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# Bimodal pulsed Nd:YAG 1064nm & Q-switched KTP 532nm lasers in the treatment of Onychomycosis

Kee Lee Tan, MD. Rejuvenate Cosmetic Medical Clinic, Perth, Australia

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## ABSTRACT

**Background** The 532nm (green light) and the 1064nm (near infra-red) wavelengths are amenable for the treatment of *Trichophyton rubrum* (T. rubrum) infected nail fungus due to their water and red/brown pigments biological characteristics prone to selective and non-selective photothermolysis, respectively.

**Method & Material** 37 infected nails (hands and feet) of 16 different patients, clinically proven by mycological testing underwent weekly treatment for 10 weeks. First two treatments were performed using Q-Switched (QSW) KTP 532nm laser while the next sessions were performed using pulsed Nd:YAG 1064nm laser (Alma Lasers Ltd). Efficacy was determined by blinded dermatologist evaluation using a 0-4 scale and patient's satisfaction. Evaluation was conducted by assessing images photographed with a high resolution digital camera (Nikon CoolPix P610) before treatment and at 2-7 weeks post-last treatment. Each treatment was conducted for 10-30 minutes, depending on number of infected nails and severity with no anesthetic use.

**Results** All patients reported significant improvement of nail appearance, high tolerance and no complications. Subjective evaluation of the before and after images conducted by single blinded evaluator had pointed out a significant improvement in all cases treated in an average of 3.125 points.

**Conclusion** Combination of both laser modalities is an acceptable treatment for nail dystrophy resulting from Tinea or bacterial infection. This study demonstrated significant efficacy regardless of severity of fungal involvement using the presented technology and protocol. In addition, treatment found tolerable with high satisfaction by patients and no post procedure complications.

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## INTRODUCTION

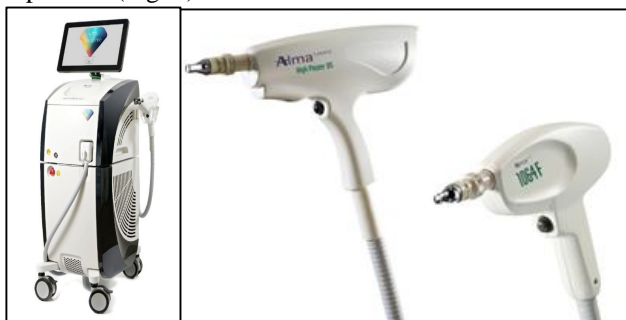
Onychomycosis is a fungal infection of nails and constitutes one of the most common dermatological infestation, affecting 10% of the general population, 20% of persons older than 60 years, and 50% of those older than 70 years in the US (1). A recent European study showed that the prevalence of onychomycosis may be as high as 26.9% in the general population (2). The causative agents of onychomycosis include dermatophytes (fungi that invade only dead tissues of the skin, nails, or hair), non-dermatophyte moulds, and rarely, yeasts of the *Candida* species (3). Many therapies are available in the market today including surgical, chemical, topical and oral methods. All these solutions have limitations such as inadequate spectrum of activity, low efficacy due to poor penetration to the nail plate, drug interactions, high costs, duration of treatment and recurrence of the infection(4).

## TECHNOLOGY

The Harmony XL PRO (Fig. 1) is a multi-technology, multi-application platform developed by Alma Lasers and combines a unique patented high powered laser system with microsecond pulsing capability and high repetition rates.

The novel non-invasive approach for treatment of onychomycosis involves the application of two types of laser to the nail plate. This combined method called "ClearChoice" utilizes QSW Nd:YAG 532nm wavelength laser followed by a pulsed Nd:YAG laser 1064nm wavelength. The pulsed 1064nm delivers high

average power - fluence of up to 200mJ/P and a repetition rate of 30Hz in a 1mm spot size. The Q-switched Nd:YAG emits laser at a fluence of up to 1200mJ/P, in a short nanosecond pulse width to a 3mm spot size (Fig. 1).



