laser assisted endo ...
new aspects of a classic protocol ...
ablution

surgery

operative dentistry

estetic & cosmetic dentistry

LLLT

laser assisted perio

laser assisted endo

decontamination
ablation

surgery

esthetic & cosmetic dentistry

LLLT

operative dentistry

laser assisted endo

decontamination

laser assisted perio
endodontics

periodontology
„laser assisted“

endodontics

periodontontology

partial shift from chemistry to biology !!
Evidence Based Dentistry
Evidence based dentistry is “an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient’s oral and medical condition and history, with the dentist’s clinical expertise and the patient’s treatment needs and preferences.” v. ADA
Evidence Based Dentistry

Decisions should be based on the best made evidence!!
Proceedings of the 1st International Workshop of Evidence Based Dentistry on Lasers in Dentistry

Editor: Norbert Gutknecht

Section Editors:
- Christian Apel
- Paul Bradley
- Carlos de Paula Eduardo
- John Featherstone
- Matthias Frentzen
- Isao Ishikawa
- Friedrich Lampert
- Jörg Meister
- Samir Nammour
- Lynn Powell
- Jean-Paul Rocca
- George Romano
- Anton Sculean
- Adam Stabholz
- Carmen Toleda
- Jan Tunér

Co-Editors:
- Marcella Esteves-Oliveira
- René Franzen
- Uta Hessbrüggen
- Maziar Mir
- Leon Vanweersch
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In February 2006, the 1st International Workshop of Evidence Based Dentistry on Lasers in Dentistry was held at the Hotel Castle Bloemendal, Veld, the Netherlands. The purpose of this workshop was to discuss the basic aspects of Laser Dentistry as well as the clinical practice of Laser Dentistry. The latter should, of course, be based on sound scientific evidence. The proceedings of this workshop cover the literature reviews, the reports of the working sessions and the consensus statements made for each session at the end of the workshop.

The sessions covered the following topics:

<table>
<thead>
<tr>
<th>Basic Science</th>
<th>Session I</th>
<th>Basic Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session II</td>
<td>Diagnosis</td>
<td></td>
</tr>
<tr>
<td>Session III</td>
<td>Prevention</td>
<td></td>
</tr>
<tr>
<td>Session IV</td>
<td>Hard Tissue, Cavity Preparation and Caries Removal</td>
<td></td>
</tr>
<tr>
<td>Session V</td>
<td>Endodontics</td>
<td></td>
</tr>
<tr>
<td>Session VI</td>
<td>Periodontics</td>
<td></td>
</tr>
<tr>
<td>Session VII</td>
<td>Oral Surgery and Implantology</td>
<td></td>
</tr>
<tr>
<td>Session VIII</td>
<td>Laser Phototherap</td>
<td></td>
</tr>
<tr>
<td>Session IX</td>
<td>Pediatric Dentistry</td>
<td></td>
</tr>
<tr>
<td>Session X</td>
<td>Prosthodontics and Esthetics</td>
<td></td>
</tr>
</tbody>
</table>

Harmonization

Session overview

Session II

Study Design Issues

Session XIII

Glossary of Terms

www.quintpub.co.uk
What wavelength for which indication?

ENDODONTICS - Germ reduction
1. Pulsed Nd:YAG laser
2. Diode laser 910 nm
3. Diode laser 980 nm
4. Erbium:YAG, Er,Cr:YSGG are used for removing smear layers and organic tissue.

