MTA and Bioceramics

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MTA and Bioceramics

- Part 1. What is MTA and what are bioceramics?
- Part 2. MTA for pulp capping and pulpotomy
- Part 3. MTA for perforation repair
- Part 4. MTA for apical barrier placement
- Part 5. Other uses in endodontics
- Part 6. Prosthodontic perforations

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Success rates

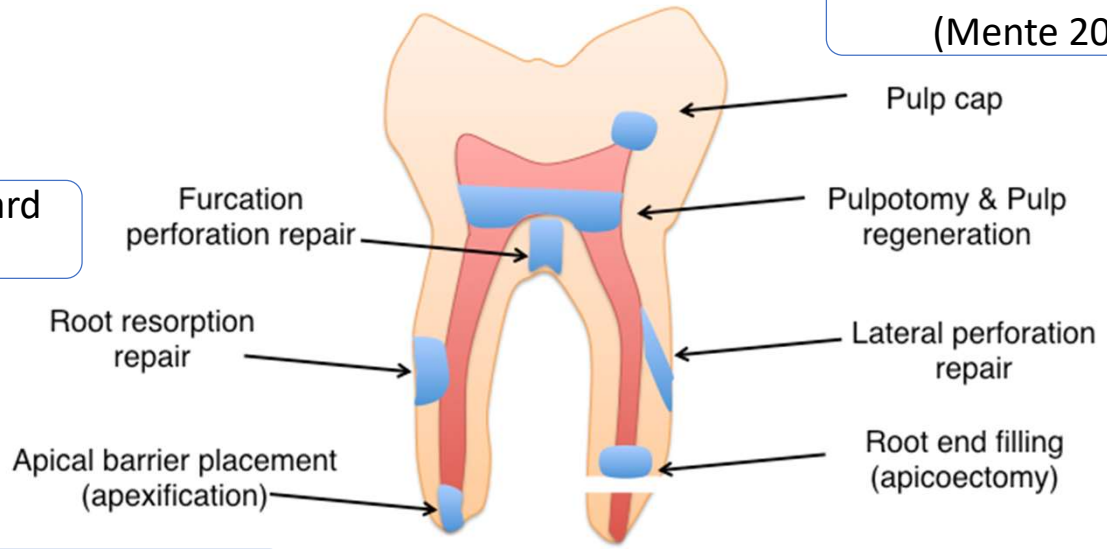
MTA ≥ CaOH
(Mente 2014, Zhu 2015)

MTA ≥ Formocresol ≥ FeSO4
(Lin 2014)

MTA is the gold standard in pulp regeneration (Kim 2018)

MTA > SuperEBA > Amalgam
(Von Arx 2007)

MTA is the gold standard
(Siew 2015)



MTA ≥ CaOH
(Lin 2014)

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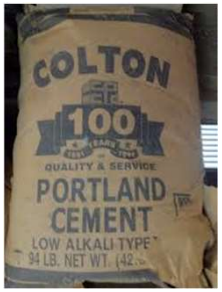
Part 1: What is MTA?



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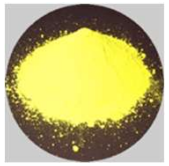

+

FDA

CE

=

80% Portland Cement Therapeutic component

20% Bismuth Oxide Radiopaque agent

Quality Assurance

Cement fit for human use

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General properties of MTA

- Great seal and low leakage
- Promotes hard tissue formation
  - Hydroxyapatite, dentine and cementum can form against MTA, hence the seal could improve with time
- Biocompatible
- Relatively insoluble

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Parirokh 2010, Torabinejad 2010

Leakage and Seal

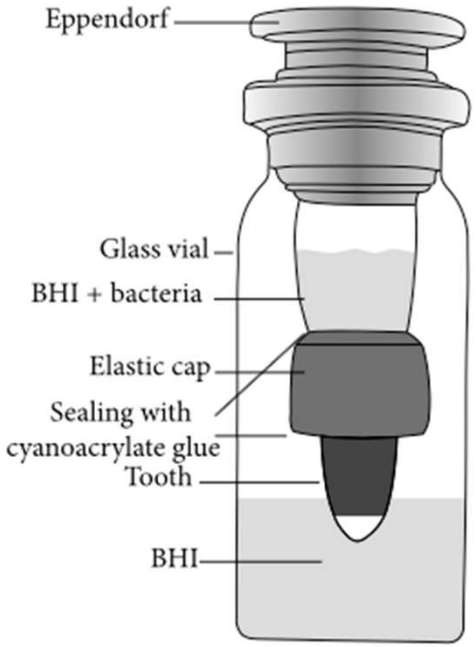

Figure 1: The leakage evaluation system.

Material	Size	Estimate of the number of days with no microleakage
MTA	1 mm	67
	2 mm	64.3
	3 mm	75.7
Gutta-percha	4 mm	22.4
	5 mm	24.8

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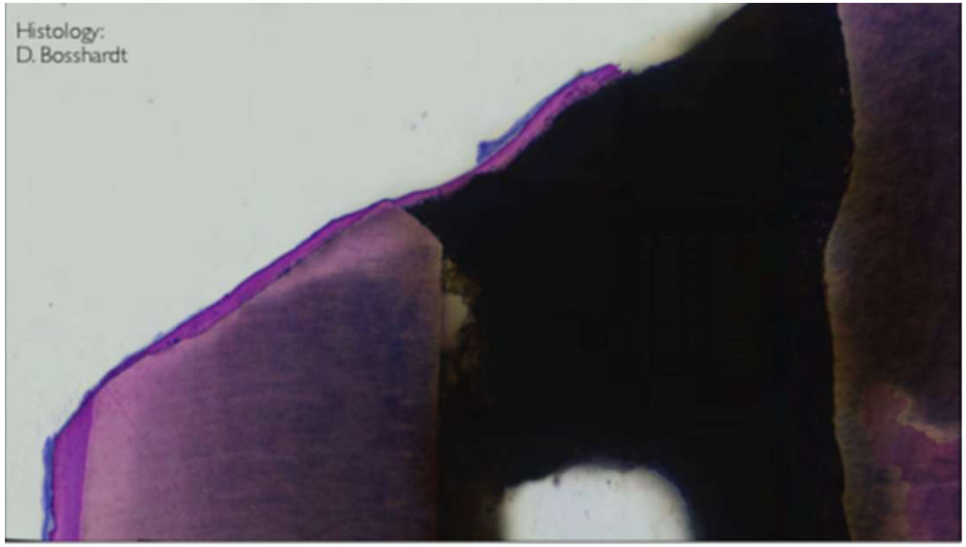
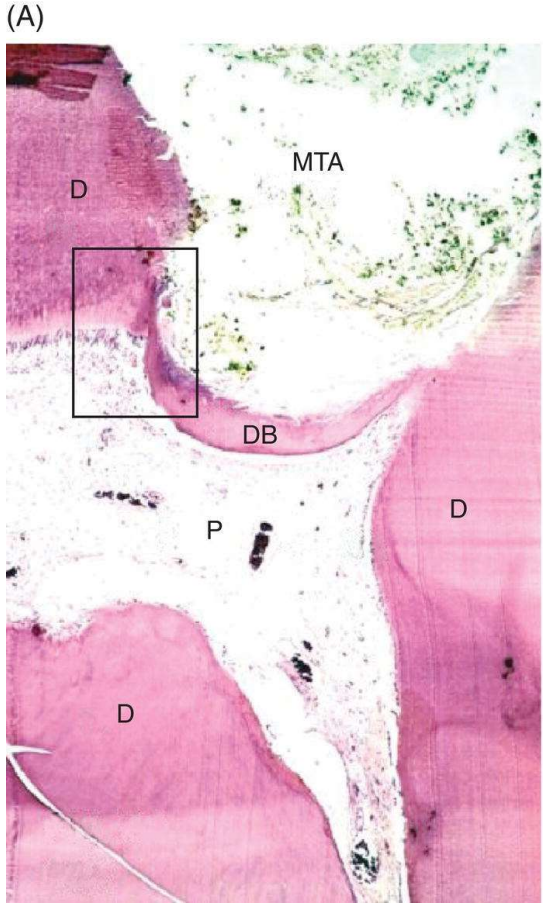
Reyhani 2015

MTA promotes hard tissue barriers





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Von Arx 2017, Caicedo 2006

Biocompatible

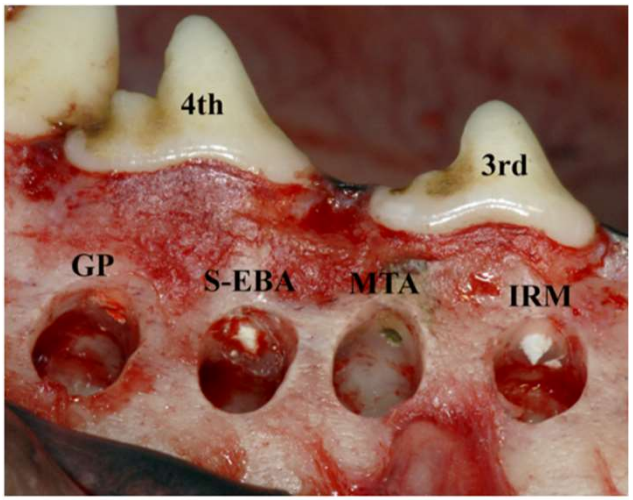

Table 1. MEAN VALUES FROM HISTOLOGIC FINDINGS FOR ALL ANALYZED MATERIAL SECTIONS (N = 23): MAXIMUM, MINIMUM, AND AVERAGE HEIGHTS OF RETROGRADE FILLINGS

Material	Maximum Height (mm)	Minimum Height (mm)	Average Height (mm)	Inflammatory Score	Bone-Material Distance (μm)	Re-established Buccal Bone (%)
GP (n = 6)	3.38	2.63	3	2.33	1,403	33
S-EBA (n = 6)	2.48	1.87	2.18	2.17	1,216	67
IRM (n = 6)	2.63	1.73	2.18	1.5	571.7	100
MTA (n = 5)	2.28	1.5	1.89	1.4	398.7	100

Abbreviations: GP, gutta-percha; IRM, intermediate restorative material; MTA, mineral trioxide aggregate; S-EBA, Super-EBA.

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Wälivaara 2012

Portland cement:

- Calcium silicates:
- 45-75% $2(CaO)_3SiO_2 + 7H_2O \Rightarrow (CaO)_3(SiO2)_2 \bullet 4H_2O + 3Ca(OH)_2$
- 7-32% $2(CaO)_2SiO_2 + 5H_2O \Rightarrow (CaO)_3(SiO_2)_2 \bullet 4H_2O + Ca(OH)_2$
- Calcium aluminate
- 0-13% $2(CaO)_3Al_2O_3 + 21H_2O \Rightarrow 2(CaO)_3Al_2O_3 \bullet 6(H_2O) + 9H_2O$

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Portland cement:

- Calcium silicates
- 45-75%
- 7-32%
- Calcium aluminate
- 0-13%

Solid Powder

Liquid Water

Solid Crystals

$2(CaO)_3SiO_2 + 7H_2O \Rightarrow (CaO)_3(SiO2)_2 \bullet 4H_2O +$

$2(CaO)_2SiO_2 + 5H_2O \Rightarrow (CaO)_3(SiO_2)_2 \bullet 4H_2O +$

$2(CaO)_3Al_2O_3 + 21H_2O \Rightarrow 2(CaO)_3Al_2O_3 \bullet 6(H_2O) +$

Soluble CaOH

$3Ca(OH)_2$

$Ca(OH)_2$

Liquid Water

$9H_2O$

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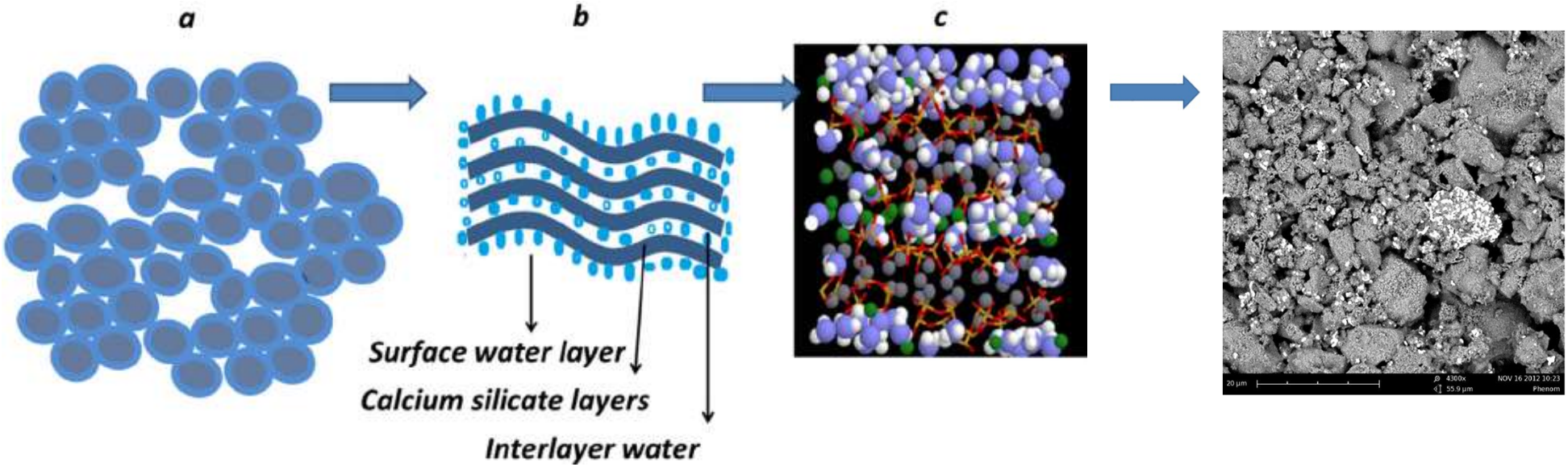
Reaction



