The method of intravenous laser blood irradiation and clinical applications
IV Laser Blood Irradiation
UV-radiation of blood
Applied of the catheter in the blood stream
IV Lasertreatment with
Red and green laser
Iv-laser treatment with blue and yellow laser
Puncture needles for intravenous laser therapy
Y-needle with 3 x Luer-lock for simultaneous infusion therapy
Intravenöse Laserblutbehandlung mit verschiedenen Wellenlängen:
Red laser intravenous therapy
The laser-needle mouth shower
The laser-needle mouth shower for systemic sublingual laser energy application
Weberneedle 12-channel modular Endolaser system
The intravenous laser blood irradiation for diabetes (blood acupuncture)

Diabetes mellitus with leg ulcer
The intravenous laser blood irradiation for allergy (blood acupuncture)

Treatment of severe allergy with combined laser therapy
Effects of intravenous laser light irradiation

**Red laser**
Stimulation of the immune system, improvement of blood viscosity

**Green laser**
Increased oxygen supply

**Blue laser:**
Increased NO, bactericidal effects

**Ultraviolett laser:**
Kills viruses and bacteria

**Yellow laser:**
Detoxification, antidepressive
Effects of intravenous laser blood irradiation on mitochondria

Figure 5.14 Three-dimensional reconstruction of mitochondria from human lymphocytes which are (a) intact and (b) irradiated with He-Ne laser at a dose of 56 J/m². Vertical and horizontal scale bars are 0.3 μm (Mantakel et al., 1997).

„Giant-mitochondria“ in human lymphocytes after laser irradiation (632 nm)

Ring-shaped mitochondria in human lymphocytes after laser irradiation (632 nm)

Figure 5.15 Electron micrograph of a section through an irradiated (632 nm, 56 J/m²) human lymphocyte. The experimental details are described by Mantakel et al., 1997. The arrow points to the ring-shaped mitochondrial profile that belongs to the giant mitochondrion (b) presented in Fig. 5.14b.
Increased ATP production

ATP-Increase under laser irradiation (632 nm, red light) of a HeLa cell-culture
Immunological effects of iv-Laser

Activation of macrophages in fluorescent light
Immunological effects of iv-Laser

Figure (1) Concentration / Time relationship of IgM of both groups

Mouayed A. Hasan et al., Estimation of IgM & IgG values in the serum after intravenous irradiation of blood with diode laser

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
Immunological effects of iv-Laser

Figure (2) Concentration / Time relationship of IgG of both groups

Mouayed A. Hasan et al., Estimation of IgM & IgG values in the serum after intravenous irradiation of blood with diode laser

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
Intravenous green laser

Green laserlight binds to haemoglobin
Effects of the green Laser on mitochondria


Mitochondrial alterations induced by 532 nm laser irradiation.

Kassak P, Przygodzki T, Habodaszova D, Bryszewska M, Sikurova L.

Division of Biomedical Physics, Faculty of Mathematics, Physics and Informatics, Comenius University, Mlynska Dolina F1, 842 48 Bratislava 4, Slovakia.

Another MTT assay was used for isolated mitochondria suspensions in order to examine the effect of green laser irradiation on stimulation of processes related to oxidative phosphorylation. It revealed 31.3% increase in MTT assay products in irradiated mitochondria as compared to controls.

Green laserlight increases the production of ATP in the irradiated mitochondria for more than 30%.
Stimulation of sodium-potassium-ATP-ase of human erythrocytes with green laser irradiation

First yellow laser worldwide:

• after the development of red, infrared, green and blue lasers, yellow was the last missing prismatic color
• yellow additionally stimulates the mitochondrial respiratory chain at complex III (cytochromes)
• yellow has an detoxifying effect
• yellow has an anti- depressive effect
• The yellow laser stimulates the strongest natural photosensitizer – Hypericin out of St. Johns wort – and is therefore one of the most efficient laser in photodynamic cancer therapy.
Application of blue laser light
The new 447nm Blue Laser
The blue Laser

Irradiation with blue laser leads to increase of the release of nitric oxide (NO) from haemoglobin

Kinetics of NO release and reabsorption triggered by He-Cd laser (40 mW) irradiation in erythrocytes enriched with NO-Hb.

(A) Anaerobic irradiation; (B) Aerobic irradiation; (C) Difference in NO concentration in solution due to switching the laser ON and OFF.

Mittermayr et al., Ludwig Boltzmann Institut Wien in Zusammenarbeit mit der Russian State Medical University in Moskau
Mol Med. 2007 Jan-Feb; 13 (1-2): 22-29
Blue laser increases nitric oxide (NO)
Blue laser increases nitric oxide (NO)

- Emerging evidence suggests that increasing nitric oxide (NO) bioavailability or endothelial NO synthase (eNOS) activity activates telomerase and delays endothelial cell senescence.

Blue laser increases nitric oxide (NO)


Chronic, smaller increases in NO levels stimulate mitochondrial biogenesis in diverse cell types.
Mikrocirculation problems in
- Macroangiopathy, Microangiopathy
- Diabetes mellitus
- coronary heart disease
- Fat metabolism disturbances
- Hypertension
- Kidney failure
- Old humans
- After transplantations

NO is in the view of today the main physiological regulator of the microcirculation and is influencing the cGMP-metabolism.

