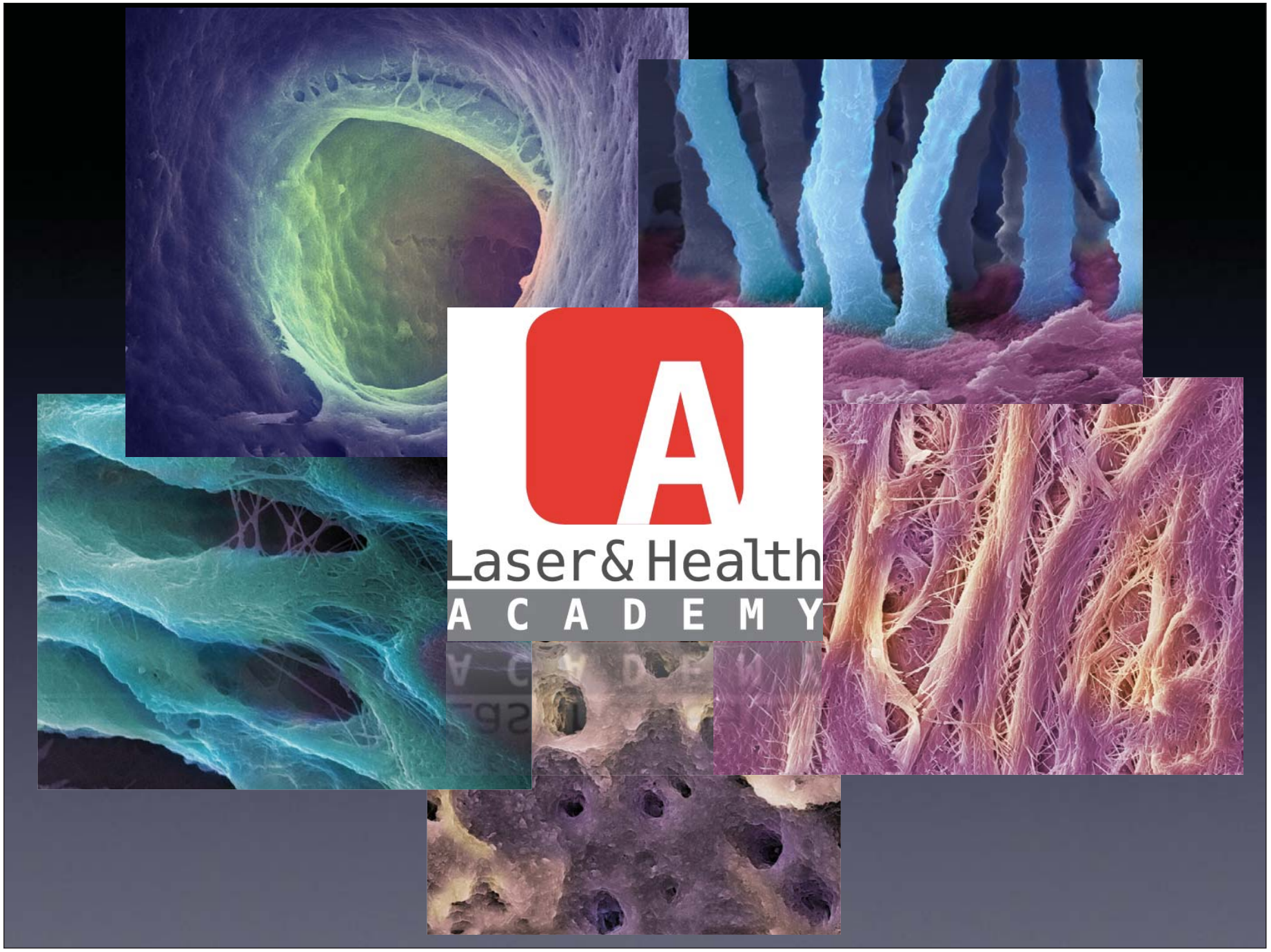
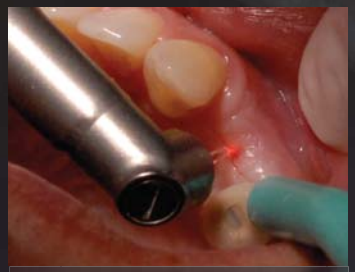
Dr. Kresimir Simunovic
CH - 8008 Zürich
www.simident.ch

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


Laser&Health
ACADEMY

ablation



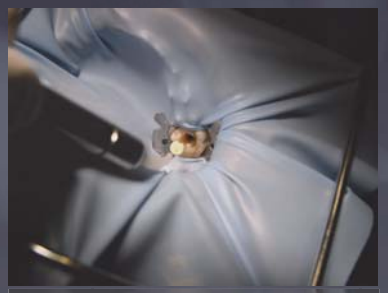
surgery

operative dentistry

estetic & cosmetic dentistry

LLLT

laser assisted perio



laser assisted endo

decontamination

ablation

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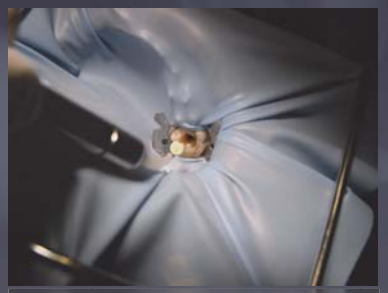
estetic & cosmetic dentistry

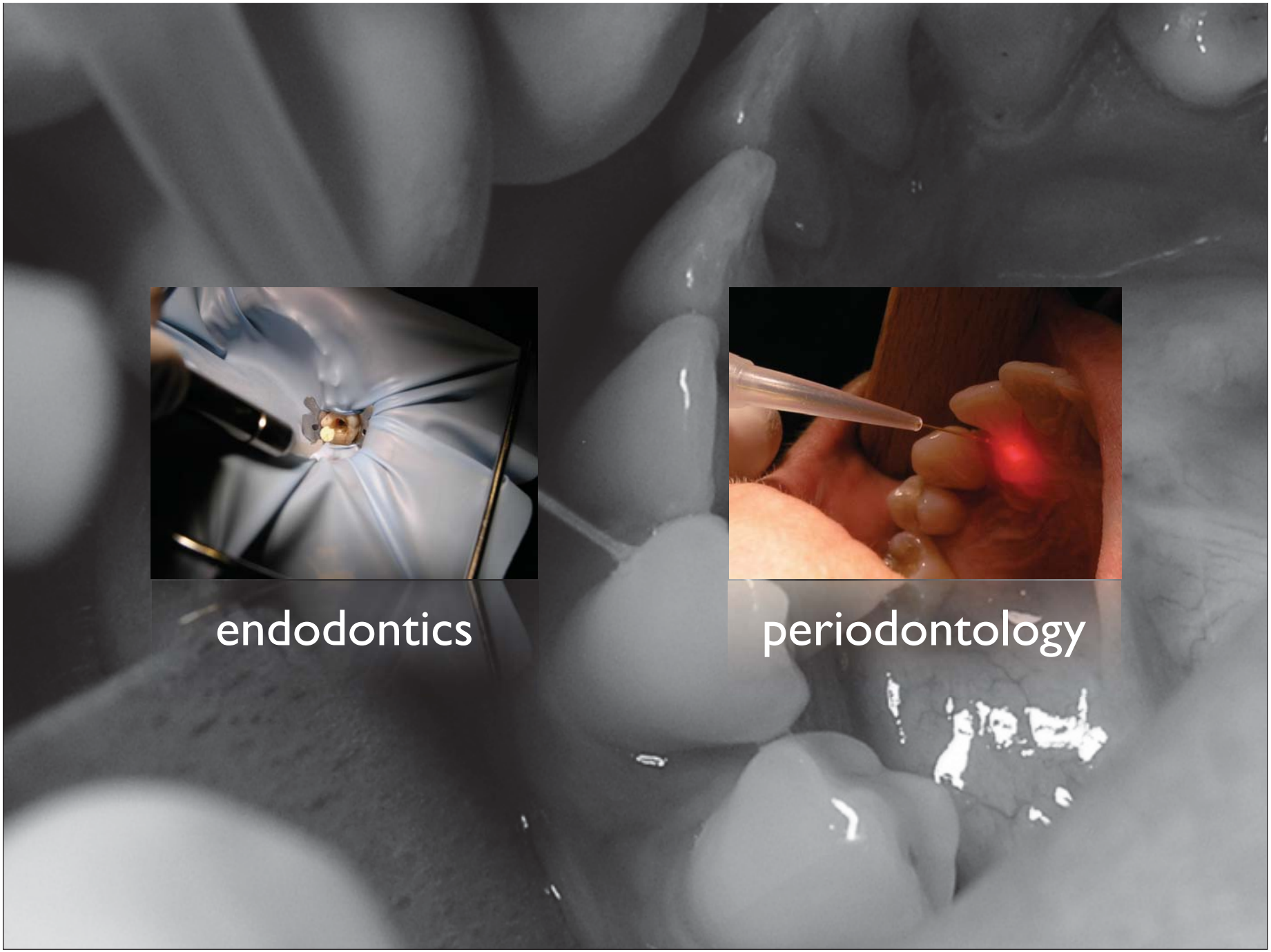
LLLT

laser assisted perio



laser assisted endo

decontamination


endodontics
periodontology

„laser assisted“

endodontics

periodontology

➠ *partial* **shift** from **chemistry** to **biology** !!

„multiwave concept“

EBD

„multiwave concept“

Evidence Based Dentistry

„multiwave concept“

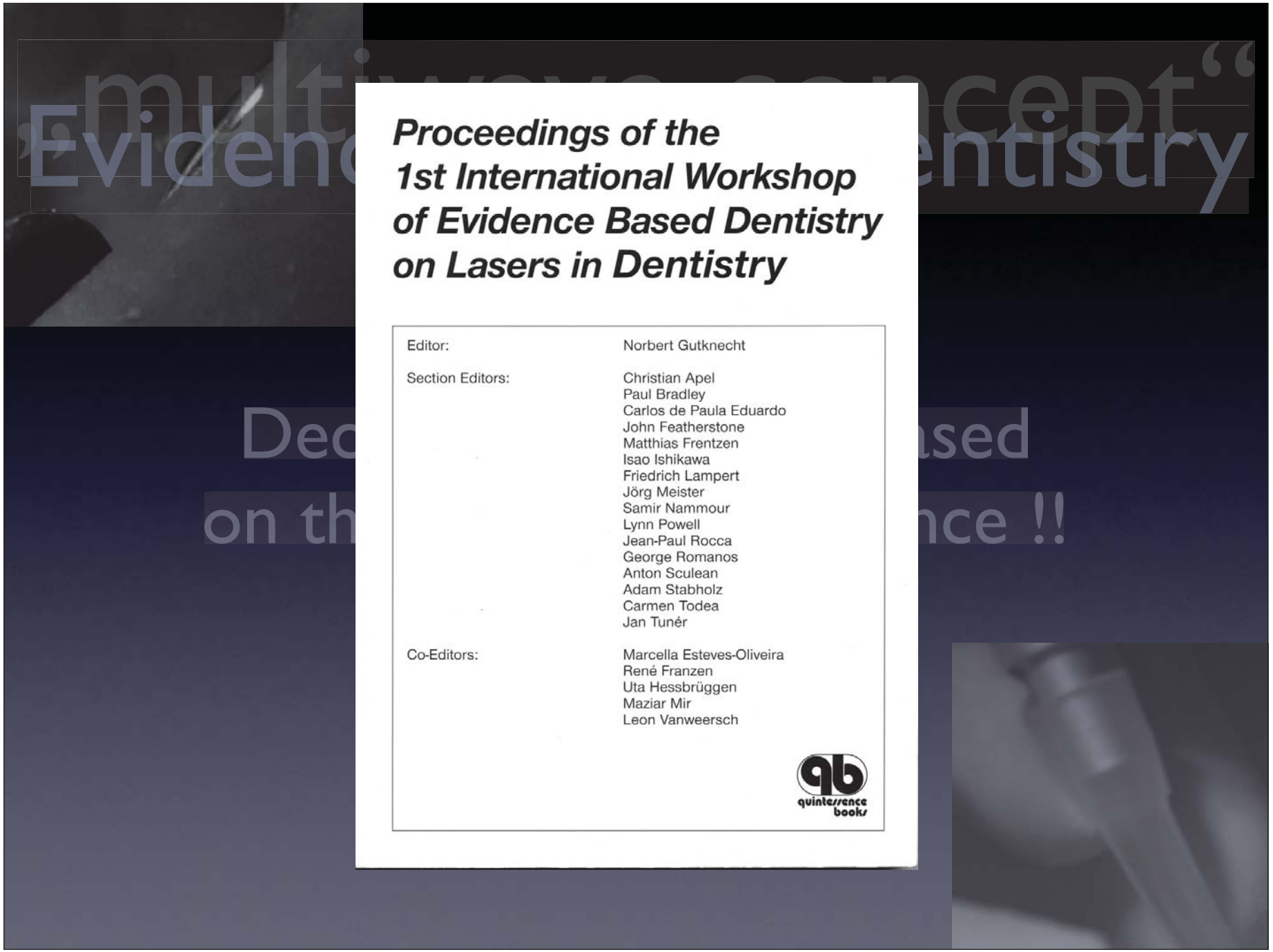
„Evidence Based Dentistry

Evidence based dentistry is

„ an approach to oral health care that requires the judicious integration of systematic assesments 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 !!



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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 Romanos Anton Sculean Adam Stabholz Carmen Todea Jan Tunér
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quintessence books

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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, Vaals, 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:

Basic Science	Session I	Basic Research
Application	Session II	Diagnostics
	Session III	Prevention
	Session IV	Hard Tissue, Cavity Preparation and Caries Removal
	Session V	Endodontics
	Session VI	Periodontics
	Session VII	Oral Surgery and Implantology
	Session VIII	Laser Phototherapy
	Session IX	Pediatric Dentistry
	Session X	Prosthodontics and Esthetics
Harmonization	Session XI	Session overview
	Session XII	Study Design Issues
	Session XIII	Glossary of Terms

ISBN: 978-1-85097-167-2

9 781850 971672

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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 removing smearlayers 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. CO_2 laser
3. Er,Cr:YSGG laser

IMPLANT DENTISTRY – Uncovering implants

1. Erbium:YAG laser with variable pulse width and/or surgical tip
2. CO_2 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. CO_2 laser (limited)

SOFT-TISSUE SURGERY – Frenectomy

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)

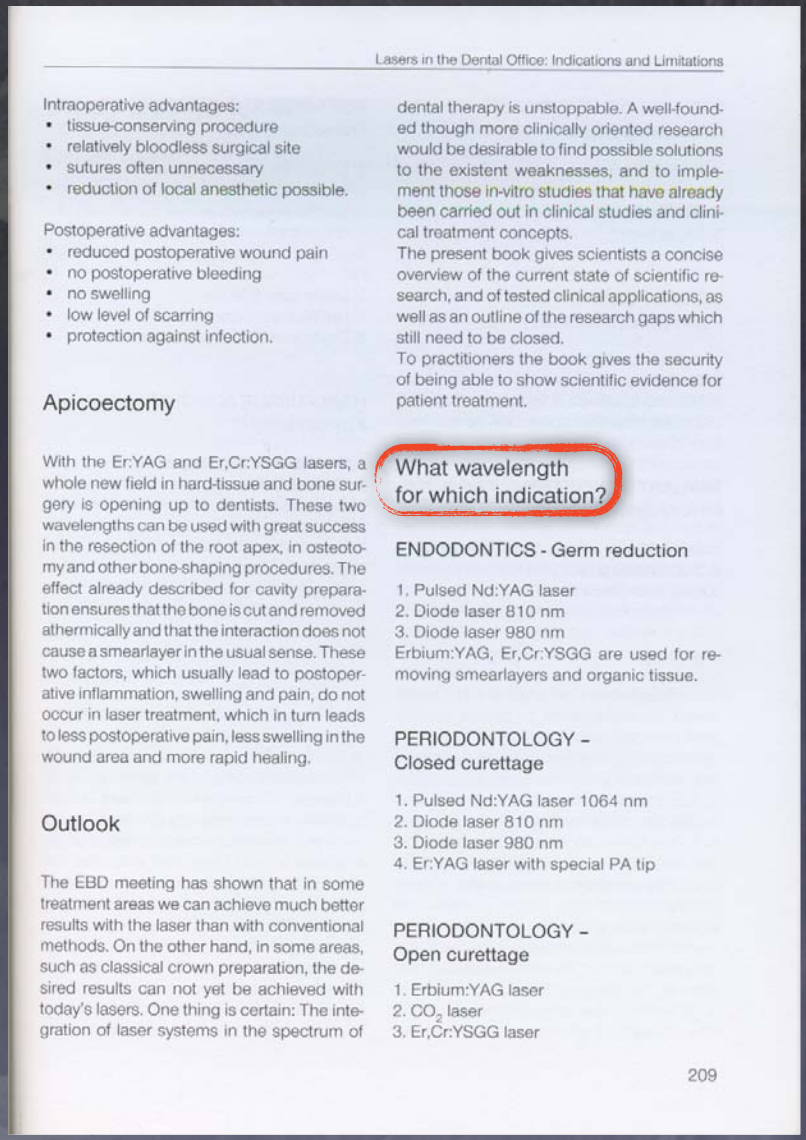
HARD-TISSUE SURGERY – Apicoectomy

1. Er:YAG laser with long pulses
2. Er,Cr:YSGG laser

Endodontics

Germ reduction

& „Smear Layer“ removal



Intraoperative advantages:
- tissue-conserving procedure
- relatively bloodless surgical site
- sutures often unnecessary
- reduction of local anesthetic possible.

Postoperative advantages:
- reduced postoperative wound pain
- no postoperative bleeding
- no swelling
- low level of scarring
- protection against infection.

Apicoectomy

With the Er:YAG and Er,Cr:YSGG lasers, a whole new field in hard-tissue and bone surgery is opening up to dentists. These two wavelengths can be used with great success in the resection of the root apex, in osteotomy and other bone-shaping procedures. The effect already described for cavity preparation ensures that the bone is cut and removed athermically and that the interaction does not cause a smearlayer in the usual sense. These two factors, which usually lead to postoperative inflammation, swelling and pain, do not occur in laser treatment, which in turn leads to less postoperative pain, less swelling in the wound area and more rapid healing.