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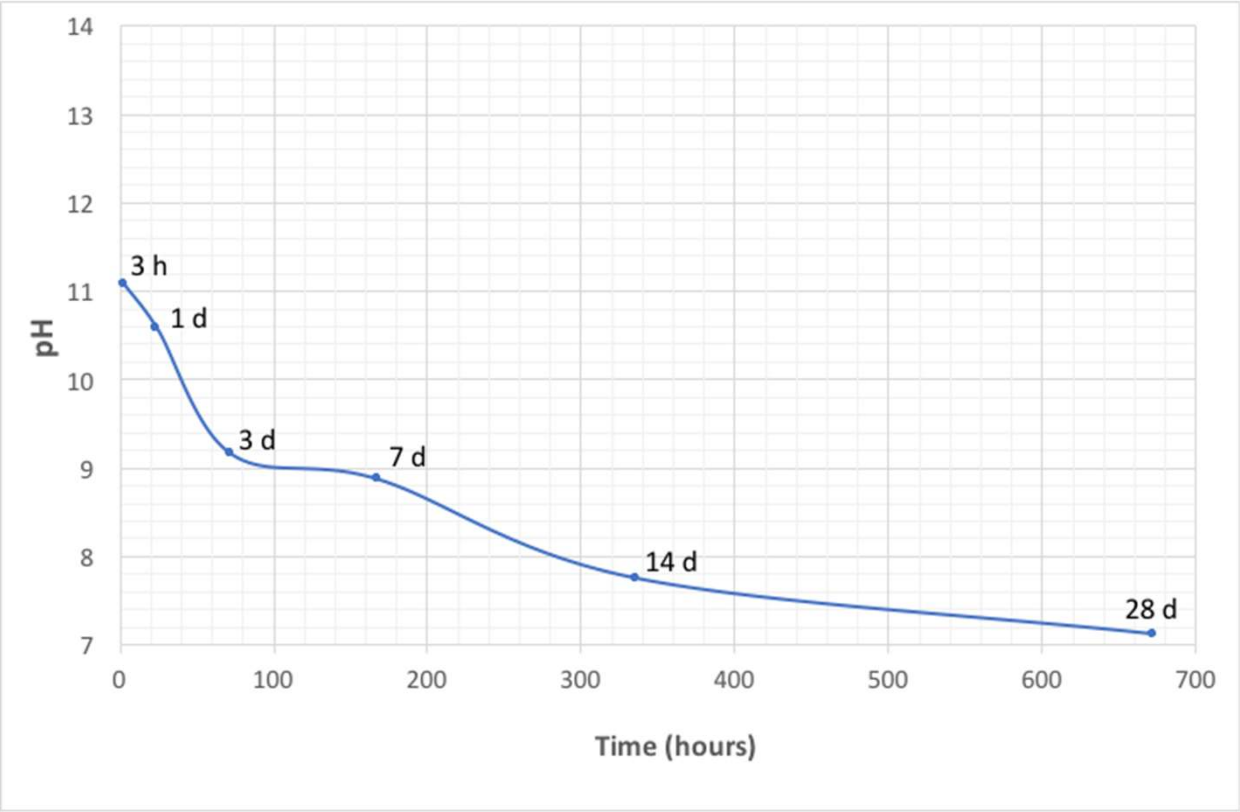
MTA's pH over time



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Gandolfi 2014

Australian and
New Zealand Society of
Paediatric Dentistry

- 35% of (special interest in paeds) general dentists use MTA
- 69% of paediatric dentists use MTA

Australian Society Of
ENDODONTOLOGY

- 40% of (special interest in endo) general dentists use MTA
- 98% of endodontists use MTA

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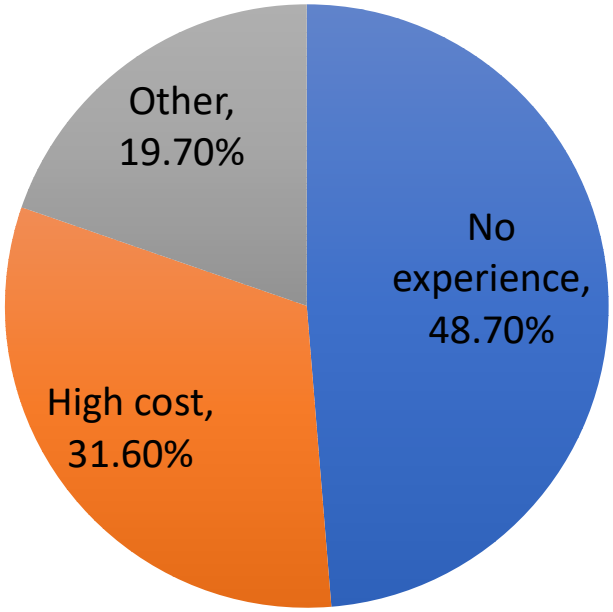
Ha 2017, Ha 2016

ASE Survey results: Reasons for not using MTA



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Ha 2016

Composition of bioceramics

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MTA vs bioceramics

- In common vernacular, many dentists and endodontists use the terms MTA, calcium silicate cements and bioceramics almost interchangeably and, often, erroneously.

- Today's MTA definition:
  - Calcium silicate + radiopacifier
  - Mixed with water PRIOR to placement

- Today's Bioceramic definition:
  - Also Calcium silicate + radiopacifier
  - NOT mixed with water prior to placement
    - Relies on water from surrounding tissues to set bioceramic

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Ha 2017

MTAs in Australia

Commercial Brands	Cement type			Radio-opacifier	H_2O	
	Calcium silicates	Calcium aluminates	Calcium sulfates		Mixed with distilled H_2O or PBS	Mixed with aqueous gel
Biodentine®	✔			ZrO_2		✔
Endocem MTA	✔	✔	✔	Bi_2O_3	✔	
Endocem Zr	✔	✔	✔	ZrO_2	✔	
MTA Angelus®	✔	✔		Bi_2O_3	✔	
NeoMTA®	✔		✔	Ta_2O_5		✔
ProRoot® MTA	✔	✔	✔	Bi_2O_3	✔	

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Ha 2017

MTAs in Australia

Commercial Brands	Cement type			Radio-opacifier	Radiopacity (mm Al)
	Calcium silicates	Calcium aluminates	Calcium sulfates		
Biodentine®	✔			ZrO_2	**2.8**
Endocem MTA	✔	✔	✔	Bi_2O_3	**4.5**
Endocem Zr	✔	✔	✔	ZrO_2	**4.2**
MTA Angelus®	✔	✔		Bi_2O_3	**4.7**
NeoMTA®	✔		✔	Ta_2O_5	**3.8**
ProRoot® MTA	✔	✔	✔	Bi_2O_3	**6.4**

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Ha 2017

Bioceramics in Australia

Commercial Brands	**Cement type**				**Radio-opacifier**	**H_2O**	
	Calcium silicates	Calcium aluminates	Calcium sulfates	Calcium phosphates		Mixed with distilled H_2O	Premixed with non-aqueous liquid
TotalFill® BC RRM™ Putty	✔		✔	✔	ZrO_2 & Ta_2O_5		✔
TotalFill® RRM Fast Set Putty	✔		✔	✔	ZrO_2 & Ta_2O_5		✔
ProRoot® MTA	✔	✔	✔		Bi_2O_3	✔	

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Ha 2017

Bioceramics in Australia

Commercial Brands	Cement type				Radio-opacifier	Radiopacity (mm Al)
	Calcium silicates	Calcium aluminates	Calcium sulfates	Calcium phosphates		
TotalFill® BC RRM™ Putty	✔		✔	✔	ZrO_2 & Ta_2O_5	**"~6"**
TotalFill® RRM Fast Set Putty	✔		✔	✔	ZrO_2 & Ta_2O_5	**"~6"**
ProRoot® MTA	✔	✔	✔		Bi_2O_3	***6.4***

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Ha 2017

ProRoot MTA vs BC Putty vs Fast-Set BC Putty

Property	ProRoot MTA	BC (Putty)	BC Fast Set (Syringe)	Relevant papers
Setting time in blood	Good	Bad	No studies	Charland 2013
Cytotoxicity	Good	Good	Not as good	Ma 2011
1-3-week Skin implantation	Good	Best	Worst	Taha 2016
6-week skin implantation	Good	Good	Worst	Kahlil 2015
Bone implantation	Good	No studies	No studies	Rahimi 2012
Antimicrobial effects	Some	Some	Some	Damlar 2014
Marginal adaptation	Good	Good	Worst or similar to ProRoot	Shokouhinejad 2014, Tran 2016
Bacterial leakage	Good	Bad	No studies	Hirschberg 2013
Solubility	Good	No studies	No studies	Camilleri 2011
Dimensional change	Good	No studies	No studies	Camilleri 2011
2-year clinical performance (apical surgery)	Good	Good	No studies	Safi 2019
5-year clinical performance (apical surgery)	Good	No studies	No studies	Von Arx 2014

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Summary of Part 1 of 5

- MTA is
  - 80% Portland cement (calcium silicates)
  - 20% Bi_2O_3 (radiopaquer)
  - Seals
  - Promotes hard tissue formation
  - Biocompatible
- Alkaline with CaOH release on setting. Once set, no longer releases significant CaOH.

- ~40% GDs use MTA. Most specialist use MTA (69% PD, 98% ED)
- Education is the biggest barrier to MTA use.

- Bioceramics are calcium silicates mixed with non-aqueous gels. They rely on water to diffuse from the dentine to set.
  - Some handling advantages over MTA. However, there are some drawbacks and there is less supporting evidence

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Part 2. MTA for pulp capping and pulpotomy

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Staining and MTA

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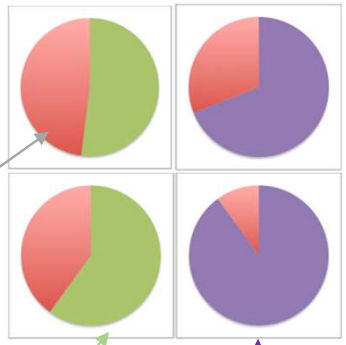
Belobrov 2011

Indirect pulp capping

- Anterior Primary teeth:
  -
  -
- Posterior Primary teeth:
  -
  -
-
  -
  -
  -
-
  -
  -
  -

Who will perform this treatment?



Members of that group who DON'T perform that treatment

Green, General dentists (GD) who perform treatment

Purple, Paediatric dentists (PD) who perform treatment

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Indirect pulp capping

- Anterior Primary teeth:
  - Glass ionomer: GD 45%, PD 58%
  - $Ca(OH)_2$ cement: GD 45%, PD 18%
- Posterior Primary teeth:
  - Glass ionomer: GD 50%, PD 65%
  - $Ca(OH)_2$ cement: GD 42%, PD 9%

General dentists (GD)

Paediatric dentists (PD)

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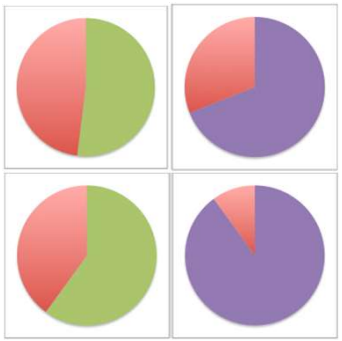
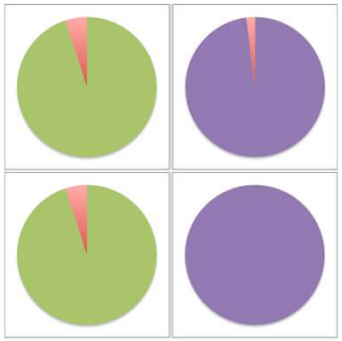
Indirect pulp capping

- Anterior Primary teeth:
- Posterior Primary teeth:
- Anterior Permanent teeth:
- Posterior Permanent teeth:

Who will perform this treatment?





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Ha 2017

Indirect pulp capping

- Anterior Primary teeth:
  - Glass ionomer: GD 45%, PD 58%
  - $Ca(OH)_2$ cement: GD 45%, PD 18%
- Posterior Primary teeth:
  - Glass ionomer: GD 50%, PD 65%
  - $Ca(OH)_2$ cement: GD 42%, PD 9%
- Anterior Permanent teeth:
  - $Ca(OH)_2$ cement: GD 40%, PD 34%
  - Glass ionomer: GD 30%, PD 47%
  - $Ca(OH)_2$ paste: GD 20%, PD 9%
- Posterior Permanent teeth:
  - $Ca(OH)_2$ cement: GD 42%, PD 29%
  - Glass ionomer: GD 26%, PD 38%
  - MTA: GD 16%, PD 15%

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Ha 2017

Indirect pulp capping

Figure 1. *Restoration procedure of an indirect pulp capping. (a): Preoperative stage. (b): Cavity preparation. (c): mineral trioxide aggregate application. (d): Glass ionomer cement (GIC) base. (e): Final restoration.*

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Vural 2017

Direct pulp capping

- Anterior Primary teeth:
- Posterior Primary teeth:
- Anterior Permanent teeth:
- Posterior Permanent teeth:

Who will perform this treatment?

