

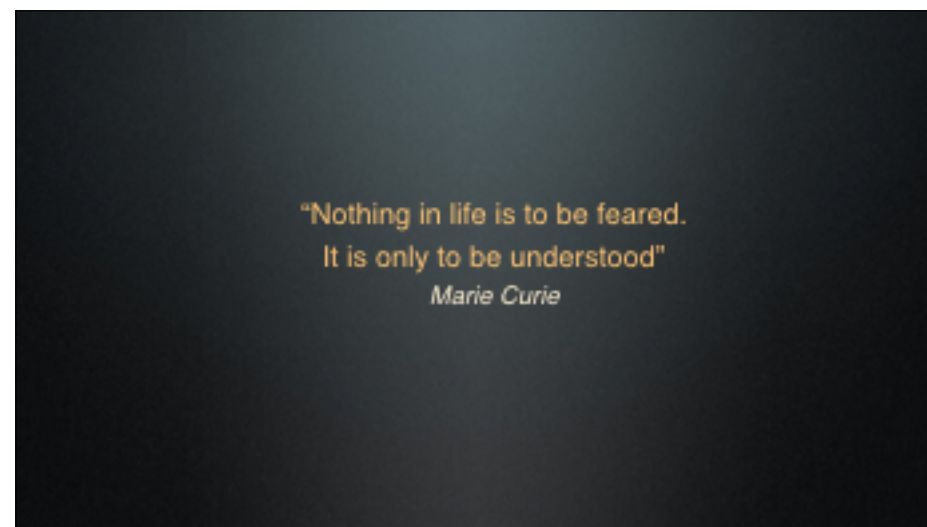
1



2



3



4

The Prevention & Treatment of Apical Periodontitis



5

The diagram on the left shows a yellow rocket with a red stripe, launching from a purple launch pad. A red arrow points from the rocket's base to a small, colorful, multi-colored object. To the right, a cartoon character with large eyes and a wide mouth is shown, with a red arrow pointing from its mouth to the same small object. Below the character, the text "Crisi Marburgensis" and "Hoclenia, Venus, F" is visible.

Kakimoto et al. 1963

6

Retrospective Evaluation of Surgical Endodontic Treatment: Traditional versus Modern Technique

1st June, 1993;¹ 2nd June, 1993;² Personal observations; and (3) 1993;³ and 2nd June, 1993.⁴



Heart

2006 JOE

Outcome of Endodontic Surgery: A Meta-analysis of the Literature—Part 1: Comparison of Traditional Root-end Surgery and Endodontic Microsurgery

Pham C, Gurney 2002, 1994, 90; Smith H 1944, 1970, 1982; Smith H, Kelly 1974, 1989; Wilson R, Gurney 1982, 85, and Gurney R, 1970, 1947



Life vest



2010 JOE

7

8

Periapical Microsurgery: Hard Tissue Management

De Rigueur Root-end Assessment & Management

- Root-end resection & inspection
- Root-end cavity preparation
- Root-end filling materials

9

Seeking Alpha in Education of Periapical Microsurgery

Alpha:
A measure of performance on a risk-adjusted basis

10

Seeking Alpha



11

Indirect Vision in Periapical Microsurgery



12

Bringing Alpha in Periapical Microsurgery

Indirect

Direct



13

Indirect Vision in Periapical Microsurgery



14

Bringing Alpha in Periapical Microsurgery

Indirect

Direct

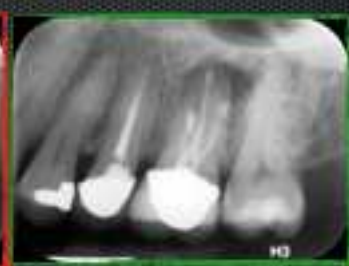


15

Bringing Alpha in Periapical Microsurgery

Indirect

Direct



16

Direct Vision Enhances Alpha

Prognostic Factors of Clinical Outcomes in Endodontic Microsurgery: A Prospective Study

Mingyi Song, DDS, MEd, PhD,¹ Sahng Gyeon Kim, DDS, MS,² Seungjung Im, DDS, MS, PhD,³ Baekil Kim, DDS, MEd, PhD,² and Eunyoung Kim, DDS, MEd, PhD²

In endodontic microsurgery, the **tooth position** and **arch type** have a greater influence on the healing outcome than intra and post operative factors.