Outlook

The EBD meeting has shown that in some treatment areas we can achieve much better results with the laser than with conventional methods. On the other hand, in some areas, such as classical crown preparation, the desired results can not yet be achieved with today's lasers. One thing is certain: The integration of laser systems in the spectrum of dental therapy is unstoppable. A well-founded though more clinically oriented research would be desirable to find possible solutions to the existent weaknesses, and to implement those in-vitro studies that have already been carried out in clinical studies and clinical treatment concepts.

The present book gives scientists a concise overview of the current state of scientific research, and of tested clinical applications, as well as an outline of the research gaps which still need to be closed.

To practitioners the book gives the security of being able to show scientific evidence for patient treatment.

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1. Erbium:YAG laser
2. CO_2 laser
3. Er,Cr:YSGG laser

Endodontics

Germ reduction

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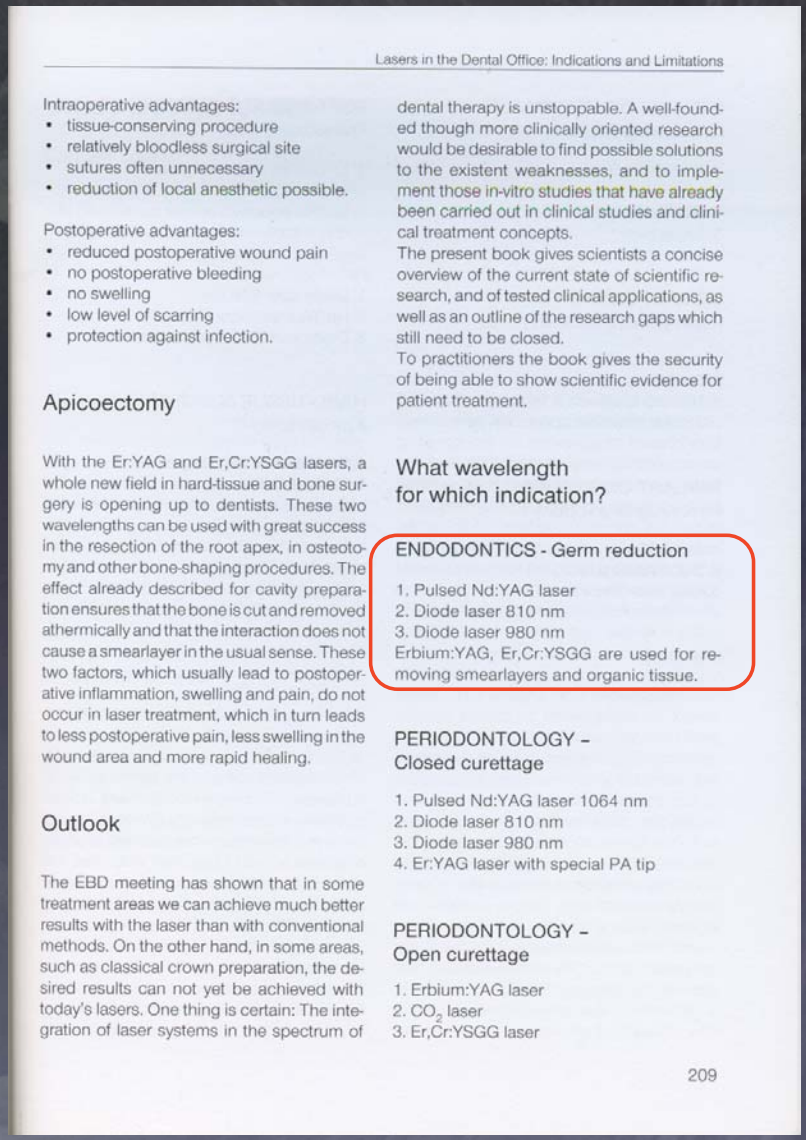

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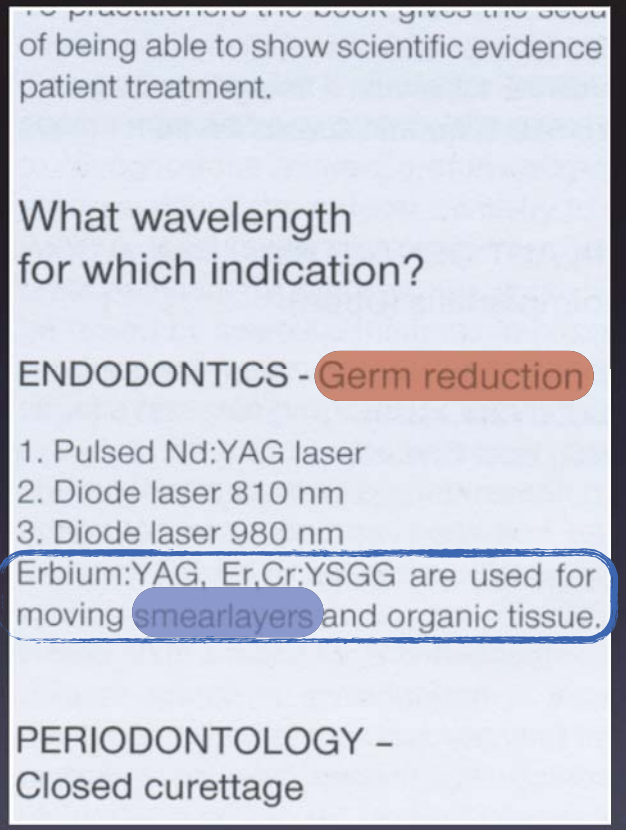
Endodontics

Germ reduction

& „Smear Layer“ removal

Nd:YAG
Diode 810
Diode 980
Er:YAG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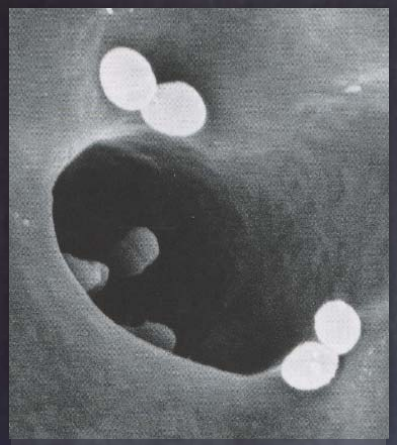
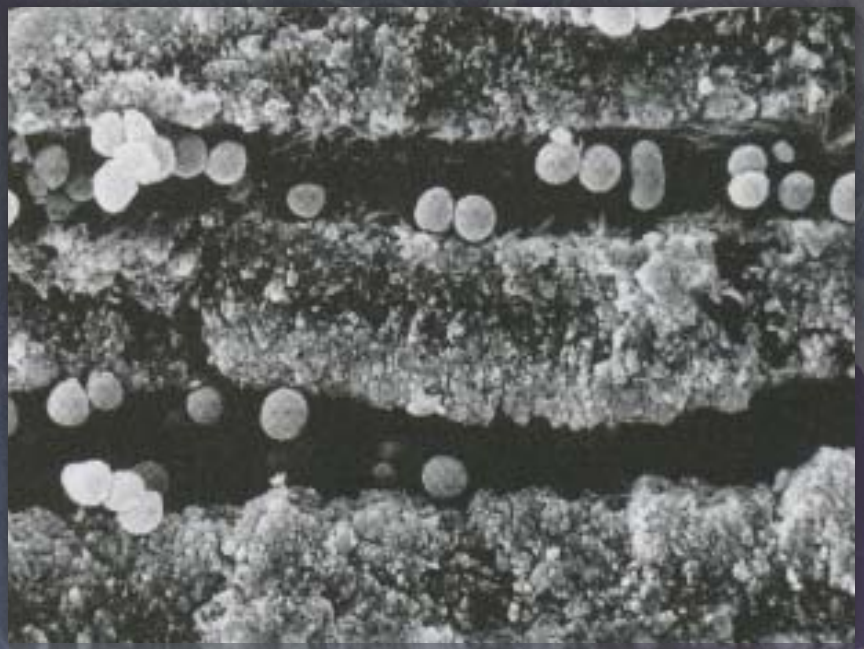
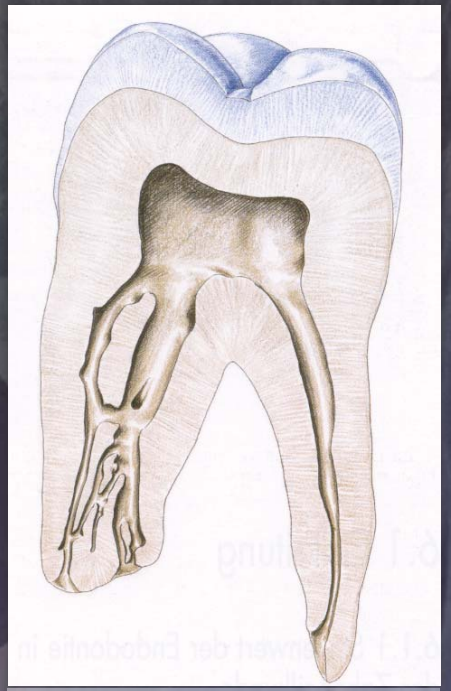
PERIODONTOLOGY –
Closed curettage


laser assisted
endo
quo vadis ?



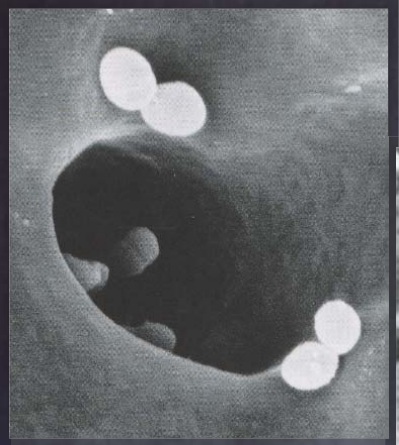
bacterial infiltration ➠ 1‘100µm !!

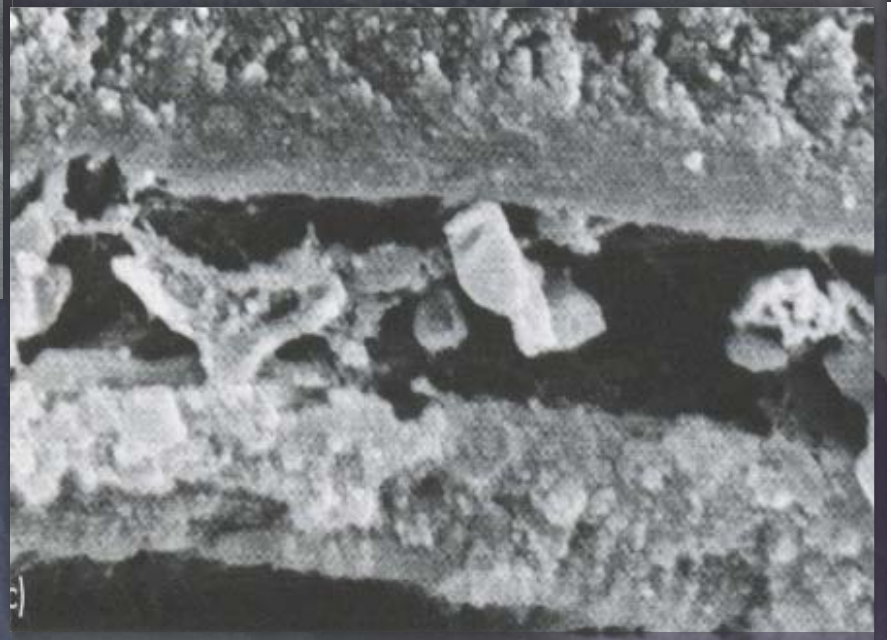


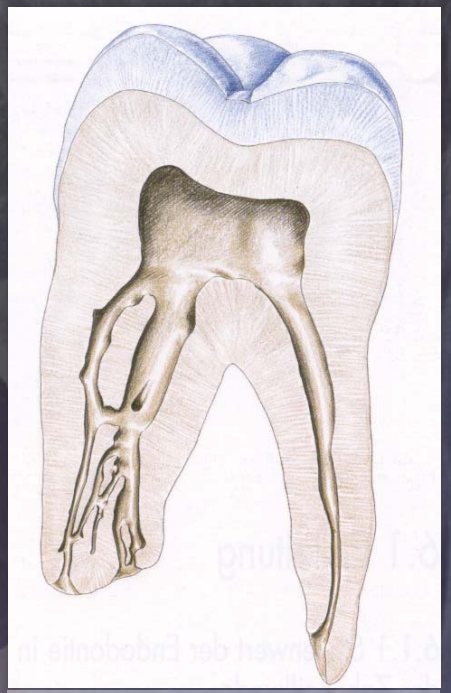


Nd:YAG	ca. 96%
Diode 810	ca. 65%
Diode 980	ca. 35%
Er:YAG	400µm
chem. standard rinsings	*100µm*

bacterial decontamination ➠ 1‘100µm !!







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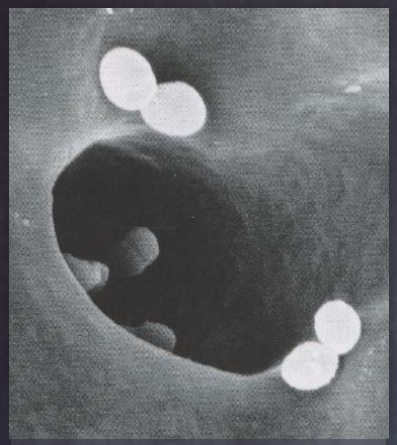
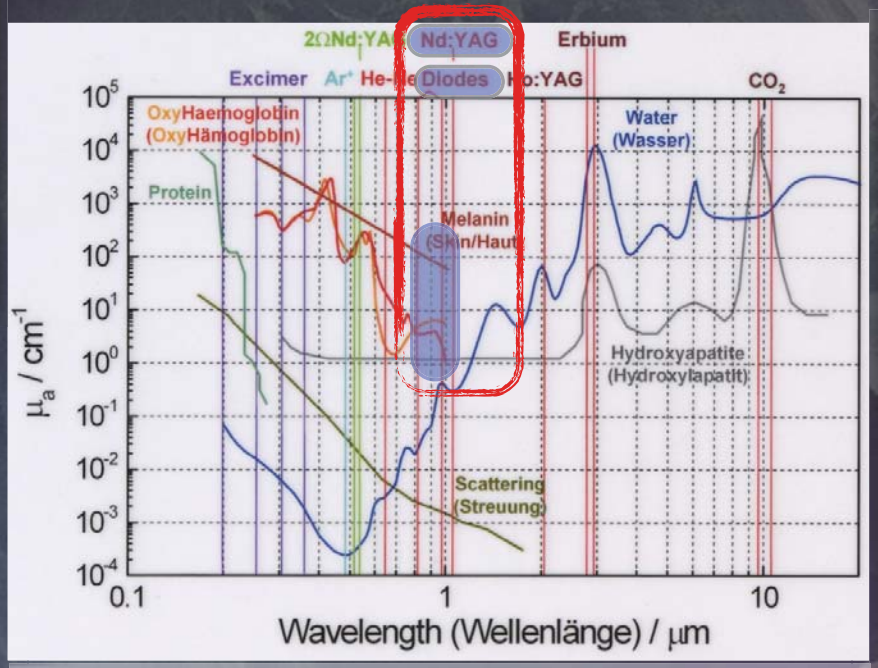
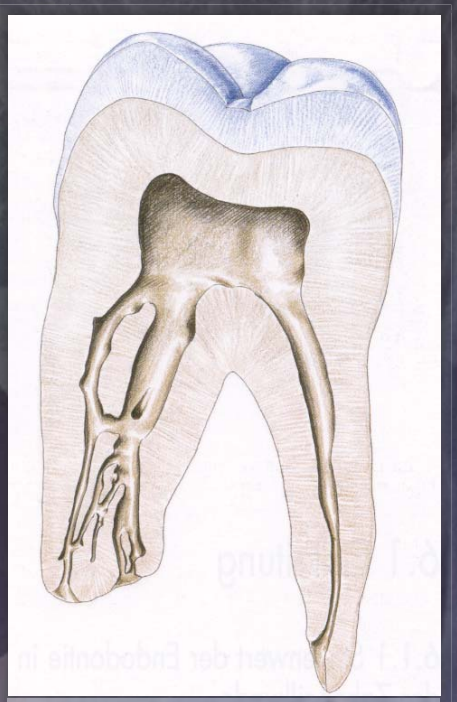


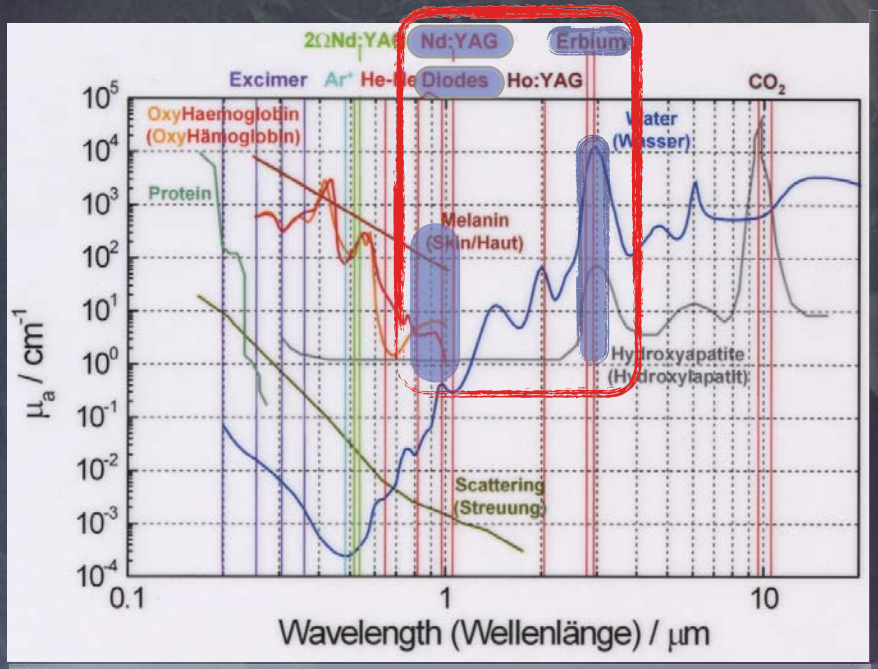
bacterial infiltration ➠ 1‘100µm !!

