COMMUNICATION

The use of the Er:YAG 2940nm laser associated with amorolfine lacquer in the treatment of onychomycosis*

Uso do laser de Er:YAG 2940nm associado ao esmalte de amorolfina no tratamento da onicomicose

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Abstract: Onychomycosis is a common disease, accounting for up to 50% of all ungual pathologies. We have been developing a clinical trial (ClinicalTrials.gov: NCT01528813) using a 2940nm Er:YAG laser to fractionally ablate human nails in vivo, aiming to increase topical amorolfine lacquer delivery to the nail unit, increasing the efficacy of topical treatment of distal and lateral subungual onychomycosis. Partial results have shown an increase in areas of nail plate free of disease. We believe that ablative lasers can increase the efficacy of topical onychomycosis treatment.
Keywords: Lasers, solid-state; Onychomycosis; Therapeutics

Resumo: A onicomicose é afecção frequente, representando até 50% do total das doenças ungueais. Um ensaio clinico (ClinicalTrials.gov: NCT01528813) em atual desenvolvimento usa o laser de Er:YAG 2940nm para realizar ablação fracionada in vivo de unhas humanas visando aumentar a permeabilidade ungueal ao esmalte de amorolfina, visando aumentar a eficácia do tratamento tópico da onicomicose subungueal distal lateral. Resultados parciais tem demonstrado um aumento na área ungueal livre de doença nas unhas tratadas com o laser, em comparação ao uso isolado do esmalte. Acreditamos que lasers ablativos possam aumentar a eficácia do tratamento tópico da onicomicose.
Palavras-chave: Lasers de estado sólido; Onicomicose; Terapêutica

Onychomycosis is undoubtedly the most common disease affecting the nails, representing up to 50% of all ungual pathologies.[1,2] High prevalence of the disease together with the limited efficacy of conventional therapies, has stimulated the development of new and more effective approaches in treating the disease. Promising device-based therapies have been launched on the market over the last few years, such as neodymium-doped yttrium aluminum garnet (Nd:YAG) laser devices.[2] Despite these advances, few steps have been taken towards the development of methods that promote nail permeability and the discovery of new effective antifungal drugs.

Laser device systems potentially represent a bright future as regards onychomycosis treatment. Trials with Nd:YAG, titanium sapphire (Ti:Sapphire) and diode lasers have already been developed.[2] These initial trial results have been impressive, not only due to the high recovery rates achieved, but also the easy, quick and painless administration of lasers to the

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affected nails. Nevertheless, the available data on the matter is still incipient and thus further efforts towards the establishment of standard treatment schedules, as well as the best pulse characteristics with regards to fluency, length and format, are still required.[2]

However, the benefits that traditional abrasion approaches (nail drilling, urea and salicylic acid ointments, etc.) have brought to the treatment of onychomycosis cannot be overlooked.[3,4] A study of foot care intervention including nail drilling in cases of white superficial and distal lateral subungual onychomycosis, showed improvement in clearing rates achieved with topical treatment, using an electric grinder device.[4] Exploring the same background, Neev *et al*., also in 1997, developed an experimental study to evaluate the safety and performance of different lasers in the ablation of human nails.[5] The 2940nm erbium yttrium aluminum garnet (Er:YAG) laser was found to cause negligible collateral damage to the nail plate, and had one of the best ablation rates among the lasers studied. The Er:YAG laser has intense affinity to water (10-30% of nail plate content), and causes ablation of nails by evaporating the tissue in the same way it does in human skin.[5]

This data, along with the current use of ablative lasers to enhance skin permeation, were the main factors that stimulated the development of a clinical trial at the University of Brasilia, using an Er:YAG laser (Etherea, Industra, São Carlos, Brazil) to fractionally ablate human nails in vivo. The study aims to determine the value of the Er:YAG laser as a way of enhancing topical drug delivery (amorolfine lacquer) to the nail plate, by means of clinical improvement in cases of distal and lateral onychomycosis, when compared to the use of amorolfine lacquer alone. We hypothesized that by creating holes through almost the entire thickness of the nail, amorolfine would easily reach subungual hyphae masses and dermatophytomas. Furthermore, larger contact areas for lacquer with nail surfaces would enhance drug permeation to the nail plate.

