NOVEMBER 2014

LASERS APPLICATIONS IN PODIATRIC MEDICINE

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AN OVERVIEW OF MODERN LASERS USAGE AND ADVANTAGES FOR COMMON PODIATRIC APPLICATIONS
Understand your laser therapy needs and provide solutions that enhance your patients’ quality of life and overall client satisfaction.
About us

Understand your clinical needs

Podiatric lasers and clinical applications

FOX Laser – Hands on workshop
A.R.C. Laser is a technology driven company specializing in the development, production and sales of laser systems for use in multiple medical areas.

The company is a world leaders in laser technology, known for its several industry standards and breakthrough developments.

Extensive research & development routinely done with large hospitals and several leading universities across Europe.

All lasers are 100% designed, manufactured and built in Nuremberg, Germany.

A.R.C. Laser's products are sold in over 55 countries worldwide.
About A.R.C. LASER

Powerful Diode Lasers

18 W
980 nm

40 W
980 nm

HS11008
HS11009
HS11010

ZU01016
ZU01024
ZU01027

BritaMed
Innovative Medical Devices
About A.R.C. LASER

KTP; ND:YAG and CO₂ Lasers
BritaMed Inc. is a medical device company, and an importer of cutting edge medical devices for physicians, health care professionals and health care facilities.

- 100% Canadian company
- Health Canada registered (MDEL- license # 4799 Company ID: 134258)
- Local offices at: British Columbia, Alberta, Ontario and Quebec

BritaMed Inc. is A.R.C. Laser’s business partner, exclusively representing the company in Canada while handling all regulatory affairs, clinical and technical issues.

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What applications do you currently use that can benefit from laser therapy?

What are your unmet needs?

Available office space

Portability / mobility

Volume (# of procedures)

Cost
Podiatric Lasers Applications

- **Fungal nail infection**
  Onychomycosis caused by Dermatophytes and Yeasts

- **Inflammation**
  - Plantar fasciitis
  - Achilles tendinitis
  - Morton's neuroma

- **Warts**
  Plantar warts (Solitary and Mosaic): coagulation and carbonization

- **Wound healing**
  Diabetic foot ulcers; Burns; Post surgery recovery;

- **Superficial dermal lesions**
  Foot telangiectasia, Venous lakes, Campbell De Morgans spots (Haemangioma), Spider naevi
**Onychomycosis - The Nail**

- Nail plate
- Hyponychium: distally "seals" the nail bed
- Lunula
- Eponychium: proximally "seals" the nail bed
- Nail matrix
- Nail bed
Infrared radiation creates reactive oxygen species (ROS), which are able to irreversibly alter the chemical Chitin - a building block of the fungi’s cell membrane.

**ROS**

(Direct) Photoinactivation

Infrared radiation was shown to irreversibly deform the fungi cell’s cytoplasmatic membrane, a process known as inactivation of membrane transport system.
Onychomycosis –
How Infrared Radiation Affect the Fungi Pathogens?

**Fungi enzymes - thermal damage**

Mycelium is the vegetative part of a fungus, it is through this part that a fungus absorbs its nutrients from the environment.

High levels of heat effect (or thermal damage) the Mycelium by denaturing the enzymes the fungus uses to digest the Keratin - nail’s protein.

Heat basically solidify these enzymes just like cooking an egg and...

Solid enzymes cannot flow freely through the membrane, causing the fungi to starve. Practically eliminating further spreading.
1. Delivering high intensity spot infrared radiation

2. Generating instant in-Depth Heat (caused by photons - radiation)

3. Accelerate Healing

- **Photoinactivation**: Cytoplasmatic membrane damage
- **Heat**: Enzyme denaturing
- **Local rise in white blood cells**
Nail growth and clearance due to a single FOX Laser treatment

Typical ~2mm clear nail growth, 30-45 days post treatment

Images courtesy of Dr. Stephen Davis, D.P.M
(Gatineau, QC)
Typical nail clearance during 3-4 sessions with the FOX Laser

Images courtesy of Dr. Stephen Davis, D.P.M (Gatineau, QC)
Onychomycosis – Treatment Examples

Typical nail clearance during 3-4 sessions with the FOX Laser

Day 0

Day 78

Day 180

Images courtesy of Dr. Stephen Davis, D.P.M (Gatineau, QC)
Anti inflammatory and Pain reduction

FOX Laser

LOW LEVEL LASER THERAPY
Penetration depth is also a function of **800nm-1200nm** Power Density (J/cm²).