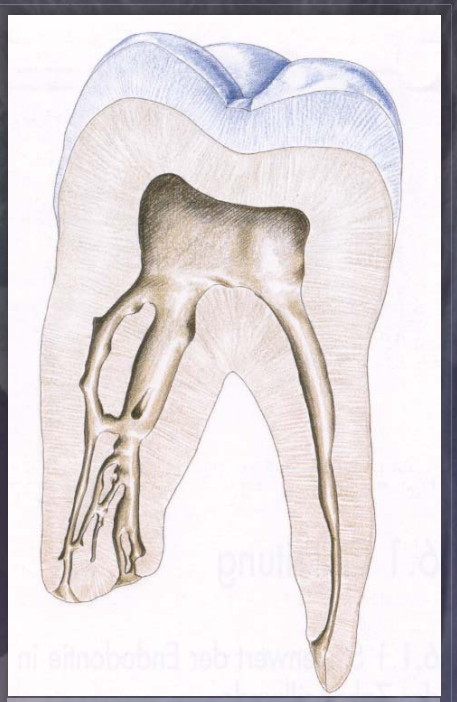




(Prof. N. Gutknecht ; J. Meister AALZ)

bacterial infiltration ➠ 1‘100µm !!

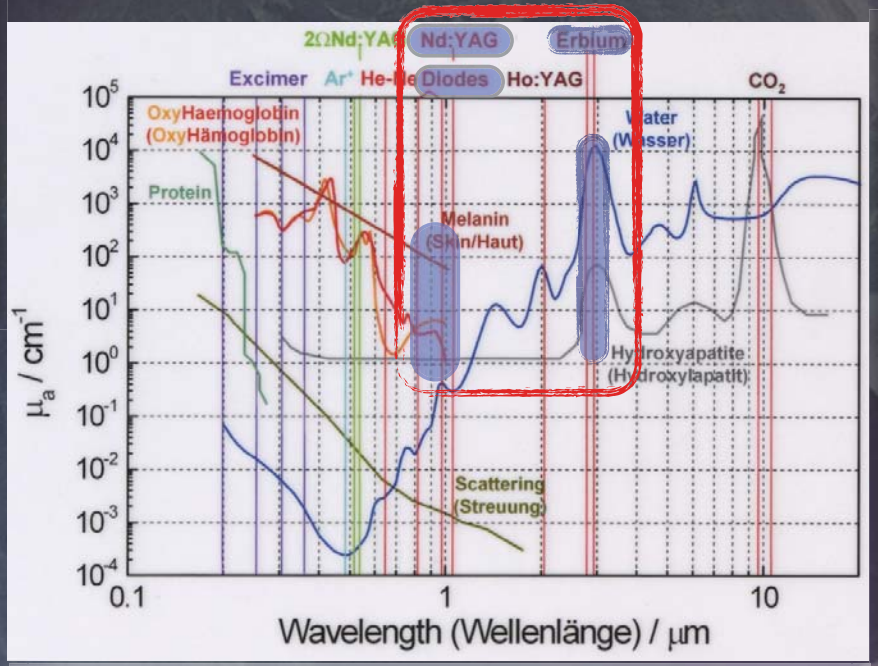




(Prof. N. Gutknecht ; J. Meister AALZ)

access
to
pulp

bacterial infiltration ➠ 1‘100µm !!



(Prof. N. Gutknecht ; J. Meister AALZ)

decontamination
biomech. steps
Smear Layer
removal

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 !!

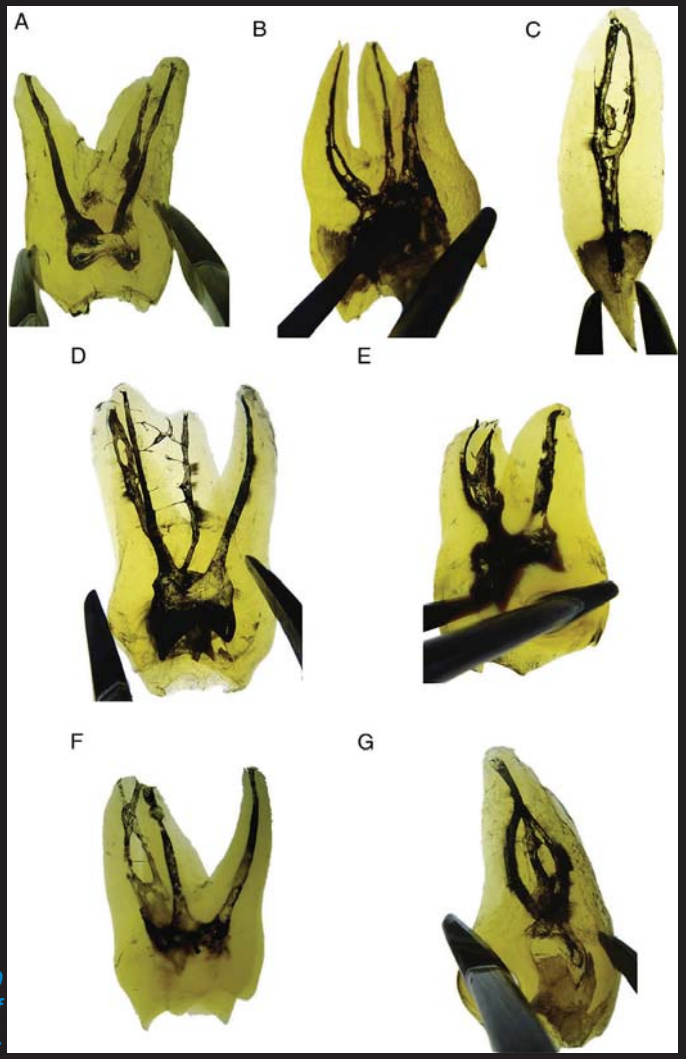
complexe micro-anatomical structure

Microcomputer Tomography

Dyed Nerve Structure

Photographic

complexe micro-anatomical structure

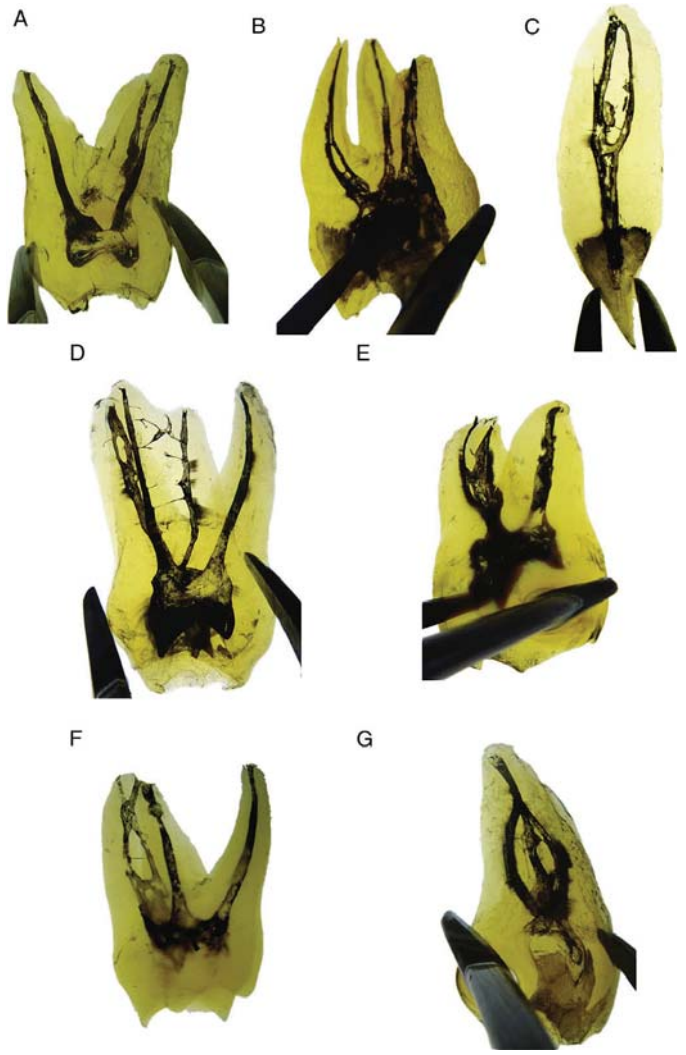


JOE — Volume 35, Number 5, May 2009
"Root Canal Morphology of
Permanent Maxillary Teeth" 651

TABLE 3. Number and percentage of lateral canals and apical deltas

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

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



Clinical Standpoint

A. **Radiographs**
B. **Apex locators**

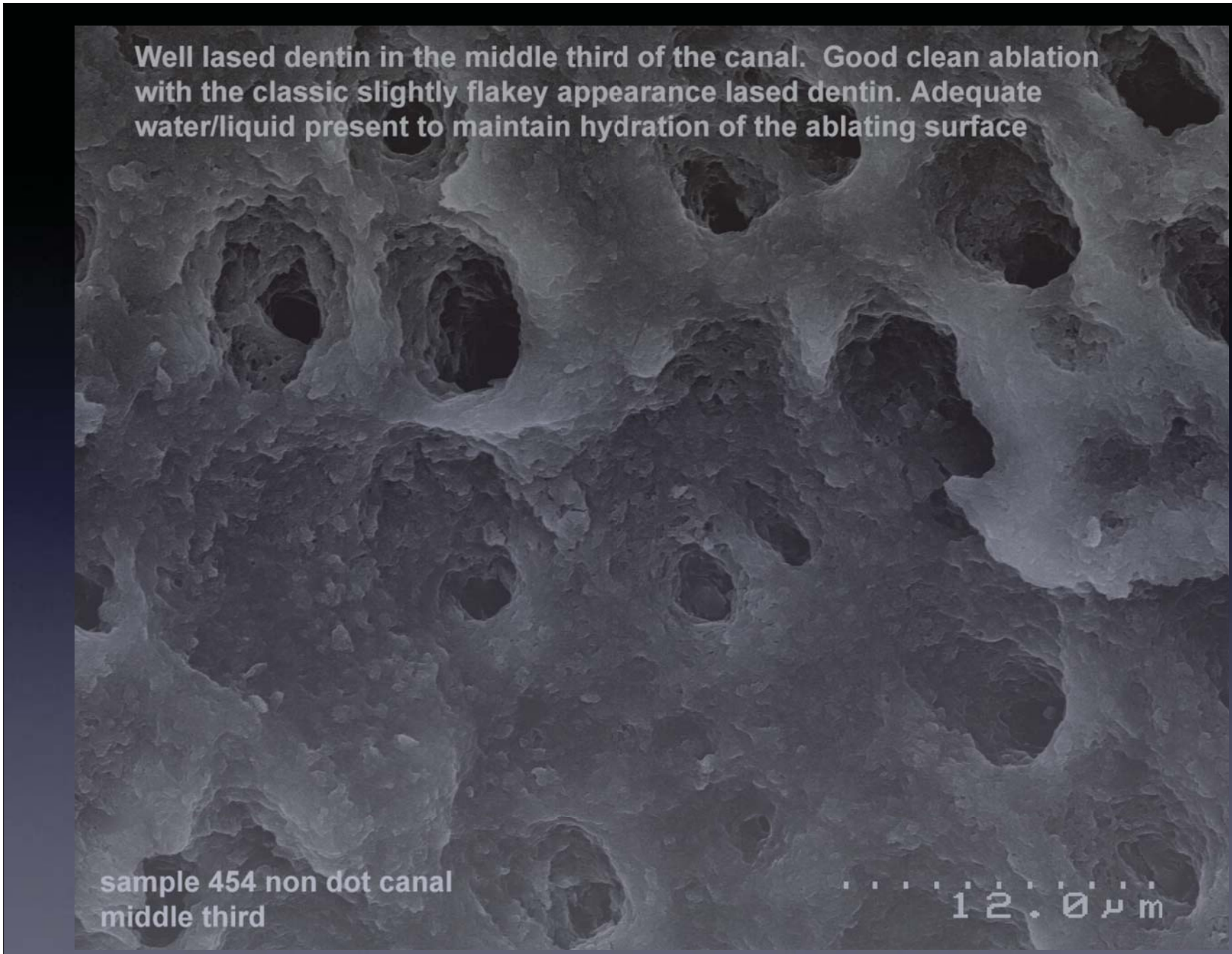
•Current accuracy of apex locators are listed at 95%

•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**

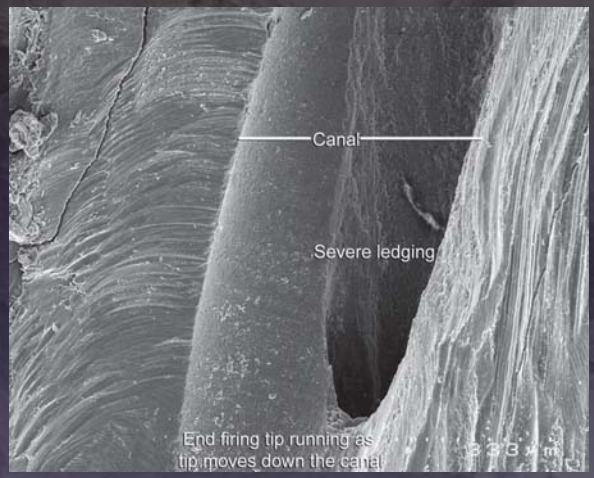

Well lased dentin in the middle third of the canal. Good clean ablation with the classic slightly flakey appearance lased dentin. Adequate water/liquid present to maintain hydration of the ablating surface
sample 454 non dot canal middle third
12.0µm

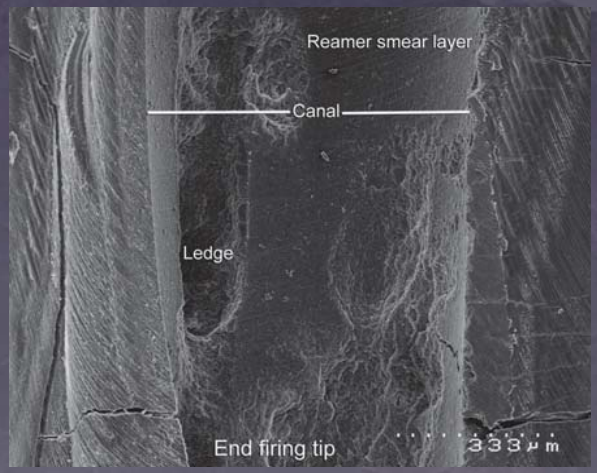
Original Laser Endo w. Er:YAG

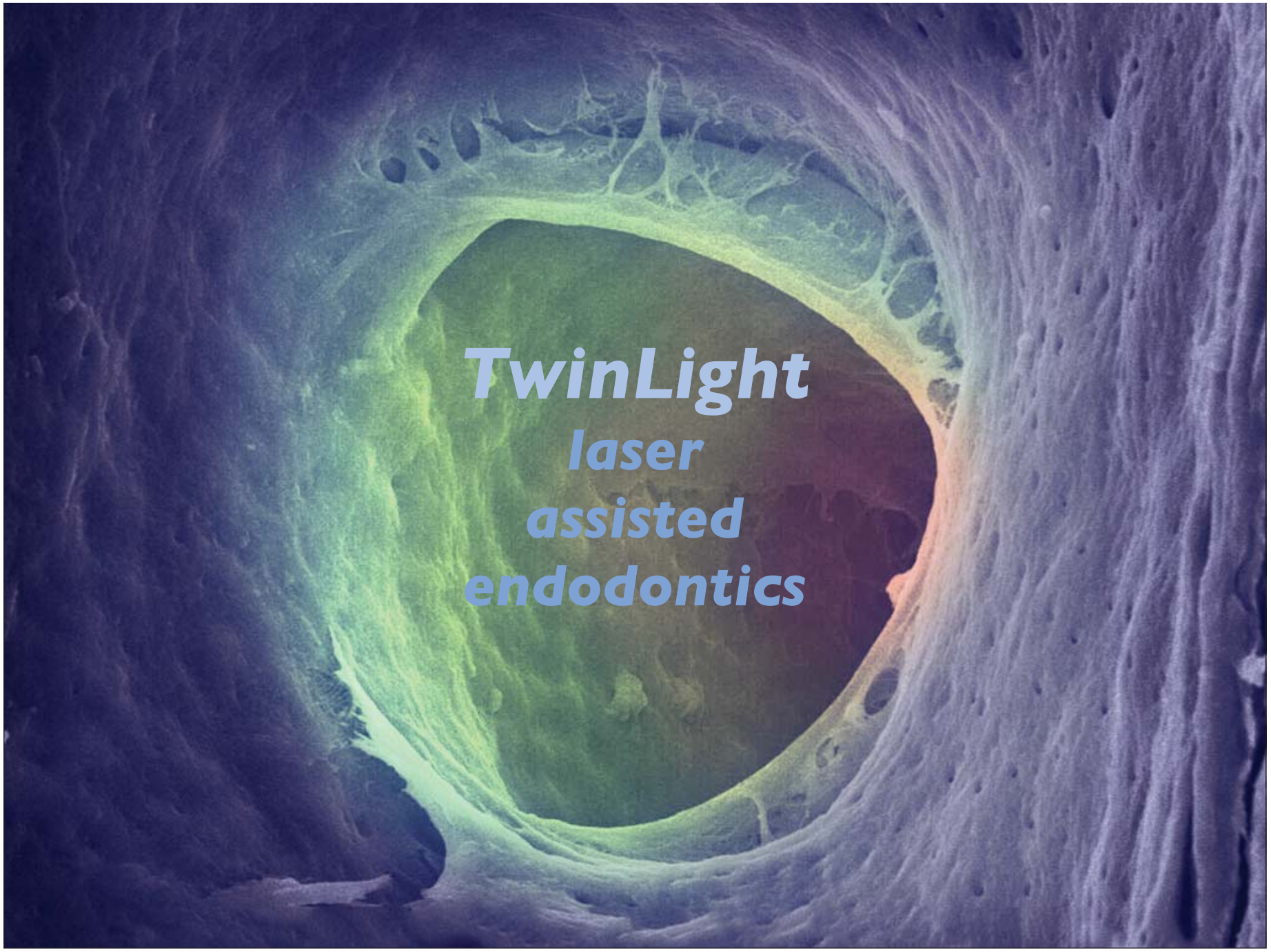
- ➠ end firing tips

- *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

bactericidial 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 wavelenght involved ...