PERIODONTOLOGY -
Closed curettage
1. Pulsed Nd:YAG laser 1064 nm
2. Diode laser 810 nm
3. Diode laser 980 nm
4. Er:YAG laser with special PA tip

PERIODONTOLOGY -
Open curettage
1. Erbium:YAG laser
2. CO₂ laser
3. Er,Cr:YSGG laser

SOFT-TISSUE SURGERY -
Tromentomy
1. Er:YAG laser with long pulses
2. Er,Cr:YSGG laser
3. Er:YAG laser with normal pulse width and only in conjunction with special surgical tip

Or:
1. Diode laser 810 nm
2. Nd:YAG laser (conditionally)
3. Diode laser 980 nm (conditionally)

HARD-TISSUE SURGERY -
Apicoectomy
1. Er:YAG laser with long pulses
2. Er,Cr:YSGG laser

IMPLANT DENTISTRY -
Uncovering implants
1. Erbium:YAG laser with variable pulse width and/or surgical tip
2. CO₂ laser
3. Diode laser

IMPLANT DENTISTRY -
Periimplantitis (closed)
1. Diode laser 810 nm
2. Diode laser 980 nm
3. Nd:YAG laser with a fiberguide system or Er:YAG laser with special PA tip

IMPLANT DENTISTRY -
Periimplantitis (open)
1. Er:YAG laser with very short pulses
2. Er,Cr:YSGG laser
3. CO₂ laser (limited)
Endodontics

Germ reduction & „Smear Layer“ removal
Endodontics

Germ reduction & „Smear Layer“ removal
Endodontics
Germ reduction
& „Smear Layer“ removal

Nd:YAG
Diode 810
Diode 980
Er:YAG

What wavelength for which indication?

ENDODONTICS - Germ reduction
1. Pulsed Nd:YAG laser
2. Diode laser 810 nm
3. Diode laser 980 nm
Erbium:YAG, Er,Cr:YSGG are used for moving smearlayers and organic tissue.

PERIODONTOLOGY - Closed curettage
laser assisted
endo
quo vadis?
bacterial infiltration → 1\,100\mu m !!

\begin{itemize}
  \item **Nd:YAG**: ca. 96%
  \item **Diode 810**: ca. 65%
  \item **Diode 980**: ca. 35%
  \item **Er:YAG**: 400\mu m
  \item *chem. standard rinsings*: 100\mu m
\end{itemize}
**bacterial decontamination ➔ 100µm !!**

<table>
<thead>
<tr>
<th>Laser Type</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nd:YAG</td>
<td>ca. 96%</td>
</tr>
<tr>
<td>Diode 810</td>
<td>ca. 65%</td>
</tr>
<tr>
<td>Diode 980</td>
<td>ca. 35%</td>
</tr>
<tr>
<td>Er:YAG</td>
<td>400µm</td>
</tr>
</tbody>
</table>

*chem. Standardspülungen 100µm*
bacterial infiltration \( \Rightarrow \) 1\,100\,\mu m !!
bacterial infiltration \( \rightarrow 1'100 \mu m \)
bacterial infiltration $\rightarrow$ l‘100μm !!

access to pulp

decontamination biomech. steps
Smear Layer removal

( Prof. N. Gutknecht ; J. Meister AALZ )
Endodontic Principles to Successful Treatment

Two goals to achieve success:

A. **Cleanse and shape** the canal to remove and neutralize bacteria and their byproducts.

B. **Obturate** the canal to prevent re-infection and perhaps "entomb" those bacteria that could not be removed.
Histological Studies of the Root Apex

A. Great deal of variation exists in how and where the canal terminates

B. The only true way to determine canal terminus is to remove the tooth and examine it microscopically.

This is the reality to which clinicians must accommodate their techniques !!
complexe micro-anatomical structure
complexe micro-anatomical structure
**Table 3.** Number and percentage of lateral canals and apical deltas