2011, JOE

17

Result of Indirect Vision

Outcomes of Endodontic Micro-resurgery: A Prospective Clinical Study

Mingyi Song, DDS, MEd, Seungjung Im, DDS, MS, and Eunyoung Kim, DDS, MEd, PhD

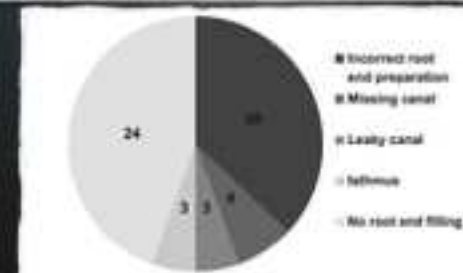


Figure 1. Possible causes of failure in previous surgery.

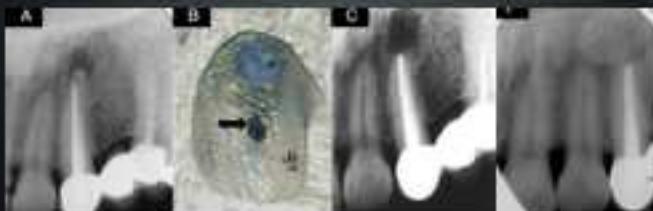
2011, JOE

18

Outcomes of Endodontic Micro-resurgery: A Prospective Clinical Study

Mingyi Song, DDS, MEd, Seungjung Im, DDS, MS, and Eunyoung Kim, DDS, MEd, PhD

Old failed apicoectomies cases that were redone with modern Periapical Microsurgery techniques showed a 93% success after 2 years



2011, JOE

19

Root-End resection & Inspection In High Definition → Direct Vision

- Microscope articulation
- Seating position
- Bevel
- Clinical Execution



20

Getting Direct Vision for Dentinal Defects Assessment & Management

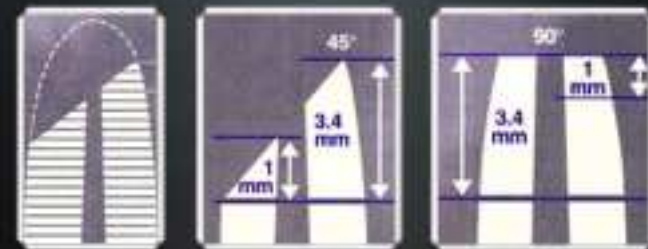
The Root #Misconception



21

The Seal Misconception

Tidmarsh et al 1989 → #Tubules misconception
Gilheany et al 1994 → #Seal misconception



Partial Litter in Endodontic Surgery
Arms, Tracheal, Cerebral, Antibiotic

22

#Tubules misconception

International Endodontic Journal (1989) 22, 194-199

Dentinal tubules at the root ends of apicect teeth: a scanning electron microscopic study

B. G. TIDMARSH & M. G. ARROWSMITH Department of Restorative Dentistry,
University of Otago School of Dentistry, Dunedin, New Zealand

Two groups of teeth, one of which contained teeth of known age. Scanning electron microscopy to count numbers of dentinal tubules.

Mid-root: 27,000 tubules per mm

Close to the dentine-cementum: 13,000 tubules per mm

23

#Tubules don't matter

International Endodontic Journal (1989) 22, 194-199

Dentinal tubules at the root ends of apicect teeth: a scanning electron microscopic study

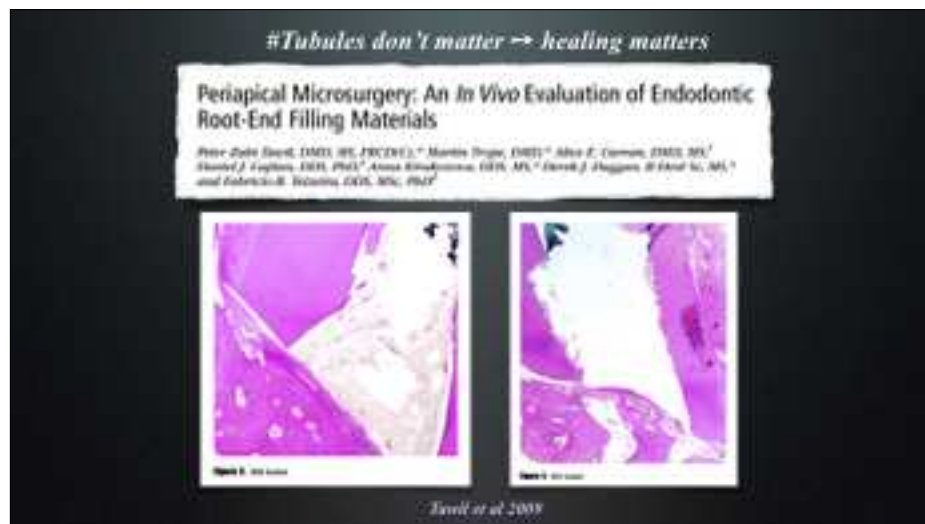
B. G. TIDMARSH & M. G. ARROWSMITH Department of Restorative Dentistry,
University of Otago School of Dentistry, Dunedin, New Zealand

