



Evaluation of the clinical efficacy of Fractional CO₂ laser combined with topical antifungal in the treatment of onychomycosis using SCIO (Score clinical index of onychomycosis)

Thesis

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By

Norhan Khaled Mohammed Ali Al-Meligi

M.B.B.CH Faculty of Medicine – Ain Shams University

Under the supervision of

Dr. Maha Adel Shaheen

Professor of Dermatology, Venerology and Andrology
Faculty of Medicine – Ain Shams University

Dr. Mohammed Taha Mahmoud

Professor of Microbiology and Immunology
Faculty of Veterinary Medicine – Zagazig University

Dr. Rania Mahmoud Al Hussein

Lecturer of Dermatology, Venerology and Andrology
Faculty of Medicine – Ain Shams University

**Faculty of Medicine
Ain Shams University**

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List of Abbreviations

Abb.	Full term
ALT	Alanine aminotransferase
AST	Aspartate aminotransferase
ATP	Adenosine tri phosphate
BCP	Bromocresol Purple
CO ₂	Carbon dioxide
CW	Continuous wave
d	Depth of involvement
DLSO.....	Distal-lateral subungual onychomycosis
DNA	Deoxyribonucleic Acid
DTM	Dermatophyte test medium
Er:YAG	Erbium-doped yttrium aluminium garnet
f.....	Clinical form
h.....	Degree of hyperkeratosis
HIV	Human immunodeficiency virus
IQR	Interquartile range IQR
KOH	Potassium hydroxide
KTP	Potassium titanyl phosphate
MHC	Major histocompatibility complex
MTZs	Micro thermal zones MTZs
MW	Megawatts

List of Abbreviations (Cont...)

Nd:YAG	Neodymium: yttrium-aluminium garnet
NRS	Numerical rating scale (NRS)
NS	Non significant
P value	Level of significance
PCR	Polymerase chain reaction
PDA	Potato dextrose agar (PDA)
PDL	Pulsed dye laser
PDT	Photodynamic therapy
PSO.....	Proximal subungual onychomycosis
r.....	Defines the strength and direction of the linear relationship between two variables
S.....	Significant
SCIO.....	Score clinical index of onychomycosis
SD	Standard deviation
SDA +C	Sabouraud s dextrose agar medium with chloramphenicol
SWO	Superficial White Onychomycosis
TDO.....	Totally Dystrophic Onychomycosis
U test.....	Mann Whitney Test
Vas	Visual analogue score

ABSTRACT

Background: Onychomycosis, a fungal infection of the nail, is considered one of the most prevalent disorders of the nail. Score clinical index of onychomycosis (SCIO) enable comparison of the severity of onychomycosis between nails despite differences in the clinical presentation. Recently fractional CO₂ laser and topical antifungal were found to be effective in treating onychomycosis.

Aim of the work: To evaluate the clinical efficacy of fractional carbon dioxide laser combined with topical antifungal in treatment of onychomycosis.

Patient's and Methods: The present study included 20 patients with toenail and fingernail onychomycosis of all age groups. The affected nails received 3 sessions of laser therapy (Fractional CO₂ laser) at 4 weeks intervals and once daily application of topical antifungal (Oxiconazole) available at the market under the name Tinox cream.

Conclusion: We concluded that Fractional carbon-dioxide laser therapy, combined with a topical antifungal agent, is effective in the treatment of onychomycosis. It can treat different types of onychomycosis safely and effectively, and is especially suitable for older patients with low immunity or liver and renal dysfunction who are not appropriate candidates for systemic antifungal agents. Thus, it could be considered as an alternative treatment modality.

Recommendations: Further studies are needed involving a larger number of cases, of both sexes with different age groups and disease durations to minimize statistical errors and to detect if there is a difference in obtained results according to these data. We recommend increasing number of laser sessions, a longer follow-up time to detect relapsing rate and if possible always support the results with a parallel mycological and microscopic examination. Studies demonstrating treatment efficacy and comparing this efficacy with oral antifungal agents are needed. We believe that this area of study will continue to expand and provide new insights of treatment options for onychomycosis.