TwinLight Endodontic Treatment

laser assisted endo - prep

not anymore one wavelenght involved ...

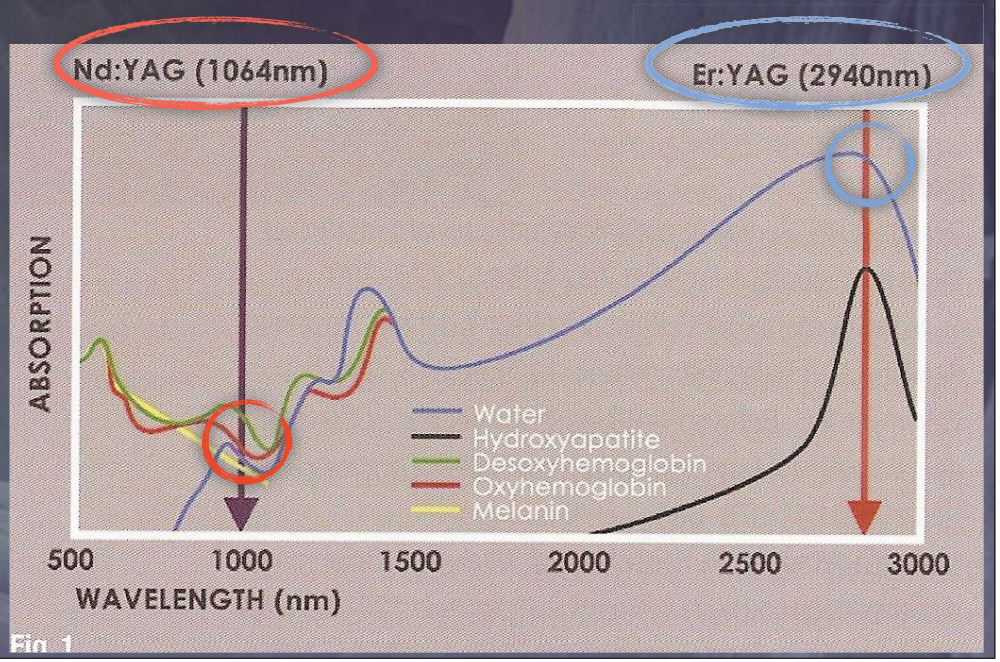
➠ excellent ***combination***
of **2** *complementary* crystalline laser sources

Nd:YAG & Er:YAG

TwinLight Endodontic Treatment

laser assisted endo - prep

not anymore one wavelenght involved ...

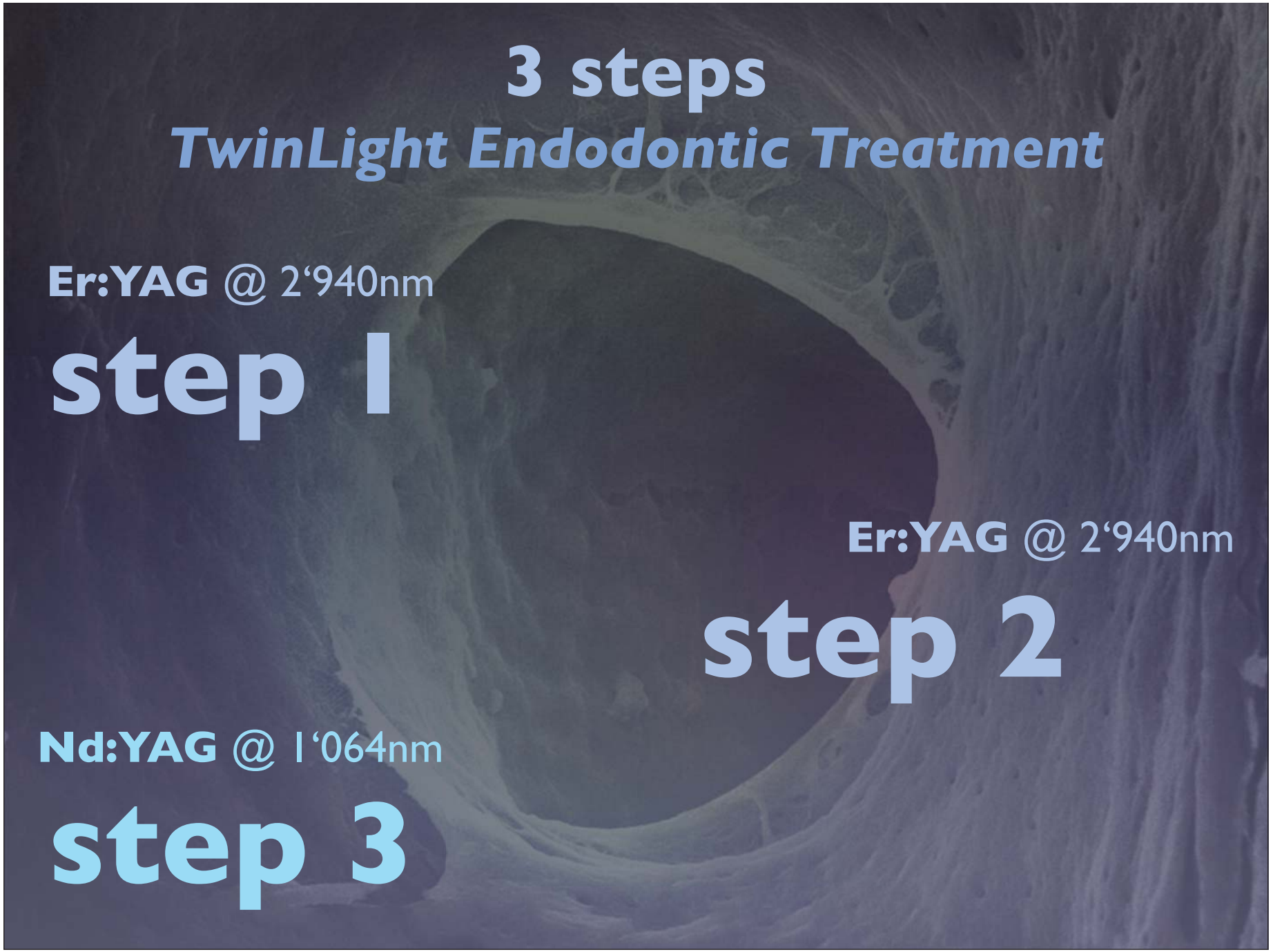


TwinLight Endodontic Treatment

Nd:YAG @ 1‘064nm & **Er:YAG** @ 2‘940nm

gold standard
most efficient wavelenght for decontamination
thermal pulsing desinfection
in the bacteria‘s immediate microenvironnement 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 mecanical cleaning & debriding


3 steps
TwinLight Endodontic Treatment
Er:YAG @ 2‘940nm
step 1
Er:YAG @ 2‘940nm
step 2
Nd:YAG @ 1‘064nm
step 3

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

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

Nd:YAG @ 1‘064nm

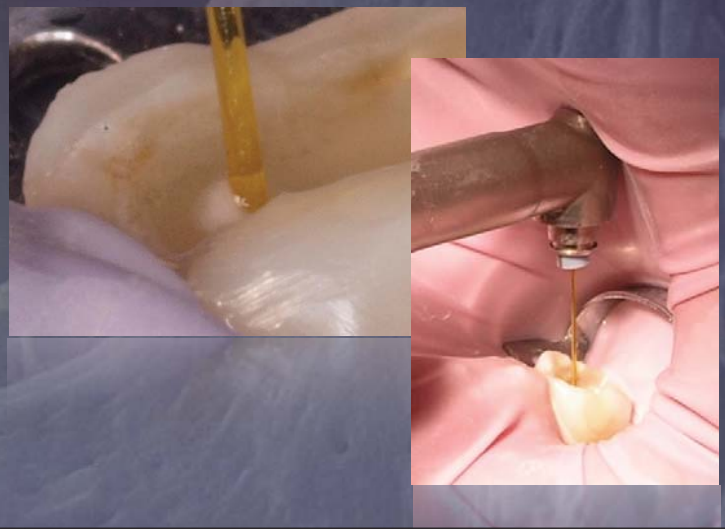
as endo gold standard
THE deep decontamination
@ 1,5W; 15 Hz by 200 µm
& 1‘000 µm lateral penetration

3 steps

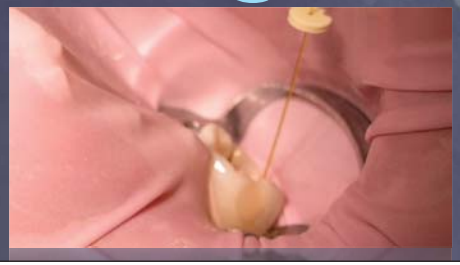
TwinLight Endodontic Treatment

Er:YAG @ 2‘940nm

Er:YAG @ 2‘940nm



Nd:YAG @ 1‘064nm

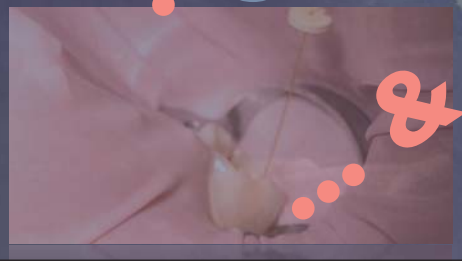


3 steps

TwinLight Endodontic Treatment

Er:YAG @ 2‘940nm

Nd:YAG @ 1‘064nm



Er:YAG @ 2‘940nm

& biomodulation of the immune system

& biostimulation of the fibroblasts !!

…

…

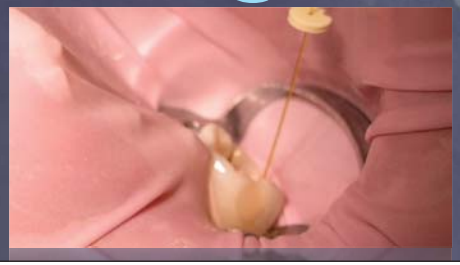
3 steps

TwinLight Endodontic Treatment

Er:YAG @ 2‘940nm

Er:YAG @ 2‘940nm

Nd:YAG @ 1‘064nm



3 steps

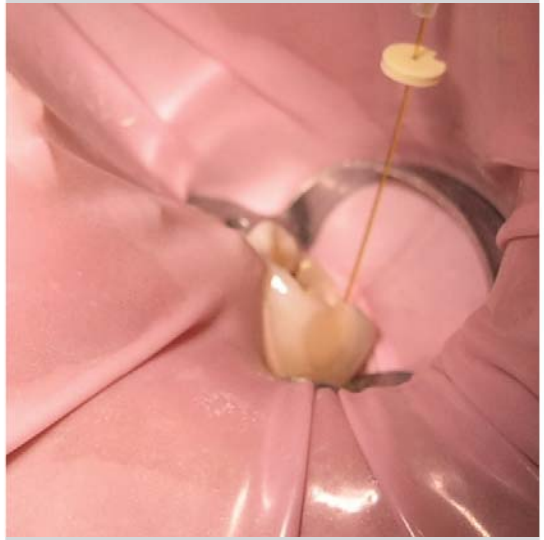
TwinLight Endodontic Treatment

Er:YAG

access &
first decontamination

Er:YAG

photomech.debridement



Nd:YAG

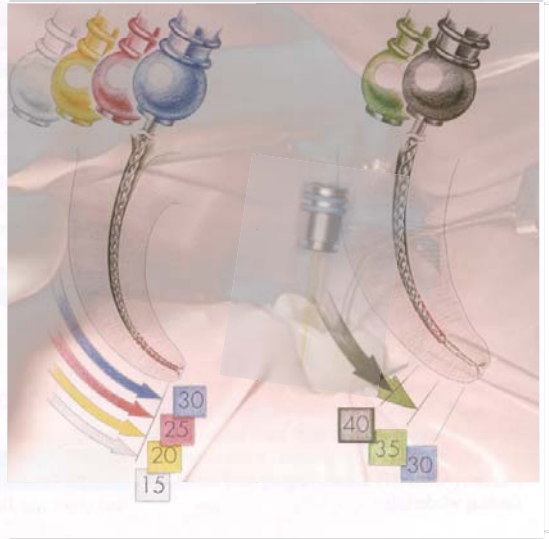
final decontamination

3 steps

TwinLight Endodontic Treatment

Er:YAG

access &
first decontamination



Er:YAG

photomech.debridement

200µm / ca. 2mm per 1“

final decontamination

final decontamination

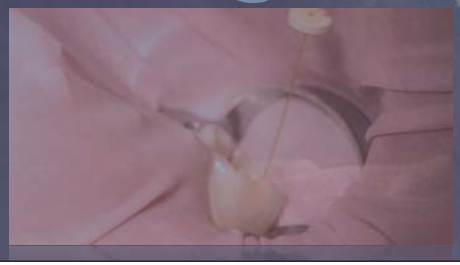
courtesy of Dr. Thorsten Wegner

3 Schritte

TwinLight Endodontic Treatment

Er:YAG @ 2‘940nm

Nd:YAG @ 1‘064nm



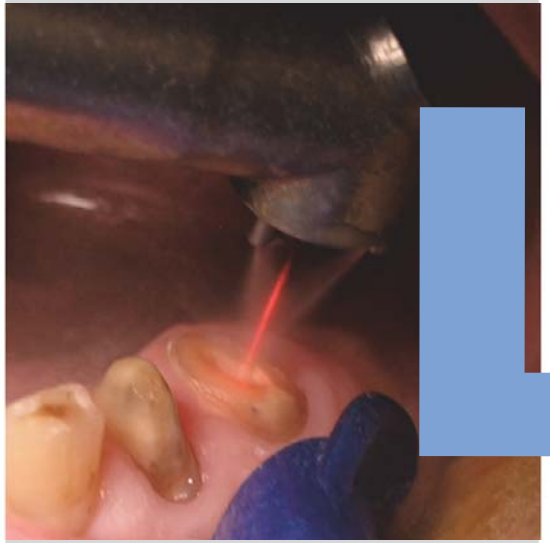
Er:YAG @ 2‘940nm

LAI


LAI
„ Laser Activated Irrigation “

3 steps

TwinLight Endodontic Treatment

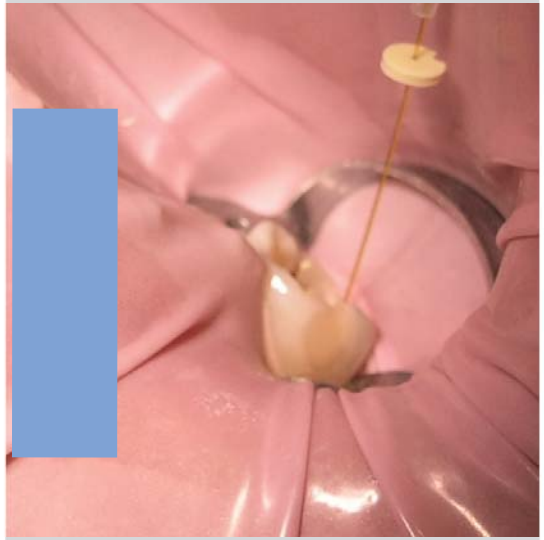


Er:YAG

access &
first decontamination

Er:YAG

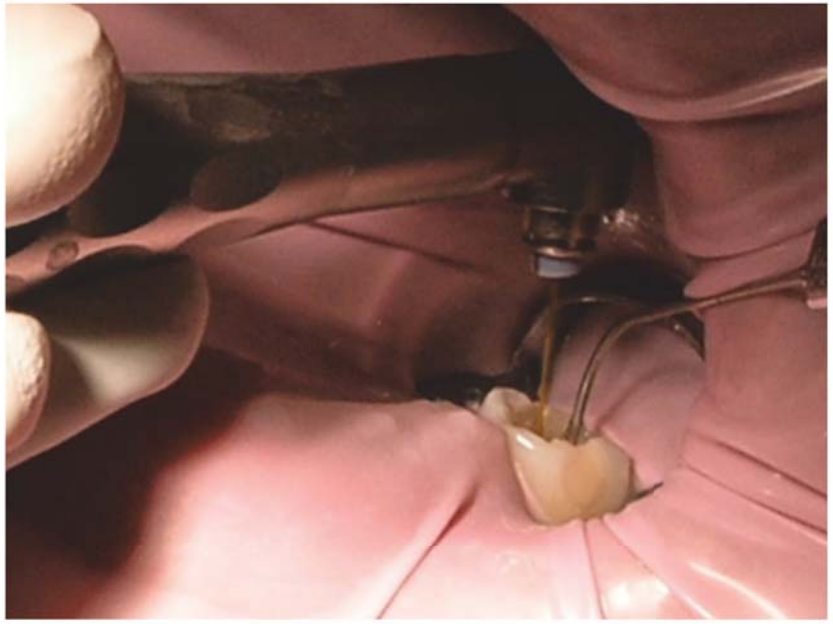
photomech.debridement

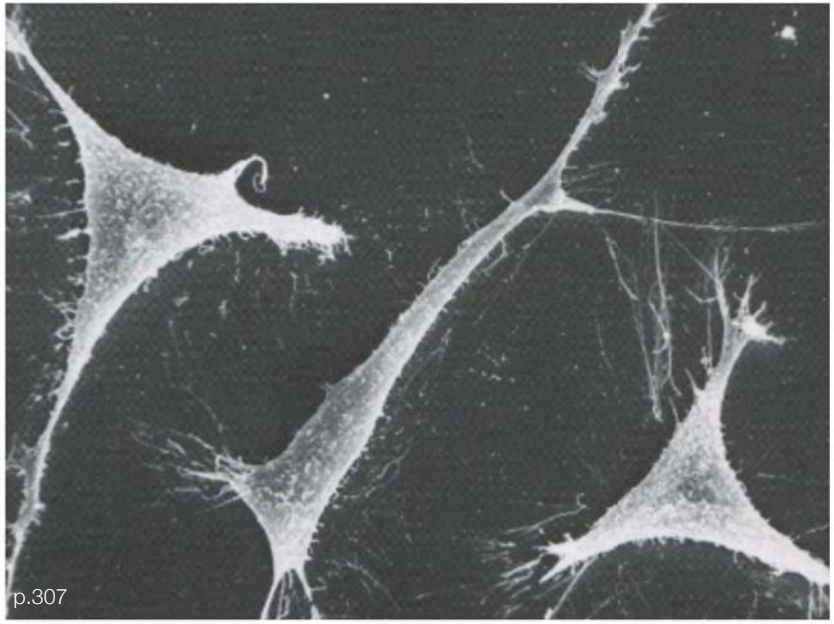


Nd:YAG

final decontamination

LAI





Laser Activated Irrigation with Er:YAG

removal of **smear layer**, exposition of the tubuli
& primary **decontamination** till approx. **400µm**

