Treatment of Onychomycosis* with the JOULE® ClearSense™

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INTRODUCTION

Onychomycosis is a non-life threatening infection of the nails caused predominantly by the dermatophytes Trichophyton rubrum, Trichophyton mentagrophytes, and Epidermophyton floccosum, and to a lesser extent by yeasts (e.g., Candida species) and non-dermatophytic molds. Although visual changes are often observed in the nail, a proper diagnosis using a test designed to detect the presence of nail fungus is often performed to rule out other causes for the nail's changed appearance. The worldwide prevalence of onychomycosis is up to 5%, and the risk of infection increases with age. Treatment options include topical antifungal medications, nail removal, oral antifungal medications, and lasers. The choice of therapy depends on the disease severity, previous treatments, other medications the patient is taking, physician or patient preference, and cost. With rising patient awareness, the global market for treatment of onychomycosis is increasing and in 2010 was estimated to be $3.6 billion (Podiatry Today).

Topical and Oral Treatments

Home remedies (e.g., bleach and permanganate soaks, Castellani carbofuchsin), although safe, inexpensive, and widely used, have limited effectiveness. Topical antifungal medications such as terbinafine (Lamisil Cream) are generally recommended if less than half of the nail is affected or if the patient cannot take oral agents. Topical treatments are unable to penetrate the nail plate and recurrence may occur quickly after the regimen is discontinued[1]. Despite these drawbacks, topical medications may be recommended for use in combination with oral medicine[2]. Oral agents such as the azoles and terbinafine are the current gold standard for the treatment of onychomycosis. Unlike topical treatments, oral agents can penetrate the nail bed systemically and offer shorter treatment periods with higher, yet suboptimal, cure rates.

Multiple studies have revealed less than optimal cure rates for the oral azoles, a class of antifungal compounds that inhibit a fungal enzyme important for producing ergosterol, a vital component of the fungal plasma membrane. For oral itraconazole, the mycological cure rate in a premarketing trial was 54%, clinical success was 35%, and complete cure was 14% after a 12-week course of treatment. (Clinical success denotes visual clearance of all signs of fungal infection while a complete cure denotes the clearance of fungal infection as demonstrated by negative mycological culture with clear or minimal nail involvement.) Adverse effects included headache, gastrointestinal problems, and skin disorders. Itraconazole is also contraindicated in patients with congestive heart failure. In addition, patients receiving itraconazole continuously for one month or longer are advised to monitor liver function as a few cases of hepatitis, liver failure, and death have been reported. Some of these

*FDA Cleared for the temporary increase of clear nail for patients with onychomycosis

cases had neither pre-existing liver disease nor a serious underlying medical condition. Fluconazole, another oral, antifungal, azole compound, is associated with nausea, pruritus, headache, and liver enzyme anomalies[3]. Furthermore, the azole class of compounds cannot be taken with many other oral medications such as the statins or calcium channel blockers due to dangerous drug interactions. Given the less than optimum cure rates and undesirable sequelae, the azoles are largely considered only moderately effective for treating nail fungus.

Oral terbinafine, a compound that also disrupts ergosterol synthesis, has fared much better than the azoles. Sigurgeirsson and colleagues[4], in their 5-year blinded prospective follow-up study comparing the effectiveness of terbinafine and itraconazole, reported a 46% mycological cure rate in terbinafine-treated patients and a 13% mycological cure rate in itraconazole-treated patients. Mycological and clinical relapse rates were significantly lower in patients treated with terbinafine. A post-marketing study[5] of the safety of terbinafine for the treatment of onychomycosis in 25,884 patients showed a 10.5% incidence of adverse events, with gastrointestinal effects comprising 4.9% and skin problems accounting for 2.3%. These events were generally mild, temporary, and reversible. Terbinafine was a possible or probable cause of only 0.04% of serious adverse events and drug interactions were not observed. In this set of studies, oral terbinafine had less adverse events and a higher cure rate than the azoles; however, a high cure rate remains elusive for oral antifungal agents.

In summary, oral antifungals, though more useful than topical treatments, may be associated with potential hepatic toxicity and life-threatening drug interactions[1]. Whether the therapies are combined or used alone, there continues to be widespread dissatisfaction with these modalities as their cure rates are quite low[6-10]. A need exists for a safer and more clinically efficacious treatment for onychomycosis.

Laser Treatments

Laser energy offers many advantages over traditional therapies for onychomycosis. Treatments are less frequent and they are given in the physician's office, avoiding compliance issues with topical and oral therapies. Potential drug interactions and renal or liver toxicity with the oral treatments are also avoided. Preliminary evaluations have been reported for a 1064-nm and 532-nm Q-switched laser, and a combination 870 nm/930 nm laser[11]. The safety and efficacy of an FDA-cleared Nd:YAG, 1064 nm laser for the treatment of toenail fungus has been reported with favorable outcomes.

Figure 1: JOULE ClearSense with audible and visible temperature sensing capability.

