

# Efficacy and Safety of Nd:YAG Laser 1064-nm in the Treatment of Onychomycosis

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## ABSTRACT

**Introduction:** Onychomycosis is a common encounter in skin clinics that has varied oral and topical medications for its treatment. At times, conventional oral regimens might be contraindicated and owing to slow growth rate of the nail, these can be time consuming and may show failure due to drug resistance. In this study we evaluate the role of a novel therapy, Nd:YAG LASER in its treatment. This study aimed at evaluation of the efficacy and safety of Nd:YAG LASER 1064-nm in the treatment of onychomycosis.

**Material and methods:** A total of 58 onychomycotic nails (constituted by 30 patients) which were KOH mount positive for fungal elements were treated with weekly sessions of Nd:YAG LASER 1064-nm until clinical resolution or 12 weeks, whichever was earlier. Besides examination for clinical cure, KOH mount was also performed at each follow up, until mycological cure was obtained.

**Results:** Out of 46 onychomycotic nails that completed the study, 82% showed mycological cure and 78% showed clinical cure at 6 months. Seven patients were lost to follow up over the period of 6 months. Mycological cure was found to be attained earlier than clinical cure. No adverse effects were observed in the majority except for burning sensation and mild erythema over the nail folds in 2 patients (4%).

**Conclusion:** Based upon the results of our study, Nd:YAG LASER 1064-nm laser is an effective and safe modality in the treatment of onychomycosis and can be used both as an alternative to conventional regimens as well as first line therapy in near future.

**Keywords:** Onychomycosis, Nd:YAG LASER, Lasers in Dermatology

## INTRODUCTION

Onychomycosis or fungal infection of the nail is a common encounter in skin clinics and has varied oral and topical medications for its treatment. However, at times, conventional oral regimens might be contraindicated in some patients and though the disease doesn't pose a serious threat, the patient requests for intervention nonetheless. Besides, owing to slow growth rate of the nail, these are time consuming and have begun to show high chances of failure due to drug resistance. Therefore, an effective and quicker modality which also doesn't pose any toxic systemic effects is need of the hour. Recently, studies on use of Nd:YAG LASER for onychomycosis have been done and have shown exceptional results with little or no side-effects.

Onychomycosis affects 5.5% of the world population<sup>1</sup> and represents 20% to 40% of all onychopathies and approximately 30% of cutaneous mycotic infections.<sup>2</sup> The

incidence of onychomycosis ranges from 0.5% to 5% in the general population in India.<sup>3</sup>

Dermatophytes are the most common etiologic agents, but yeasts and non-dermatophyte molds also constitute a substantial number of cases.<sup>4</sup> An accumulation of debris under distorted, deformed, thickened, and discolored nails, particularly with ragged and furrowed edges, strongly suggests tinea unguium.<sup>5</sup> Candidal onychomycosis lacks gross distortion and accumulated detritus and mainly affects fingernails.<sup>6</sup> Non-dermatophytic molds cause 1.5% to 6% of cases of onychomycosis, mostly seen in toenails of elderly individuals with a history of trauma. Researchers have found certain habits of the population in the Indian subcontinent (eg., walking with bare feet, wearing ill-fitting shoes, nail-biting, working with chemicals) to be contributing factors for onychomycosis.<sup>7</sup> Several studies have shown that the prevalence of onychomycosis increases with age, possibly due to poor peripheral circulation, diabetes mellitus, repeated nail trauma, prolonged exposure to pathogenic fungi, suboptimal immune function and inability to trim the toenails and care for the feet.<sup>8</sup>

Five types of onychomycosis, characterized according to clinical presentation and the route of invasion, are recognized. Distolateral subungual onychomycosis (DLSO) is the most common form of onychomycosis. It is characterized by invasion of the nail bed and underside of the nail plate beginning at the hyponychium. Mild inflammation develops, resulting in focal parakeratosis and subungual hyperkeratosis, with two consequences: onycholysis (detachment of the nail plate from the nail bed) and thickening of the subungual region. This subungual space then can serve as a reservoir for superinfecting bacteria and molds, giving the nail plate a yellowish brown appearance.<sup>9</sup> Proximal subungual