&biostimolation (Fibroblasts)

complex emergency
first session

photodebriding

&

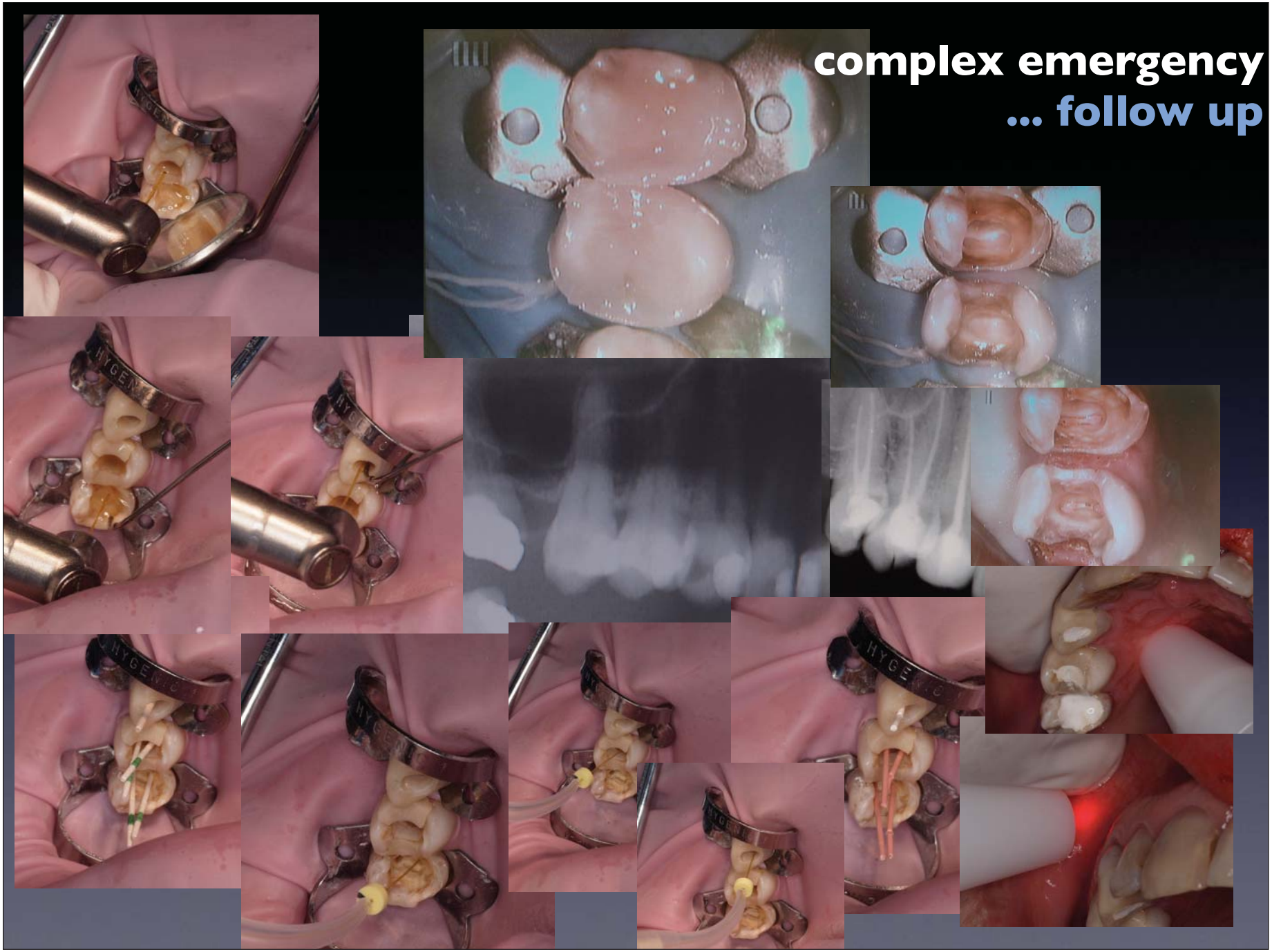
photodecontamination



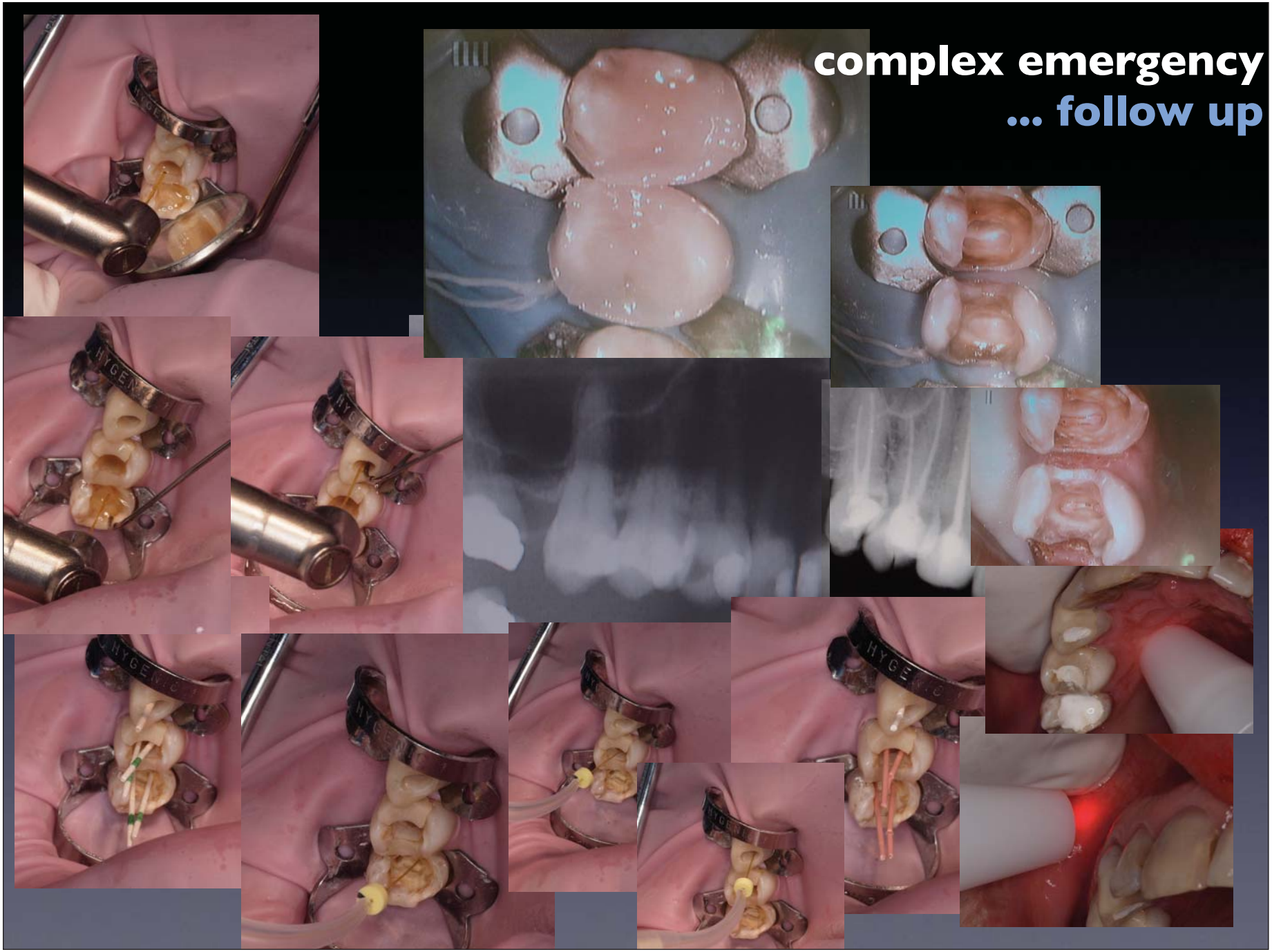




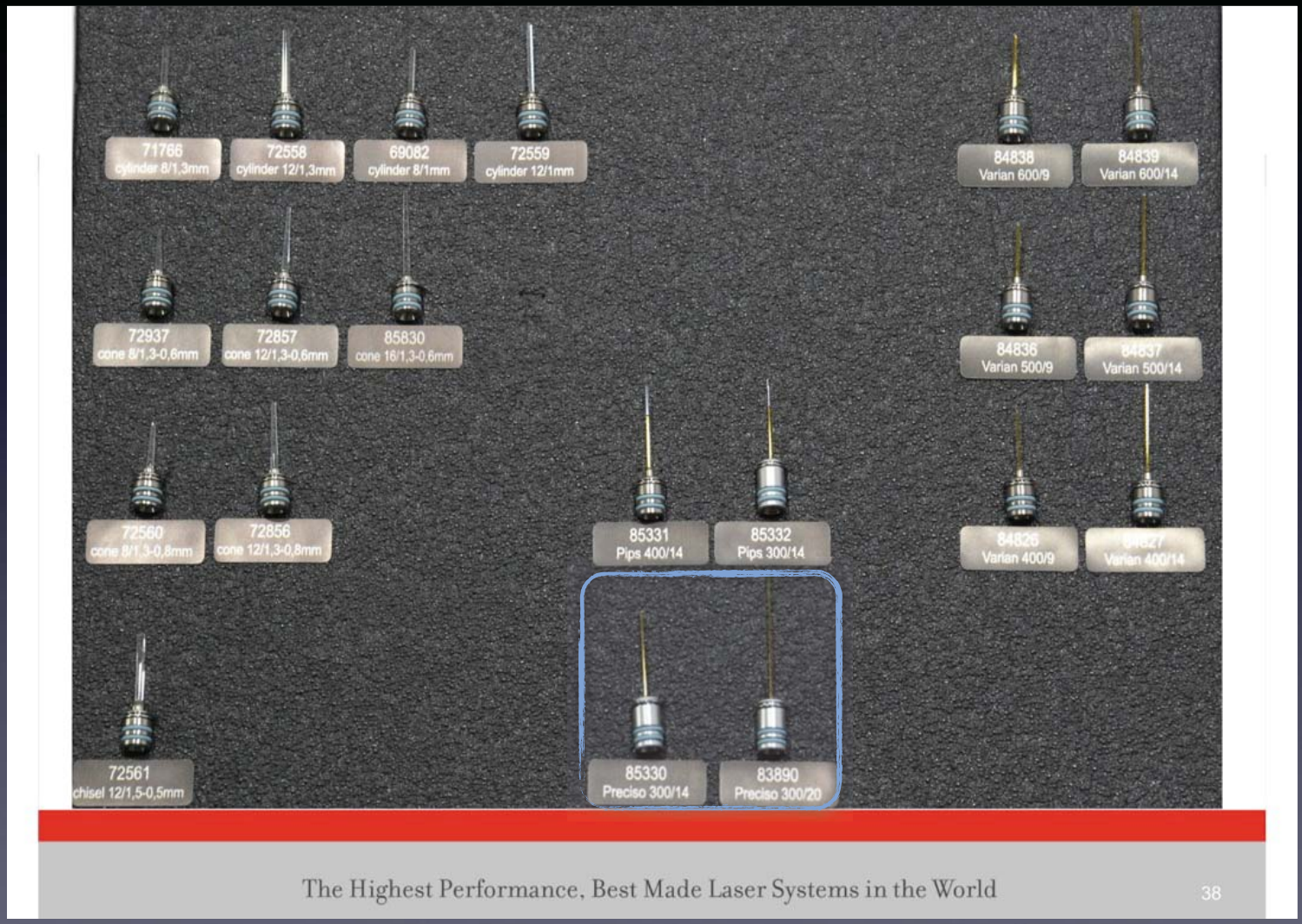

complex emergency
... follow up



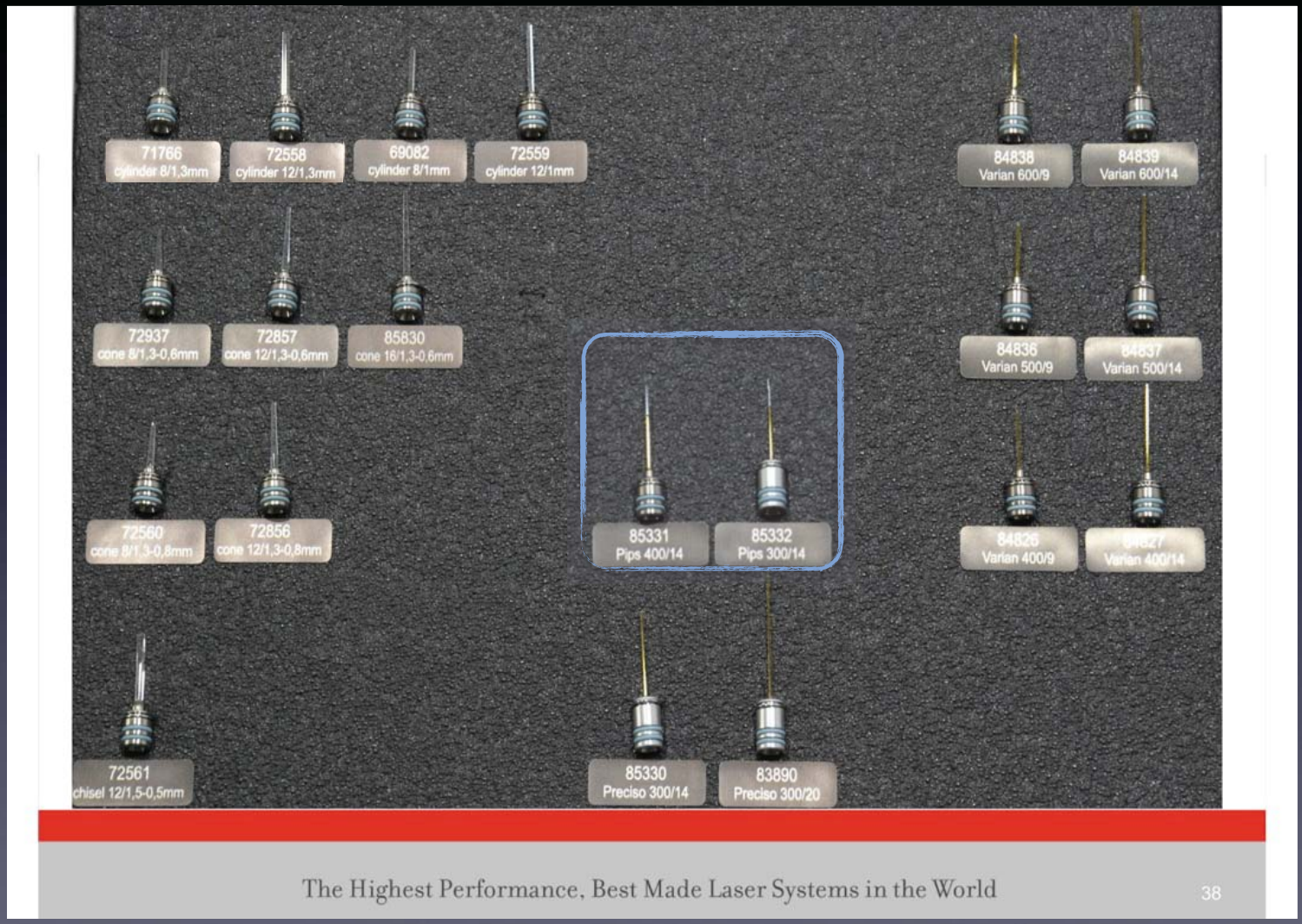
complex emergency
... follow up



Er:YAG fiber tips

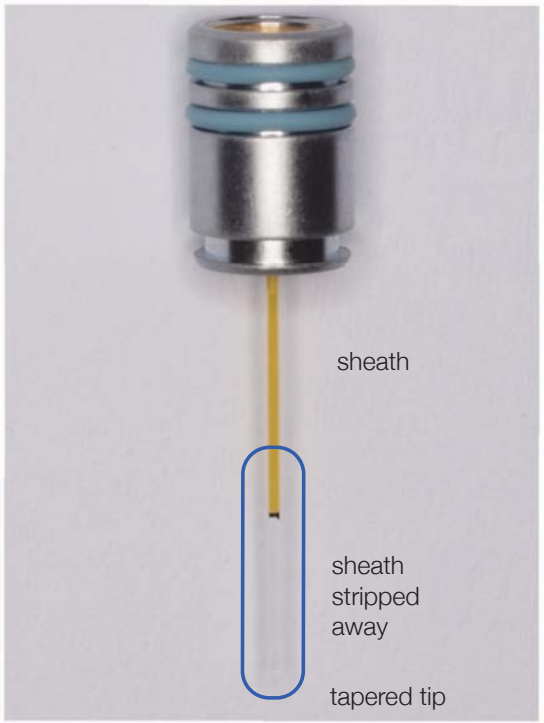


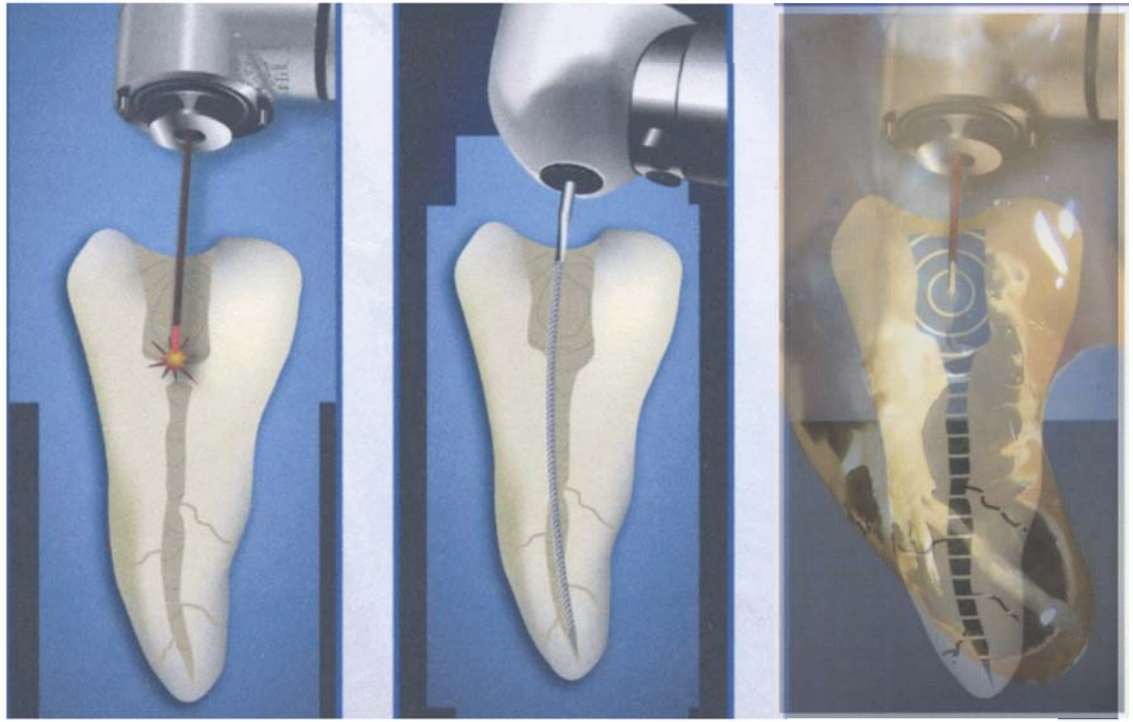
Er:YAG fiber tips



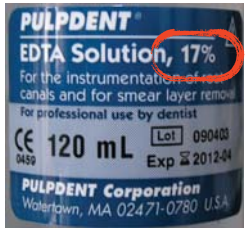
PIPS

Enrico DiVito & Mark Colonna, Arizona Center for Laser Dentistry





Procedure :

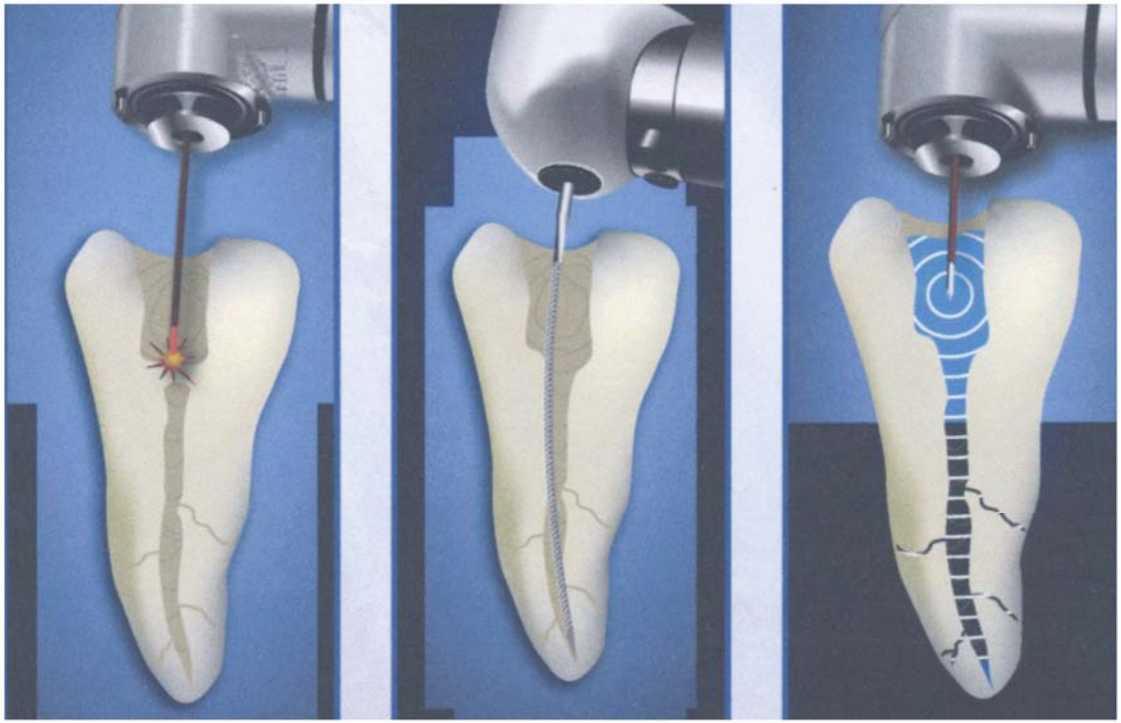


- a. pulp & root opening w. Er:YAG
- b. root prep
- c. PIPS in action & EDTA 15%
- d. rinsing & drying

.....

Photon Induced Photoacoustic Streaming

Enrico DiVito & Mark Colonna, Arizona Center for Laser Dentistry



„Lightwalker“

20mJ
15Hz
SSP/50µs
seq. 20“

updated : 4. march 2011 / ALD San Diego

Procedure :

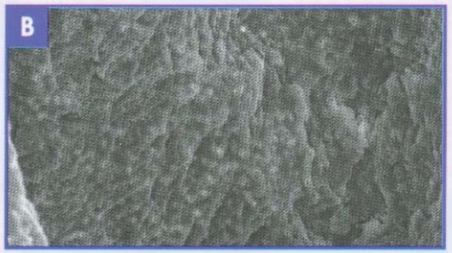
a. pulp & root opening w. Er:YAG
b. root prep
c. PIPS in action & EDTA 15%
d. rinsing & drying
e. final decontamination w. Nd:YAG

PIPS

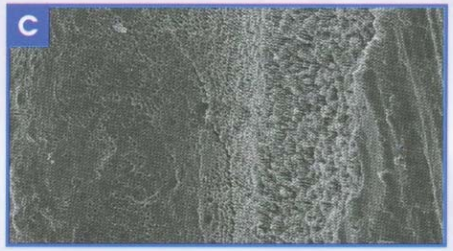
Enrico **DiVito** & Mark **Colonna**

Debrided lateral canal

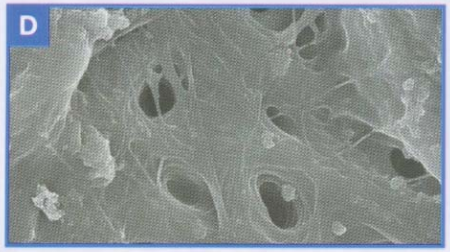
Open dentinal tubules
with minimal smear layer

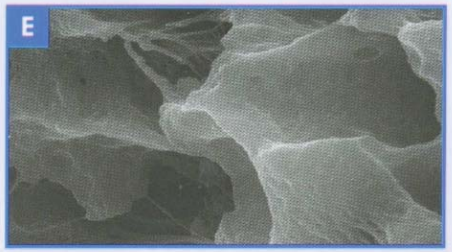


Clean dentinal canal walls



D-E. Canal wall collagen fibers and internal hydroxyapatite matrices intact and visible



