Lack of efficacy with 1064-nm neodymium:yttrium-aluminum-garnet laser for the treatment of onychomycosis: A randomized, controlled trial

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Background: Laser therapies have been Food and Drug Administration approved for temporary nail plate clearance; however, there is minimal evidence of their long-term efficacy.

Objective: We sought to evaluate the clinical and mycological clearance of toenails treated with 1064-nm neodymium:yttrium-aluminum-garnet laser versus no treatment.

Methods: This was a randomized, controlled, single-center trial comparing 2 treatments with 1064-nm neodymium:yttrium-aluminum-garnet laser (fluence of 5 J/cm^2, rate of 6 Hz) spaced 2 weeks apart versus no treatment in 27 patients (N = 125 affected nails) with clinical and mycological diagnosis of onychomycosis. At 3 months, patients were assessed with mycological cultures and proximal nail plate measurements. Patients treated with laser were also assessed with proximal nail plate measurements at 12 months.

Results: At 3 months, 33% of patients treated with laser achieved a negative mycological culture compared with 20% of the control group (P = .49), and had more proximal nail plate clearance compared with control subjects (0.44 vs 0.15 mm, P = .18), which was not statistically significant. At 12 months, there was no difference in nail plate clearance between laser versus control subjects (0.24 vs 0.15 mm, P = .59).

Limitations: Our study was limited by the small sample size and number of treatments.

Conclusions: There was no significant mycological culture or clinical nail plate clearance with 1064-nm neodymium:yttrium-aluminum-garnet laser compared with control. (J Am Acad Dermatol 2014;70:911-7.)

Key words: 1064-nm neodymium:yttrium-aluminum-garnet laser; onychomycosis.

Onychomycosis is exceedingly common, afflicting approximately 14% of the US population and representing the most common nail disorder in adults.[1] Modalities for treatment of onychomycosis include pharmacologic and mechanical, with a recent focus on laser methods. Treatment selection is often based on the number and location of affected nails, type of causative fungi, concomitant systemic medications, treatment costs, and patient preference.[2] Clinicians are required to weigh both the likelihood and value of eliminating an individual patient's toenail fungus against the likelihood of

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The JOULE ClearSense handpiece was loaned to Stanford Department of Dermatology from Sciton Inc for the purposes of the study.
Conflicts of interest: None declared.
Accepted for publication December 17, 2013.
Reprints not available from the authors.

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Published online March 17, 2014.
0190-9622/$36.00

http://dx.doi.org/10.1016/j.jaad.2013.12.024

recurrence if treatment is successful and possible adverse events associated with systemic antifungal medications.[3,4]

Although the mechanism of action is not clearly understood, lasers have been proposed to penetrate through the nail plate and reach a temperature that kills the colonized fungus. Five lasers are currently Food and Drug Administration (FDA) approved for the temporary increase of clear nail in patients with onychomycosis: PinPointe FootLaser (PinPointe USA Inc, Chico, CA),[5] Cutera GenesisPlus laser system (Cutera Inc, Brisbane, CA),[6] CoolTouch VARIA laser (CoolTouch Inc, Roseville, CA),[7] Light Age Q-Clear laser (Light Age Inc, Somerset, NJ),[8] and Sciton Inc JOULE ClearSense (Sciton Inc, Palo Alto, CA).[9] Four of the 5 lasers use a 1064-nm wavelength and deliver energy in a short pulse duration (microseconds).

CAPSULE SUMMARY

- There are limited data supporting the use of laser therapies for onychomycosis.
- In our study, 1064-nm neodymium:yttrium-aluminum-garnet laser treatment at a fluence of 5 J/cm^2 (rate of 6 Hz) did not achieve negative mycological culture or long-term proximal nail plate clearance.
- The 1064-nm neodymium:yttrium-aluminum-garnet laser using these settings does not appear to be an effective treatment for onychomycosis.

However, there are limited data supporting the use of laser therapies for onychomycosis with the only published clinical trial evaluating the use of a 870- and 930-nm laser,[10,11] which is not FDA approved for treatment of onychomycosis. Of the aforementioned FDA-approved lasers, medical device approval is primarily based on being substantially equivalent to currently marketed devices.[5-9] The cost of 1 treatment session from these lasers ranges from $400 to $1200, yet none have been rigorously studied against a control population or with long-term follow-up. We conducted a randomized, controlled trial of 1064-nm neodymium:yttrium-aluminum-garnet (Nd:YAG) laser for the treatment of onychomycosis.

METHODS

The study was a randomized, controlled trial conducted at a single academic institution. The primary end point for the study was the percentage of patients with a negative mycological culture from all clinically involved nails at 3 months, and the secondary end point was the difference in clinical proximal nail plate clearance at 3 months and at 12 months. An additional secondary end point was the number of nails with complete clinical nail plate clearance at 3 months and, for laser patients, at 12 months. This study was approved by the institutional review board at the Stanford University Medical Center (clinicaltrials.gov identifier: NCT01666002), and all patients signed written informed consent. This study was conducted in accordance with the CONSORT statement.[12]

We enrolled adults (18-75 years) with a clinical diagnosis of onychomycosis from the dermatology clinic at Stanford between July and December 2011. The key inclusion criterion was a diagnosis of onychomycosis by clinical toenail morphology confirmed by positive culture. Patients whose cultures revealed nondermatophyte molds were included if periodic acid—Schiff staining-assisted microscopic evaluation was positive (4 in laser group; 3 in control group). All patients met diagnostic criteria for onychomycosis as defined by prior studies.[13] Patients were not excluded based on the severity of disease or prior treatment regimen. Patients were randomized following simple randomization procedures (computerized random number generator) in a 2:1 ratio into laser or control groups. Both groups underwent evaluation by study dermatologists at baseline and follow-up. Photographs, nail plate measurements, and fungal cultures from all clinically suspicious toenails were obtained at each study visit. We followed up the laser-treated group for an additional 12 months to assess long-term clinical clearance with proximal nail plate measurements. Treatment was performed using the 1064-nm Nd:YAG laser fitted with the 6-mm JOULE ClearSense handpiece (Sciton Inc, Palo Alto, CA). Laser settings were those recommended by the laser manufacturer and included a fluence of 5 J/cm^2, pulse width of 0.3 milliseconds, spot size of 6 mm, and rate of 6 Hz to achieve a measured target temperature of 40°C to 42°C. The entire nail plate, proximal and lateral nailfolds, and matrix in all 10 toenails (regardless of clinical or mycological status) were treated with 2 to 3 passes of the laser. Patients in the laser group underwent 2 treatments separated by 2 weeks. Patients in the control group were not treated and were observed at baseline and 3-month follow-up. All patients randomized to control were offered a single laser treatment at the end of the 3-month observation period. Patients in both groups underwent no other types of treatment (no oral or topical antifungal medications) during the course of the study.