At 10 watt and 2.5cm beam spot size penetration depth will be approx. 2-3cm.

Laser radiation between in wavelengths of 800nm-1200nm absorbs very little in water, meaning a laser beam can pass through the tissue without losing much of its energy and not heating up its surrounding.
Anti-inflammatory; Pain reduction

PHOTONS

Absorbed in Mitochondria and Cell Membrane within Cytochromes and Porphyry’s

Singlet Oxygen is Produced

Changes in Membrane Permeability

ATP Synthesized and DNA Produced

Increase in Cell Metabolism from a Depressed Rate to a Normal Level

Selective Bio-Stimulatory Effect on Impaired Cells (note cells and tissues functioning normally are not affected)

Ant-inflammatory:
- Anti-Inflammation
- Anti-Pain (Analgesic)

Other benefits:
- Accelerated Tissue Repair and Cell Growth
- Faster Wound Healing
- Increased Metabolic Activity
- Improved Vascular Activity
- Improved Nerve Function
- Reduced Fibrous Tissue Formation
Analgesia - how does laser therapy reduce pain?

1. Increase in beta endorphins
2. Increased nitric oxide production
3. Decreased bradykinin levels
4. Ion channel normalization
5. Blocked depolarization of C-fiber afferent nerves
6. Increased nerve cell action potentials
7. Increased release of acetylcholine
8. Axonal sprouting and nerve cell regeneration
Acute Inflammation Reduction – how do lasers reduce inflammation?

1. Stabilization of the cellular membrane
2. Enhancement of ATP production and synthesis
3. Stimulation of vasodilation
4. Acceleration of leukocytic activity
5. Increased prostaglandin synthesis
6. Reduction in interleukin
7. Enhanced lymphocyte response
8. Increased angiogenesis
9. Temperature modulation
10. Enhanced superoxide dismutase (SOD) levels
11. Decreased C-reactive protein and neopterin levels
Hold perpendicular to create a beam spot size of approx. 2cm in diameter.
Repeat laser irradiation through the side of the foot as well.

Applying massage in between laser irradiation helps dissipate the heat and increase blood flow.
Defocus beam to approx. 2cm spot size, maintain perpendicular to the surface.

Images courtesy of Dr. Joseph Stern, D.P.M. (Vancouver, BC)
There are two clinical approaches to treat warts:

1. Coagulation
2. Carbonization

Energy = Power x Time

Increased carbonization
Increased coagulation
Coagulation is a **non-ablative** treatment, achieved by applying focused laser radiation, that dry out the wart, by coagulating its capillaries;

This method works extremely well on mosaic warts as well.
Laser radiation eradicate the Papilloma virus, since IR laser radiation causes intense heat at a subdermis level.

The dried tissue will separate from the healthy tissue underneath and fall off during the following days. In some cases blistering may appear, which promote the healing process.
1. Preparing the patient

2. Irradiate at the wart’s root

3. Scrape away loose tissue

Images courtesy of Dr. Anthony Yung, M.D. (Vancouver, BC)
Lower extremity ulcerations are a common complication seen in diabetic patients; numerous treatment modalities exist to manage lower extremity diabetic ulcers. Frequently, multiple adjunctive treatments are required to successfully manage an ulceration.

Treatments include surgical debridement and revascularization (when necessary), ointments, hydrogels, antibiotic therapies, offloading and hyperbaric oxygen treatment (HBO).

Healing of diabetic ulcers is often slow even when treated appropriately and occasionally full healing cannot be achieved.

Low Level Laser Therapy (LLLT) is believed to function through multiple Mechanisms, stimulates damaged or injured cells to increase cellular metabolism and ATP production. LLLT is also believed to increase oxygenation and blood flow to the irradiated area.

