Finger Onychomycosis Due to *Candida Tropicalis*: Treatment with Nd:YAG Short Pulse Laser
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Abstract

**Background** - Treatment options for onychomycosis are numerous but limited in efficacy, potentially dangerous and / or relatively restrictive.

**Case Report** - We describe the first case of Candida tropicalis onychomycosis, resistant to usual topical treatments, successfully treated with 4 sessions of laser Nd:YAG in Short Pulse Mode. The effectiveness of treatment was verified by a negative control sample at 3 months and was maintained until 6 months.

**Discussion** - Laser Nd:YAG is a versatile laser, widely used in dermatology. Its mode of action in the treatment of onychomycosis is possibly a thermal non-specific effect, but differentiated between the healthy nail and pathologic nail, that responded differently to impact. This case's main interest is participating in paving the way for a new way of onycomycoses treatment.

**Key Words:** onychomycosis, *Candida tropicalis*, laser, Nd:YAG

Fungal nail infections affect a significant proportion of the population. There are numerous treatment options, but these have limited efficacy, are relatively restrictive or are potentially dangerous. It has thus been shown that varnishes had an efficacy that did not exceed 5.7% of recoveries in 48 weeks of daily treatment for ciclopirox-based ones [1] and 38% after 6 months for amorolfine-based ones [2]. Keratolytic treatments, another alternative therapy, are sometimes considered damaging by patients due to the destruction of the affected nail that they cause, and their efficacy is evaluated at 50-60%[2]. Finally, several serious cases of hepatitis potentially resulting in death or transplantation, even in patients not predisposed to it, were attributed to taking terbinafine[3], the efficacy of which is 50-80%[2]. Alternatives are therefore necessary in cases of resistance or contraindications to these treatments.

**Nd:YAG laser** (1064 nm) is a polyvalent laser which, due to its high penetration and low specificity, is widely used in dermatology for each of the cutaneous chromophores: melanin (depilatory use), haemoglobin (vascular use), water (use as a remodelling laser) as well as for exogenous chromophores like tattoo ink. Some publications have shown its efficacy in treating mostly trichophytique fungal nail infections[4-6].

We will describe the first case of a Candida tropicalis fungal fingernail infection successfully treated by Nd:YAG laser in Short Pulse mode.

**Observation**

A 33-year-old woman was seen for onychodystrophy of the left middle finger that had been progressing for two years (Fig. 1A). Her medical history included a case of psoriasis located mainly on the elbows and another of plantar keratoderma since adolescence. The patient had been unsuccessfully treated several times with amorolfine and ciclopirox varnishes, which were respectively applied twice a week and every day, with each one being used for at least six consecutive months. She had also received a keratolytic treatment (bifonazole + urea) followed by a treatment with bifonazole cream. This was equally ineffective. Direct examination of a nail sample in a specialist laboratory six months after all treatment had been stopped showed the presence of pseudomycelia; the culture revealed the presence of Candida tropicalis. The patient refused all systemic treatment due to fear of side effects. In view of this requirement and the failure of
the previous treatments, a treatment by Nd:YAG Short Pulse laser was suggested. The treatment parameters were: **Synchro FT platform** (DEKA, Florence, Italy), Nd:YAG laser in Short Pulse mode, fluence 30 J/cm², 5mm spot, frequency 1 Hz, 0.5 ms micropulses divided into three pulse trains 125 ms apart, several passes carried out in unfocused scanning at a 5 mm distance over the entire affected nail and adjacent skin (5 mm overhang) for five minutes, temporary stoppage of treatment for a few seconds in the event of pain. During the first session, the external temperature taken with a non-contact thermometer showed that the pain peaks occurred at a temperature of 40-45°C. These pain peaks were mainly reported while passing over the macroscopically contaminated zone. Sparks were also displayed when these zones were passed over. Four sessions were held, 15 days apart. The noticeable clinical improvement after each session encouraged the continuation of treatment. From the third session onwards, the nail had regained a normal appearance (Fig. 1B). The mycological test samples taken three months after the final session were negative in both the direct examination and the culture. Clinical recovery was maintained beyond the sixth month (Fig. 1C).