By Tidmarsh

Amel (H) awareness

is this through procedure the incorporation of root canal

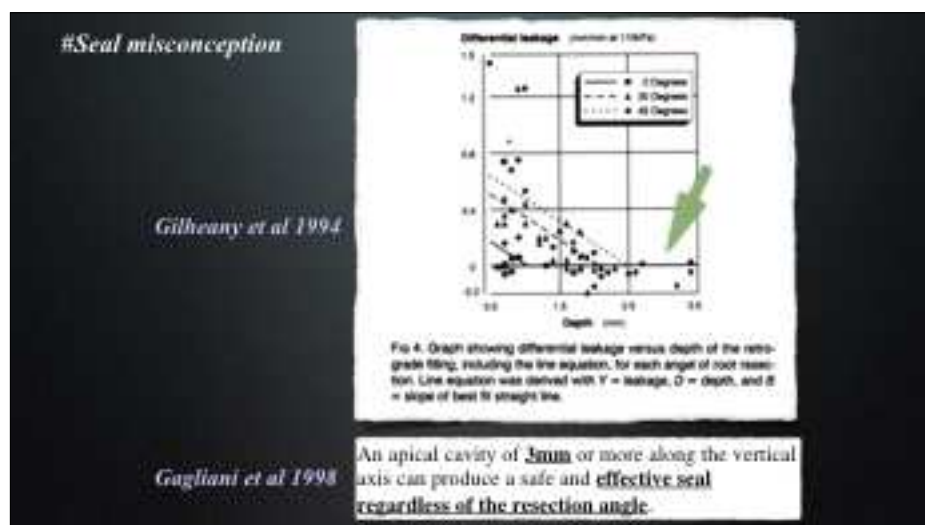
24



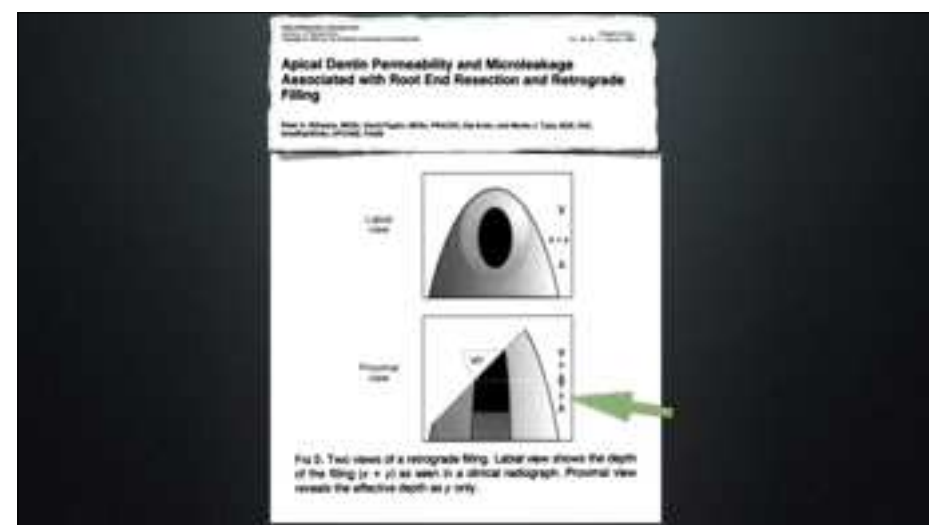
25



26



27



28



29

**Getting Direct Vision for
Dentinal Defects Assessment & Management**

The best risk adjusted performance (Alpha) in apical
microsurgery is obtained through direct vision

#BringBevelBack

30

Root-End resection & Inspection
In High Definition → Direct Vision

- Microscope articulation
- Seating position
- Bevel
- Clinical Execution**

31

3mm root-end resection

Canal ramifications and deltas are located in the
apical area of the root

De Deus 1971, reprint 1997
Seltzer et al 1986

32

3mm root-end resection



Partial Lesion in Endodontic Surgery
Arns, Trindade, Chiriac, Ambrosio

33

Root-end resection Cutting VS Shaving → Why not both...?



Partial Lesion in Endodontic Surgery
Arns, Trindade, Chiriac, Ambrosio

34

Biopsy

Is the apical lesion harmless?