In the blood NO is not free but will bind immediately to haemoglobin.

Der HbNO-complex is photosensitive and reacts on laser irradiation.

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
The blue laser in ENT

Patient, 45 y., acute hearing loss, medication without effect

Improvement ca. 50 % after 4 sessions
Effects on Telomeres

Telomeres end caps that protect the chromosomes

As cells divide

over time ...

... telomeres shorten, and eventually cell division stops.
Effects on Telomeres
Nitric Oxide

- Anti-ageing effects
- Increases energy production
- Increases blood flow to vital organs
- Boosts exercise performance & endurance
- Manages diabetes by regulating insulin
- Prevents diabetic complications
- Lowers blood pressure & LDL (bad) cholesterol
- Reverses atherosclerotic plaque formation
- Reverses kidney disease/failure
- Improves sexual performance
- Offsets damage from tobacco use
- Enhances memory & cognitive function
Typical diseases to treat with laser blood irradiation

- Diabetes mellitus
- Chronic liver diseases
- Lipometabolism disorders
- Chronic pain syndromes
- Rheumatoid Arthritis
- Polyneuropathy
- Chronic inflammatory diseases
- Cancer (photodynamic therapy)
- Fibromyalgia
- Hypertension
- Tinnitus
- Macula degeneration
- Multiple Sclerosis
- Chronic fatigue syndrome
- allergies and eczemas

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
The intravenous laser blood irradiation

*General effects:*

- Improvement of the general performance
- Improved Sleep
- Positive effect on depression
- Improvement of the immune system
Regenerative effects of intravenous laser therapy

- There is strong evidence that the regenerative effects of intravenous laser therapy are induced by stimulation of the body’s own stem cells released from the bone marrow in the blood stream.
Studies
Application in cardiology and angiology
Before Lasertherapy

After Lasertherapy
Cardiovascular Disease

- Includes anything adversely affecting heart and blood vessels such as:
  - Angina / Ischemic Heart Disease
  - Atherosclerosis
  - Dysrhythmia
  - Hypertension
  - Hyperlipidemia
  - Myocardial Infarction
  - Stroke
  - …and more

Widespread effects on Blood & Blood Vessels

- Reduced aggregation of platelets.
- Increased elasticity/deformability of red cells.
- Reduced viscosity / improved microcirculation.
- Reduced coagulability.
- Increased antioxidant levels.
- Increased oxygen binding to red blood cells.
- Prevention, even regression of plaque.
- Immune activation.
- Increase of kidney function
Study about the efficacy of laser therapy on patients with coronary heart disease

F. Noohi, MD. FACC , M. Javdani, MD*, M. kiavar, MD
Shaheed Rajaei Cardiovascular Medical & Research Center. IRAN
University of Medical Science, Tehran, IRAN, Nov.2008
16th Congress of
Iranian Heart Association
In Collaboration with
American College of Cardiology

Nov. 18-21, 2008
Aban 28- Azar 1, 1387
6 Minuten Lauftest
Ejektionsfraktion des Herzens
Diabetes

Used by permission of the Czech Society for the Use of Laser in Medicine, www.laserpartner.org

Ambulatory Application of Combined Laser Therapy in Patients with Diabetes Mellitus and Dyslipidemia

Laser Partner, 17.5.2002
T.V. Kovalyova, Out-Patient Department of the 2-nd Municipal Clinical Hospital, Izhevsk, Russia
e-mail: laser@udm.ru

Abstract

This study sought to evaluate the dynamics of lipid metabolism in blood plasma and clinical efficiency of combined laser therapy (CLT) in patients with diabetes mellitus.
The effect of intravenous laser on metabolism and diabetes

Die Dynamik des Lipidprofils (mmol/l bei Patienten mit Diabetes mellitus ($M \pm m$))