<table>
<thead>
<tr>
<th></th>
<th>No. of roots</th>
<th>No. of canals</th>
<th>Lateral canals</th>
<th>Apical deltas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central incisors</td>
<td>71</td>
<td>74</td>
<td>24 (32.4)</td>
<td>9 (12.2)</td>
</tr>
<tr>
<td>Lateral incisors</td>
<td>70</td>
<td>72</td>
<td>32 (44.4)</td>
<td>28 (38.9)</td>
</tr>
<tr>
<td>Canines</td>
<td>65</td>
<td>80</td>
<td>30 (37.5)</td>
<td>45 (56.3)</td>
</tr>
<tr>
<td>First premolars</td>
<td>95</td>
<td>178</td>
<td>92 (51.7)</td>
<td>52 (29.2)</td>
</tr>
<tr>
<td>Second premolars</td>
<td>65</td>
<td>112</td>
<td>77 (68.8)</td>
<td>49 (43.8)</td>
</tr>
<tr>
<td>MBR of first molars</td>
<td>45</td>
<td>53</td>
<td>19 (35.8)</td>
<td>31 (58.5)</td>
</tr>
<tr>
<td>DBR of first molars</td>
<td>45</td>
<td>48</td>
<td>9 (18.8)</td>
<td>29 (60.4)</td>
</tr>
<tr>
<td>PR of first molars</td>
<td>45</td>
<td>45</td>
<td>10 (22.2)</td>
<td>6 (13.3)</td>
</tr>
<tr>
<td>MBR of second molars</td>
<td>50</td>
<td>57</td>
<td>20 (35.1)</td>
<td>29 (50.9)</td>
</tr>
<tr>
<td>DBR of second molars</td>
<td>50</td>
<td>51</td>
<td>7 (13.7)</td>
<td>20 (39.2)</td>
</tr>
<tr>
<td>PR of second molars</td>
<td>50</td>
<td>50</td>
<td>15 (30.0)</td>
<td>30 (60.0)</td>
</tr>
<tr>
<td>MBR of third molars</td>
<td>24</td>
<td>31</td>
<td>13 (41.9)</td>
<td>25 (80.6)</td>
</tr>
<tr>
<td>DBR of third molars</td>
<td>24</td>
<td>24</td>
<td>9 (37.5)</td>
<td>20 (83.3)</td>
</tr>
<tr>
<td>PR of third molars</td>
<td>24</td>
<td>24</td>
<td>6 (25.0)</td>
<td>4 (16.7)</td>
</tr>
<tr>
<td>FR of third molars</td>
<td>19</td>
<td>28</td>
<td>17 (60.7)</td>
<td>10 (35.7)</td>
</tr>
</tbody>
</table>

MBR, mesiobuccal root; DBR, distobuccal root; PR, palatal root; FR, fused root.
Clinical Standpoint

A. Radiographs
B. Apex locators

- Current accuracy of apex locators are listed at 95%
- Variation between these two can be as much as 0.2 mm to 3.8mm

There is no current clinical method to determine the precise location of the foramen with 100% certainty.

⇒ the only clinical way to assure long term endodontic success is to incorporate a cleansing methodology that logically, efficiently and successfully debrides and renders inactive any bio-organisms within the canal system.

LASER ASSISTED DENTISTRY brings new level of efficacy to endodontics
Well lased dentin in the middle third of the canal. Good clean ablation with the classic slightly flakey appearance lased dentin. Adequate water/liquid present to maintain hydration of the ablating surface.
Original Laser Endo w. Er:YAG

- end firing tips
- careful technique
- 3 potential problems:

1. Ledging
2. Transportation
3. Apical perforation
TwinLight laser assisted endodontics
TwinLight Endodontic Treatment
TwinLight Endodontic Treatment

chemo-mech. standard prep

bactericidal effect of rinsings is modest & by high surface tension ...
... mechanical prep of lat. tubuli et al. & complete smear layer removal not guaranted

laser assisted endo - prep

not anymore one wavelength involved ...
**TwinLight Endodontic Treatment**

laser assisted endo - prep

not anymore one wavelength involved ...