35

American Association of Endodontists Indication for a biopsy



- Adequate amount of tissue removed from surgical site
- Pathosis inconsistent with endodontic disease
- Medical history indicates the merits of biopsy
- ▶ At no time should a surgeon remove tissue and accept the responsibility of its diagnosis based on its appearance, color, or consistency

~ Lin & al 1998, Walton 1998, Moody & al 2004
VS

• Brazier 2005, Solner 1997, Stockdale 1998, Spolek 1993, Robinson 1993, Tyler-Kolado et al 2012, Rice 2005, Peters 2002

36



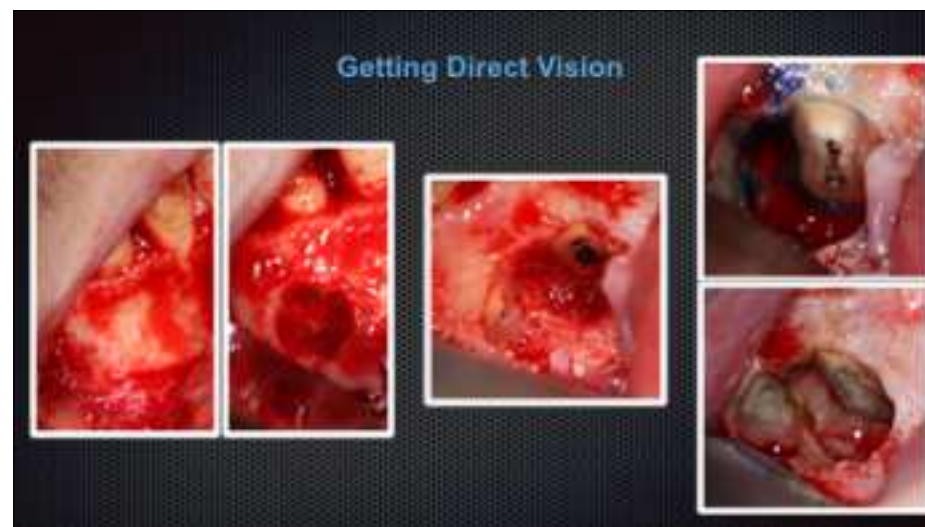
37



38



39



40

Root-end resection



41

Root-end resection



Use new surgical length carbide burs to avoid excessive heat generation (Calderwood 1964)

Diamond burs are inefficient at cutting bone and create excessive heat (Loken 1961)

42

Inspection of the resected root

- ◆ Magnification, illumination and methylene blue staining
- ◆ Identification of un-negotiated canals & isthmuses is the first and most important step after root-end resection
- ◆ Dentinal defects and cracks at the cut root surface decrease the outcome

Von Arx et al 2011, Tawil et al 2015

43

Transillumination




M. Coelho, S. Card, P. Tawil, 2016

44

Transillumination

- ✓ Ensure complete resection of the root
- ✓ Visualize the isthmuses
- ✓ Investigate for any potential fracture or dentinal defects



Tawil et al 2015

45

Methylene Blue

- ✓ Ensure complete resection of the root
- ✓ Visualize the isthmuses
- ✓ Investigate for any potential fracture



Hoskinson A.E. 2005, Endod Topics

46

Inspection of the resected root



Vin Aze et al 2011

47

Periapical Microsurgery: Root-End Inspection



P.Z. Tawil

48

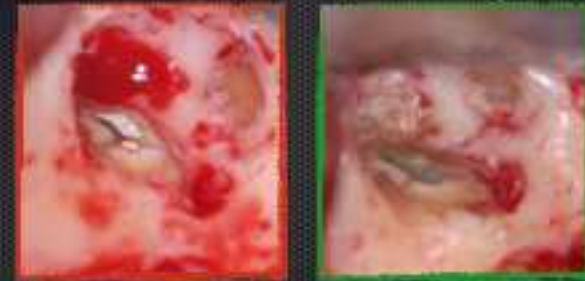
Root Resections : Missed Canals



Tanaka et al. 2010

49

Root Resections : Isthmuses



50

Root Resections : Isthmuses



Tanaka et al. 2010

51

Root Resections : Isthmuses



Kim et al. 2010

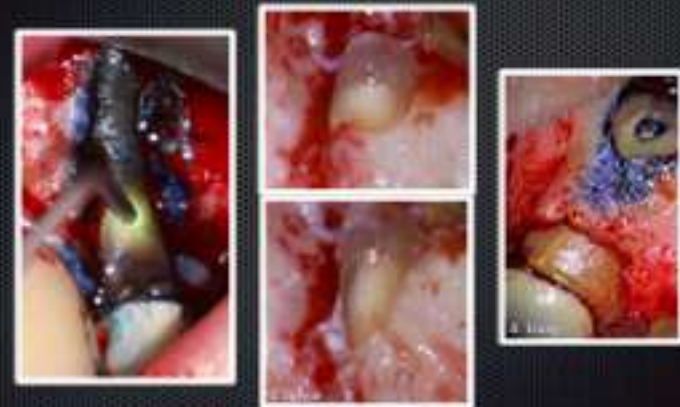
52

Root Resections : Isthmuses



53

Root Resections : Fractures



54

Root Resections : Dentinal Defects



Tawil et al 2018

55

Root Resections : Dentinal Defects



Tawil et al 2018

56

Clinical Research

Periapical Microsurgery: The Effect of Root Dentine Defects on Short- and Long-term Outcome