There are a wide variety of methods to provide laser irradiation to wound surfaces and as such there are a wide variety of treatment parameters that have shown successful results. All studies agree however, repeated treatment sessions are required for successful healing of wounds.
Wound healing

The Effect of Low Level Laser Therapy with a 1064 nm Diode Laser on the Healing of Diabetic Foot Ulcers

Richard Bauer DPM, Eliezer Eisenberger DPM, Ian Marion DDS  Faculty: Andrew Campbell DPM FAPWCA, Dara Rosenberg DDS

St. Barnabas Hospital, Bronx NY

Fig.1: Percentage Decrease In Wound Surface Area: Treatment vs. Control

Study performed with A.R.C. FOX Laser device
Superficial dermal lesions
VENOUS LAKES
A venous lakes are soft dark blue to purple spots which can measure up to 1 cm. The cause is unknown. No anaesthetic is required as the treatment is not uncomfortable.

CAMPBELL DE MORGANS SPOTS (HAEMANGIOMA)
Small blood blisters spots, also known as haemangiomas, often found on the body or arms, can be with usually one treatment. The laser heats up the blood inside the vessels and causes the vessel walls to stick together and thus collapse. Usually No anaesthetic is required as the treatment is tolerable.

SPIDER NAEVI
Small lesions with a number of tiny blood vessels resemble the legs of a spider. The centre is about 1 mm in diameter and the whole lesion about 5 to 10 mm across.
Firm pressure will cause it to blanch and when the pressure is released it will rapidly refill again from the centre outwards.

TELANGIECTASIA
are dilated small blood vessels, purple and red, found most commonly on the thighs or lower legs.
Telangiectasia are different from Spider naevi by their visual appearance, common location and the way they fill up after applying surface pressure. (Spider naevi blanch with pressure, and refill again from the centre outwards).
### FITZPATRICK CLASSIFICATION OF SKIN TYPES

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Always burns, never tans</td>
<td><img src="image" alt="Type I" /></td>
</tr>
<tr>
<td>Type II</td>
<td>Usually burns, difficult in tanning</td>
<td><img src="image" alt="Type II" /></td>
</tr>
<tr>
<td>Type III</td>
<td>Sometimes burns, average tan</td>
<td><img src="image" alt="Type III" /></td>
</tr>
<tr>
<td>Type IV</td>
<td>Rarely burns, tans with ease</td>
<td><img src="image" alt="Type IV" /></td>
</tr>
<tr>
<td>Type V</td>
<td>Very rarely burns, tans very easily</td>
<td><img src="image" alt="Type V" /></td>
</tr>
<tr>
<td>Type VI</td>
<td>Never burns, tans very easily</td>
<td><img src="image" alt="Type VI" /></td>
</tr>
</tbody>
</table>

Fitzpatrick classification of skin types, also identified in this document as:

Image courtesy of Dr. Joseph Stern, D.P.M. (Vancouver, BC)
# Superficial dermal lesions

## FOOT TELANGIECTASIA - FOX 980

<table>
<thead>
<tr>
<th>Handpiece</th>
<th>Skin Type</th>
<th>Power (W)</th>
<th>Pulse ON (ms)</th>
<th>Pulse OFF (ms)</th>
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<tbody>
<tr>
<td>Red (HS11009)</td>
<td>I-IV</td>
<td>8-10</td>
<td>140-160</td>
<td>500</td>
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<tr>
<td></td>
<td>V-VI</td>
<td>7-8</td>
<td>120-140</td>
<td>500</td>
</tr>
<tr>
<td>Blue (HS11008)</td>
<td>I-IV</td>
<td>7-9</td>
<td>100-120</td>
<td>500</td>
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<tr>
<td></td>
<td>V-VI</td>
<td>5-7</td>
<td>80-100</td>
<td>500</td>
</tr>
</tbody>
</table>

- Always start with lowest laser settings and gradually increase when necessary.

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Image courtesy of Dr. Joseph Stern, D.P.M. (Vancouver, BC)
THANK YOU FOR YOUR ATTENTION