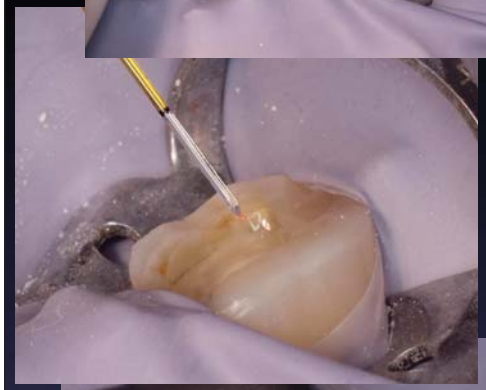


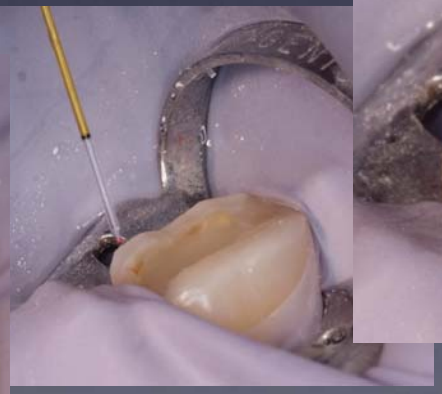
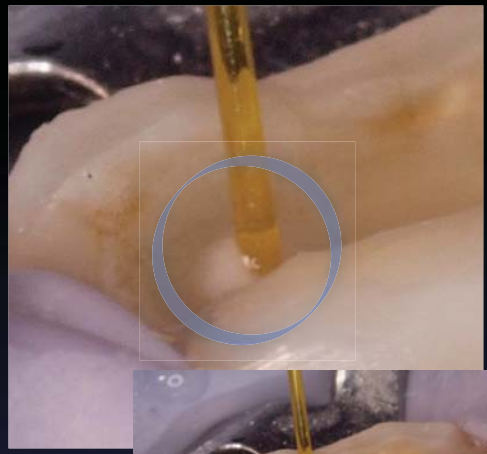
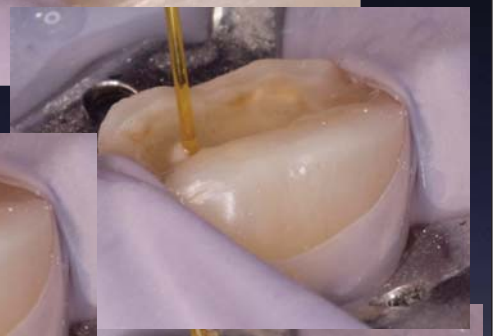
Procedure :

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

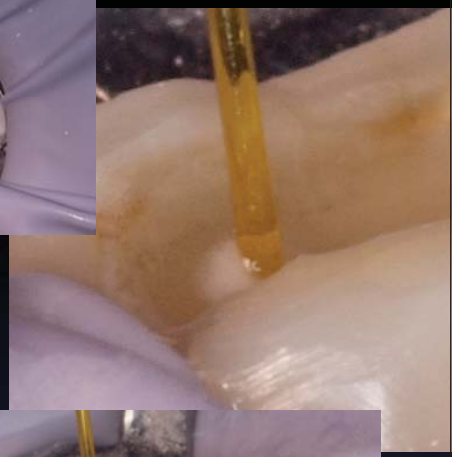






Laser assisted endo w. Er:YAG

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 lenght*** 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

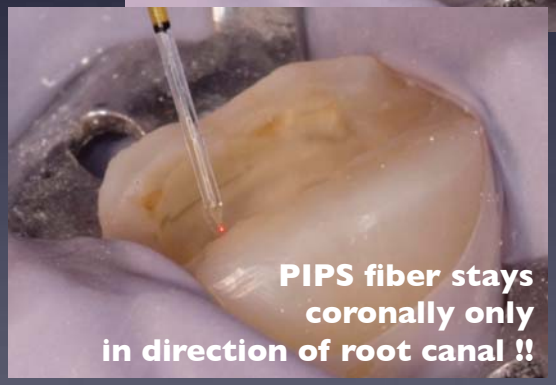
✔ ***access*** by office protocol / Er:YAG

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

✔ ***PIPS Protocol*** :

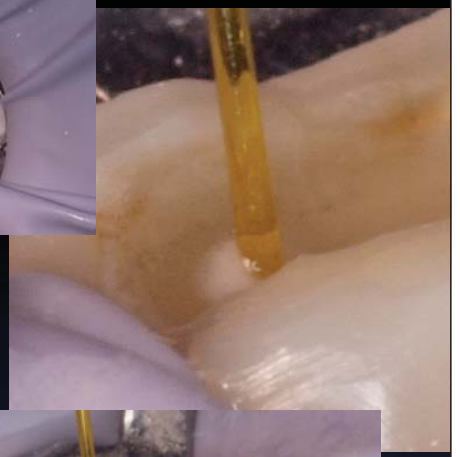
- rinsing w. NaCl & File #10
- PIPS & NaCl/EDTA 20“
- rinsing w. NaCl & File #15
- PIPS & NaCl/EDTA 20“

... 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



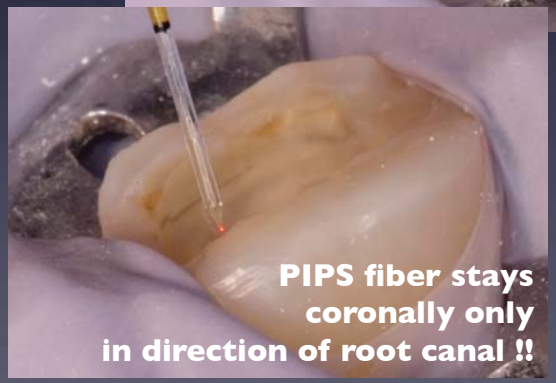
✔ ***access*** by office protocol / Er:YAG

✔ Measurement of the ***working lenght*** 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* :-)



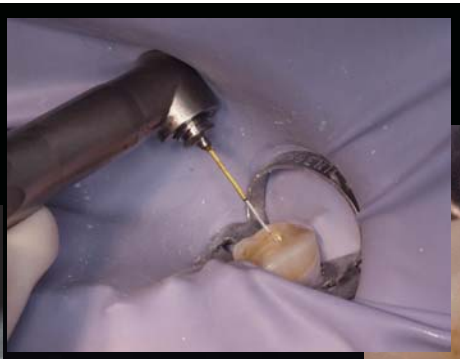
✔ ***EDTA*** rinsing till covering the coronal part,
irradiation with PIPS20“ @ 15Hz, 20mJ, 50µs
without w/a

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

✔ ***root canal filling*** by office protocol

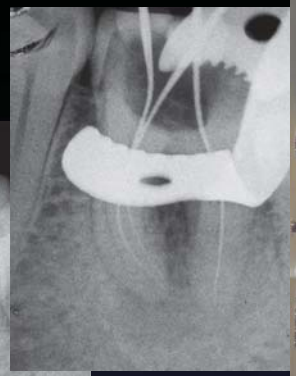
Laser Assisted Endo mit Er:YAG

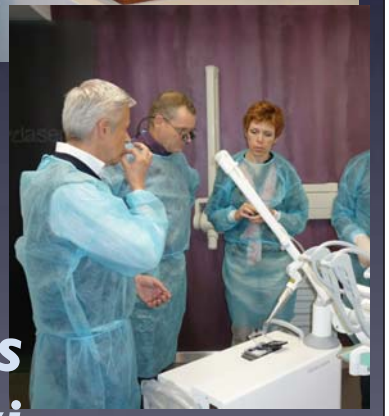
15Hz, 20mJ, 50µs, ohne W/L



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 :