- excellent *combination*
  of *2 complementary* crystalline laser sources

**Nd:YAG & Er:YAG**
TwinLight Endodontic Treatment

laser assisted endo - prep

not anymore one wavelength involved ...
TwinLight Endodontic Treatment

Nd:YAG @ 1‘064nm & Er:YAG @ 2‘940nm

gold standard
most efficient wavelength for decontamination
thermal pulsing disinfection in the bacteria's immediate microenvironment till 1‘000 µm lateral penetration

gold standard
extremely high absorption in water & chem. rinsings cleansing mechanical photo-acoustic effect inside the root canal system: complete absorption into the rinsing shockwaves inside the solution complete mechanical cleaning & debriding
3 steps

TwinLight Endodontic Treatment

step 1

Er:YAG @ 2'940nm

step 2

Er:YAG @ 2'940nm

step 3

Nd:YAG @ 1'064nm
3 steps
TwinLight Endodontic Treatment

**Er:YAG @ 2'940nm**
selective & pressure-free removal of hard tissue with free access to the pulp & reduced bact. spread into deeper layers and into the body system

**Nd:YAG @ 1'064nm**
as endo gold standard
THE deep decontamination @ 1.5W; 15 Hz by 200 µm & 1'000 µm lateral penetration

**Er:YAG @ 2'940nm**
photo-acoustic cleaning & debriding of the root canal system
Preciso & NaCl @ 20-65mJ; 15-25Hz
PIPS & EDTA @ 10-20mJ; 10-50 Hz
3 steps

TwinLight Endodontic Treatment

Er:YAG @ 2‘940nm

Nd:YAG @ 1‘064nm
3 steps

*TwinLight Endodontic Treatment*

Er:YAG @ 2,940nm

Nd:YAG @ 1,064nm

... & biomodulation of the immune system & biostimulation of the fibroblasts!!
3 steps
TwinLight Endodontic Treatment

Er:YAG @ 2'940nm

Nd:YAG @ 1'064nm
3 steps
TwinLight Endodontic Treatment

Er:YAG
access & first decontamination

Er:YAG
photomech.debridement

Nd:YAG
final decontamination
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Er:YAG access &amp; first decontamination</td>
</tr>
<tr>
<td>2nd</td>
<td>Er:YAG photomech.debridement</td>
</tr>
<tr>
<td>3rd</td>
<td>200µm / ca. 2mm per 1&quot; final decontamination</td>
</tr>
</tbody>
</table>
final decontamination
courtesy of Dr. Thorsten Wegner
3 Schritte
TwinLight Endodontic Treatment
Er:YAG @ 2‘940nm
Nd:YAG @ 1‘064nm
LAI

„ Laser Activated Irrigation “
3 steps

TwinLight Endodontic Treatment

Er:YAG
access & first decontamination

Er:YAG
photomech debridement

Nd:YAG
final decontamination
Laser Activated Irrigation with Er:YAG

removal of smear layer, exposition of the tubuli & primary decontamination till approx. 400µm & biostimulation (Fibroblasts)
complex emergency
first session

photodebriding
&
photodecontamination
complex emergency
... follow up
complex emergency

... follow up
Er:YAG fiber tips
Er:YAG fiber tips
PIPS
Enrico DiVito & Mark Colonna, Arizona Center for Laser Dentistry

Procedure:

- a. pulp & root opening w. Er:YAG
- b. root prep
- c. PIPS in action & EDTA 15%
- d. rinsing & drying
Photon Induced Photoacoustic Streaming
Enrico DiVito & Mark Colonna, Arizona Center for Laser Dentistry

Procedure:

a. pulp & root opening w. Er:YAG
b. root prep
c. PIPS in action & EDTA 15%
d. rinsing & drying
e. final decontamination w. Nd:YAG
PIPS
Enrico DiVito & Mark Colonna

Procedure:

a. pulp & root opening w. Er:YAG
b. root prep
c. PIPS in action & EDTA 15%-17%
d. rinsing & drying
c. Nd:YAG Dekontamination
PIPS in office

chemodebriding
Laser assisted endo w. Er:YAG
15Hz, 20mJ, 50µs, no W/L for Fidelis AT
12-15Hz, 40mJ, 100µs, no W/L for Fidelis III plus

