well.

CONCLUSION

Non-ablative 1064 long-pulsed Nd: YAG laser is a safe and effective choice for the treatment of warts. Limitations of our study were small sample size and statistical analysis.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest

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