General dentists (special interest in paeds)

Paediatric dentists

Red: % does not perform treatment

Ha 2017

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Direct pulp capping

- Anterior Primary teeth:
  - MTA: GD 50%, PD 42%
- Posterior Primary teeth:
  - MTA: GD 50%, PD 43%

- Anterior Permanent teeth:
  - $Ca(OH)_2$ cement: GD 44%, PD 23%
  - $Ca(OH)_2$ paste: GD 33%, PD 51%
  - MTA: GD 17%, PD 18%
- Posterior Permanent teeth:
  - MTA: GD 31%, PD 44%
  - $Ca(OH)_2$ cement: GD 44%, PD 16%
  - $Ca(OH)_2$ paste: GD 25%, PD 31%

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Ha 2017

Clinical steps for using MTA for direct pulp capping

- Under rubber dam, complete the cavity preparation outline using high speed burs, under constant water cooling
- Excavate caries using a slow-speed bur
- Rinse the cavity and exposure site with 2.6% - 5% NaOCl. Heavy bleeding may be controlled with a cotton pellet moistened with NaOCl. If bleeding cannot be controlled, reconsider your diagnosis.
- Mix MTA
- Apply a small amount of MTA over the exposure
- Remove the excess moisture with a dry cotton pellet
- Apply compomer or RMGIC over the MTA and light-cure
- Etch the remaining cavity and restore permanently with composite resin

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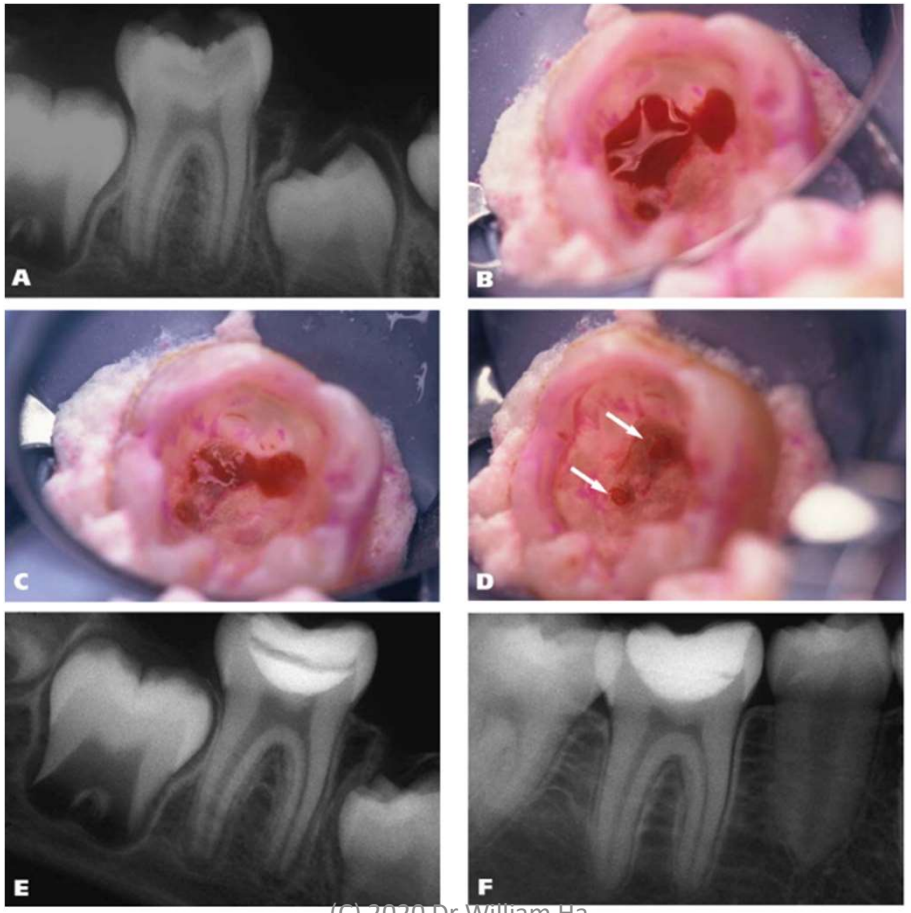
Modified from ProRoot MTA's Instructions for Use

Direct pulp capping



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Bogen 2008

Direct pulp capping

- When used with MTA: 98% successful over 9 years
- But!
  - **Only** for diagnoses no more severe than reversible pulpitis
  - Confirmed with cold tests and radiographs
  - Rubber dam
  - Caries free with caries detector dye
  - Under rubber dam
  - NaOCl for haemostasis
  - MTA over exposure

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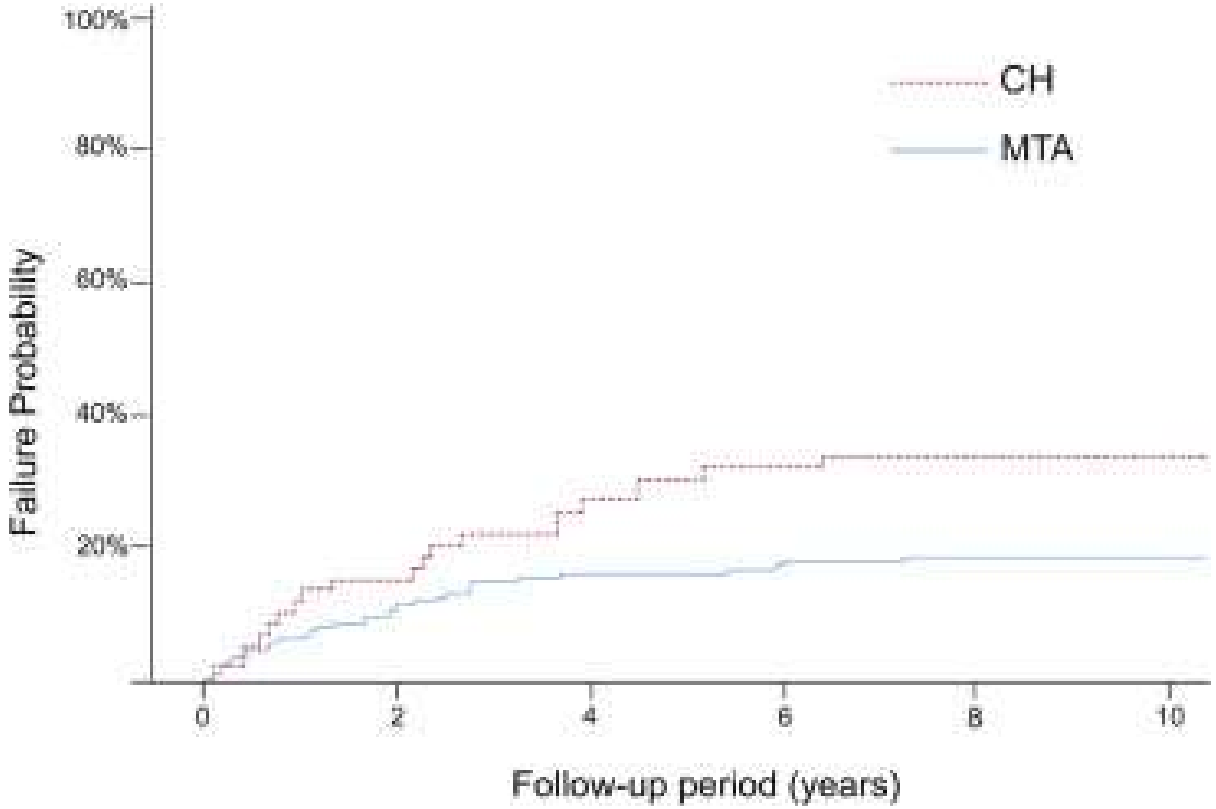
Bogen 2008

Direct pulp capping



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Mente 2014

MTA for pulpotomy

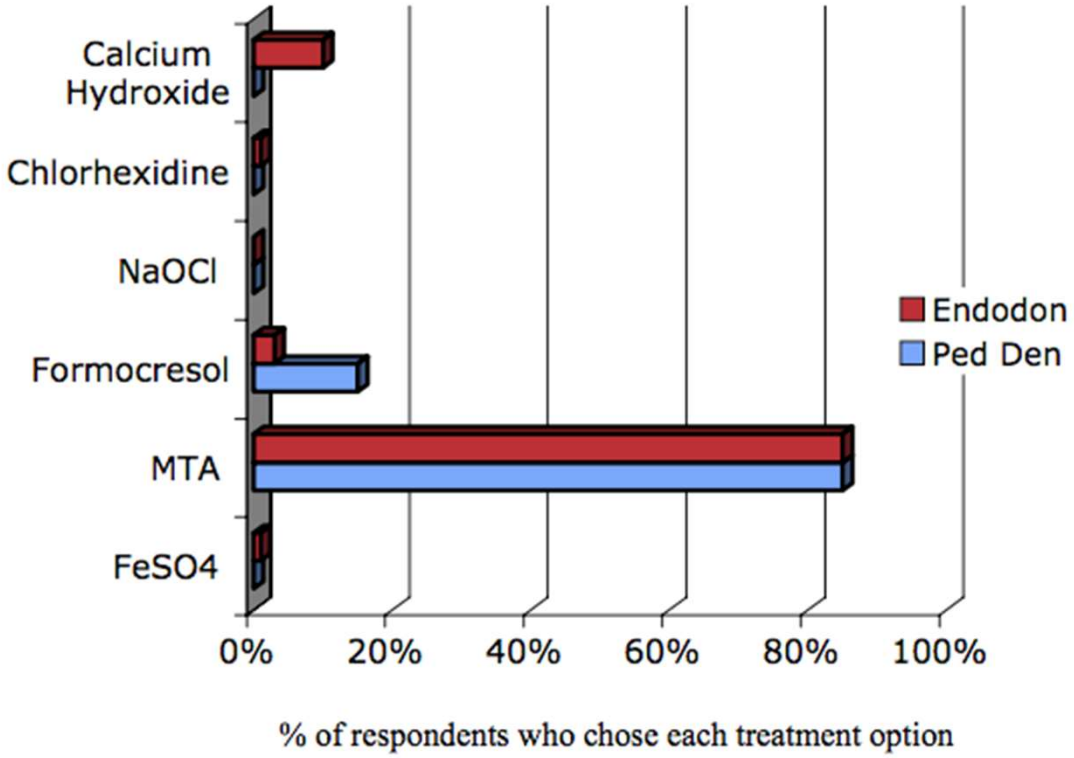


Figure 2. Comparison by specialty of responses to the question: If cost were not an issue, which is the recommended medicament for primary tooth pulpotomy?

Seale 2008

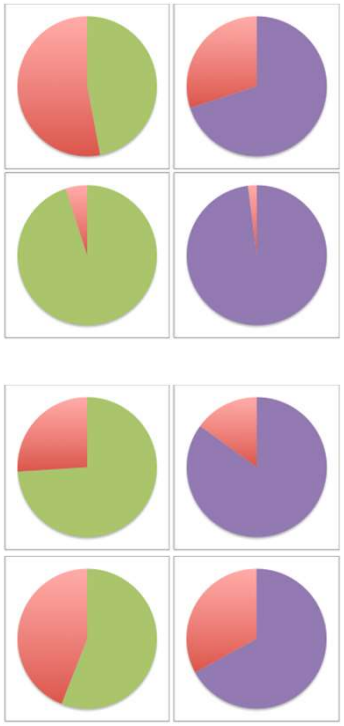
Pulpotomies

- Anterior Primary teeth:
- Posterior Primary teeth:
- Anterior Permanent teeth:
- Posterior Permanent teeth:

Who will perform this treatment?