Peter Z. Tawil, DMD, MS, FRCD(C), Dip ABE,* Vincent M. Savatys, DDS, MPR,*
Johnnie C. Gallick, DMD, MS, PhD† and Derek J. Duggan, BDS, MS, Dip ABE*

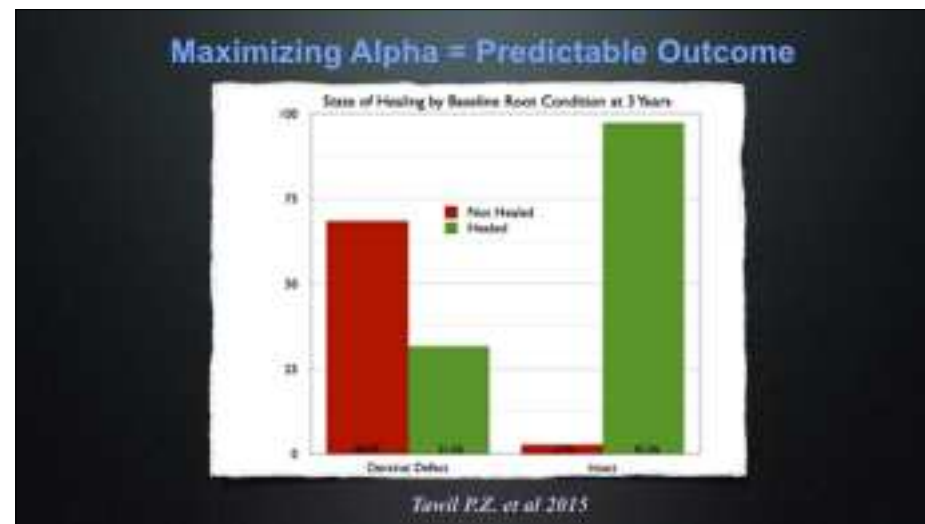
Significant **superior clinical outcome for intact roots** when compared with roots with dentinal defects

Intact roots: 97.3% complete healing at 3 years

Dentinal defect roots: 31.5% complete healing at 3 years

Tawil P.Z. et al 2015

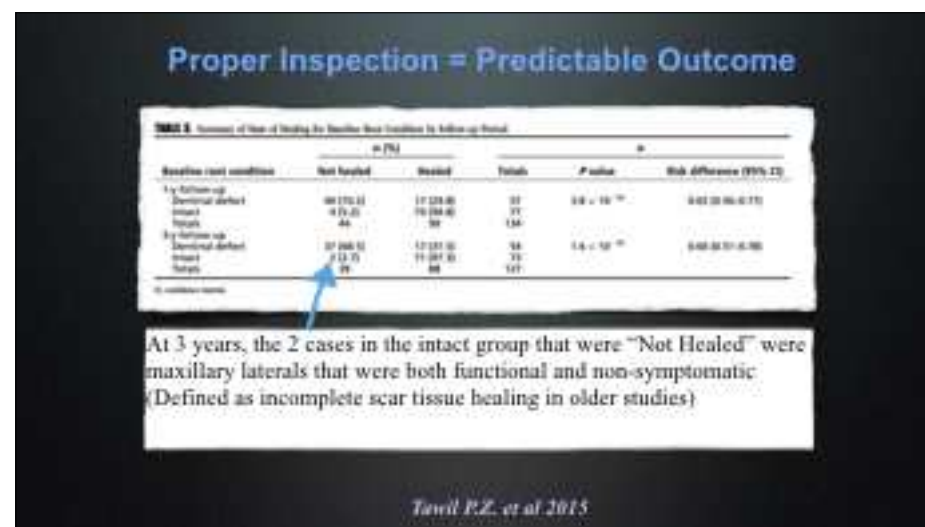
57



58



59



60

What's causing dentinal defects?

Tawil et al. *Evidence-Based Endodontics* (2017) 28
DOI 10.1186/s41213-017-0014-3

Evidence-Based Endodontics

REVIEW

Open Access

Root-originating dentinal defects: methodological aspects and clinical relevance

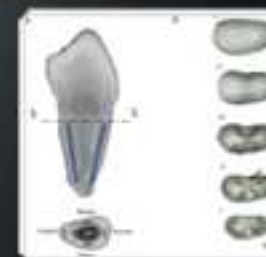
Peter Zahn Tawil^{1*}, Elise Kristin Arnardottir² and Massimo Santoro Corbelli³

Basic Research—Biology

Reduction in Fracture Resistance of the Root with Aging

Wenchi Sun^{1*}, Caroline Montoya, PhD², Marc Ellis, DDS, PhD^{1,3}, Alex Hase, PhD¹,
Arina Panagiotou, BDS, MS, MSD, PhD⁴, Mai Zhang, DMD, PhD¹, and Douglas Arora, PhD^{1,2,3}

- Damage tolerance reduction of radicular dentin with increasing age.
- Related to changes in the microstructure, chemical composition and increase collagen cross-linking.
- Most severe near the apex.