**Discussion**

Our observation shows the efficacy of **Nd:YAG Short Pulse laser treatment** in treating a fungal nail infection that had lasted two years and resisted local treatments. To the best of our knowledge, this is the first described case of treating a Candida tropicalis fungal infection of the fingernail with a **Nd:YAG Short Pulse laser**. The finger site, where nail growth is faster than on the toes, made it possible to assess the treatment’s result very quickly. It has been shown that the **Nd:YAG laser** allowed Candida albicans and Trichophytons rubrum colonies to be destroyed in vitro, at a low fluence of between 4 and 8 J/cm². The hypothesis made regarding the mode of action that all laser techniques dedicated to treating fungal nail infections possibly have in common involves heating the nail along with the underlying and adjacent skin, which makes it possible for the heat-sensitive microorganism to be destroyed. In our patient, the thermal effect seemed more significant on the macroscopically contaminated zones; the pain peaks and sparks occurred mainly on these zones. This distinct response could be linked to the differences in optical properties between the healthy nail and the affected nail, allowing the laser to perform selective thermolysis action on the contaminated keratin.

In the absence of a validated protocol, we preferred to use a low fluence combined with a long exposure time in order to optimise tolerance. This was made possible by the “Short Pulse” mode, which is equivalent to a particular emission normally used in photoaging treatment. The duration of the short pulse, one tenth of a millisecond, is intermediate: shorter than the long pulse mode used in hair removal or vascular treatment (about ten milliseconds) but longer than that of a Q-Switched laser (one nanosecond). This emission mode combined with a low fluence and repeated passes makes progressive and constant heating of the nail possible, which sets it apart from the brutal and painful impact of the customary modes. In this observation, the diagnosis of a Candida tropicalis nail yeast infection could be discussed inasmuch as these yeasts are very often contaminants from a preexisting onychopathy and

![Fig. 1: (A) Initial condition of the nail. (B) Healing apparent after the third session. (C) Maintenance of healing six months later.](image-url)
without real pathogenicity. A histomycological sample of the nail bed would have been an additional argument to prove the yeast’s direct responsibility, but this was not done because of its invasive nature. Nevertheless, the Candida tropicalis infection was documented in our patient by a positive direct examination with the presence of pseudomycelia in addition to the positive culture. According to a published recommendation[2]: “a positive direct examination allows a distinction to be drawn between colonisation of an onychopathy with another aetiology such as nail psoriasis and a real infection responsible for onychomycosis”.

The results of the examinations performed therefore lead to the conclusion of a genuine Candida tropicalis fungal nail infection, even though this infection could have occurred on a prior psoriatic onycholysis.

The efficacy of laser treatments in finger psoriasis therapy has already been reported, but only in the case of pulsed dye lasers [9]. The pulsed dye laser is a laser specifically for vascular treatments.

Its mode of action evoked in psoriasis is the direct destruction of microvascularisation of the patch associated with the release of cytokines caused by selective vascular photothermolysis [9]. Nd:YAG laser can have a vascular action, but at fluences at least three times higher than those used to treat our patient. As far as the fluences used in our study are concerned, the Nd:YAG laser’s action is only thermal and non-specific.

That is why we think that the treatment had an impact on the destruction of the heat-sensitive microorganism but was unable to affect possible nail psoriasis in the absence of vascular action.

As one of the leading publications [6] reported, we did not want to combine an antimycotic treatment with the laser. This was to limit interpretation biases of the test sample and considering the very low risk of recontamination from the adjacent skin at this site. Likewise, we did not consider it useful to actively monitor the temperature increase and preferred to follow the patient’s feeling of pain in order to adapt the treatment’s progress. It has indeed been shown that the sensitive fibres conveying pain are activated by temperatures higher than 43°C [10], which was confirmed when the external temperature was taken during the first session. This temperature is a natural tolerance threshold beyond which tissue complications can occur.

The main interest of this clinical case is in contributing towards paving the way for a new method of treating fungal nail infections. Nd:YAG Short Pulse laser is a fast method that is not too restrictive or damaging and therefore not dangerous. Nor is any additional investment involved for a dermatologist who already has this laser equipment for other indications. Additional studies are needed to define the optimal treatment plan, evaluate the technique’s success rates and determine its place in the treatment strategy for fungal nail infections.

Bibliography