<table>
<thead>
<tr>
<th>Zeitliche Einleitung der Untersuchung</th>
<th>Patientengruppen</th>
<th>TG (0,40 - 1,53)</th>
<th>TC (3,9 - 5,2)</th>
<th>LDL-c (3,0 - 4,5)</th>
<th>HDL-c (1,5 - 3,3)</th>
<th>AR (2,5 - 3,5)</th>
<th>LDL/HDL-c ratio (up to 5,0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zu Beginn</td>
<td>I</td>
<td>2,11 ± 0,12</td>
<td>7,92 ± 0,44</td>
<td>7,80 ± 0,43</td>
<td>0,91 ± 0,05</td>
<td>7,70 ± 0,43</td>
<td>8,57 ± 0,48</td>
</tr>
<tr>
<td></td>
<td>II (1)</td>
<td>2,14 ± 0,10</td>
<td>8,20 ± 0,38</td>
<td>7,87 ± 0,37</td>
<td>0,99 ± 0,04</td>
<td>7,28 ± 0,27</td>
<td>7,94 ± 0,30</td>
</tr>
<tr>
<td>Nach der Therapie</td>
<td>II (2)</td>
<td>2,51 ± 0,11</td>
<td>7,98 ± 0,37</td>
<td>7,90 ± 0,37</td>
<td>1,14 ± 0,05</td>
<td>6,00 ± 0,23</td>
<td>6,92 ± 0,26</td>
</tr>
<tr>
<td>Während 3 Wochen</td>
<td>II (3)</td>
<td>1,69 ± 0,07</td>
<td>5,31 ± 0,25</td>
<td>6,63 ± 0,31</td>
<td>1,42 ± 0,06</td>
<td>2,73 ± 0,10</td>
<td>4,66 ± 0,18</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>2,10 ± 0,12</td>
<td>7,91 ± 0,44</td>
<td>7,79 ± 0,44</td>
<td>0,92 ± 0,05</td>
<td>7,59 ± 0,42</td>
<td>8,46 ± 0,47</td>
</tr>
<tr>
<td>Veränderung Zeitbezug</td>
<td>(?)</td>
<td>1,3</td>
<td>1,54</td>
<td>1,2</td>
<td>1,4 (?)</td>
<td>3,3</td>
<td>2,0</td>
</tr>
<tr>
<td></td>
<td>p (1 - 2)</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
</tr>
<tr>
<td></td>
<td>p (2 - 3)</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
</tr>
<tr>
<td></td>
<td>p (1 - 3)</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
</tr>
<tr>
<td>Während 3 Monaten:</td>
<td>II</td>
<td>1,72 ± 0,08</td>
<td>5,42 ± 0,25</td>
<td>6,21 ± 0,29</td>
<td>1,61 ± 0,07</td>
<td>2,37 ± 0,09</td>
<td>3,85 ± 0,18</td>
</tr>
<tr>
<td>Vor der Therapie während 3 Wochen</td>
<td>II</td>
<td>1,51 ± 0,07</td>
<td>5,27 ± 0,24</td>
<td>5,42 ± 0,25</td>
<td>1,67 ± 0,07</td>
<td>2,15 ± 0,10</td>
<td>3,24 ± 0,15</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>2,12 ± 0,12</td>
<td>7,94 ± 0,44</td>
<td>7,84 ± 0,44</td>
<td>7,90 ± 0,05</td>
<td>7,82 ± 0,44</td>
<td>8,71 ± 0,49</td>
</tr>
<tr>
<td>Während 6 Monaten:</td>
<td>II</td>
<td>1,62 ± 0,07</td>
<td>6,01 ± 0,28</td>
<td>5,82 ± 0,27</td>
<td>1,39 ± 0,06</td>
<td>3,30 ± 0,15</td>
<td>4,18 ± 0,19</td>
</tr>
<tr>
<td>Vor der Therapie während 3 Wochen</td>
<td>II</td>
<td>1,54 ± 0,07</td>
<td>5,28 ± 0,24</td>
<td>5,70 ± 0,26</td>
<td>1,42 ± 0,06</td>
<td>2,70 ± 0,12</td>
<td>4,00 ± 0,18</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>2,12 ± 0,12</td>
<td>7,89 ± 0,44</td>
<td>7,80 ± 0,44</td>
<td>0,91 ± 0,05</td>
<td>7,67 ± 0,43</td>
<td>8,57 ± 0,48</td>
</tr>
</tbody>
</table>

I= Kontrollgruppe (n=22) ohne CLT- Behandlung

II= Hauptgruppe (n=37) mit Behandlung
Blutzuckerwerte \((M \pm m)\)

<table>
<thead>
<tr>
<th>Beobachtungsperioden</th>
<th>Patientengruppen</th>
<th>Glukose, mmol/l</th>
<th>(\text{NIDDM})</th>
<th>(\text{IDDM})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zu Beginn</td>
<td>I</td>
<td>14,43 (\pm) 0,86</td>
<td>9,97 (\pm) 1,02</td>
<td></td>
</tr>
<tr>
<td>Nach der Therapie</td>
<td>II (1)</td>
<td>14,21 (\pm) 0,85</td>
<td>10,46 (\pm) 1,46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II (2)</td>
<td>11,27 (\pm) 0,67</td>
<td>11,82 (\pm) 1,65</td>
<td></td>
</tr>
<tr>
<td>Während 3 Wochen</td>
<td>II (3) 1</td>
<td>6,01 (\pm) 0,35</td>
<td>7,45 (\pm) 1,04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p (1-2)</td>
<td>&gt; 0,05</td>
<td>&gt; 0,05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p (2-3)</td>
<td>&lt; 0,05</td>
<td>&lt; 0,05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p (1-3)</td>
<td>&lt; 0,05</td>
<td>&lt; 0,05</td>
<td></td>
</tr>
<tr>
<td>Während 3 Monaten:</td>
<td>II</td>
<td>7,98 (\pm) 0,47</td>
<td>6,38 (\pm) 0,89</td>
<td></td>
</tr>
<tr>
<td>Vor der Therapie</td>
<td>II</td>
<td>6,03 (\pm) 0,36</td>
<td>5,72 (\pm) 0,79</td>
<td></td>
</tr>
<tr>
<td>während 3 Wochen</td>
<td>I</td>
<td>14,41 (\pm) 0,86</td>
<td>10,24 (\pm) 1,05</td>
<td></td>
</tr>
<tr>
<td>In 6 Monaten:</td>
<td>II</td>
<td>6,81 (\pm) 0,40</td>
<td>5,89 (\pm) 0,82</td>
<td></td>
</tr>
<tr>
<td>Vor der Therapie</td>
<td>II</td>
<td>6,02 (\pm) 0,36</td>
<td>5,54 (\pm) 0,77</td>
<td></td>
</tr>
<tr>
<td>während 3 Wochen</td>
<td>i</td>
<td>14,37 (\pm) 0,86</td>
<td>10,31 (\pm) 1,06</td>
<td></td>
</tr>
</tbody>
</table>