Keywords:

CO₂: Carbon dioxide ; DLSO: Distal-lateral subungual onychomycosis; SCIO: Score clinical index of onychomycosis

Introduction

Onychomycosis, a fungal infection of the nail, is considered one of the most prevalent disorders of the nail. It occurs after primary infection of the nail bed, which may lead to subungual hyperkeratosis (*Bhatta et al., 2015*). Primary caused by dermatophytes such as *Trichophyton rubrum* and *Trichophyton mentagrophytes* (*Gupta and Nakrieko, 2014*). Other causative organisms are non dermatophyte molds (*Sreepurna et al., 2017*). *Candida albicans* accounts for approximately 70% of onychomycosis caused by yeasts. Direct microscopic examination after (KOH) preparation and fungal culture are commonly used to confirm the diagnosis (*Bhatta et al., 2015*).

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, 2013*). Topical antifungals are often ineffective because of their inability to penetrate via nail plate. Systemic treatments, although effective, have limited application because of adverse effects such as hepatotoxicity, potential drug interactions (*Scher et al., 2013*).

Score clinical index of onychomycosis (SCIO) enable comparison of the severity of onychomycosis between nails despite differences in the clinical presentation, The SCIO may prove to be an accurate indicator of therapeutic effectiveness (*Gupta et al., 2002*). It has:

1. Clinical pattern component based on (1) clinical form, (2) depth of nail involvement and, (3) thickness of subungual hyperkeratosis.
2. Growth pattern component based on location of the onychomycosis, digit number and age of the patient.

Photodynamic therapy is considered to be a non traditional method for treatment of onychomycosis (**Grover and Khurana, 2012**). Photodynamic therapy offers a number of advantages over traditional antimicrobial therapies as it has a broad spectrum action and is effective independent of patterns of antimicrobial resistance (**Robres et al., 2015**). Laser-based treatments have been explored as a possible alternative treatment for onychomycosis. Long pulse 1064-nm neodymium: yttrium-aluminiumgarnet (Nd:YAG) laser, diode laser and Q-switched Nd:YAG laser have all been studied and found to be safe and effective for treating onychomycosis (**Robres et al., 2015**) .

The fractional CO₂ laser systems were developed to maximize the effect of ablative laser therapies and minimize side effects (**Tierney et al., 2011**). Recently fractional CO₂ laser and topical antifungal were found to be effective in treating toenail onychomycosis (**Bhatta et al., 2015**).

Aim of the Work

To evaluate the clinical efficacy and safety of fractional carbon dioxide laser combined with topical antifungal in treatment of toenail and fingernail onychomycosis.

Chapter 1

Onychomycosis

Knowledge of the terminology and anatomy is important for understanding nail diseases and for scientific work within this field. The nail plate can be considered a translucent window to the underlying structures, mainly the nail bed. This can change in disease states where the nail often becomes thick and non-translucent. The nail bed is highly vascular giving the nail a pink color. The color of the nail changes in many disease states and can give important clues to the diagnosis of nail diseases (*Ólafsson et al., 2016*).

Nail anatomy:

The nail is attached to the nail bed, which holds it in place with the nail folds and matrix. **The nail plate** consists of tightly packed cells that have lost their nuclei. The nail plate is continuously formed by the matrix and continues to grow throughout life. **The nail matrix** is often divided into two parts. The ventral matrix is also called the nail bed and starts at the distal end of the lunula. It is limited distally by the hyponychium. The dorsal matrix lies under or is a part of the ventral part of the proximal nail fold. The lunula (from Latin: half-moon) is the more lightly colored part of the proximal nail plate which often looks like a half-moon. It is best seen on the thumbs and great toenails. The lunula determines the shape of the nail (*Phillips and Gest, 2013*).

The lateral nail folds are the folded part of the skin that helps to hold the nail in place. The proximal or posterior nail fold has a similar function and is continuous with the cuticle, but on the ventral surface, it becomes the dorsal part of the matrix. The cuticle (eponychium) is a thin translucent layer of the epidermis extending from the proximal nail fold and adheres to the nail plate (*Ólafsson et al., 2016*).

The hyponychium is the area beneath the free edge of the nail. The distal area of the nail bed has a different color. This 1–2 mm band is called the onychodermal band and is light in color in fair-skinned individuals, but darker in people with darker skin. This band is the first defense against microorganisms, and if it is disrupted, fungal invasion is easier. The distal groove is a landmark that delineates the subungual structures from the pulp (*Phillips and Gest, 2013*) (Figure 1) illustrates anatomical structure of the nail.