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onychomycosis (PSO) is a relatively uncommon subtype, and occurs when organisms invade the nail unit via the proximal nail fold through the cuticle area, penetrate the newly formed nail plate, and migrate distally. The clinical presentation includes subungual hyperkeratosis, proximal onycholysis, leukonychia, and destruction of the proximal nail plate. White superficial onychomycosis (WSO) can be recognized by the presence of well-delineated opaque “white islands” on the external nail plate, which coalesce and spread as the disease progresses. At this point, the nail becomes rough, soft, and crumbly.<sup>9</sup> Total dystrophic onychomycosis (TDO) may be the end result of any of the main patterns of onychomycosis. The entire nail unit becomes thick and dystrophic.<sup>10</sup> Endonyx onychomycosis is characterized by diffuse milky white discoloration of nail plate without surface change. It does not show clinical signs of inflammation in the nail bed, such as onycholysis and subungual hyperkeratosis.<sup>11</sup> Nd: YAG LASER is a device that emits amplifies light radiation using a neodymium-doped yttrium aluminum garnet crystal. Nd:YAG LASER has many applications in dermatology including hair removal, tattoo removal, treating pigmentary disorders including exogenous ochronosis. Recently, a novel laser treatment was described for onychomycosis using long-pulsed Nd:YAG LASER.<sup>12</sup> Many studies have thereafter been conducted proving efficacy of laser treatment of onychomycosis without considerable adverse effects.

Study aimed to observe the efficacy and safety of Nd:YAG LASER 1064-nm in the treatment of onychomycosis.

## MATERIAL AND METHODS

Study was done in the department of dermatology, rohilkhanda medical college and hospital after ethical approval. A total of 58 onychomycotic nails (in 30 patients) which were KOH mount positive for fungal elements, after proper consent, were treated with weekly sessions of Nd:YAG LASER 1064-nm upto 3 months (12 sittings) or clinical resolution, whichever was earlier. Thereafter, patients were followed up every month upto 6 months.

Patients who did not give consent for laser therapy, those in which nail clippings didn't show fungal elements on KOH mount, those who had concomitant fungal infections anywhere else on the body and those who took antifungals in the past 2 months were excluded from the study. All such patients, as well as those who didn't respond to laser therapy were started on standard regimens.

Each nail enrolled for the study was subjected to KOH mount at each follow up, besides at baseline, until mycological cure was established [Figure 1]. The KOH mount was performed and evaluated in the skin department itself using 10% KOH solution prepared fresh each day and a compound microscope. The nail clippings were kept in the solution for 24 hours before examination. The nail was said to have attained mycological cure when 2 KOH mounts prepared from the nail clippings of the same nail didn't reveal any fungal elements under the microscope.

The laser therapy was performed using the Q-switched

Nd:YAG LASER 1064-nm device at weekly intervals with the specifications as mentioned in [Table 1]. As the spot size was smaller than the nail plate area, laser shots were given in a grid pattern, twice in each sitting, covering the entire nail plate in TDO and the affected area along with a 2mm clean margin in other cases where only a part of the nail plate was apparently affected.

Clinical cure was said to be attained when all the clinical signs of onychomycosis; nail plate discoloration, nail plate dystrophy and subungual debris were absent. Clinical photographs were taken at each follow-up [Figure 2]. Nails that showed some degree of clinical improvement but not complete resolution within the time frame were not kept in the cured category.

Adverse effects were assessed from history of pain, redness, swelling, itching and burning sensation and from examination for erythema, crusting, edema and tenderness at each follow-up.

## STATISTICAL ANALYSIS

The results were statistically analysed using descriptive statistics like mean and percentages.

## RESULTS

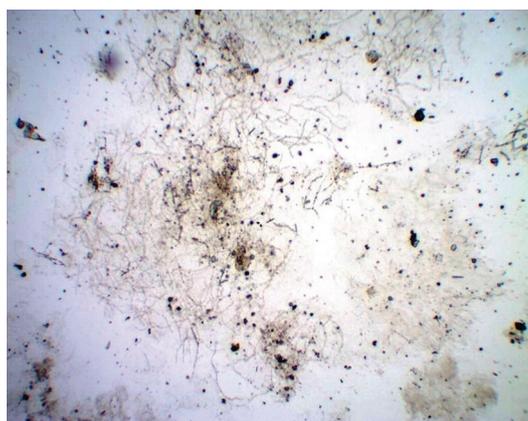
Thirty patients that were enrolled for the study constituted a total number of 58 onychomycotic nails. Out of these, 7 patients were lost to follow up over the period of 6 months congregating a drop out of 12 nails (Five nails at second month, followed by 3 nails at third and 4 nails at 6 months) [Table 2]. Three nails (5%) showed mycological cure within the first month. At the end of third month, a total of 28 nails out of 50 (56%) showed mycological cure [Table 2][Figure 3]. Clinical cure got established as early as 2 months in 6 nails (11%) and was obtained in a total of 36 nails (78%) at 6 months [Figure 3]. Mycological cure was found to be