I= Kontrollgruppe (n=30) ohne CLT- Behandlung

II= Hauptgruppe (n=37) mit Behandlung
Evaluating the Efficiency of Low Level Laser Therapy (LLLT) in Combination With Intravenous Laser Therapy (IVL) on Diabetic Foot Ulcer, Added to Conventional Therapy

Soheila Mokmeli MD1, Mahrokh Daemi MD2, Zahra Ayatollahzadeh Shirazi MD1 Fatemah Ayatollahzadeh Shirazi PhD3, Mitra Hajizadeh MD4

1Department of Medical Laser, Milad Hospital, Social Security Organization, Tehran, Iran
2Department of Surgery, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran
The total response to healing (Diagram 2)

Percent (%)

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely Healed</td>
<td>62.2</td>
</tr>
<tr>
<td>More than 50%</td>
<td>12.2</td>
</tr>
<tr>
<td>Less than 50%</td>
<td>8.1</td>
</tr>
<tr>
<td>Not Healed</td>
<td>5.4</td>
</tr>
<tr>
<td>Did not Continue the Treatment</td>
<td>12.2</td>
</tr>
</tbody>
</table>

Total Response to Healing
Diabetes mellitus, metabolic syndrome
New Diabetes study 2008
( Dr. Andreas Wirz, Basel, Switzerland)

• **Protocol**: 100 diabetic patients were treated with 10 sessions red and green lasers intravenously with the new insuline frequency of 3023 Hz

• **Results**: positive effects in 75 %
  Reduction of HbA1c of 1,5 %

( this study was presented at the international congress for acupuncture in Davos, Switzerland, February 2008, will be published soon )
The Hypoglycemic Effect of Intravenous Laser Therapy in Diabetic Mellitus Type 2 Patients; A Systematic Review and Meta-analyses

Kazemikhoo N1, 2, Ansari F2 and Nilforoushzadeh2
1 Skin Diseases and Leshmaniasis Research Center, Isfahan University of Medical Sciences, Isfahan, Iran 2 Skin and Stem Cell Research Center, Tehran University of Medical Sciences, Tehran, Iran
12/2015
Studies

R. Chen, 2000 (Chen, Chen, Xie, Chen, & Zhang, 2000) 10 67.3 93.3
He-Ne laser extravascular irradiation therapy instrument, O—4Omw, 632.8nm, 60 min
197.1±73.8 106.2±540

T.V. Kovalyova, 2002 (Kovalyava, 2002) 27 57.3 13
ILBI intravenously 2 mW, l =0,63 mm 405-nm 15-30 min
259.74±15.48 255.78±15.3

N. KazemiKhoo, 2013 (N Kazemi Khoo et al., 2013) 9 60.63 55
ILBI intravenously 1.5 mW, continuous, 405-nm 30 min
190±17 165±20
Macular degeneration
Application in macular degeneration
Results

Overall results

- **MD1**: Percentage gained, Percentage seen "before"
- **MD3**: Percentage gained, Percentage seen "before"
- **RP1**: Percentage gained, Percentage seen "before"
- **RP3**: Percentage gained, Percentage seen "before"

Legend:
- **Percentage gained**
- **Percentage seen "before"**
INTRAVENOUS LASER BLOOD IRRADIATION IN SPORTS MEDICINE
Materials and Methods

• Definitions
  – Maximum strength tests:
    1. Pectoral muscle maximum lifting power
      » Weight is lift in supine position, while athlete lies on the bench
      » Maximum weight has to be confirmed by 8 following lifting of sub-maximal weight (80% of maximum)
Results

Maximum strength tests:
*Pectoral muscle maximum lifting power*

% variation (mean)

<table>
<thead>
<tr>
<th>Time</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>0,00</td>
</tr>
<tr>
<td>after</td>
<td>11,45</td>
</tr>
<tr>
<td>4 weeks</td>
<td>11,17</td>
</tr>
<tr>
<td>8 weeks</td>
<td>12,29</td>
</tr>
<tr>
<td>12 weeks</td>
<td>10,34</td>
</tr>
<tr>
<td>16 weeks</td>
<td>7,26</td>
</tr>
<tr>
<td>20 weeks</td>
<td>-1,12</td>
</tr>
</tbody>
</table>

Legend:
- before treatment
- after treatment
- 4 weeks after end
- 8 weeks after end
- 12 weeks after end
- 16 weeks after end
- 20 weeks after end
Materials and Methods

• Definitions
  - Endurance tests:
    1. Cord jumping time
      » Is the maximum time that athlete could perform in cord jumping until he felt tired
Results

Endurance tests:
Cord Jumping time % variation (mean)