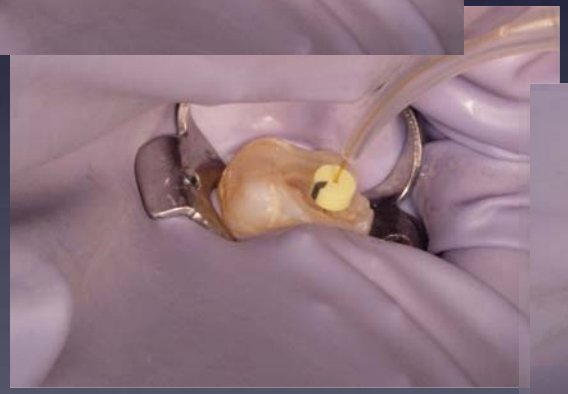
a. pulp & root opening w. Er:YAG
b. root prep
c. PIPS in action & EDTA 15%
d. rinsing & drying
e. final decontamination w. Nd:YAG

chemodebriding

PIPS in office

chemodebriding

photo-
decontamination



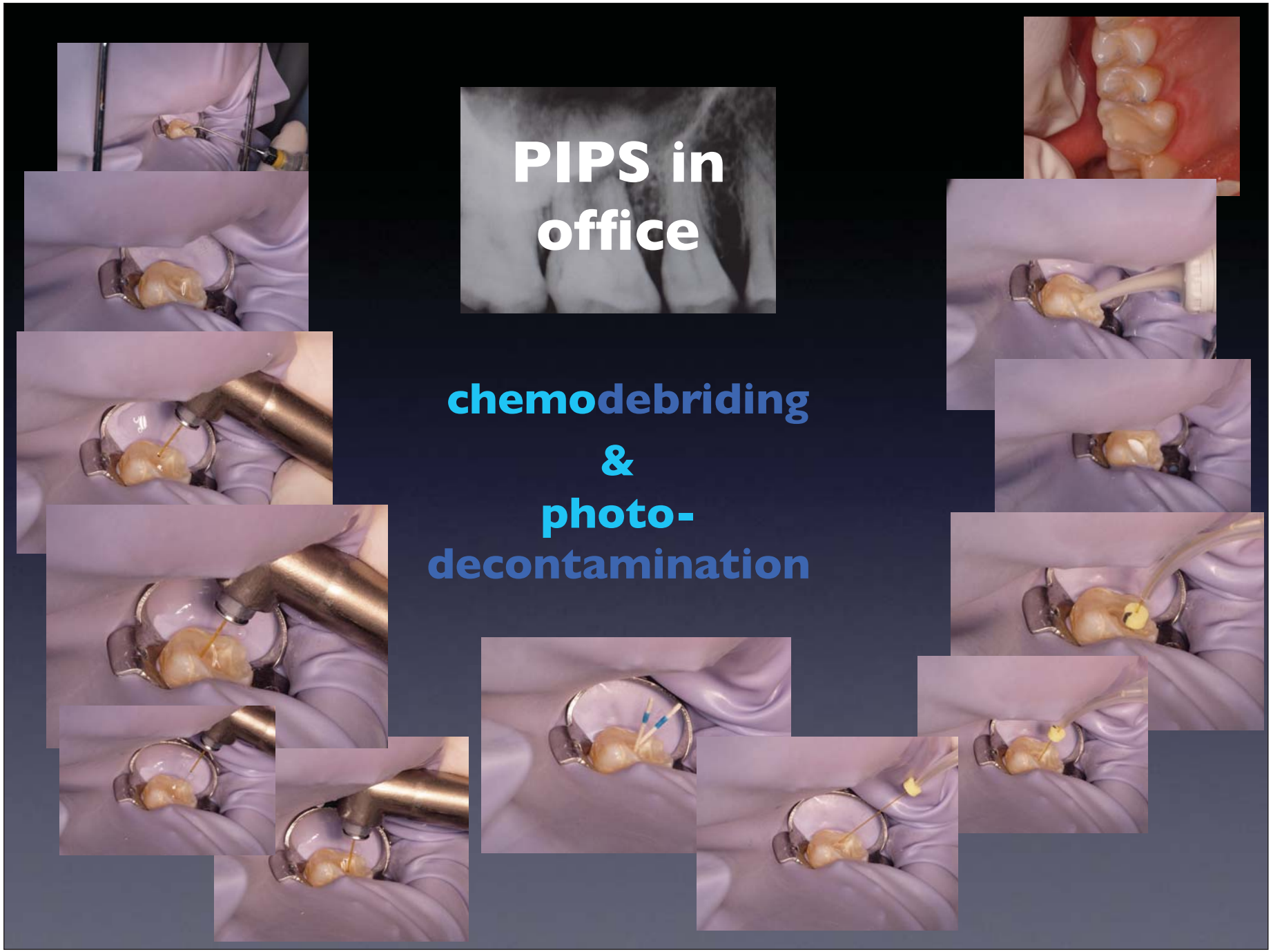
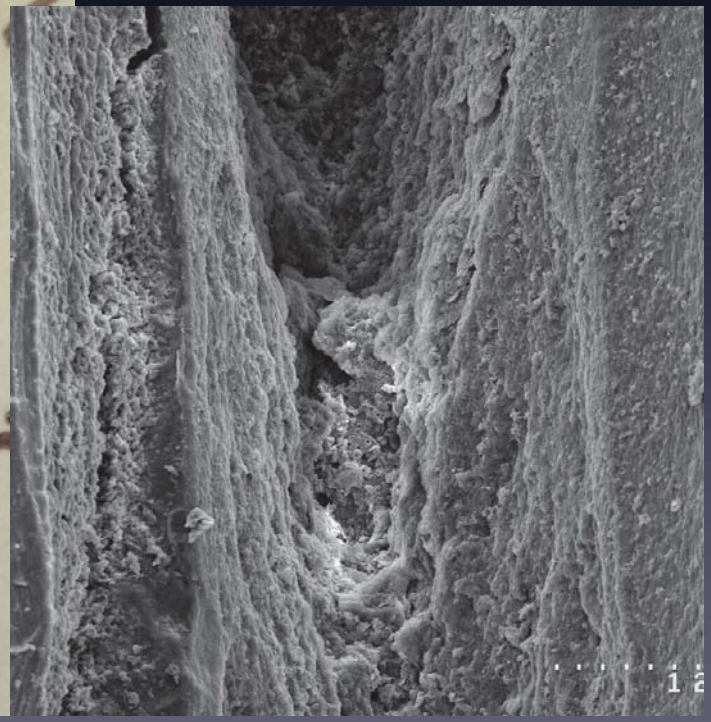
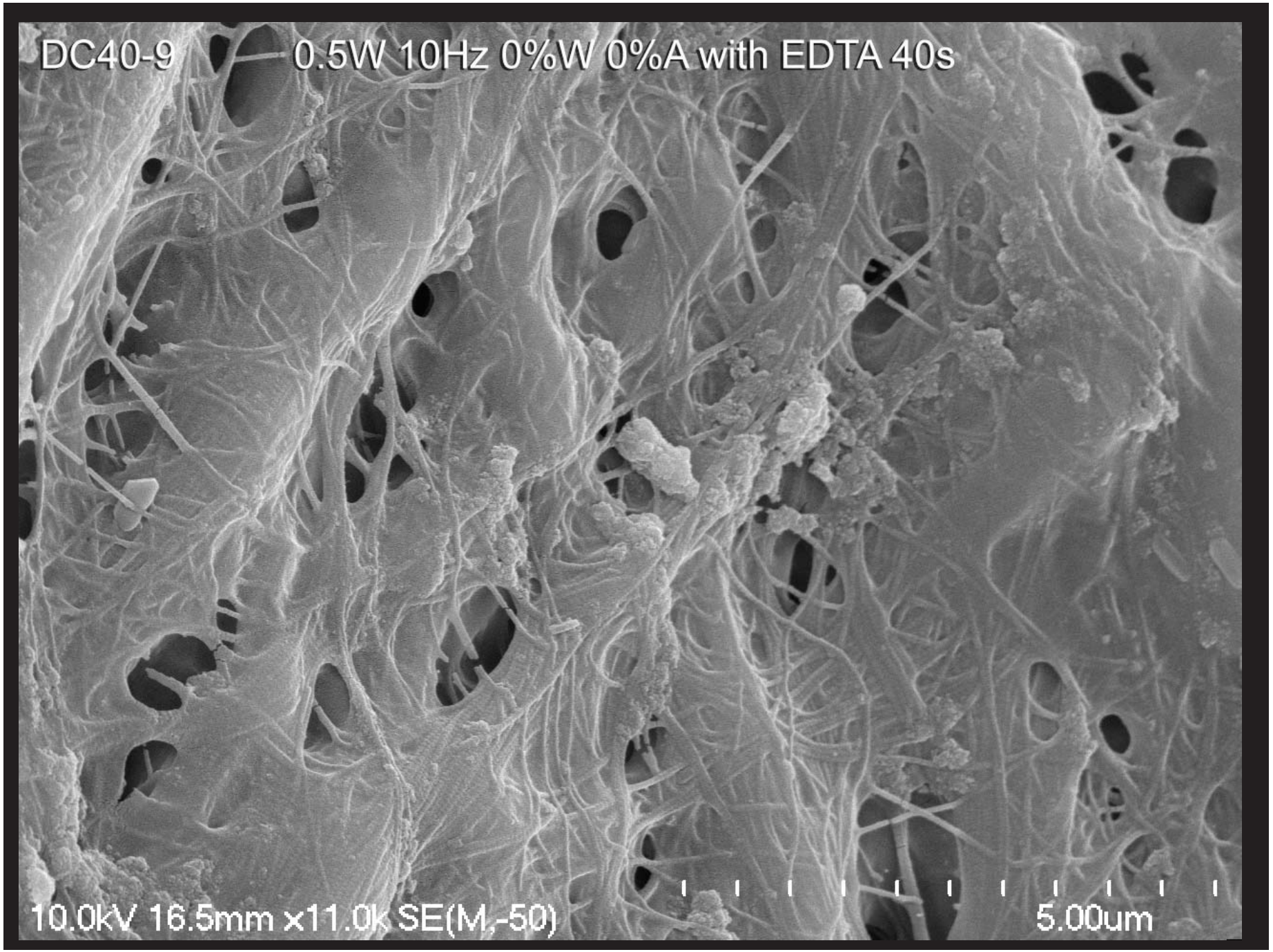

PIPS in office
chemodebriding
&
photo-
decontamination

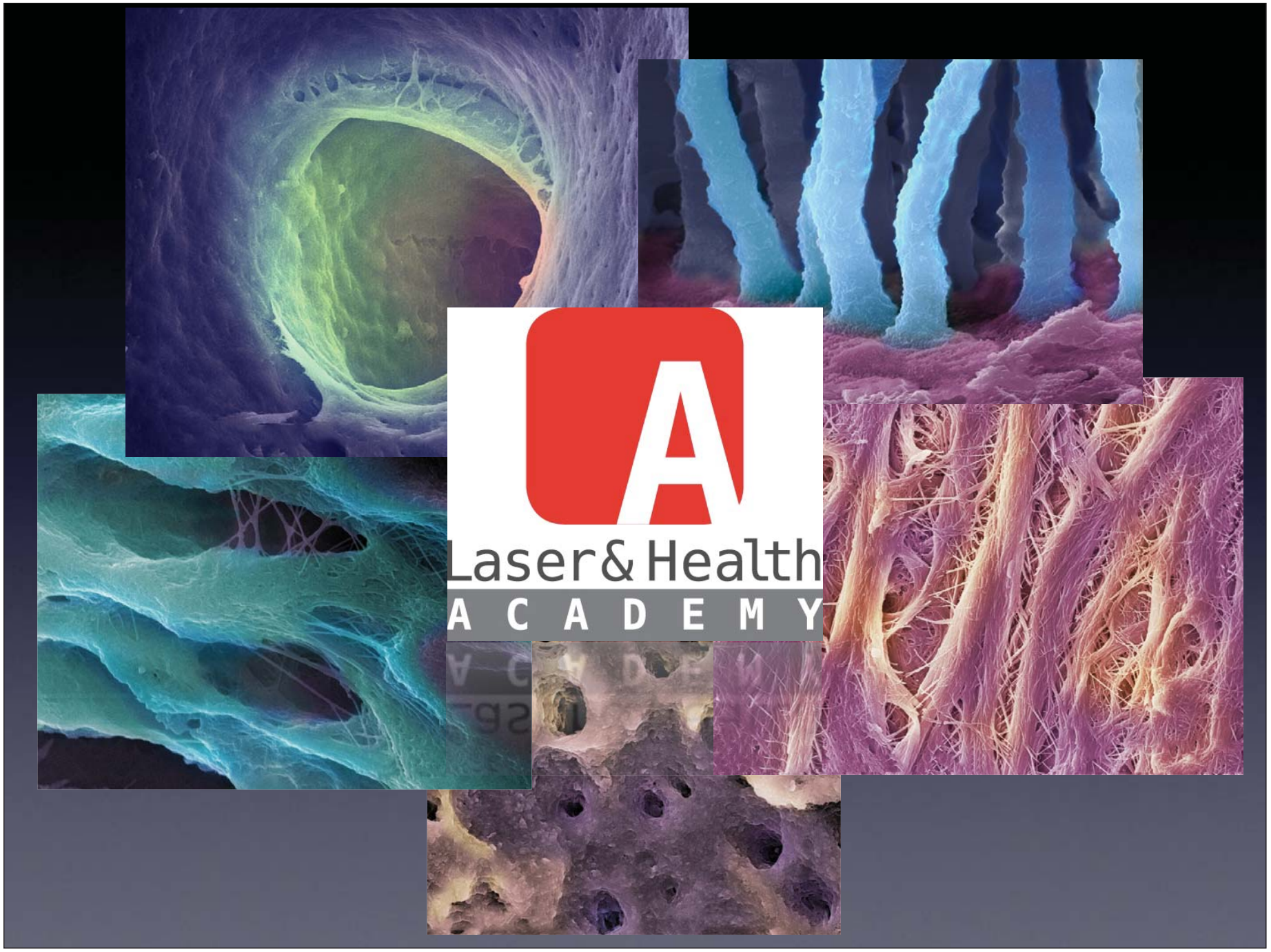
Photo Thermal Ablation Protocol



PIPS cleans effectively and debrides without thermal effect

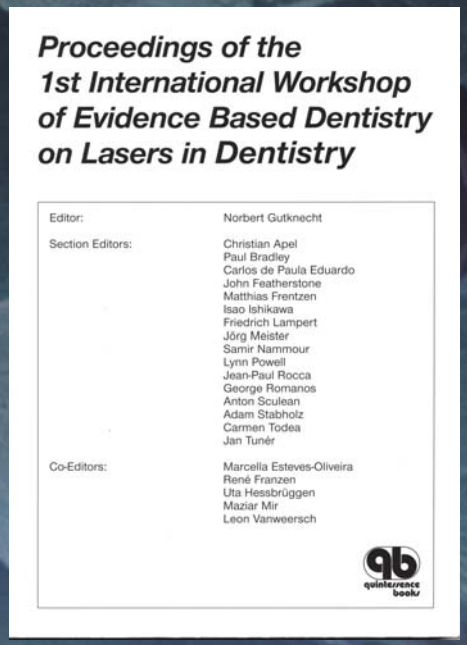

DC40-9
0.5W 10Hz 0%W 0%A with EDTA 40s
10.0kV 16.5mm x11.0k SE(M,-50)
5.00um


DC20-2
0.5W 10Hz 0%W 0%A with EDTA 20s
10.0kV 13.7mm x3.50k SE(M,-50)
10.0um


Laser&Health
ACADEMY

Prof. Norbert Gutknecht

University of Aachen



Prof. Andreas Moritz

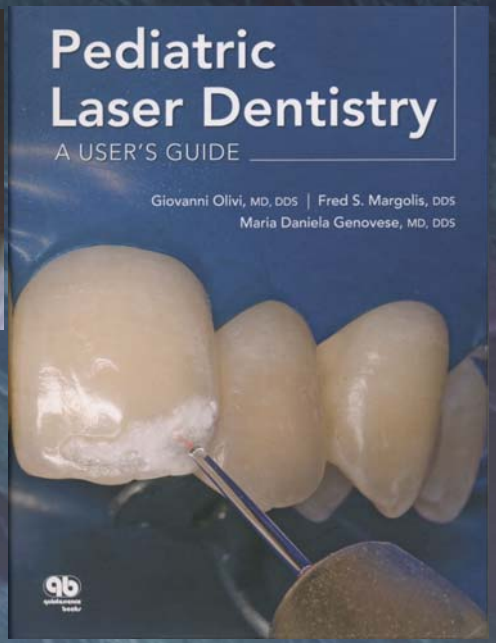
University of Vienna

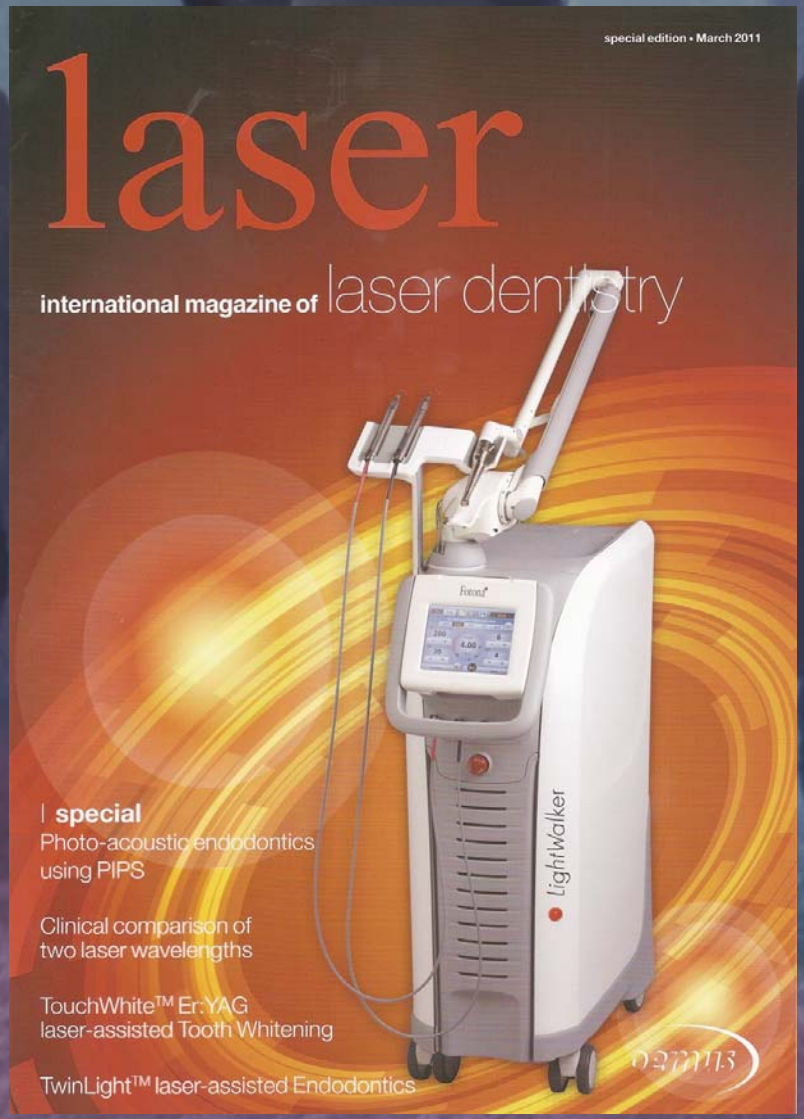
Enrico di Vito, DDS

Mark Colonna, DDS

Prof. Giovanni Olivi

University of Genova





TwinLight™ laser-assisted endodontics

Author _ Dr Kresimir Simunovic, Switzerland

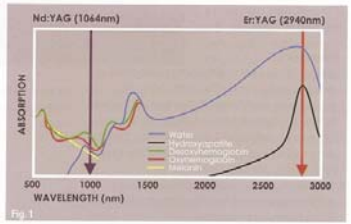


Fig. 1

Fig. 1 _Absorption coefficient in human tissues, as a function of laser wavelength. The absorption coefficient is at a minimum with the Nd:YAG laser wavelength (1.064 µm), and at the maximum with the Er:YAG laser wavelength (2.940 µm).

Fig. 2 _Removal of the debris and smear layer from the root canal walls using the Er:YAG laser. The treatment is accompanied by collateral irrigation with saline solution.