Yan et al. 2017 JGE

61

62

Periapical Microsurgery: Can Root Canal Retreatment Clinically Cause More Dentinal Defects?

Arnardottir E.K., Saemundsson S.R., Phillips C., Tawil P.Z., 2018



- Retreated teeth had more dentinal defects ($p < 0.001$)
- Multivariate analysis showed only the type of treatment to be significant ($p < 0.001$)
- Multivariate analysis included: age, gender, tooth location and treatment

Managing Dentinal Defects & Fractures

63

64

Case 1/3



65



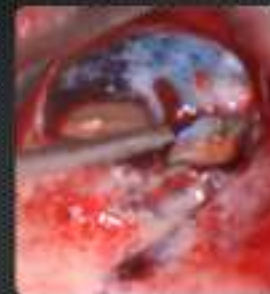
Access & Resection → Smooth 1 plane

66



Polish and remove defect → Smooth 1 plane

67



Final Inspection

68



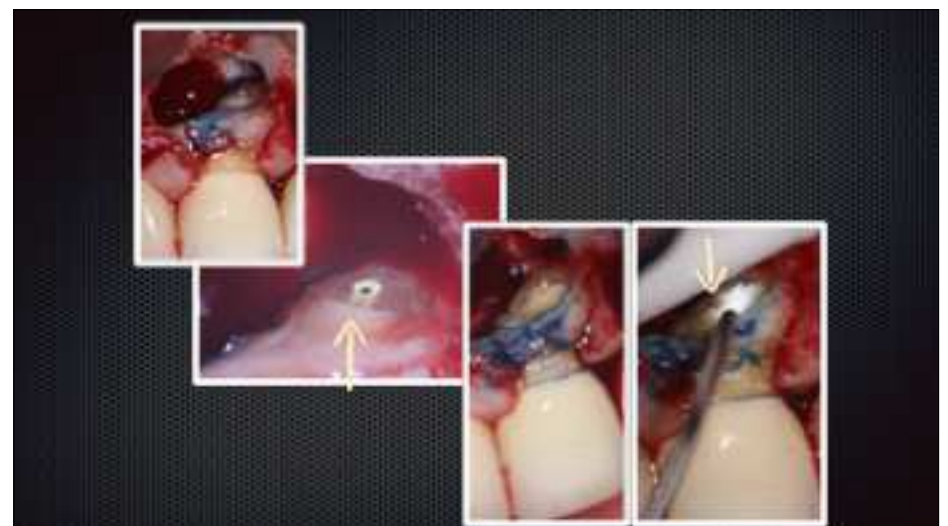
69



70



71



72



73



74



75

Periapical Microsurgery: Hard Tissue Management

De Rigueur Root-end Assessment & Management

- Root-end resection & inspection
- Root-end cavity preparation
- Root-end filling materials



Get your surgical alpha
Do it!

76

Root-end cavity preparation

The advantages that ultrasonic tips offer over burs

- ✓ Deeper root-end preparation
- ✓ Parallel walls in the axis of the root
- ✓ More retention
- ✓ Less bevel is needed
- ✓ Smaller bony crypt



Minakawa J. et al 1977, Rockwell B. et al 1999
Hosoi et al. Periapical Extension of Root-end Preparation

77

Clinical Research

Periapical Microsurgery: Can Ultrasonic Root-end Preparations Clinically Create or Propagate Dentinal Defects?

Page 27, J End, 1995; 30: 550-553, 55p 550

Ultrasonic root-end preparations are **safe to use on intact roots**.

Preexisting **dentinal defects can be propagated by ultrasonic root-end preparations**.

Through the use of LED, dentinal defects can be detected, special root-end management can be implemented, & more predictable outcomes may be achieved.

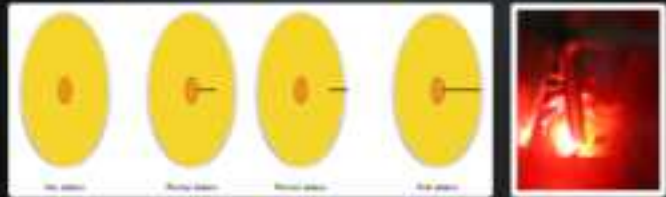
Tawil P.Z. 2016 JOE

78

Periapical Microsurgery: Can Ultrasonic Root-end Preparations Clinically Create or Propagate Dentinal Defects?