<table>
<thead>
<tr>
<th>Time</th>
<th>% Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>0.00</td>
</tr>
<tr>
<td>Treatment</td>
<td>83.33</td>
</tr>
<tr>
<td>4 weeks</td>
<td>90.48</td>
</tr>
<tr>
<td>8 weeks</td>
<td>88.10</td>
</tr>
<tr>
<td>12 weeks</td>
<td>95.24</td>
</tr>
<tr>
<td>16 weeks</td>
<td>85.71</td>
</tr>
<tr>
<td>20 weeks</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Race camels in Dubai
Endurance sport
Sheik Nasser, Prince of Bahrain
New Developments in Regenerative Medicine:

Interstitial laser therapy, PRP, Stem cells, intravenous laser and cosmetic laser therapy
Absorption of laser light in biological tissue

Absorption

405, 447 nm, 532 nm, 589 nm, 635 nm, 658 nm, 810 nm

Hämoglobin
Melanin

0,1

400 600 800 1000 1200 1400 nm

Wellenlänge

Wellenlänge

405, 447 532 nm, 589 635 nm, 658 nm 810 nm

green  red  Infrared
The skin barrier
Disturbing effects of laser penetration in biological tissue
Optical penetration depth of different wavelengths

- depends upon the wavelength
- Tissue penetration of blue laser very low, green laser ca. 5mm, red 3 cm, infrared 6 cm
The structure of the mitochondria can be different in the special types of tissue cells.

In living cells mitochondria have a dynamic structure; this means that they can vary their structure and size. They are able to merge or to divide themselves.

The mitochondria are making out about 10 – 15 % of the volume of a living cell.

Their main task is the production of ATP.

The mitochondria have an inner and outer membrane.

In the inner room of the mitochondria we can find the christae, formed by double layer membranes, where the respiratory chain is located and the production of ATP.
The respiratory chain in the mitochondria

---

Karp, Molekulare Zellbiologie
The respiratory chain in the mitochondria

Karp, Molekulare Zellbiologie
The respiratory chain in the mitochondria

In figure 13 we find the processes of energy production in the mitochondria.

We should remember again that with the blue laser we will stimulate the starter complex NADH-dehydrogenase and with the red and infrared laser the end-complex cytochrome-c-oxydase.
The intraarticular laser therapy
The anatomy of the shoulder
Shoulder syndrome
Shoulder syndrome

Loss of the joint space

Bone Spur
Intraarticular laser therapy
Interstitial laser therapy for spine syndromes
Interstitial laser therapy for spine syndromes

Figure 6.6.
Axial view of lumbar transforaminal and selective nerve root injection. The anatomy and proper needle position (axial view) for right (1) L3/L4 transforaminal injection and (2) L3 selective spinal nerve injection.

Laserclinic Dr. med.
Dipl. chem. Michael Weber, Germany
Step 1: Local anaesthesia
NaCl for improvement of beam spreading
Interstitial fiberoptic canula (4, 5, 8, 10, 12 cm)
New blue laser 447 nm
Blue laser increases nitric oxide (NO)

  Nitric oxide and mitochondrial biogenesis.

Chronic, smaller increases in NO levels stimulate mitochondrial biogenesis in diverse cell types.
Blue laser increases nitric oxide (NO)

- Emerging evidence suggests that increasing nitric oxide (NO) bioavailability or endothelial NO synthase (eNOS) activity activates telomerase and delays endothelial cell senescence.

Sterile fiberoptics with circular irradiation
Sterile fiberoptics with spheric irradiation
Step 3:
Inserted catheter for interstitial laser therapy
Interstitial laser application

- Blue and yellow laser
- Cooling effect
- Antiinflammatory effect
Spinal interstitial laser therapy
The intraarticular laser therapy for knee osteoarthritis

OA is a disease of joints that affects all of the weight-bearing components of the joint:

• Articular cartilage
• Menisci
• Bone
Advanced knee osteoarthrits

- Periarticular sclerosis
- Osteophytes
- Sub-chondral bone cysts
Fiberoptic cannulas for intraarticular laser therapy
Fiberoptic plastic cannula
The intraarticular laser therapy
Fiberoptic butterfly for small joints
The intraarticular laser therapy

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
The intraarticular laser therapy

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
The intraarticular laser therapy

Laserclinic Dr. med. Dipl. chem.
Michael Weber, Germany
Intraarticular laser in Shoulder syndromes
presented on World of Pain conference, Miami 2012

- Number of patients = 15
- Number of treatments mean value 9.40
  - VAS before 6.67
  - VAS after 3.33 (dose about 1 J)
Intraarticular laser in knee syndromes
presented on world of Pain conference, Miami 2012

- Number of patients = 11
- Number of treatments mean value 6
  - VAS before 7,27
  - VAS after 3,36
  (dose about 10 J)
Interstitial laser in spine syndromes
presented on world of Pain conference Miami 2012