General dentists (special interest in paeds)

Paediatric dentists



Red: % does not perform treatment

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Ha 2017

Pulpotomies

- Anterior Primary teeth:
  - Ferric sulfate: GD 33%, PD 45%
  - MTA: GD 33%, PD 26%
  - Diathermy: GD 11%, PD 13%
  - Formocresol: GD 11%, PD 10%
- Posterior Primary teeth:
  - Ferric sulfate: GD 61%, PD 36%
  - MTA: GD 11%, PD 40%
  - Formocresol: GD 11%, PD 11%
- Anterior Permanent teeth:
  - $Ca(OH)_2$ paste: GD 57%, PD 54%
  - $Ca(OH)_2$ cement: GD 21%, PD 18%
  - MTA: GD 14%, PD 18%
- Posterior Permanent teeth:
  - MTA: GD 21%, PD 41%
  - $Ca(OH)_2$ paste: GD 43%, PD 18%

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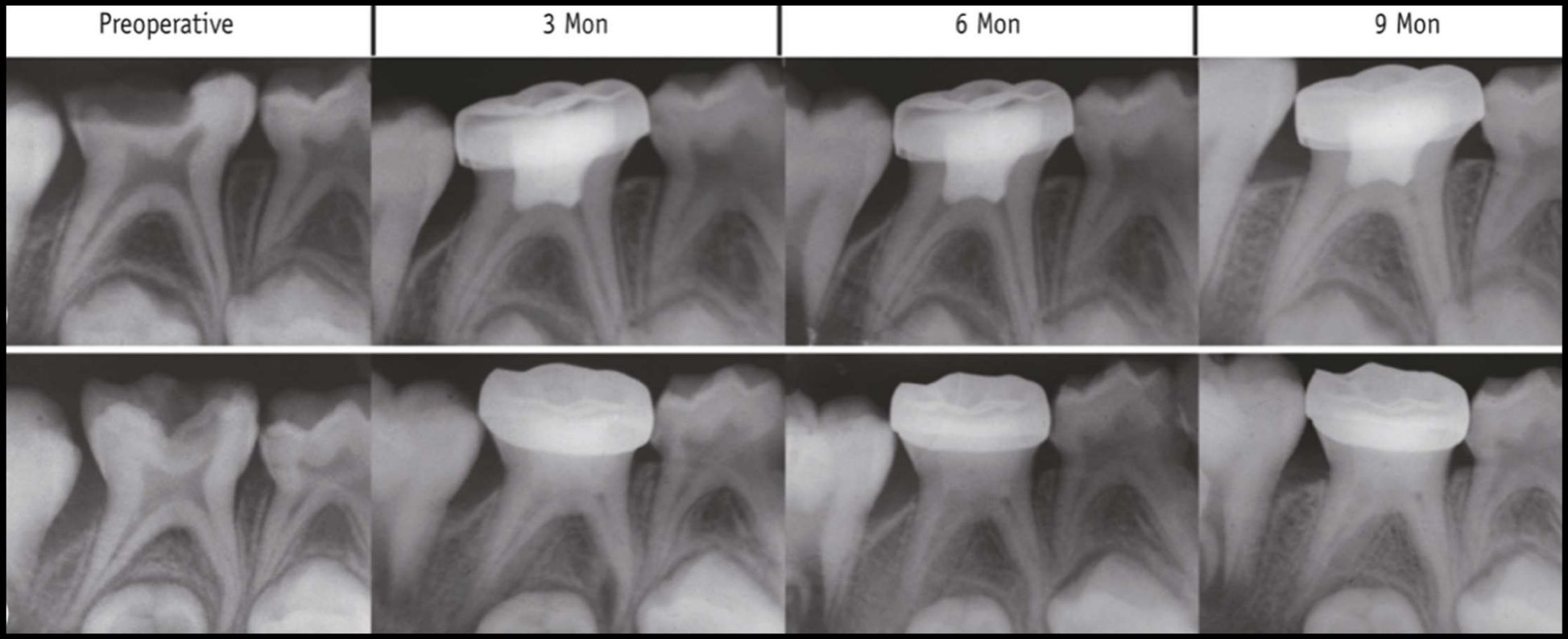
Ha 2017

Pulpotomy



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Kusum 2017

Clinical steps for using MTA for pulpotomy

- Similar to steps for pulp capping
- Under rubber dam, complete the cavity preparation outline using high speed burs, under constant water cooling
- Excavate caries using a slow-speed bur
- Remove all, or part of the, pulpal chamber, as required
- Rinse the cavity and exposure site with 2.6%-5% NaOCl. Heavy bleeding may be controlled with a cotton pellet moistened with NaOCl. If bleeding cannot be controlled, reconsider your diagnosis.
- Mix MTA
- Apply a small amount of MTA over the exposure
- Remove the excess moisture with a dry cotton pellet
- Apply compomer or RMGIC over the MTA and light-cure
- Etch the remaining cavity and restore permanently with composite resin

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Modified from ProRoot MTA's Instructions for Use

Summary for Part 2 of 5

- MTA stains – be cautious when performing pulp therapy on anterior teeth
- Few people use it for indirect pulp therapy. Probably little benefit
- More people use it for direct pulp therapy. Better success than calcium hydroxide.
- Often used in pulpotomy. Less controversial than Formocresol.

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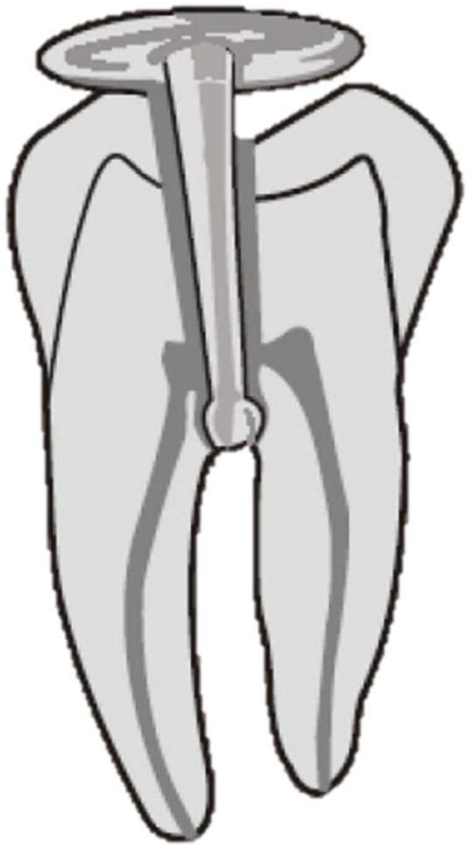
Part 3. MTA for perforation repair



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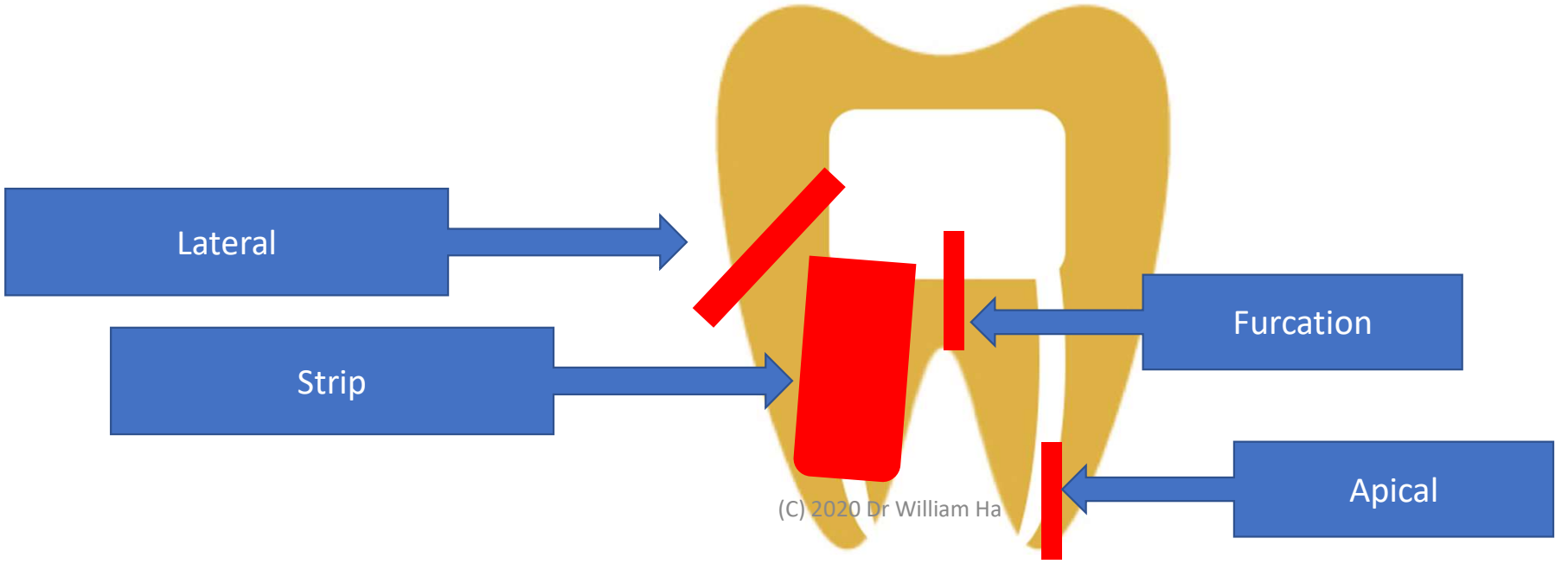
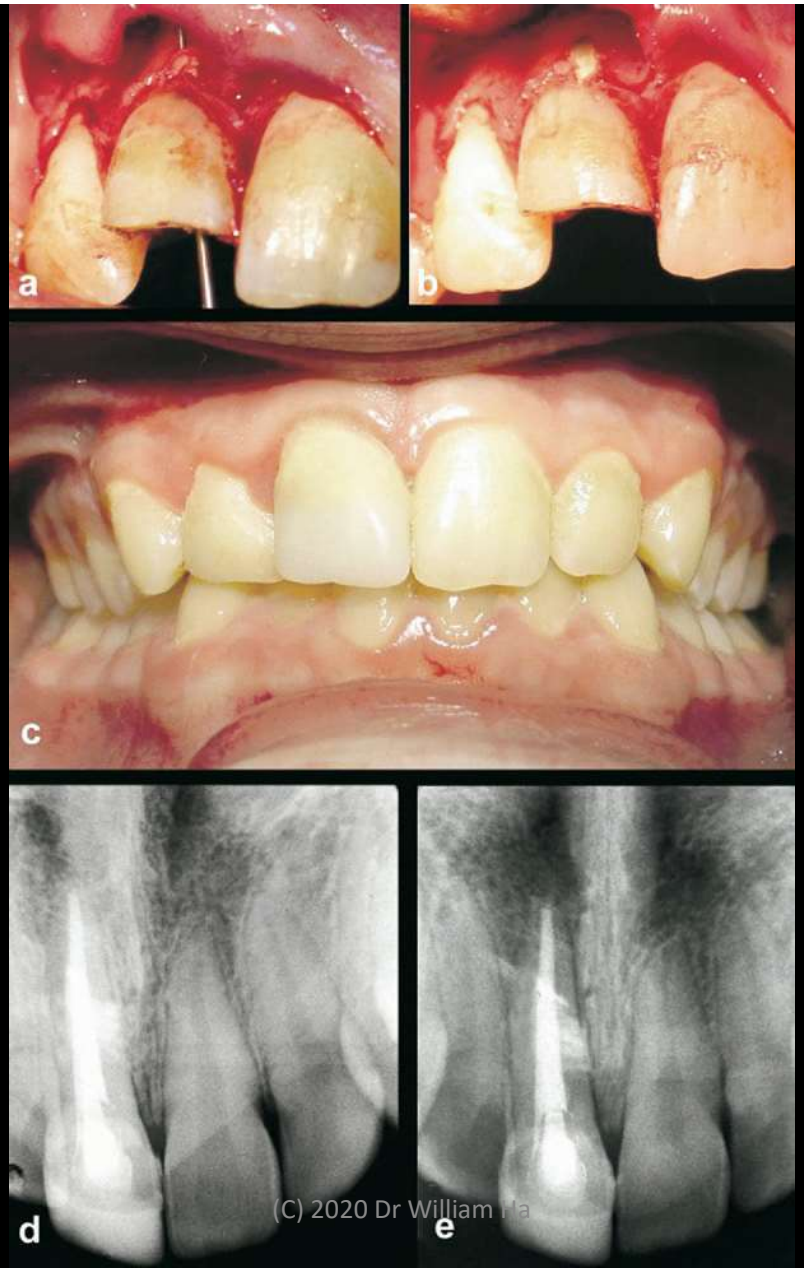
What are perforations?

- The American Association of Endodontists Glossary of Endodontic Terms:

"The mechanical or pathologic communication between the root canal and the external tooth surface"



AAE Glossary 2012



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Yildirim 2006

Meta Analysis on factors on clinical success of repaired root perforations

- The following have worse outcomes:
- Mandibular perforations
- Possibly signs and symptoms
- Radiolucency adjacent to perforation
- Crestal perforations

- *Size of perforation does not seem to be a contributing factor*
- *Time since when the perforation occurred does not seem to be a contributing factor*
  - However, PARLs and symptoms are more likely to be present in older perforations.

Factors examined and studies [in brackets] included in the analysis	N	OR	95% CI
Gender [15, 18, 19]			
Male	183	1	—
Female		1.33	0.64–2.76
No. of root(s) [15, 18, 19]			
1	183	1	—
>1		1.07	0.48–2.42
Tooth type [15, 18–20]			
Posterior	202	1	—
Anterior		1.35	0.48–3.79
Tooth position in the jaw [15, 18–20]			
Mandible	183	1	—
Maxilla		2.22	1.04–4.76
Size of perforation (mm) [15, 18]			
< 1	154	1	—
1–3		1.25	0.44–3.57
>3		0.58	0.16–2.06
Nature of treatment [18, 19]			
Primary treatment	93	1	—
Retreatment		1.26	0.39–4.09
Signs and symptoms [15, 18, 20]			
Present	173	1	—
Absent		1.62	0.77–3.40
Radiolucency adjacent to the perforation [15, 18]			
Present	154	1	—
Absent		2.57	1.15–5.75
Apical periodontitis [15, 18]			
Present	154	1	—
Absent		1.02	0.45–2.31
Duration of perforation repair [18, 19]			
Immediate	93	1	—
<1 mo		1.28	0.20–8.36
>1 mo*		0.88	0.15–5.03
Unknown†		1.19	0.04–36.14
Location of perforation/position to level of crestal bone [15, 19]			
Crestal	119	1	—
Supracrestal‡		2.63	0.31–21.92
Subcrestal		1.63	0.66–4.04