Page 27, J End, 1995; 30: 550-553, 55p 550

- Ultrasonic root-end preparations are safe to use on intact roots
- Preexisting dentinal defects can be propagated by ultrasonic root-end preparations and special root-end management should be implemented



No defect, Minor defect, Moderate defect, Severe defect

79

Root-end cavity preparation

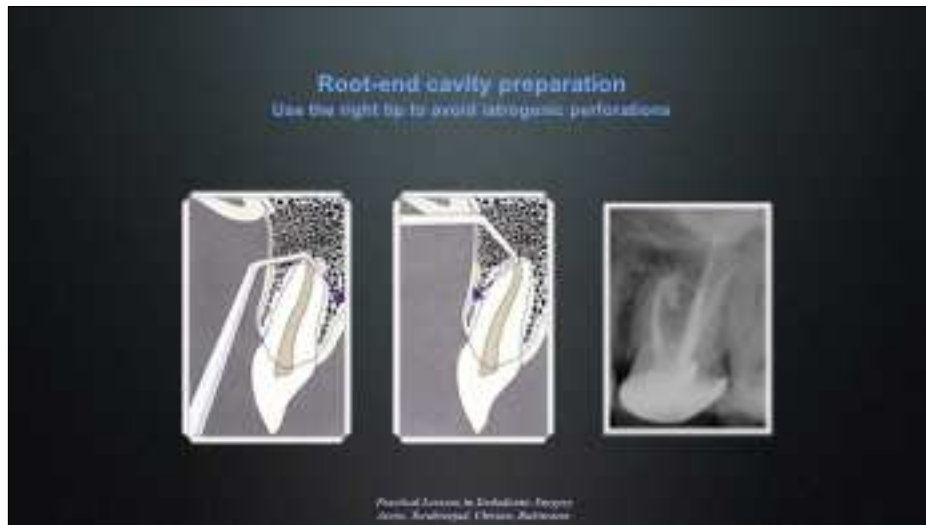
When treating teeth with thin roots:

- ✓ Use lower setting on the ultrasonic unit
- ✓ Use diamond coated ultrasonic tips
- ✓ Use light apical pressure, letting the instrument go to the path of least resistance along the path of the canal

Layton, Marshall, Morgan and Baumgartner 1996

- ✓ When root have cracks, more cracks were generated with a high setting of the ultrasonic

80



81



82



83



84

Endo Success Surgical Ultrasonic tips

3 length tips for deep retro-preparations by Bernhard Wenzel



A250 3mm tip



A250 3mm tip



A250 3mm tip

85

Periapical Microsurgery: Hard Tissue Management

De Rigueur Root-end Assessment & Management

- Root-end resection & inspection
- Root-end cavity preparation
- Root-end filling materials

86

Root-end fillings

Needs to be biocompatible and needs to offer a good apical seal
(in order to cut off the nutrients from the anaerobe bacteria)

- ▣ MTA
- ▣ Zinc oxide (SuperEBA / IRM)
- ▣ BioCementic (EndoSequence)
- ▣ BioDentine (Sagadent)
- ▣ Resins (Retropast, Gensistore)
- ▣ Acrylics

87



MTA



- Cost effective
- Easy to mix, similar to wet sand on the beach
- Easiest to place when used with proper instruments
- ProRoot MTA working time: 3-5 hours
- MTA Angelus working time: 10-15 minutes
- Easy to place: if used with proper instrument (MAP system or Davgan carrier)



88



89

MTA Clinical Outcome Studies

Von Arx Thomas & al
✓ 1 year follow up with 90% success for MTA.

Chong and Pitt Ford 2003
✓ 2 year follow up with 92% success for MTA.

Tawil P.Z. et al 2009
✓ Dog study showed new PDL regeneration for both MTA & IRM

Tawil P.Z. et al 2015
✓ 3 year follow up with 97% success for MTA & IRM

Standard MTA

The slide features several small images: a box of MTA, a box of IRM, a box of MTA, a box of IRM, a box of MTA, and a box of IRM.

90

MTA Literature

Parirokh & Torabinejad 2010
Part 1 Chemical, physical and antibacterial properties

Torabinejad & Parirokh 2010
Part 2 Leakage and biocompatibility investigations

Parirokh & Torabinejad 2010
Part 3 Clinical applications, drawbacks and mechanism of action

The slide includes several small images: a box of MTA, a box of IRM, a box of MTA, a box of IRM, a box of MTA, and a box of IRM.