S. No.	Technical specification	Value
1	Laser source	Q-switched Nd:YAG
2	Wavelength	1064-nm
3	Frequency	5 Hz
4	Power	1000 mJ pulse energy
5	Spot size	2-5 mm

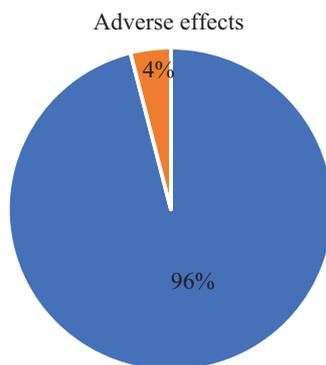
**Table-1:** Laser specifications

Months	Nails lost to follow-up	Total number of nails that achieved mycological cure	Total number of nails that achieved clinical cure
1	0	3	1
2	5	18	6
3	3	28	12
4	1	36	28
5	1	38	32
6	2	38	36

**Table-2:** Patient follow up depicting drop-outs and number of nails that showed mycological and/or clinical cure over 6 months



**Figure-1:** KOH mount of nail clippings showing fungal elements (40x magnification)

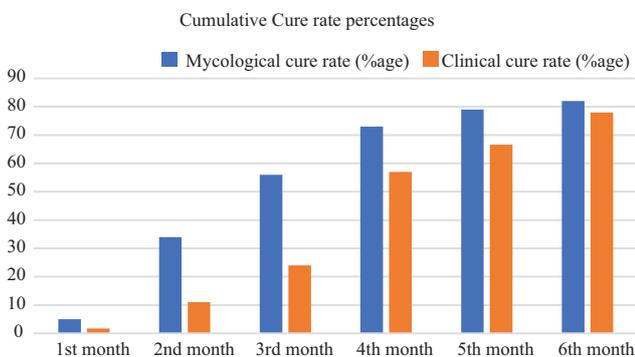


■ none ■ erythema and burning sensation

**Figure-4:** Adverse effects



**Figure-2:** Onychomycotic toenail at baseline (a) and after 8 weeks of laser therapy (b)



Nd:YAG	Neodymium-doped yttrium aluminum garnet
LASER	Light amplification by stimulated emission of radiation
DLSO	Distolateral subungual onychomycosis
PSO	Proximal subungual onychomycosis
WSO	White superficial onychomycosis
TDO	Total dystrophic onychomycosis
KOH	Potassium hydroxide
nm	nanometer
Hz	Hertz
mJ	milli Joules

**Figure-3:** Mycological and clinical cure rates

attained earlier than clinical cure [Table 2][Figure 3]. No adverse effects were observed except for burning sensation and mild erythema over the proximal and lateral nail folds in 2 (4%) patients after laser sessions which subsided on their own within a few hours without treatment [Figure 5].

**DISCUSSION**

Based upon the results of our study, treatment of onychomycosis with Nd:YAG LASER seems to be efficacious and well-tolerated. Apart from situations in which conventional oral therapy for onychomycosis cannot be instituted for example in case of hypersensitivity or drug toxicity in systemic illness, laser can also act as a fall back option when oral therapy fails and when there is drug resistance. There are other conditions where oral therapy could be contra-indicated like in pregnancy and when drug interactions with antifungals poses threat to the patient. Besides that, in the future, laser can also be used as a first line treatment as it has no systemic adverse effects and is not prone to the phenomenon of resistance. In our study, laser therapy isn't stopped upon mycological cure of the nail but is continued upto clinical cure or 12 weeks whichever is earlier, as laser still might help in clearing out the nail debris faster. The observation in our study pertaining to attainment of mycological cure earlier than the clinical cure is explained by the slow turnover of the nail plate. Whether laser treatment offers a quicker cure than conventional oral regimens, has to be established by a comparative study on both the modalities.

**CONCLUSION**

Nd:YAG LASER is an efficacious and safe modality in the treatment of onychomycosis

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