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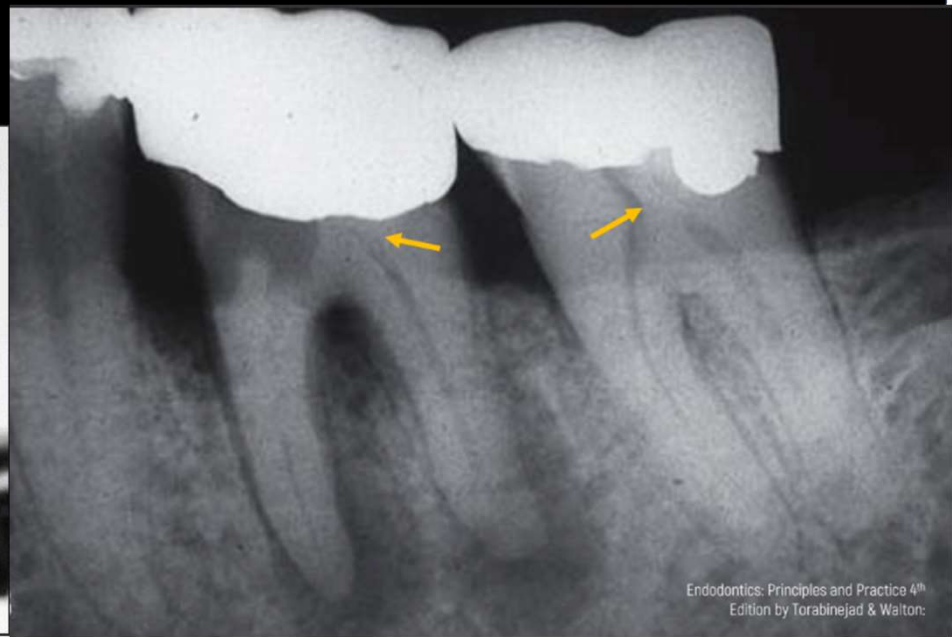
Siew 2015

Perforation prevention

- Know your canal anatomy
- Inspect the radiograph for depth and angulations
- Know the axial inclination – tilted teeth, heavily restored and crowns will throw you off



Perforation recognition

- More reliable signs
  - Radiographically malpositioned file
  - “Apex” on apex locator far from working length

- Less reliable, but signs are signs!
  - Sudden pain during during WL determination
  - Sudden haemorrhage
  - Burning pain or bad taste during NaOCl irrigation

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Torabinejad 2014

Initial treatment

- Perforations should be sealed immediately before bacterial invade the perforation
  - But if there is excessive bleeding or too much pus, dress with CaOH or wait it out until the bleeding stops
  - Do not irrigate NaOCl into the perforation
- But, you MUST have found all the canals first
  - Otherwise, dress with CaOH and
    - try again another day
    - refer on
- Prognosis studies:
  - 73% after 3.4 years
  - 86% after 2.75 years

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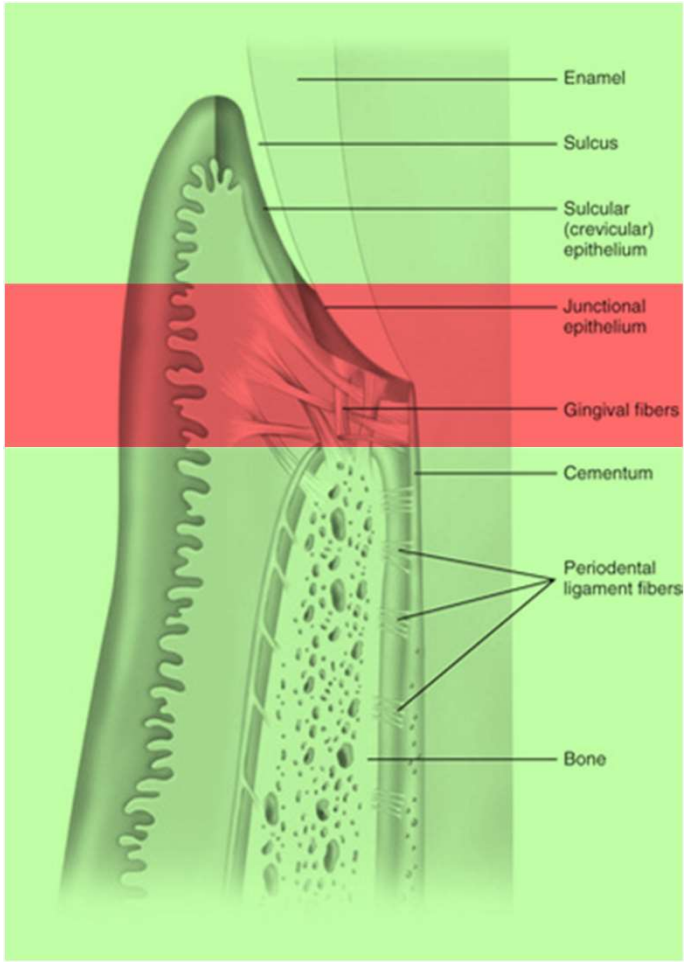
Torabinejad 2014, Krupp 2013, Mente 2010

Use normal restoratives

Use MTA

Use MTA



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	General Dentists	Endodontists
Do you restore perforations?	39.8%	98.8%
What do you use to restore perforations?		
MTA	87.8%	97.5%
Biodentine	6.1%	0.0%
If radiolucency is present how do you manage the radiolucency?		
Will use a calcium hydroxide dressing first	58.7%	51.9%
Will restore the tooth immediately	32.6%	40.5%

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Ha 2016

	General Dentist	Endodontist
Final irrigant for perforation repair		
Sodium hypochlorite	35.8%	64.2%
EDTA	20.8%	19.8%
Chlorhexidine	11.3%	3.7%
What is your order of restoring perforations?		
Perforation first, obturate rest of tooth in subsequent appointment	54.3%	44.3%
Perforation first, obturate rest of canals in the same appointment	32.6%	13.9%
Obturate canals first and then perforation in the same appointment	4.3%	27.8%

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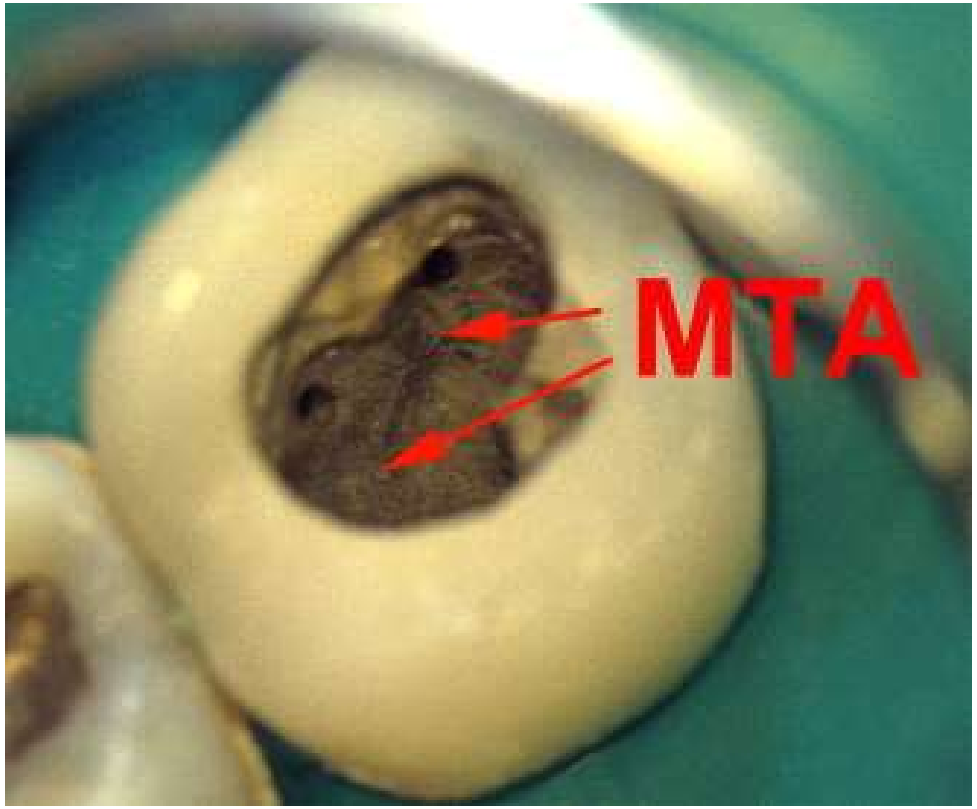
Ha 2016

Repair perforation first



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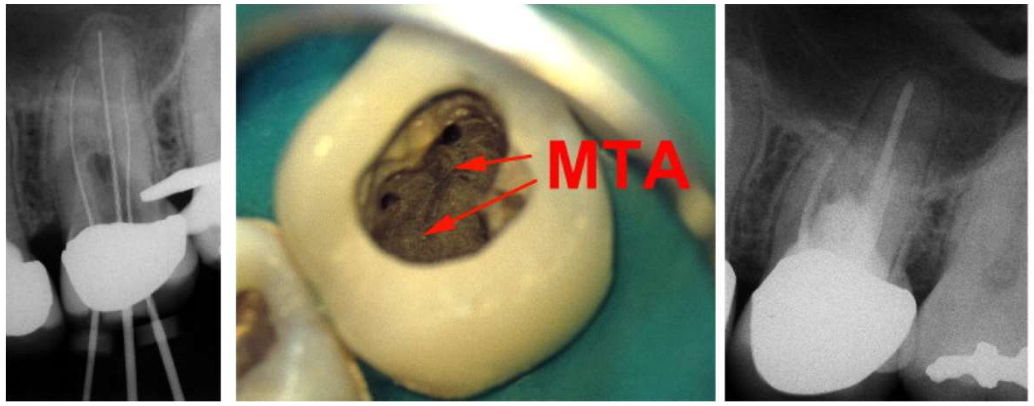
Mente 2014

Repair perforation first



- Advantages:
  - Once repaired, there will not be any blood contamination affecting obturation of the canals

- Disadvantages
  - MTA can fall into the canals making obturation difficult

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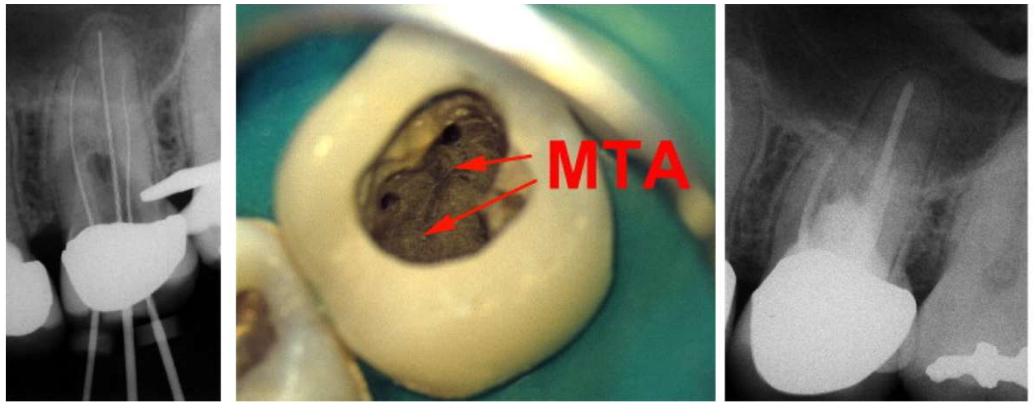
Repair perforation first



- Tricks
  - Magnification and illumination
  - If bleeding is coming from the perforation, focus on preparing the canals. The bleeding will be reduced by the time you've finished preparing and dressing the canals.
  - Place Cavit or small teflon tape or cotton pellets into the canal orifices then restore the perforation with MTA. MTA must not cover the orifice barriers.
  - OR, place GP into each canal to stop MTA entering canals. These can easily be removed at the next visit as there is no sealer sticking the GP to the dentine

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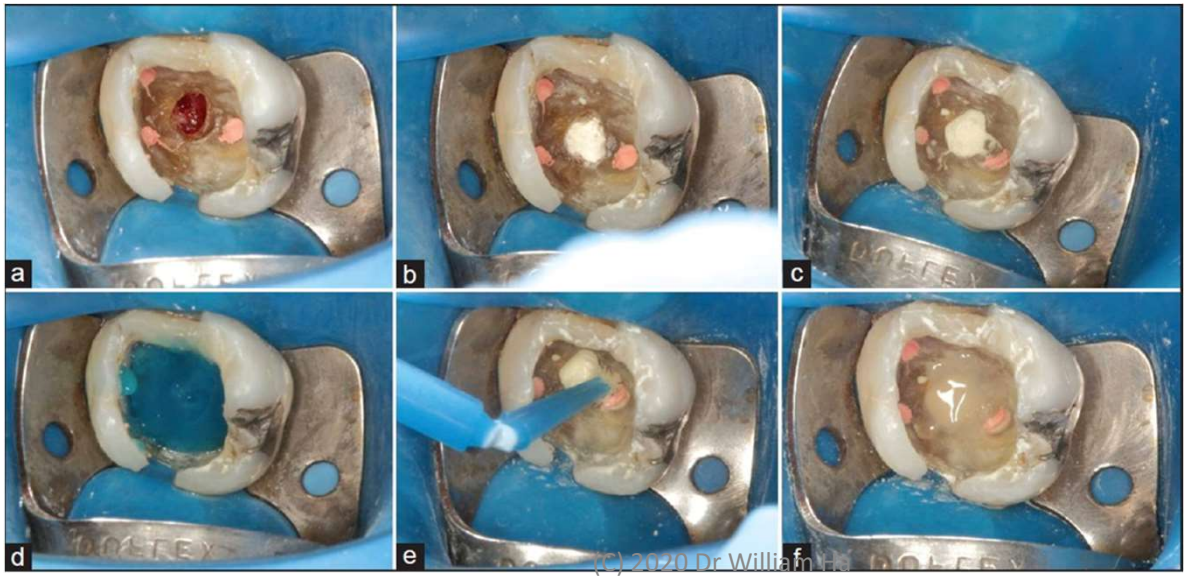
Mente 2014

Obturate canals first



da Silva 2012

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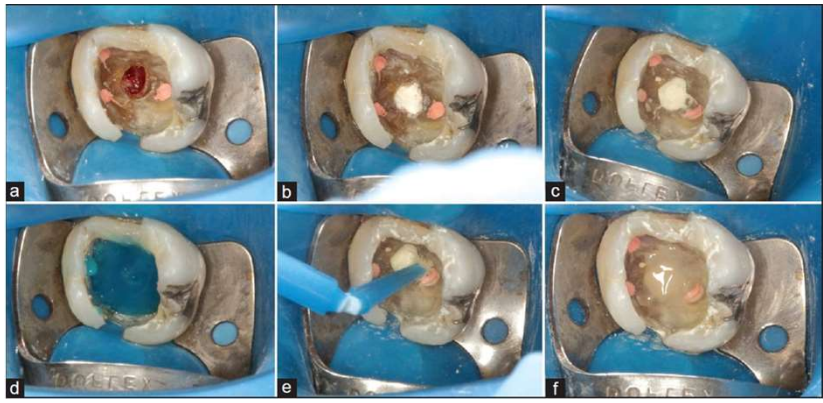
Obturate canals first



- Advantages:
  - If the canals are already obturated, there's no risk of MTA entering the canals.