The study protocol involved patients with hands and feet distal lateral onychomycosis, caused by *T. rubrum* or *T. mentagrophytes*. A single session of the 2940nm Er:YAG laser was applied to the damaged nail plate area, plus a 2 to 3mm adjacent margin of unaffected area. The following settings were used: fluency of 50mJ/mtz, 2ms pulse duration and 1Hz frequency. During laser application to the area in question, the handpiece was kept static so that lasers beams would always reach coincident points on the surface of the nail plate. Perforated metal sheets were used to narrow laser beams to the target area and protect periungual tissue from damage. The number of pulse shots applied to a same area depended on nail thickness (minimum of 20µm ablation per pulse),[5] and was limited by patient complaints of pain.

Laser application to nails involved mild discomfort, with patients reporting acute pain and an overheating sensation, lasting up to 5 seconds after pulse shots were interrupted. Mild bleeding running from the area of treatment was a frequent adverse event following damage to the nail bed by the laser.

Given the greater density of keratin and the lower water content in nails compared to skin, it was necessary to apply longer pulses to achieve higher fluency, allowing for greater ablation rates (not shown). With the settings used, the Er:YAG laser was reliable in ablating nail plate areas, although there was large variation in terms of the average number of pulses per nail treated. It occurred mainly due to the differing levels of pain reported among patients, the variation in the extension of affected nail areas, and the degree of subungual hyperkeratosis.

Drawing on the ongoing trial, promising partial results have already been observed (Figure 1). Nails treated with Er:YAG laser plus amorolfine lacquer have presented greater clearing rates compared to those treated with amorolfine alone. This data points to the possibility of using ablative lasers as an additional approach to increase the efficacy of onychomycosis topical treatment, and therefore, highlights the need for further investigation in this field. ❑

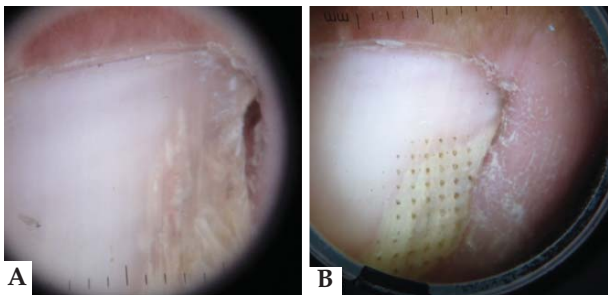

Figure 1: Dermoscopy of a nail affected by distal lateral subungual onychomycosis before **(A)** and after 10 weeks **(B)** following fractionated ablation by 2940nm Er:YAG laser, followed by weekly use of amorolfine lacquer. Holes on the nail plate surface can be seen, measuring 0.1 to 0.8mm in diameter, 0.2 to 0.5mm apart from each other, as well as an outgrowth of nail plate free of disease **(B)**

REFERENCES

1. Araújo AJG, Bastos OMP, Souza MAJ, Oliveira JC. Occurrence of onychomycosis among patients attended in dermatology offices in the city of Rio de Janeiro, Brazil. An Bras Dermatol. 2003;78:299-308.
2. Gupta AK, Simpson FC. New therapeutic options for onychomycosis. Expert Opin Pharmacother. 2012;13:1131-42.
3. Di Chiacchio N, Kadunc BV, de Almeida AR, Madeira CL. Nail abrasion. J Cosmet Dermatol. 2003;2:150-2.
4. Sumikawa M, Egawa T, Honda I, Yamamoto Y, Sumikawa Y, Kubota M. Effects of foot care intervention including nail drilling combined with topical antifungal application in diabetic patients with onychomycosis. J Dermatol. 2007;34:456-64.
5. Neev J, Nelson JS, Critelli M, McCullough JL, Cheung E, Carrasco WA, *et al*. Ablation of human nail by pulsed lasers. Lasers Surg Med. 1997;21:186-92.

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