**Fig. 1.** Harmony XL PRO platform (left) and the QSW Nd:YAG and pulsed Nd:YAG 1064nm laser modules (right).

## LASER-NAIL INTERACTION

The energy used in Nd:YAG lasers is intended to be absorbed by the organism located on the nail bed based on the principle of selective photothermolysis. Light energy is converted to thermal energy to thermally deactivate the fungi cells and spores without damaging the nail plate. In addition, T. rubrum pigment (red and brown) photothermolysis is associated to the Q-Switched laser that is well absorbed by the fungi's pigments rather than a nonspecific thermal damage caused. In the past,

several studies attempted to treat onychomycosis using CO<sub>2</sub> laser with a satisfactory level of success and acceptable pain levels yet relatively high recurrence rate. Moreover, CO<sub>2</sub> was found to be absorbed in the shallow layers of the nail, making the treatment less effective in cases of deeper infections which created the high recurrence rates.

QSW Nd:YAG 1064-nm laser was suggested due to its higher penetration, relatively low discomfort levels compared to the former CO<sub>2</sub> treatments.

## STUDY POPULATION

All subjects are participants with at least one toenail and/or fingernail with clinically proven fungal infections. All between 18-45 years of age, willing to sign a written informed consent statements before beginning laser treatment and have expressed willingness to collaborate with the protocol. Exclusion criteria included use of systemic antifungal drugs.

## MATERIALS AND METHODS

Treatments were conducted at the Rejuvenate Cosmetic Medical Clinic, Perth, Australia by a single practitioner. 37 nails (hands and feet) of 16 different patients with clinically proven onychomycosis by mycological testing onychomycosis were included in this study. Infected areas were submitted to a weekly treatment according to the following regimen: treatments we performed weekly for 10 weeks in average. First 2 treatments were performed using the QSW KTP 532nm laser at a fluence of 500mj/P at one pass to cover all nail plate. The total energy is dependent on nail size. Next 8 treatments were performed using "ClearChoice" 1064nm at a fluence of 150mJ/P. Total energy per nail average range from 400-600J depending on size of infected nail. Efficacy of the treatment was evaluated both by a blinded objective evaluation of a dermatologist and a subjective patient's satisfaction evaluation using digital images of the treated nails taken before and a few weeks following last session. Evaluation was performed using a 0-4 scale (0 = no improvement, 1 = 0-25%, 2 = 26-50%, 3 = 51 - 75%, 4 = 76 - 100% improvement). All cases were photographed with a high resolution digital camera (Nikon CoolPix P610) before treatment and at follow up visit (2-7 weeks). Treatments were approximately 10-30 minutes, depending on number of infected nails, no anesthesia was used.

## RESULTS

All 16 patients reported on significant improvement of nail appearance. Regarding treatment tolerance and post procedure complications, all patients had unanimously pointed out that procedure was tolerable and no complication had occurred during their participation in the study. Dermatologist evaluation of the before and after images was that improvement was substantial in all cases and in an average of 3.125 points (Fig. 2).



**Figure 2.** Before (left column) and 2-7 weeks after (right column) nail infected cases treated with the bimodal QSW KTP 532nm and pulsed Nd:YAG 1064nm lasers "ClearChoice" protocol.

## SUMMARY

"ClearChoice" is an acceptable modality of treatment for nail dystrophy resulting from Tinea infections or bacterial infection. This clinical report has shown that "ClearChoice" results is significant efficacy regardless of severity of fungal involvement. Moreover, this treatment method was found very acceptable on patients with a very good satisfaction feedback, no post procedure complications and fair tolerance.

It is the writers' opinion that a longer follow-up can lead to an ever improved results and a higher patient satisfaction. This is due to the fact that improvement seen in most patients in the post procedure images is noticeable from the proximal part of the nail plate. This new healthy growth is accompanied by a noticeable improvement in plate surface and skin texture surrounding the nail.

## REFERENCES

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