Fig. 3 _Deep decontamination with the Nd:YAG laser (3–5 times per session).

_Classical root treatment involves cleaning the root canal using mechanical means and rinsing with antibacterial solutions and solvents. However, there are two major disadvantages of standard chemo-mechanical preparations.[1] First, the bactericidal effect of the rinsing solutions is limited to the root canal. Because of the narrow diameter of the dentinal tubules and the high surface tension of the liquid solutions, they are able to penetrate only a small distance down the tubules. The penetration depth of chemical disinfectants reaches only 100 µm into the dentinal tubules[2], while the bacteria can penetrate over 1,000 µm from the canal lumen[3], and remain protected in the deeper layers of dentin. The second important disadvantage is that the mechanical preparation of side canals and other branches, as well as the complete removal of the smear layer, are impossible using classical means.


Fig. 2

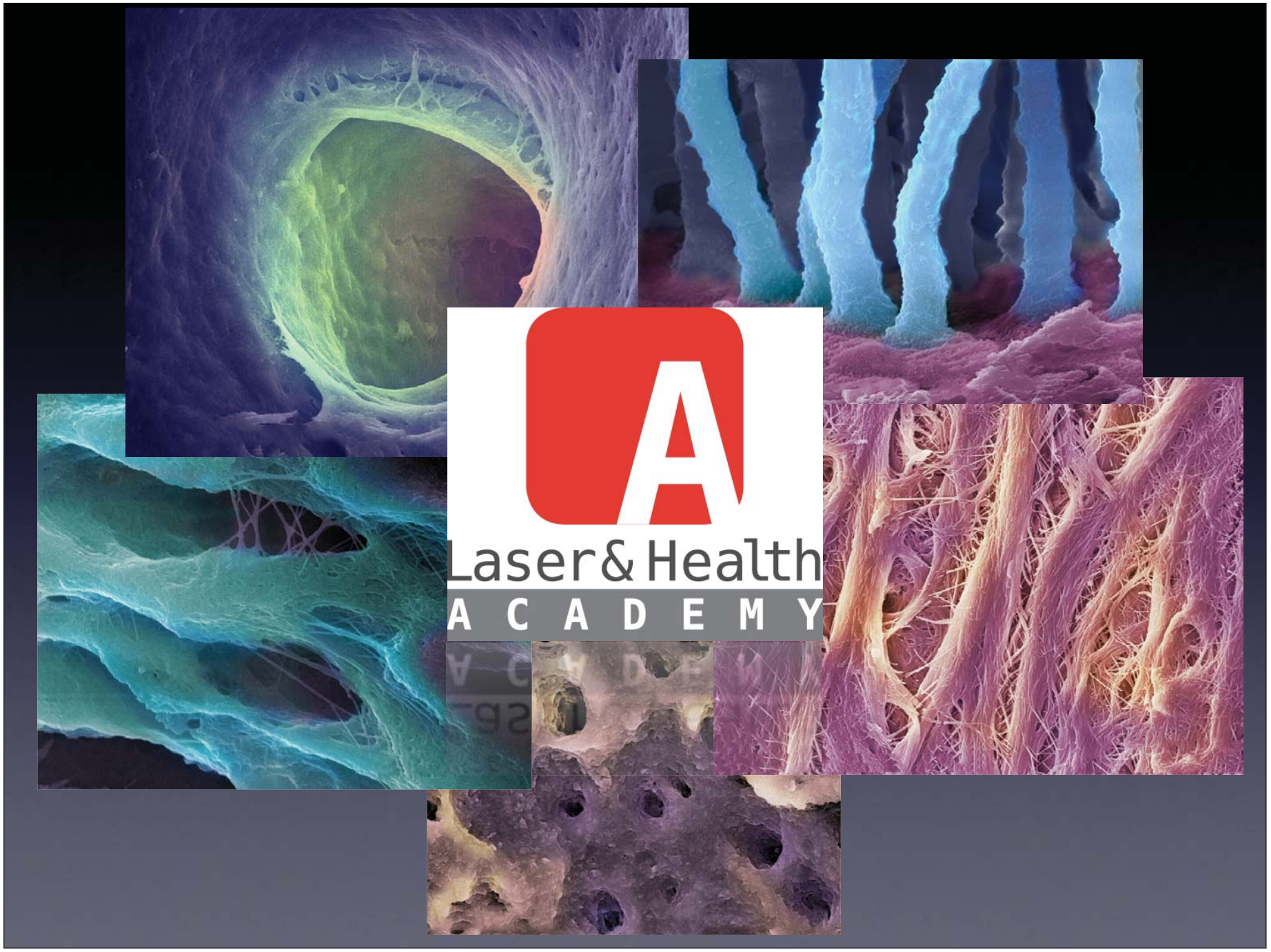

Fig. 3

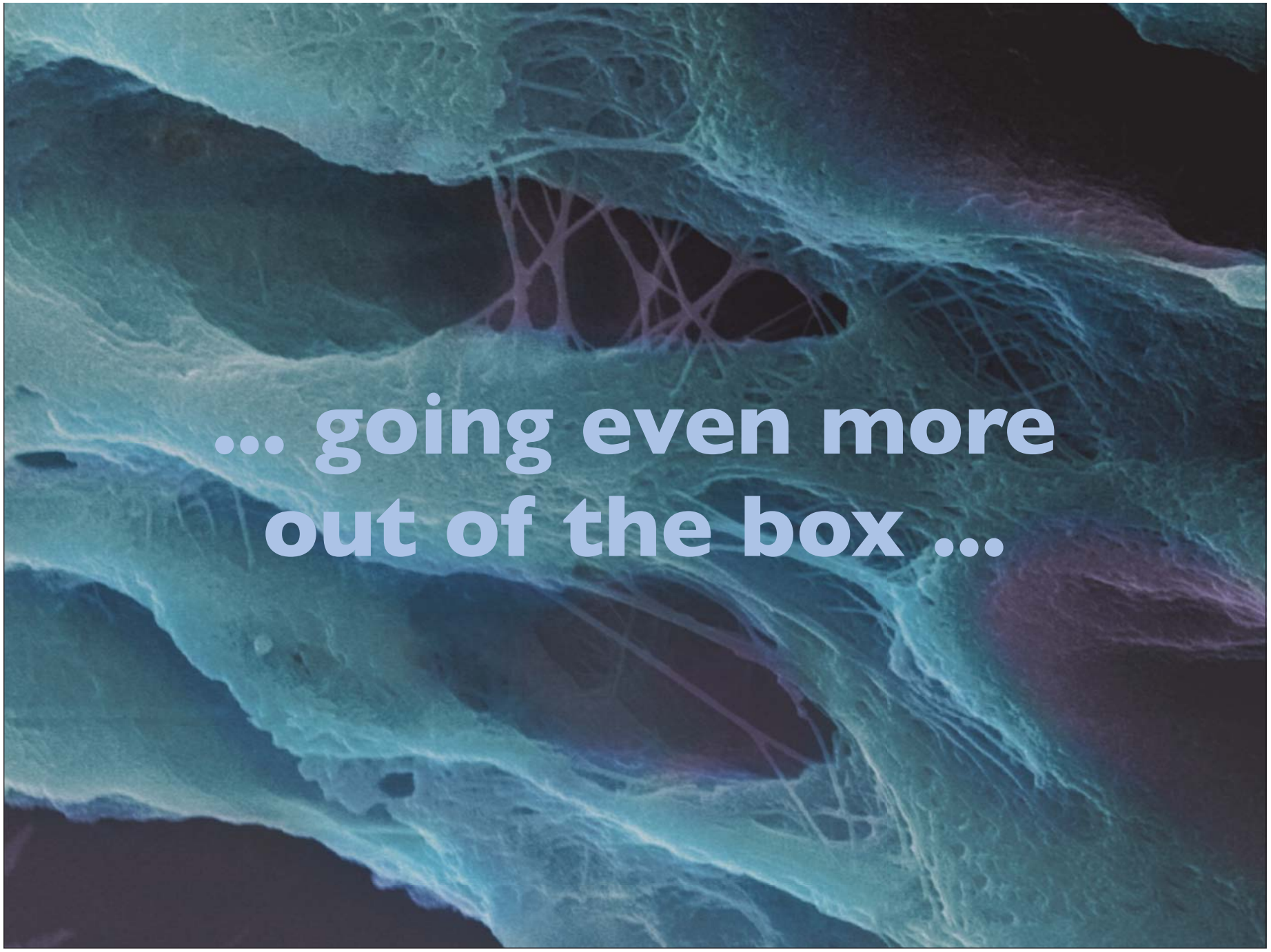
Over the past twenty years many types of laser sources have been studied and used as a means to improve upon the classical dental treatments.[1-4] No single "universal" laser source has been found that could be effectively and safely used for every dental procedure. Instead, as studies have demonstrated, each of the laser-assisted procedures should be performed with a laser that produces laser pulses at a wavelength that is known to be most effective for that particular procedure. In addition, many treatments would benefit immensely if they were performed with a succession or simultaneously using a multiplicity of laser sources. Of course, having a large number of laser sources in a practice would be impractical and very expensive. For this reason, the TwinLight™ treatment concept has been developed by Fotona d.d., based on the scientific understanding and clinical experience that for most laser-assisted treatments there exists an optimal combination of two basic complementary crystal laser sources, namely the Nd:YAG and the Er:YAG laser sources. The Nd:YAG laser wavelength (1,064 nm) is the most versatile and most deeply penetrating laser wavelength, while the Er:YAG laser wavelength (2,940 nm) is the wavelength with the highest absorption in human tissues (Fig. 1).

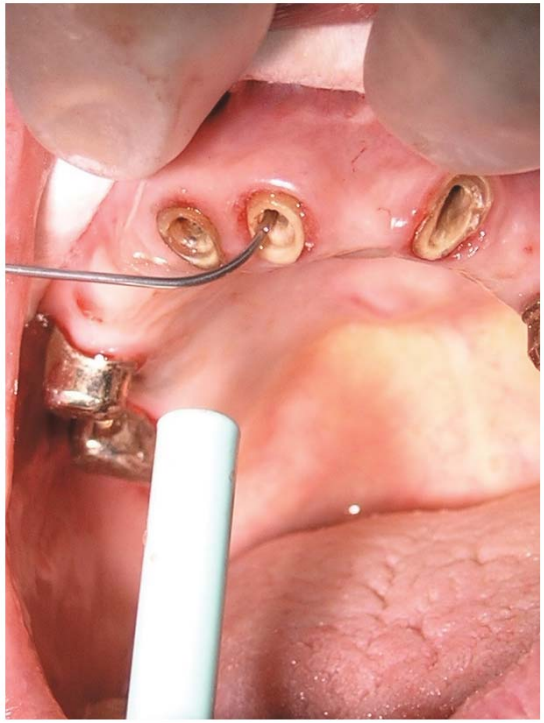
The use of the TwinLight™ laser-treatment concept in the field of endodontics was recently introduced by Dr Norbert Gutknecht.[5]

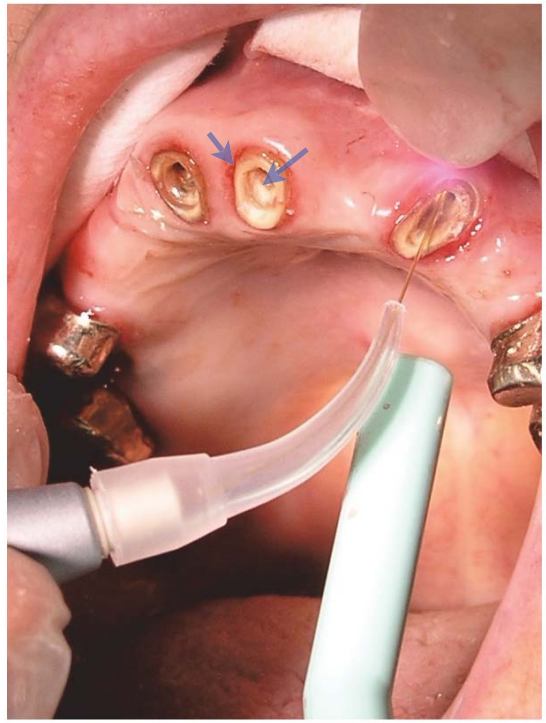
_The Nd:YAG laser wavelength in endodontics

For addressing the problem of deeply lying bacteria, lasers with a deep penetration into dentin, and preferably with a high peak-pulse power, are now being routinely used for disinfecting root canal systems.[6-13] As a result of their capability to spread and


Laser&Health
ACADEMY

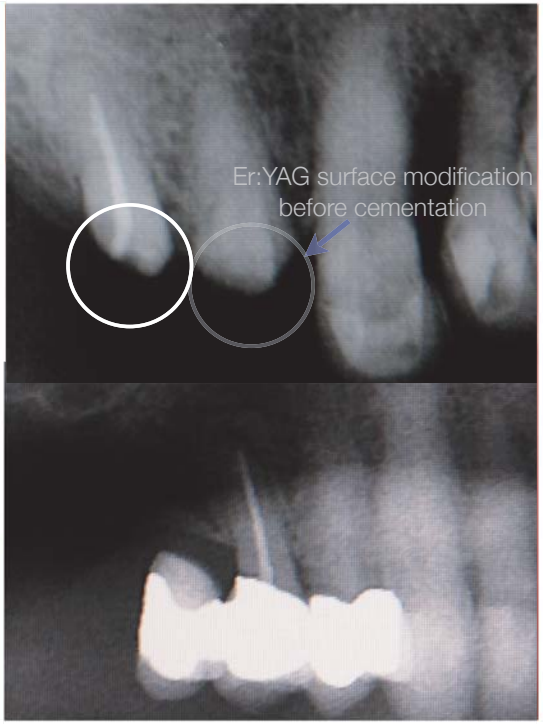

... going even more
out of the box ...



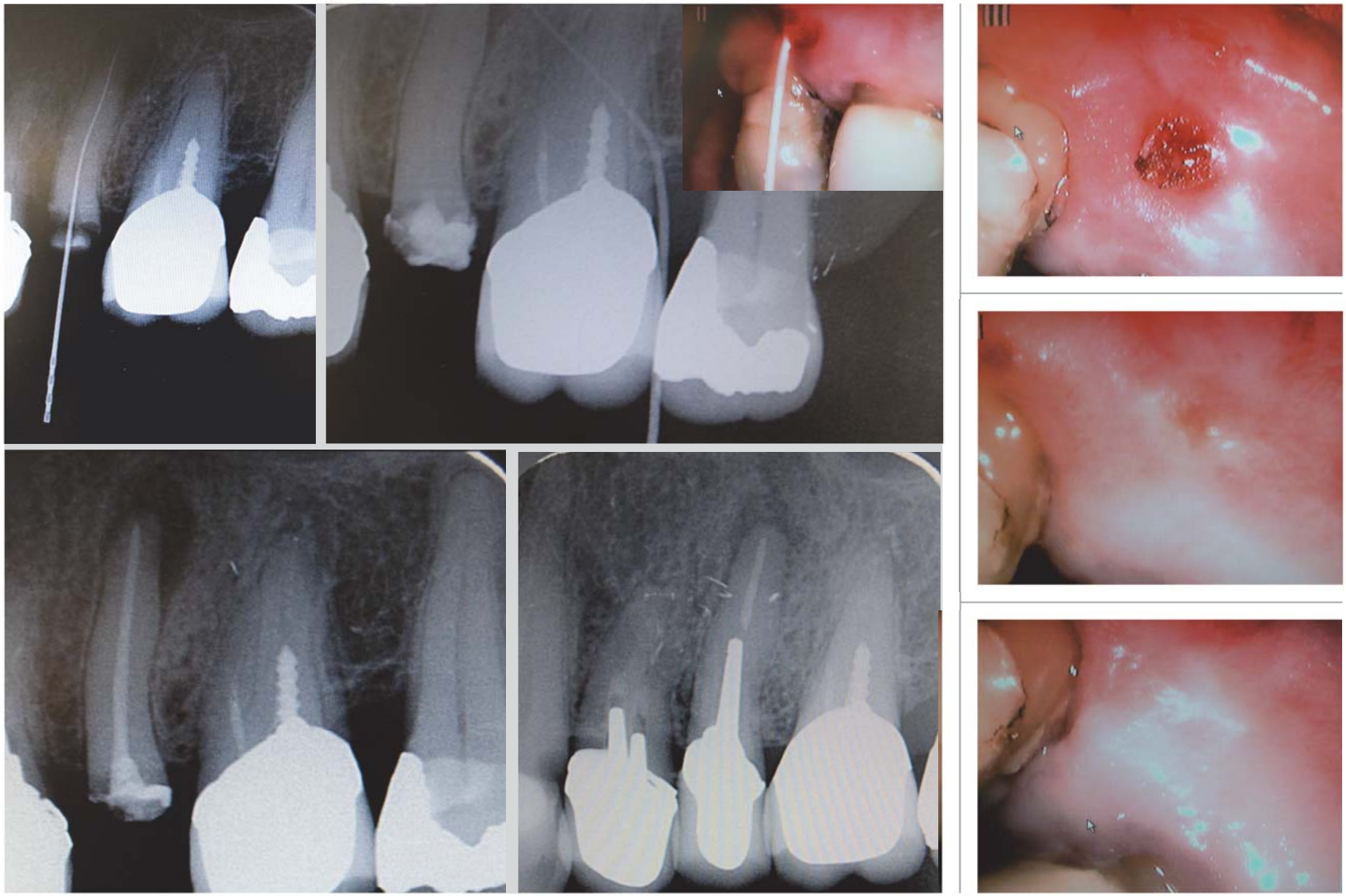


root decontamination after temporaries & **sulcus troughing**
before definitive cementation of retentive elements on root caps
integrated into hybrid removable prosthesis

one session emergency case



root photodebridement & photodecontamination
sulcus troughing
before definitive cementation of a pin on tooth 15
recostruction & recementation of the bridge as a short therm solution



active fistula
from a periapical pathology 25 in the area buccala 26


Thank you
for
your attention !!