Onychomycosis:

Onychomycosis is a chronic fungal infection of the nail and may involve the nail bed, the nail plate, and the matrix. It is difficult to be treated. Relapses and reinfections are common. The diagnosis can be made only when both positive laboratory and clinical criteria are present (*Scher et al., 2007*). Onychomycosis can be caused by dermatophytes or non dermatophyte moulds. Onychomycosis can also be caused by more than 1 organism, for example, a non dermatophyte mould in addition to a dermatophyte (*Gupta*

and Nakrieko, 2014). Clinical signs of onychomycosis include nail discoloration, hyperkeratosis, and onycholysis (**Elewski et al., 2013**). Onychomycosis frequently presents as distal-lateral subungual onychomycosis (DLSO), with fungi entering the nail through the distal and/or lateral sides of the nail plate (**Elewski et al., 2013**).

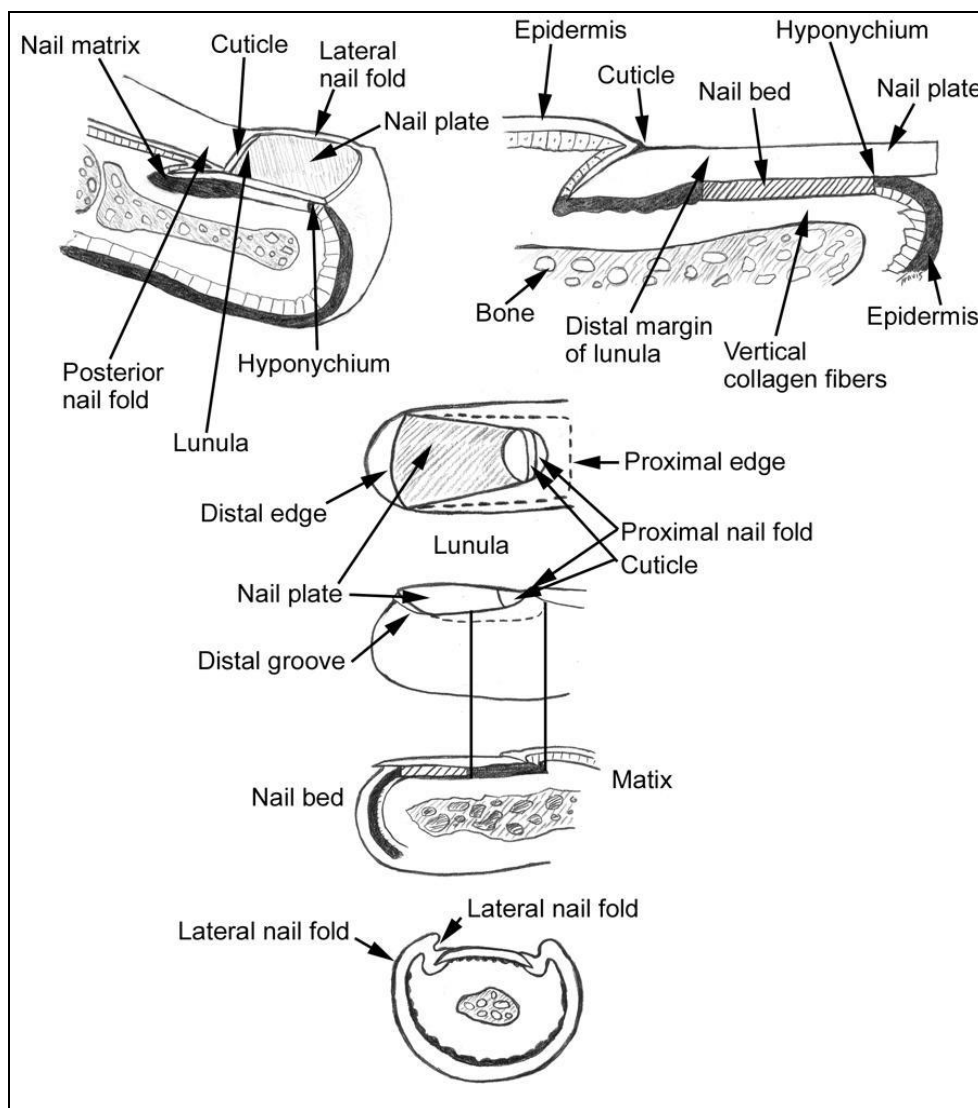


Figure (1): Anatomical structure of the nail (**Phillips and Gest, 2013**).