- Disadvantages
  - Blood from the perforation can enter the canals resulting in leakage.
  - Sealer from canals may enter perforation

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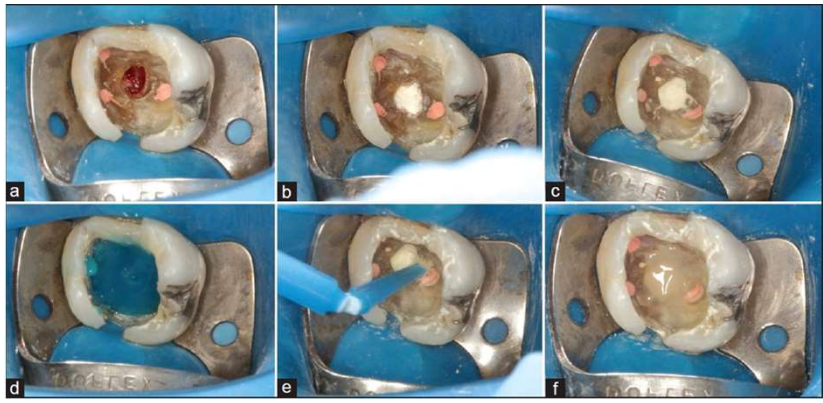
Obturate canals first



- Tricks
  - Magnification and illumination
  - Cover the perforation with a small cotton pellet or Endofrost pellet to prevent contamination with sealer and the flow of blood out of the perforation
  - The pellet may need to be soaked in NaOCl or a haemostatic agent.

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Clinical steps for perforation repair

- Using a rubber dam, debride the root canal system using intra-canal instruments and irrigate with NaOCl
- Dry the canal system with paper points and isolate the perforation
- Mix MTA
- Apply MTA into perforation site. Condense using small plugger, damp cotton pellets or paper points
- Confirm placement with a radiograph. If an adequate barrier has not been created, rinse material out and repeat procedure
- Temporize remainder of pulp chamber
- Revisit tooth and restore remaining canals and chamber

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Modified from ProRoot MTA's Instructions for Use

Clinical steps for perforation repair

- Using a rubber dam, debride the root canal system using intra-canal instruments and irrigate with NaOCl
- Dry the canal system with paper points and isolate the perforation
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- Temporize remainder of pulp chamber
- Revisit tooth and restore remaining canals and chamber

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Modified from ProRoot MTA's Instructions for Use

My preferred steps for perforation repair

- Focus on preparing other canals first – at least perform initial orifice opening and place medicament.
- Cover the orifices
- Dispense MTA into a dappens dish
- Add a single droplet of water to a dappens dish
- Pick up small ‘wet crumbs’ and compact it with endodontic pluggers into the perforation. As you compact pieces, you will notice it will become solid-like
- Dry cotton pellets are good for cleaning excess amounts
- Once it’s compacted, you can gently wash out the debris with saline

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Modified from ProRoot MTA’s Instructions for Use

Summary of Part 3 of 5: Perforation repair

- Old, large and crestal perforations have a questionable prognosis
- Prevention is better than cure
  - Know your anatomy
  - Have a radiograph and know your intended angulation and depths
- Early identification prevents further diasters
  - Radiographs & Apex locator
- Initial treatment
  - Find the actual canal locations, otherwise, temporise and refer
  - Prep the canals first, then fix the perforation with MTA

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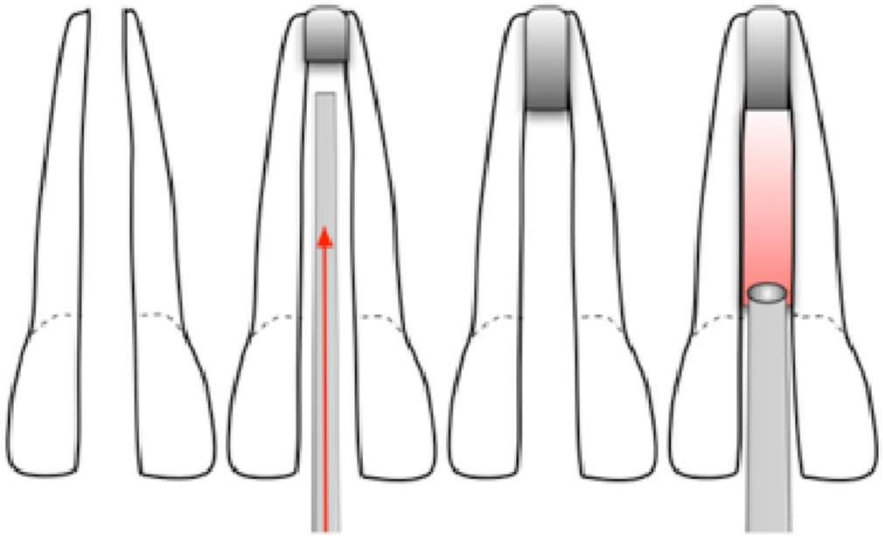
Step 4: Apical barrier placement



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Apical barrier placement

- MTA apical placement is indicated for
  - Immature teeth with open apices as there is no apical constriction
  - Teeth with apical resorption as the apical constriction is lost
  - In horizontal root fractures where MTA is used to seal apical orifice of the coronal fragment

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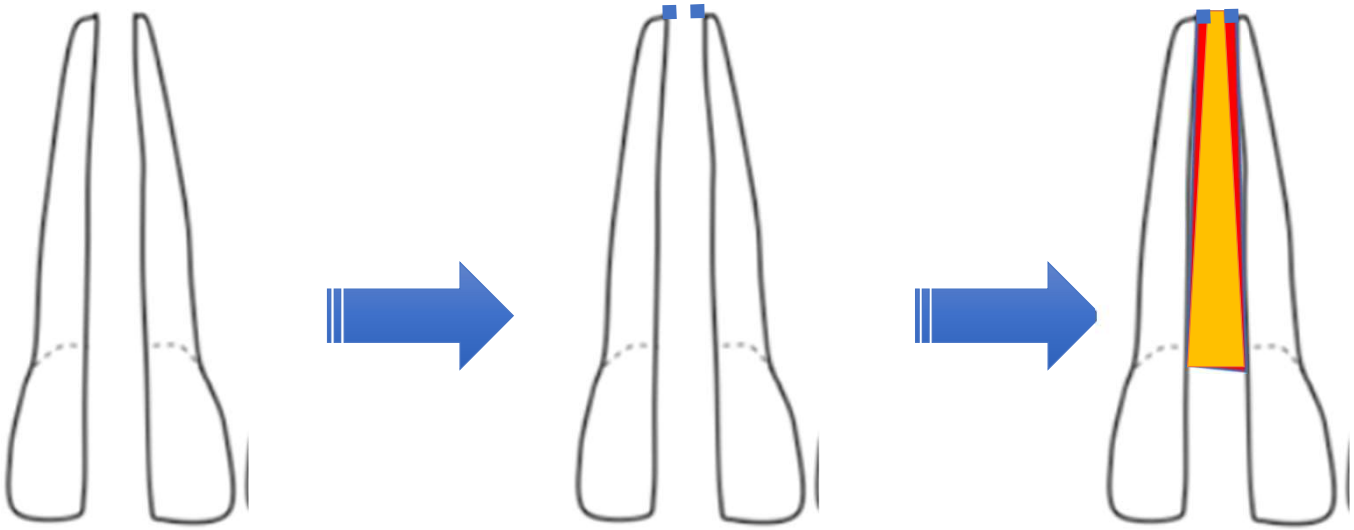
Problems with CH dressings



~3 monthly dressings of CaOH:
-Increased overheads of revisits and temporisation
-Increased risk of compromised seal and hence re-infection
-Poor patient retention
-Porous calcific barrier. (Not a sealed barrier)

-Risk of insufficient calcific barrier leading to GP extrusion
-No matter how many GP cones are placed, cones have a taper and in a parallel-walled tooth, there will be voids towards the apex

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Why use apical barrier placement

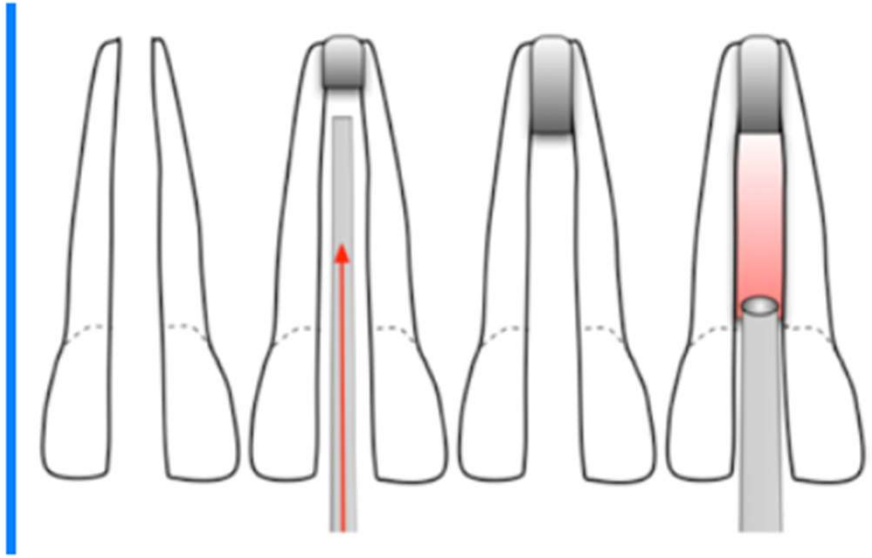

Figure 13. Apical barrier technique: where canal diameter procludes adequate sealing with conventional techniques MTA is placed using pre-measured pluggers in increments apically. Intra-operative radiographs should be taken to confirm that the MTA has been placed optimally before further increments are placed. Once 3–5 mm has been placed the canal is backfilled with plasticized GP.

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Apical barrier placement: preferences

	General Dentists	Endodontists
	%	%
Do you perform apexification / apical barrier placement procedures?	42.7%	96.3%
What material do you prefer to use for apexification?		
MTA	28.3%	83.3%
GP after apical closure with calcium hydroxide dressing	69.8%	15.4%
If a radicular radiolucency is present, would you prefer?		
An interim calcium hydroxide dressing	94.7%	82.3%
To restore the tooth immediately	5.3%	17.7%

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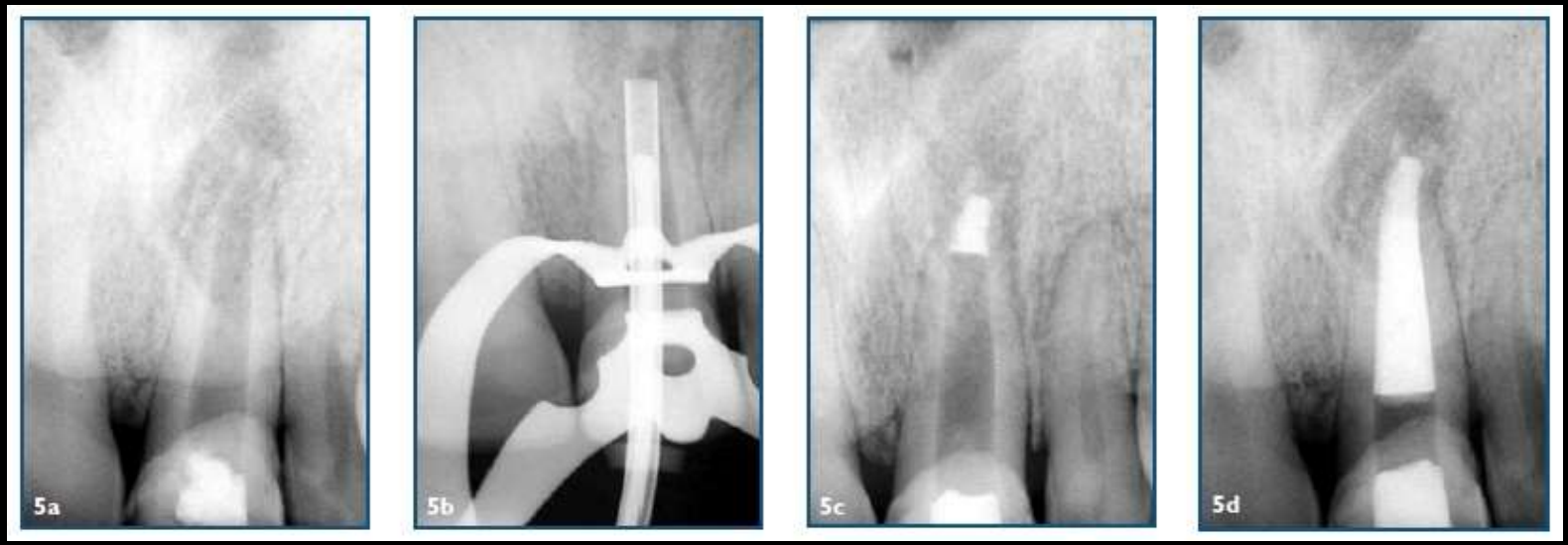
Ha 2016