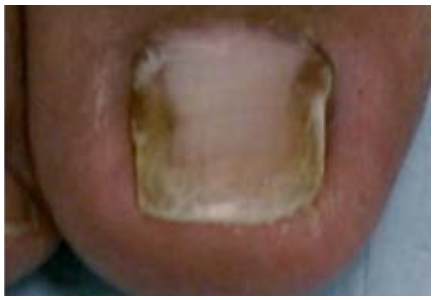
One of the first 1064-nm lasers reported for treating onychomycosis uses a small spot size of 1 mm, consumables, and requires 45 to 60 minutes for a single treatment. Without adequate measures in place to detect optimum treatment temperatures, this laser treatment can result in both undertreated areas and areas of hotspots leading to suboptimal treatment.

Unlike other laser systems, the JOULE ClearSense (Sciton Inc., Palo Alto, CA) accessory for the 1064 nm laser provides real-time audible and visual temperature feedback during treatment, increasing safety and optimizing clinical results in the treatment of onychomycosis. The accessory is shown in Figure 1. With Sciton's expandable platform technology and 1064 nm wavelength, physicians may also be able to treat other dermatologic conditions including but not limited to warts, vascular conditions, wrinkles, and hypertrophic and keloid scars.

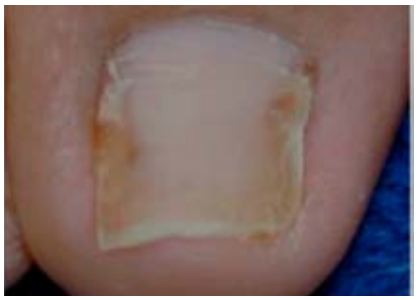
CASE STUDIES

Case 1

A 50-year-old woman with distal subungual onychomycosis of the right great toe received two ClearToe treatments spaced one month apart (Figure 2). Parameters for each treatment were 5 J/cm^2 fluence, 0.3 ms pulse width, 3 Hz, and 4.8 W. The patient experienced no discomfort and adverse events were not observed.



Pre-ClearToe treatment

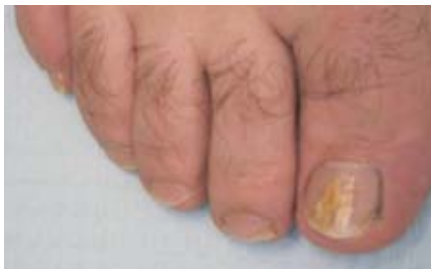


2 months post 2 treatments

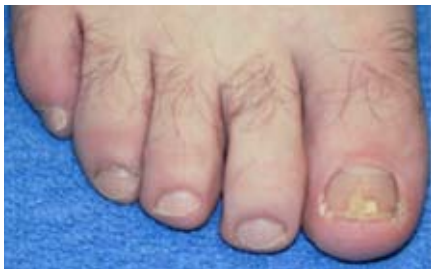
Figure 2: The right great toe of a 50-year-old woman. The infected areas (gold color) before ClearToe treatment are along both sides of the nail. Two months post the second treatment there is significant proximal clearing of the nail plate.

Case 2

A 53-year-old man with onychomycosis of the right great toe received two ClearToe treatments spaced one month apart (Figure 3). Parameters for each treatment were 5 J/cm^2 fluence, 0.3 ms pulse width, 3 Hz, and 4.8 W. The patient experienced no discomfort and adverse events were not observed.



Pre-ClearToe treatment



2 months post 2 treatments

Figure 3: The right great toe of a 53-year-old man. The infected nail plate shows proximal clearing two months after the second ClearToe treatment.

DISCUSSION

During the treatment, Sciton's ClearSense Accessory with the JOULE platform and Nd:YAG 1064 nm laser heats the nail plate resulting in a decrease in nail fungus and subsequent growth of normal nail proximal to the diseased areas. The treatment involves passing the handpiece across the nail in a serpentine pattern until the nail plate and proximal and lateral nail folds are heated to a temperature of 40-42 °C or to patient tolerance. The nail feels warm during the treatment, but there is minimal discomfort and no downtime. Immediately following treatment, no visual change in the nail is detectable, as it takes time for the normal nail to grow out. Most infections improve after two 15-20 minute treatments.

Preliminary studies of additional patients show that treatment with the ClearSense Nd:YAG laser is rapid and comfortable for patients. Adverse events have not been observed and patient satisfaction is high.

CONCLUSION

The ineffective treatment of onychomycosis with home remedies, topical antifungals and oral antifungals means many practitioners and patients desire a safe therapy that can increase the aesthetic appearance of the nail safely and clear the fungus predictably. Sciton's ClearSense Accessory with the JOULE platform and Nd:YAG 1064 nm laser is a safe, effective, and user-friendly modality for the treatment of onychomycosis. The temperature monitoring capability provides real-time feedback alerting the practitioner that the optimal treatment temperature has been reached. With this extra level of treatment monitoring, the patient will enjoy the benefits of a successful treatment without any adverse side effects. The encouraging results of these patients justify additional studies with more patients and longer follow-up times (up to 1 year).

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