- Number of patients = 23
- Number of treatments mean value 8.13
  - VAS before 6.48
  - VAS after 3.78
  (dose about 10 J)
**Neuraxial Low-Level- Laser Therapy for Lumbar Disc Herniation**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnose</th>
<th>VAS initial</th>
<th>Neuroaxiale LLLT</th>
<th>VAS final</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH</td>
<td>NPP L2/3</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>BM</td>
<td>NPP L4/5/S1</td>
<td>8-9</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>GG</td>
<td>NPP L4/5/S1</td>
<td>3-4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>KH</td>
<td>NPP L4/5/S1</td>
<td>4-5</td>
<td>3</td>
<td>2-3</td>
</tr>
<tr>
<td>MH</td>
<td>NPP L5/S1</td>
<td>4-5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>NN</td>
<td>NPP L4/5</td>
<td>2-3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>SG</td>
<td>NPP L4/5</td>
<td>5-6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>VR</td>
<td>NPP L3/4/5</td>
<td>8</td>
<td>7</td>
<td>2-3</td>
</tr>
<tr>
<td>WH</td>
<td>NPP L4/5/S1</td>
<td>7</td>
<td>3</td>
<td>2-3</td>
</tr>
<tr>
<td>WR</td>
<td>NPP L5/S1</td>
<td>6-7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Summe</strong></td>
<td></td>
<td>55,5</td>
<td>33</td>
<td>27,5</td>
</tr>
</tbody>
</table>
3) Henry B.H. and Sherry N. Fanous, Spine Care Center, Cairo, Egypt (2015):

Knee Pain Management using Ultrasound-Guided Weberneedle Endolaser in Comparison to Fluoroscopy-Guided Continuous Radio-Frequency

Abb. 20: Ultrasound Guidance
Abb. 21: Intra-articular use of two red lasers and one blue laser
Results Middle-age and old-age population

- 8 of 22 middle-age patients (36%) treated with laser therapy achieved 71-80% pain relief after 6 months
- 9 of 22 middle-age patients (41%) treated with laser therapy achieved 81-90% pain relief after 6 months
- 2 of 22 middle-age patients (9%) treated with laser therapy achieved 91-100% pain relief after 6 months
- 3 of 6 old-age patients (50%) treated with laser therapy achieved 71-80% pain relief after 6 months
- 2 of 6 old-age patients (33%) treated with laser therapy achieved 81-90% pain relief after 6 months
- 1 of 6 old-age patients (17%) treated with laser therapy achieved 91-100% pain relief after 6 months
The interstitial and intraarticular laser therapy

• The laser can be applied in the depth of the tissue close to the spot of injury

• One or more interstitial needles can be added to superficially applied laserneedles

• Pain relief is quicker and more effective

• Combination of metal needle with fiberoptics (true laserneedle)
The interstitial and intraarticular laser therapy

- Important in patients with dark skin
- Blue and green laser with anti-inflammatory effects can be applied as well
- Better effect on tissue regeneration
Combination of laser with platelet rich plasma (PRP)

- Serum from patient’s own blood, enriched with cytokines and growth factors
- Injected intraarticularly or interstitially
- Intraarticular and interstitial laser irradiation
Peripheral blood (6% platelets)
Preparation of PRP

10 ml Blut aseptisch aus der Arterie des Patienten entnehmen, z. B. mit einem Butterfly oder einer Kanüle.

Nach der Inkubation muss das Medizinprodukt für 5 Min. bei 4,000 Umdrehungen zentrifugiert werden. Vorsichtige Entnahme des Medizinproduktes aus der Zentrifuge.

Anschließend wird das Blut unter Verwendung einer neuen Kanüle in das Medizinprodukt übergeleitet.

Die Kanüle befindet sich im Behandlungsset.

Das autologe konditionierte Serum sollte unter Anwendung eines Sterilfilters umgeben in das betroffene Gelenk reinjiziert werden.
Centrifugation of PRP (low speed)
Platelets are crucial for tissue repair and vascular remodelling. The first stage of normal wound healing, immediately following injury or insult, is inflammation, where activated platelets adhere to the site of injury releasing growth factors including:
94% Platelets in PRP
PRP Composition

1. Platelets
   growth factors and antiinflammatory cytokines,
   Interleukin-1 receptor antagonist
2. Neutrophiles
   40-75% of circulating leukocytes
3. Monocytes
   2-10% highly motile and migrate to soft tissues
4. Fibroblasts
   produce collagen, glycosaminoglycans, glycoproteins
5. Keratinocytes
   Stratified, squamous epithelial cells Primary function is to act as a barrier
6. Small number of primitive stem cells
Chronic inflammation and osteoarthritis

- Interleukin 1 (IL-1) leads to cartilage damage
- The autologue serum contains increased amount of IL-1-receptor antagonist (IL 1 RA)
- IL 1 RA inhibits inflammation and improves regeneration
Different growth factors in PRP

- transforming growth factor (TGF-β): promotes formation of extracellular matrix and regulates bone cell metabolism;
- platelet-derived growth factor (PDGF): promotes cell replication, angiogenesis, epithelialisation and granulation tissue formation;
- basic fibroblast growth factor (bFGF): promotes proliferation of endothelial cells and fibroblasts and stimulation of angiogenesis;
- epidermal growth factor (EGF): promotes cell differentiation and stimulates re-epithelialisation, angiogenesis and collagenase activity;
- vascular endothelial growth factor: promotes angiogenesis; and
- connective tissue growth factor: promotes angiogenesis, vessel permeability, and stimulates mitogenesis for endothelial cells.\(^3,^4\)
Advantages of PRP - Therapy

1. Boosts local healing and tissue (re)growth
2. Natural procedure with patient’s own blood, no side effects or toxicities
3. Individual therapy
4. Easy handling, procedure doesn’t take longer than 20 min.
5. Supports the body’s own potency of healing
6. Cartilage protection and anti-inflammatory effects
7. Prevention or delay of surgery
8. Improvement in quality of life
9. Cost efficiency (no other substances necessary)
10. Can be combined with other methods such as laser therapy
Indications of PRP applications:

- Wound healing
- Tendinopathies
- Fractures
- Bone regeneration
- Osteoarthritis
- Spinal syndromes
- Skin rejuvenation
- Hair loss
# PRP without Laserstimulation

<table>
<thead>
<tr>
<th>Indication</th>
<th>Pain before therapy (VAS)</th>
<th>Pain after therapy (VAS)</th>
<th>Positive Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder (n=11)</td>
<td>67,5</td>
<td>27,5</td>
<td>59,26</td>
</tr>
<tr>
<td>Spine (n=5)</td>
<td>60,0</td>
<td>22,0</td>
<td>63,33</td>
</tr>
<tr>
<td>Thumb (n=10)</td>
<td>64,5</td>
<td>21,0</td>
<td>67,44</td>
</tr>
<tr>
<td>Knee (n=22)</td>
<td>66,43</td>
<td>23,67</td>
<td>64,37</td>
</tr>
<tr>
<td>Toe (n=2)</td>
<td>67,5</td>
<td>22,50</td>
<td>66,67</td>
</tr>
<tr>
<td>Total</td>
<td>65,9</td>
<td>22,18</td>
<td>66,34</td>
</tr>
</tbody>
</table>

Fig. 17: Results for body’s own serum therapy
### PRP with Laserstimulation

<table>
<thead>
<tr>
<th>Indication</th>
<th>Pain before therapy (VAS)</th>
<th>Pain after therapy (VAS)</th>
<th>Positive Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder (n= 6)</td>
<td>80,0</td>
<td>18,4</td>
<td>77,0</td>
</tr>
<tr>
<td>Spine (n = 2)</td>
<td>68,5</td>
<td>10,0</td>
<td>85,4</td>
</tr>
<tr>
<td>Thumb (n= 1)</td>
<td>20,0</td>
<td>0,0</td>
<td>100,0</td>
</tr>
<tr>
<td>Knee (n= 22)</td>
<td>65,6</td>
<td>21,7</td>
<td>66,92</td>
</tr>
<tr>
<td>Achilles tendon (n=3)</td>
<td>55,0</td>
<td>1,7</td>
<td>96,91</td>
</tr>
<tr>
<td>Heel spur (n=2)</td>
<td>81,0</td>
<td>10,0</td>
<td>87,65</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61,68</strong></td>
<td><strong>10,3</strong></td>
<td><strong>83,30</strong></td>
</tr>
</tbody>
</table>

*Fig. 18: Results for combination therapy of body's own serum and laser therapy*
STEM CELLS

- Embryonic vs Adult Stem Cells

Adult Stem Cells are more Ethical
Adipose derived stem cells and low intensity laser irradiation

5-10 J/cm² @ 630-660nm

APPLICATION OF LILI TO STIMULATE ADSC PROLIFERATION AND VIABILITY

ADDITION OF GROWTH FACTORS TO INDUCE DIFFERENTIATION & APPLICATION OF LILI TO STIMULATE DIFFERENTIATION AND PROLIFERATION

NEURONS

CARDIAC MUSCLE

SKELETAL MUSCLE

SMOOTH MUSCLE

SKIN CELLS: KERATINOCYTES

UNIVERSITY OF JOHANNESBURG
PHOTO ACTIVATION of stem cells

Laser irradiation can positively affect human stem cells by increasing cellular viability, proliferation and differentiation.
ADIPOSE STEM CELLS (ADSC)

Capabilities of Adipose Stem Cells

Adipose-Derived Mesenchymal Stem Cells

- Endothelium
- Adipose
- Muscle
- Bone
- Myocardium
- Liver
- Pancreas
- Neuron
- Cartilage
Stem cells for Osteoarthritis
Stem cells for Osteoarthritis
Stem cells for skin rejuvenation
Stem cells for brain
Stem cells for brain
Stem cells for COPD

Chronic Obstructive Pulmonary Disease (COPD)

Chronic Bronchitis
- Healthy
- Inflammation & excess mucus

Emphysema
- Healthy
- Alveolar membranes break down
Stem cells for diabetes
Stem cells ED
Stem cells for heart failure
Lasers stimulate stem cells for heart repair (Prof. Uri Oron, Tel Aviv) (WALT-Laserconference, Washington DC, September 2014)

- A simple new process significantly reduces heart scarring after an ischemic event.
- Discovered by professor Uri Oron at Tel Aviv University, the method, called shining, consists of applying low-level laser energy to living bone marrow stem cells a few hours after a heart attack.
- This procedure reduces scarring by up to 80 percent.
Lasers stimulate stem cells for heart repair

(Uri Oron, Tel Aviv)
Lasers stimulate stem cells for kidney repair
(Uri Oron, Tel Aviv)

**Induction of Autologous Bone-Marrow Stem Cells by Low-Level Laser Therapy Has Beneficial Effects on the Kidneys Post-Ischemia-Reperfusion Injury in the Rat**

Hana Tuby, Idiya Malco, Uri Oron

Department of Zoology, the George S. Wise Faculty of Life Sciences, Tel Aviv University, Tel-Aviv, Israel.