MTA apical barrier placement methods



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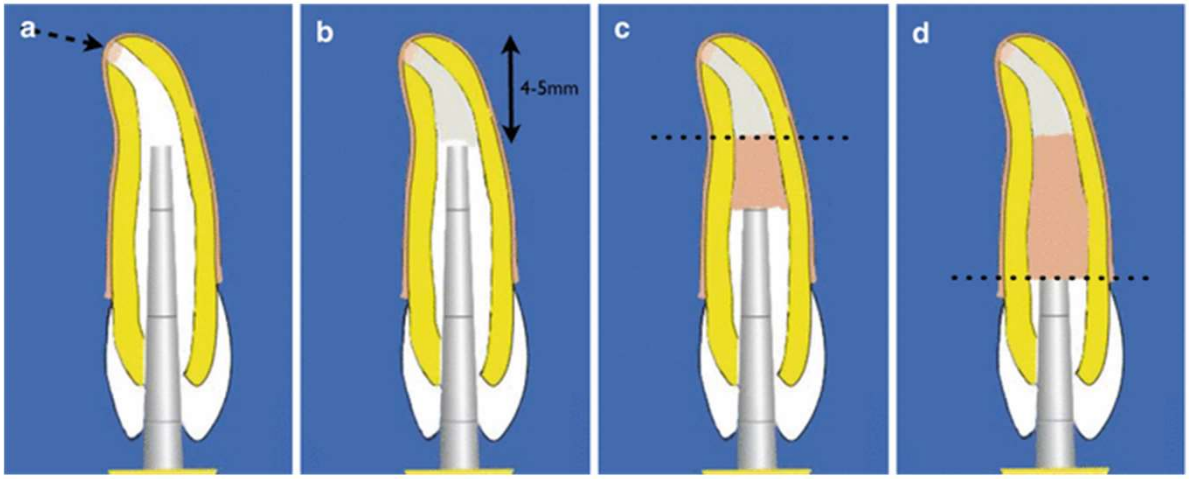
Castelluci 2003

Buchanan pluggers



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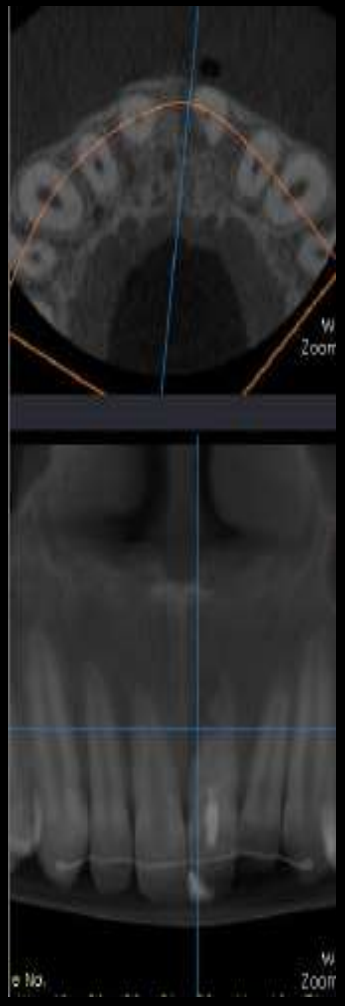
PocketDentistry 2016

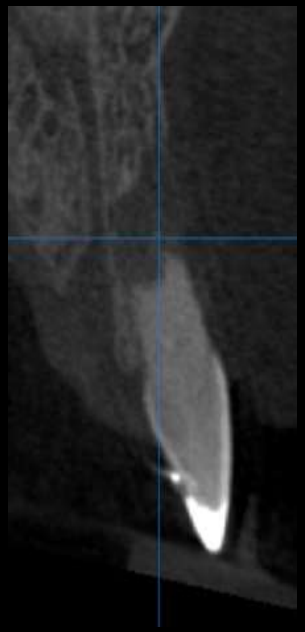
Cases

(C) 2020 Dr William Ha

Case from A/Prof Kahler

Cases





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Case from A/Prof Kahler

MTA apical barrier placement: preferences

	General dentists	Endodontists
If there is blood in chamber, how do you manage the hemorrhage?		
Dress the canal and complete the treatment in a subsequent visit	47.4%	60.0%
Wait passively for bleeding to stop	26.3%	16.9%
Apply hemostatic agent	10.5%	13.8%
What is your final irrigant prior to placing MTA?		
NaOCl	31.6%	70.8%
EDTA	31.6%	18.5%
Chlorhexidine	15.8%	1.5%

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Ha 2016

MTA apical barrier placement: preferences

	General Dentists	Endodontists
Do you immediately obturate canals after MTA placement?	55.6%	85.9%
What is your method of obturation after MTA placement?		
Injection technique	5.6%	53.1%
Vertical compaction	22.2%	14.1%
If you restored the tooth in the same appointment, what material do you place above the MTA?		
GP	54.5%	71.4%
GIC/RMGIC	18.2%	16.1%
If you permanently restore the tooth in a subsequent appointment, how do you temporize the tooth?		
Damp cotton pellet followed by Cavit (3M ESPE)	87.5%	100.0%

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Ha 2016

Methods of compacting MTA

	Largest matching paperpoint	Standard GP points (not greater tapered)	Buchanan Plugger (KavoKerr)	Machtou Plugger (DentsplySirona / VDW)
Keeps the canal dry	Best	Won't' dry	Won't dry	Won't dry
Fits the canal ***depends on size and taper of canal**	All ISO sizes, **02 taper is ideal**	All ISO sizes, **02 taper is ideal**	#0 (Yellow): NiTi size ISO 25, taper 03, SS ISO 75 taper 02 #1 (Blue) NiTi size ISO 40, taper 03, SS ISO 120 taper 02 #2 (Red) NiTi size ISO 70, taper 03, SS ISO 120 taper 02	0 (Yellow) NiTi 0: ISO 40 1-2 (Red) SS 1: ISO 50 SS 2: ISO 60 3-4 (Grey) SS 3: ISO 80 SS 4: ISO 100
Risk of deforming instrument during placement	Easy crumbles with smaller sizes	Rarely deforms	Won't deform	Won't deform
Ability to compact MTA to minimize voids	Cannot compact MTA	Mild compaction	Good compaction	Good compaction
Can extrude MTA past the apex	Will crumble before extruding	Rarely extrudes	Will easily extrude with excess force	Will easily extrude with excess force
My preference	Use to push MTA to create first 1-3mm	Use to push MTA create first 1-3mm	Compact remaining 4-5 mm	Compact remaining 4-5 mm

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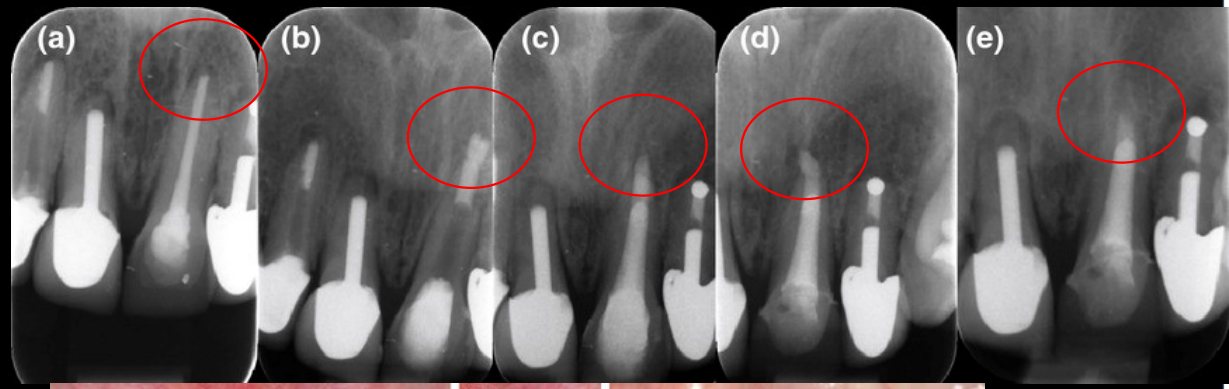

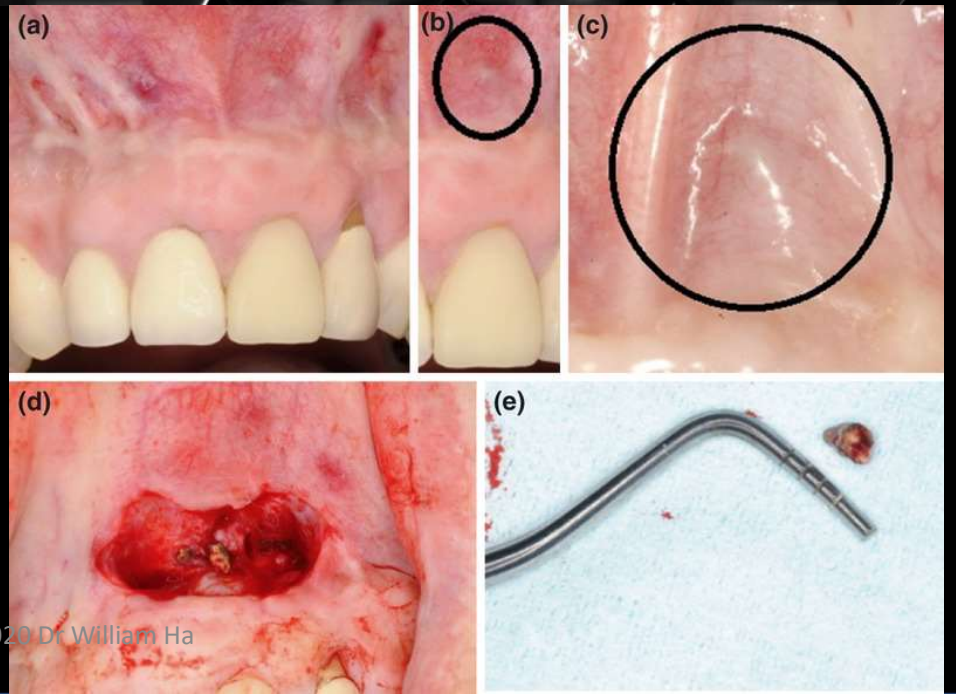

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Nosrat 2012

Clinical steps for MTA apical barrier placement

1. Anaesthetize with LA with a vasoconstrictor and Isolate.

2. Determine the working length of the tooth. Note that apex locators may give inconsistent readings in open apices so it's good to also confirm the WL using radiographs and the "paper point past the apex" method.

3. If the dentine walls are thin, you don't want to use files to shape the walls. Use the largest fitting GP you can fit into the tooth and "pump" it in the canal to brush against the walls and to disturb irrigant to promote biofilm removal. Alternatively, use a length controlled Endoactivator tip. You don't want to instrument past the apex as damage to the periapical tissues will result in bleeding which can impair your MTA placement and impair the properties of your MTA.

4. Irrigate in this order: EDTA, then NaOCl then saline or distilled water. The reason why you should finish with saline or distilled water is because NaOCl mixed with MTA will stain and EDTA mixed with MTA will be more soluble.

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Clinical steps for MTA apical barrier placement

5. Irrigate in this order: EDTA, then NaOCl then saline or distilled water. The reason why you should finish with saline or distilled water is because NaOCl mixed with MTA will stain and EDTA mixed with MTA will be more soluble. Do not use LA as anaesthetics are mildly acidic.

6. Determine the largest paperpoint/GP point that can fit to length in the tooth. Bend the point at that length.

7. Dry the canals. The wetter the canals, the more likely the MTA will stick to the walls rather than sliding down the canals. If there have been symptoms or there is exudate in the canal, dress with CaOH and restore in a week.

8. MTA is typically mixed into a putty. However, for an apical barrier placement, a drier and "crumbly" mix is better. This is because it's far easier to push solid than it is to push liquid.

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Clinical steps for MTA apical barrier placement

9. Place the smallest practical amount into the orifice and push down to length with your length-controlled point. If the point does not go to length, you may have placed too much MTA into the canal and there is now a pocket of air blocking your MTA from being packed down. If this has occurred, you need to place file to the obstruction and disrupt the MTA and break the pocket of air.

10. As you progressively pack MTA you will find that the plugging instrument cannot reach as far. Once you are 4mm short of your working length you can stop and a take a radiograph to confirm the density of your packing.

11. Once you have you reached 4mm barrier placement, consider using a plugger to compact the plug. Gently irrigate with distilled water or saline. Dry and clean canals with paperpoints.

12. Then obturate with warm backfill or place a Carrier based GP. Or, if a direct post is to be placed, consider placing Cavit on top of your MTA so that the canals can be etched and washed with less risk of disrupting your setting MTA.