91

Zinc oxide: SuperEBA & IRM

- Cost effective materials
- SuperEBA is hard to mix, but once properly mixed it handles well
- To avoid your instrument from sticking to these materials: Dip the tip of your condenser in the powder or in saline

The slide features two small images: a box of SuperEBA and a box of IRM.

92

Zinc oxide: SuperEBA & IRM
Are ideally polished when the set

Fitzpatrick & al 1997
Retrofillings finished with a finishing bur displayed significantly better marginal adaptation (EBA & IRM)



Practical Aspects in Endodontic Therapy
Dent. Radiological Clinics Baltimore

93

Zinc oxide: SuperEBA & IRM
Clinical outcome studies

Rubinstein & al 2002

✓ 5-7 year follow with 91.5% success for SuperEBA

Maddaloni et al 2003

✓ 3 year follow up with 92.5% success for SuperEBA

Zuolo et al 2006

✓ 1-4 year follow up with 91.2% success for IRM

Tawil P.Z. et al 2009

✓ Dog study showed new PDL regeneration for both MTA & IRM

Tawil P.Z. et al 2015

✓ 3 year follow up with 97% success for MTA & IRM

Healed IRM



94

BioCeramic

Setting time: 4h or 20 minutes

- New "BioCeramic" material
- Made out of calcium silicate (like MTA), zirconium oxide, tantalum oxide, calcium phosphate and filler agents
- Comes in a putty in a jar or in an injectable syringe
- Most publications are case reports or in-vitro studies
- Great promising material, but we still lack published outcome studies from independent sources



95

BioDentine
Setting time: 10-12 minutes

- New "Active Bio-Silicate Technology"
- Made out of Calcium Silicate (like MTA), Calcium Carbonate, Calcium Oxide, Iron Oxide and Zirconium oxide
- Most publications are case reports or in-vitro studies
- Great promising material, but we still lack published outcome studies from independent sources



96



Resins



- A dome/concave retro-preparation shape is usually used
- Useful in cases with long metal posts where a deep retro-preparation is impossible to obtain
- These bonding techniques are moisture sensitive and clinically challenging to use in a surgical site
- Retroplast has good clinical outcome studies
- Geristore has conflicting results in clinical outcome studies

97



Resins Clinical outcome studies



Rud J, Rud V 1997

✓ 4 year follow up with 92% success for Retroplast

Von Arx et al 2010

✓ 1 year follow up showed 79.5% success for Retroplast

✓ 1 year follow up showed 91% success for MTA

Tawil P.Z. et al 2009

✓ Dog study: Geristore had worst results in histology when compared to IRM & MTA



98

Amalgam

Problems

- It initially leaks due to the metal primary shrinkage
- Produces corrosive by-products
- Risk of mercury contamination
- Moisture sensitive
- May cause tissue tattooing
- Scattered particles are not absorbable by the body
- Galvanic effect when in contact with metal posts



Dorn and Gartner 1990

- ✓ 10 year follow up showed a significant higher failure rate for amalgam
- ✓ Success: 75% for amalgam, 95% for Super EBA

99

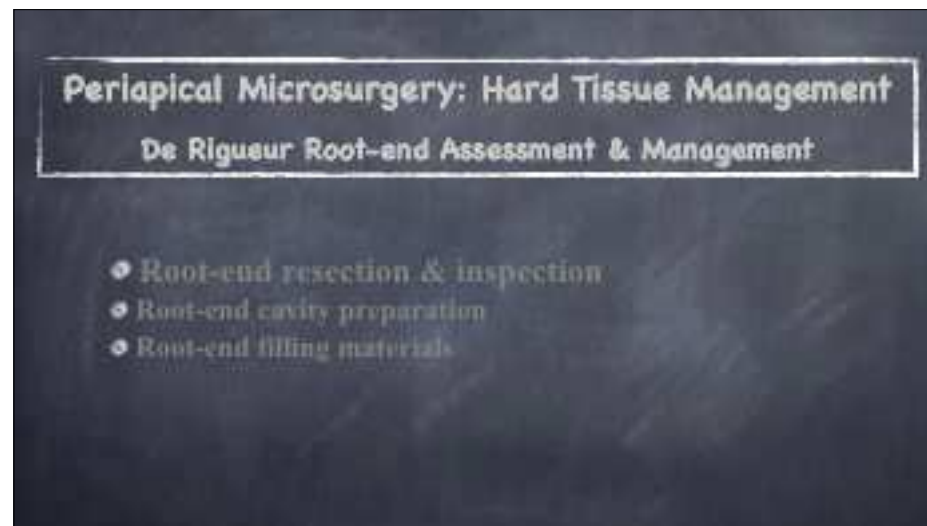
Clinical examples

Root-end management

100



101



102



103