Email: haviv@tamu.edu

Received 7 April 2014; revised 21 May 2014; accepted 1 June 2014

Figure 1. Representative light microscope micrographs of renal tissue in intact (a) laser-treated (b, c, d, e) and non laser-treated to the bone marrow (c, d) rats, 14 days post-30 min ischemia injury and reperfusion. Note a marked dilatation (arrows) of the renal tubules and necrotic areas with infiltration of mononucleated cells in control microscopic slides as compared to a minor dilatation of the renal tubules in the laser-treated groups.
Lasers stimulate stem cells for kidney repair

(Uri Oron, Tel Aviv)

Figure 2. Effect of LLLT application to the bone marrow on the histopathological features of the kidney as reflected in the arbitrary score in non laser (open column) and laser-treated (solid column) rats. Results from 2-3-month-old rats that underwent 15 and 30 min IRI are presented in (a) & (b) respectively. Results from 7-month-old rats are presented as (c). **p < 0.01.
Fat is a "High Density" Source of Stem Cells

<table>
<thead>
<tr>
<th>Tissue/Source of SCs</th>
<th>Stem Cell Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone marrow</td>
<td>1 out of 100,000 cells</td>
</tr>
<tr>
<td>Adipose tissue</td>
<td>1 out of 100 cells</td>
</tr>
</tbody>
</table>

* In old age
Comparison of the amount of stem cells in fat and bone marrow (1000:1)
Adipose derived mesenchymal stem cells
Liposuction
Small incision
Infiltration cannula
Tuminescense solution

<table>
<thead>
<tr>
<th>Wirkstoff</th>
<th>Wirkstoffmenge</th>
<th>Handelspräparat*</th>
<th>Menge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prilocain (nach Klein: Lidocain)</td>
<td>500 mg</td>
<td>Xylonest 1% (nach Klein: Xylocain 1%)</td>
<td>50 ml</td>
</tr>
<tr>
<td>Epinephrin</td>
<td>1 mg</td>
<td>Suprarenin 1:1 000</td>
<td>1 Ampulle = 1 ml</td>
</tr>
<tr>
<td>Natriumhydrogencarbonat</td>
<td>500 mg</td>
<td>Natriumhydrogencarbonat Fresenius 8,4%</td>
<td>6 ml</td>
</tr>
<tr>
<td>Natriumchlorid</td>
<td>9 000 mg</td>
<td>Isotone Kochsalzlösung Braun</td>
<td>1 000 ml</td>
</tr>
</tbody>
</table>

Es ergibt sich eine Konzentration des Lokalanästhetikums von 0,049 % LA.

* Beispiel
Infiltration, 150 – 200 ml
Liposuction with harvesting cannula
2 phases, fat on top
Processing of fat and stem cells

- Indirect sonication
- Centrifugation
- Separation of fat
- Filtration
- Washing
- Freezing (stem cell banking)
Laminar Flow
Ultrasonic system
Counting of viable stem cells (Flow cytometry)
Stem cells can be used for:

- intrarticular injection
- interstitial injection
- intravenousous infusion

followed by laser irradiation
with all spectral colors
Before and 1 year after stem cell therapy
Before and 1 year after stem cell therapy

Post cell therapy at 12 months improvement of 0.3 mm at posterior condyle
Ultrasound shock waves for targeting of stem cells
Low-Level Laser Stimulation on Adipose-Tissue-Derived Stem Cell Treatments for Focal Cerebral Ischemia in Rats

Chiung-Chyi Shen,1,2,3,4 Yi-Chin Yang,1 Ming-Tsang Chiao,1 Shiuh-Chuan Chan,5 and Bai-Shuan Liu6

1Department of Neurosurgery, Taichung Veterans General Hospital, Taichung 40705, Taiwan
Differentiation in neuronal cells
Intravenous mesenchymal stem cell therapy early after reperfused acute myocardial infarction improves left ventricular function and alters electrophysiologic properties

IV Laser Blood Irradiation

Dr. Michael H. Weber
IV Lasertreatment with
Red and green laser
Iv-laser treatment with blue and yellow laser
Y-needle with 3 luer-lock for iv-Laser with simultaneous infusion
Effects of intravenous laser light irradiation

**Red laser**
Stimulation of the immune system, improvement of blood viscosity

**Green laser**
Increased oxygen supply

**Blue laser:**
Increased NO, bactericidal effects

**Yellow laser:**
antidepressive effects and more?

All colors stimulate the respiratory chain in the mitochondria with increased ATP production.
Cosmetic laser medicine with Micro-fatgrafting

- Fat preparation by small liposuction
- Separation from tuminscence solution
- Injection of fat below wrinkles for filling (Microfatgrafting)
- Laser stimulation
Skin aging
fat micro grafting

3,000 rpm / 1,200G
for 2 mn
autologous fat micro grafting
autologous fat micro grafting
Total: 16.5 cc
Cosmetic laser medicine
Nano-Fatgrafting

- Small liposuction
- Separation from tuminesense solution
- Emulsification of the fat
- Injectionen intracutanously with 27 G needle
- Enriched with stem cells
- Laser stimulation
Emulsification process
Special filter system

Top
Single-Use O-Ring
Single-Use Cartridge
Base
autologous fat micro grafting
Thank you for your attention