✔ access by office protocol / Er:YAG

✔ Measurement of the working length via apex locator & File .06, .08 or .010mm & EDTA Gel
Laser assisted endo w. Er:YAG
15Hz, 20mJ, 50µs, no W/L for Fidelis AT
12-15Hz, 40mJ, 100µs, no W/L for Fidelis III plus

✔ access by office protocol / Er:YAG

✔ Measurement of the working length via apex locator & File .06, .08 or .010mm & EDTA Gel

✔ PIPS Protocol:

- rinsing w. NaCl & File #10
- PIPS & NaCl/EDTA 20"
- rinsing w. NaCl & File #15
- PIPS & NaCl/EDTA 20"
... till file #25, following crown down :-)
Laser assisted endo w. Er:YAG

15Hz, 20mj, 50µs, no W/L for Fidelis AT
12-15Hz, 40mj, 100µs, no W/L for Fidelis III plus

✔ access by office protocol / Er:YAG

✔ Measurement of the working length via apex locator & File .06, .08 or .010mm & EDTA Gel

✔ PIPS Protocol

- rinsing w. NaCl & File #10
- PIPS & NaCl/EDTA 20" 
- rinsing w. NaCl & File #15
- PIPS & NaCl/EDTA 20"

... till file #25, following crown down :-)

✔ EDTA rinsing till covering the coronal part, irradiation with PIPS20" @ 15Hz, 20mj, 50µs without w/a

✔ after EDTA, rinsing w. NaCl @ same settings
3-4x min. till the liquid appears clear

✔ root canal filling by office protocol
Laser Assisted Endo mit Er:YAG
15Hz, 20mJ, 50µs, ohne W/L
Laser Assisted Endo mit Er:YAG

15Hz, 20mJ, 50µs, ohne W/L

corso endo/pips
Prof. Giovanni Olivi
Roma, 1 aprile 2011
PIPS

(Enrico DiVito & Mark Colonna, Arizona Center for Laser Dentistry)

Procedure:

a. pulp & root opening w. Er:YAG
b. root prep
c. PIPS in action & EDTA 15%
d. rinsing & drying
e. final decontamination w. Nd:YAG
PIPS in office

chemodebriding
PIPS in office

chemodebriding
PIPS in office

chemodebriding
&
photo-decontamination
Photo Thermal Ablation Protocol
**PIPS** cleans effectively and debrides without thermal effect.
TwinLight™ laser-assisted endodontics

Author: Dr. Kaspari Binunius, Switzerland

Fig. 1. Absorption coefficients in human tissue, in a solution of human serum, and in the laser wavelength (532 nm) of the TwinLight™ laser. The treatment involves a combination of the Nd:YAG and the Er:YAG lasers. The treatment is minimally invasive and can be performed under local anesthesia.

Fig. 2. The TwinLight™ laser-assisted endodontics treatment involves the use of two laser wavelengths: the Nd:YAG (1,064 nm) and the Er:YAG (2,940 nm) lasers. The Nd:YAG laser is used for initial preparation, while the Er:YAG laser is used for further refinement.

Fig. 3. The TwinLight™ laser-assisted endodontics treatment involves the use of two laser wavelengths: the Nd:YAG (1,064 nm) and the Er:YAG (2,940 nm) lasers. The Nd:YAG laser is used for initial preparation, while the Er:YAG laser is used for further refinement.
... going even more out of the box ...
root decontamination after temporaries & sulcus troughing before definitive cementation of retentive elements on root caps integrated into hybrid removable prosthesis
root photodebridement & photodecontamination
sulcus troughing
before definitive cementation of a pin on tooth 15
reconstruction & recementation of the bridge as a short term solution
active fistula
from a periapical pathology 25 in the area buccala 26
Thank you for your attention!!