# Conventional Photodynamic Therapy versus Fractional $CO_2$ Laser Assisted Photodynamic Therapy in Treatment of Onychomycosis

Thesis

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By

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# List of Abbreviations

| Abb. | Full term |
|---|---|

*AIDS .....: Acquired immune deficiency syndrome*
*ALA .....: Aminolevulinic acid*
*APC .....: Antigen presenting cells*
*CCA.....: Chromogenic Candida Agar*
*CMI .....: Cell-mediated immunity*
*CO .....: Candida onychomycosis*
*DLSO .....: Distal and lateral subungual onychomycosis*
*DNF .....: Distal nail fold*
*DTM .....: Dermatophyte test medium*
*EO .....: Endonyx onychomycosis*
*FDA.....: Food and Drug Adminstration*
*HIV .....: Human immunodeficiency virus*
*HSF .....: Heat shock factor*
*KOH.....: Potassium Hydroxide*
*MAL .....: Methyl aminolevulinate*
*MB .....: Methylene blue*
*MHC .....: Major histocompatibility*
*NDMs .....: Non-dermatophyes moulds*
*NK .....: Natural Killer*
*OCT .....: Optical coherence tomography*
*OM .....: Onychomycosis*
*OSI .....: Onychomycosis Severity Index*
*PCR .....: Polymerase chain reaction*
*PDT .....: Photodynamic therapy*
*PNF .....: Proximal nail fold*
*PNM .....: Proximal nail matrix*

# List of Abbreviations (Cont...)

| Abb. | Full term |
|---|---|
| *PSO* | *Proximal subungual onychomycosis* |
| *PWSO* | *Proximal white subungual onychomycosis* |
| *ROS* | *Reactive oxygen species* |
| *SDA* | *Sabouraud dextrose agar medium* |
| *SWO* | *Superficial white onychomycosis* |
| *TDO* | *Total dystrophic onychomycosis* |
| *TRT* | *Thermal relaxation time* |

# 1. INTRODUCTION

Onychomycosis is considered to be a common complex problem involving chronic nail fungal infection, which can result in nail dystrophy and discomfort. Onychomycosis is caused in most of cases by dermatophytes especially Trichophyton rubrum ***(Gupta et al., 2000).*** Clinical diagnosis of onychomycosis should be confirmed by laboratory identification of fungal elements as the clinical picture of onychomycosis may mimic other conditions like nail psoriasis and chronic nail trauma ***(Ameen et al., 2014).*** Direct microscopic examination after potassium hydroxide (KOH) preparation and fungal culture using Sabouraud medium are commonly used to confirm the diagnosis ***(Lawry et al., 2000).***

The classical treatment modalities for onychomycosis include oral as well as topical antifungal; however, the cure rate is considered to be low and regression rate is found to be high ***(Gupta and Simpson, 2012; Gupta et al., 2004).*** Traditional systemic antifungals have the risk of multiple drug interactions and systemic side effects in some patients with systemic diseases ***(Shemer, 2012; Piraccini and Gianni, 2013).*** Several factors may lead to the poor treatment outcomes including the difficulty of achieving penetration of the nail plate, lack of adherence to treatment (which lasts for months), the poor response of some fungi to antifungals, and individual susceptibility ***(Robres et al.,***

***2015).*** So, there is an intense need to find other methods to assure higher cure rates and better patient satisfaction, yet with lesser side effect ***(Thomas, 2010).***

Nowadays, laser and photodynamic therapy (PDT) are considered to be new nontraditional methods for treatment of onychomycosis ***(Grover and Khurana, 2012; Gupta and Simpson, 2012; Souza et al., 2013).*** PDT offers several advantages over traditional antimicrobial therapies as it has a broad spectrum of action and is effective independent of patterns of antimicrobial resistance. Moreover, it allows for the specific delivery of the photosensitizer to the infected area sparing the adjacent healthy tissue and thus, avoiding systemic side effects ***(Robres et al., 2015).***

Photodynamic therapy involves the use of photosensitizer agents as amino levulinic acid, methyl amino levulinic acid and methylene blue followed by exposure to light source to trigger the production of reactive oxygen species (ROS) which have shown fungicidal properties ***(Silva et al., 2013; Figueiredo Souza et al., 2014). Figueiredo Souza et al. (2014)*** examined the efficacy of PDT for treatment of onychomycosis using 2% methylene blue as a photosensitizer agent following mechanical abrasion of thick nails. They showed a cure rate of 90% with minimal recurrence at 12 months post-treatment. ***De Oliveira et al. (2015)*** showed marvelous success in seven mycotic nails through the use of

fractional $CO_2$ laser in association with photodynamic therapy as fractional $CO_2$ gives immediate effect with destruction of the area affected by fungi. This allows for a deeper penetration of photosensitizer agent used in the PDT and thus, the combination provided a high success rate. However, these results need to be further verified on a larger scale of patients.

Though PDT showed a reasonable success in treatment of onychomycosis, yet there is a little clinical experience with the use of PDT in the treatment of onychomycosis and no standardized protocol exists ***(Robres et al., 2015).***

# 2. Aim of the Work

The aim of the current study is to evaluate two PDT approaches in the treatment of onychomycosis. The study will compare the effect of PDT using conventional method versus fractional $CO_2$ assisted PDT for achievement of a clinical and mycological cure in cases of onychomycosis.