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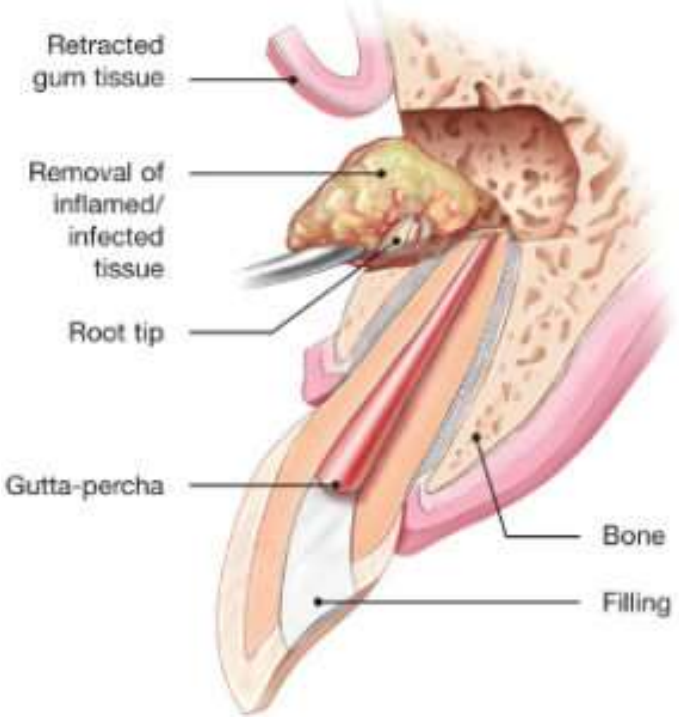
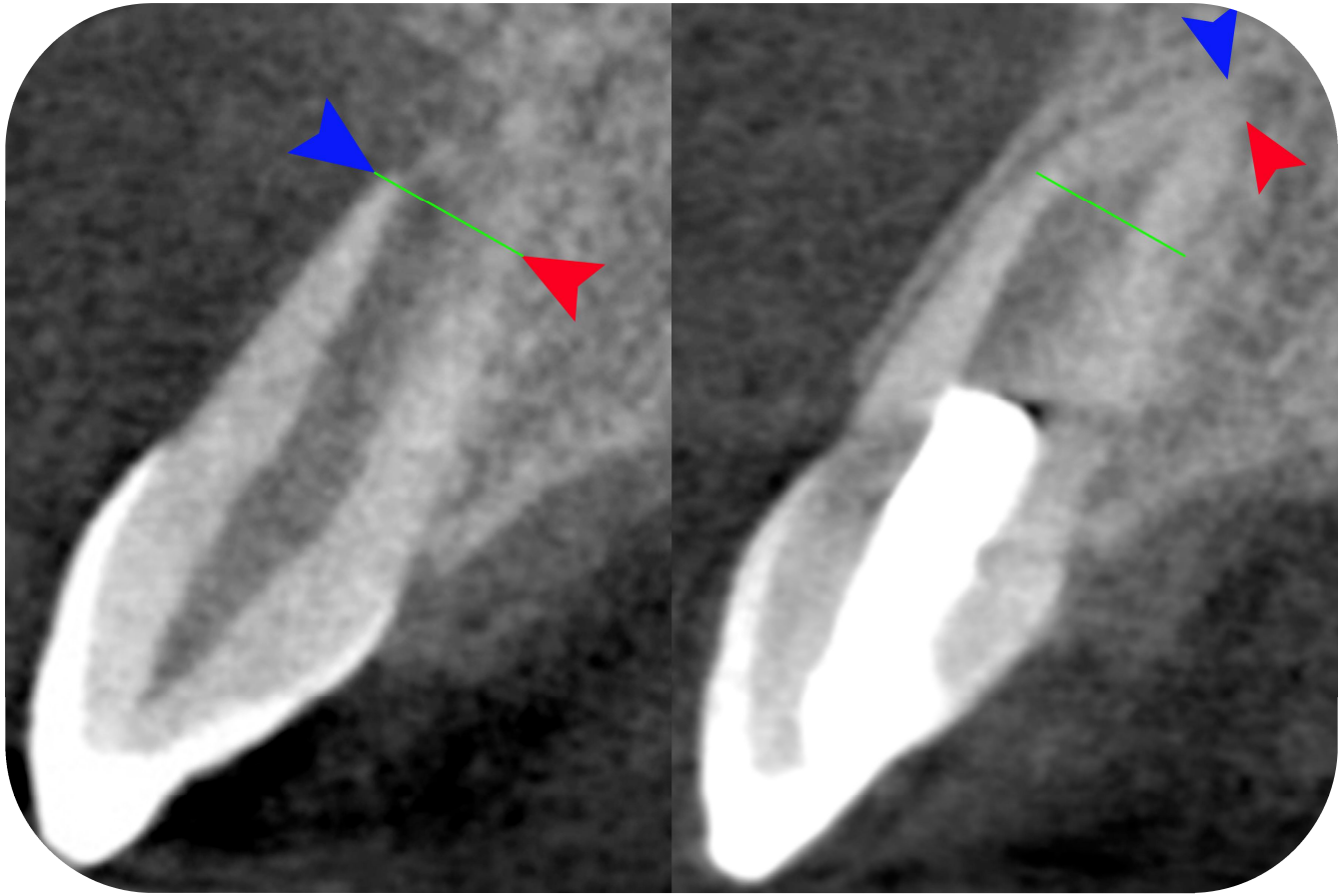
Part 5: Other uses of MTA





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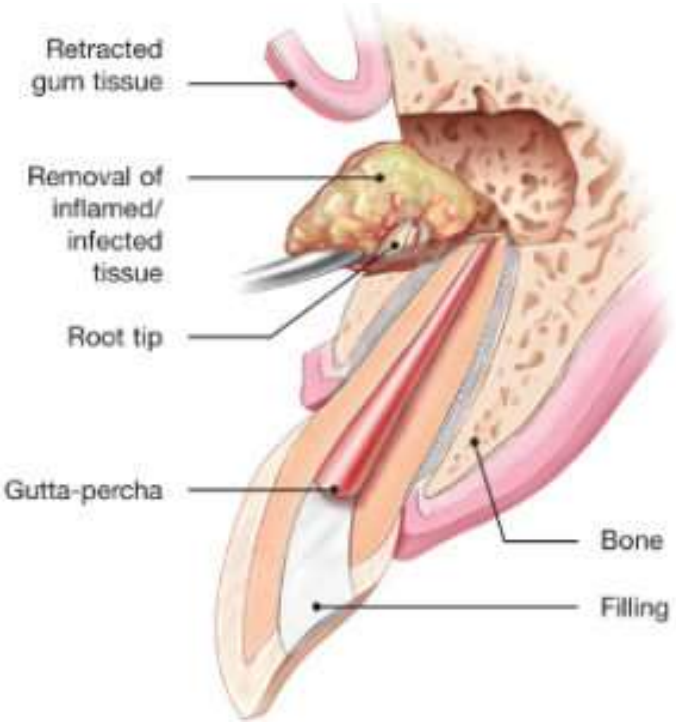
Indications for apical surgery



- Persisting or emerging disease following root-canal treatment when root canal re-treatment is inappropriate e.g. an obstruction which cannot be removed and the risk of treatment is too great.

- Extruded material with clinical or radiological findings of apical periodontitis and/or symptoms continuing over a prolonged period.

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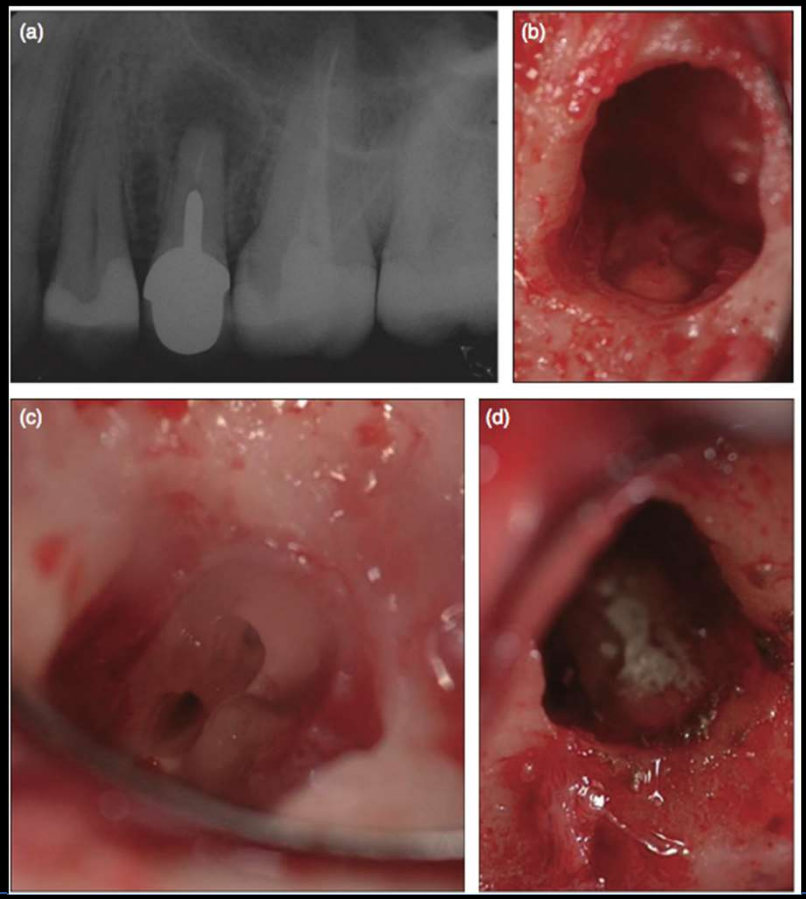
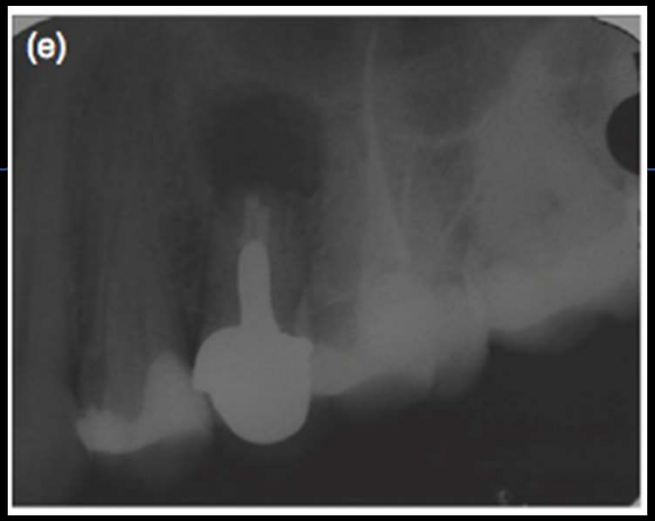
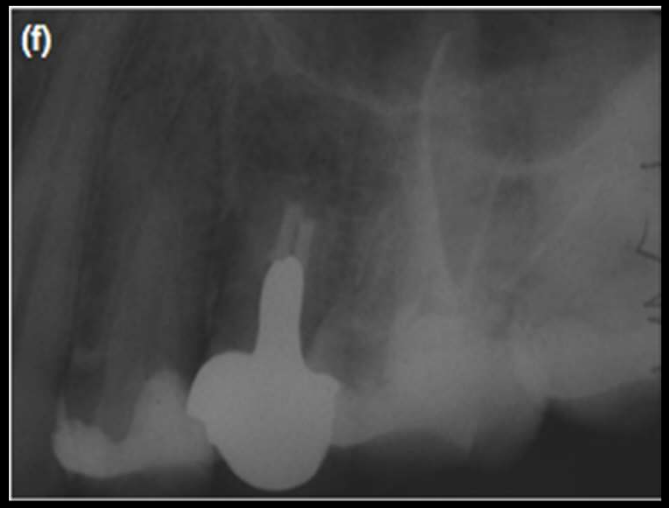
European Society of Endodontology 2006, AAE 2018

Apical surgery







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Kahler 2010

General procedure

- Remove cortical bone overlying infected root
- Use microscope to see apical orifice(s)
- Removing infected 3mm of apical root surface
- A 3mm retrograde cavity is prepared into the apical orifice(s) and restored with MTA

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Von Arx 2011

Pulp regeneration






18 months

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Thomson 2010

Success rates

- Regenerative endodontics 85%. Compared with 100% success rates for MTA apical barrier placement

- Where possible, it is better to try regenerative endodontics as it will lead to thickening of the dentinal walls reducing risk of fractures. If a regenerative endodontics cases fails, an MTA apical barrier can be placed.

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Kahler 2017

Pulp regeneration

- Visit 1
  - LA, Rubber dam, access
  - Irrigate with 1% NaOCl, then saline or EDTA
  - Dry with paperpoints
  - Place antibacterial medicament
  - Seal with Cavit
- Visit 2(1-4 weeks later)
  - LA with no adrenaline, rubber dam, access
  - Irrigate with EDTA
  - Dry
  - Create bleeding by over-instrumenting 2mm past the apical foramen
  - Stop bleeding at a level at the CEJ. Possibly with resorbable matrix
  - Place MTA, then RM/GIC then composite.

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AAE 2016

Pulp regeneration

- Indications
  - First treatment option for permanent immature teeth with pulp necrosis (Diogenes 2016)
- Goals
  - Resolution of signs and symptoms
  - Further root maturation
  - Positive vitality testing (AAE 2017)

- Be careful of diagnosing traumatised teeth with periapical radiolucencies as having periapical disease.
  - This may be transient apical breakdown (reparative remodelling)
  - Ie. Dark teeth with PA lesions with no pulpal responses may be vital (Andreasen, 2015)

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Summary of Part 5

- Consider MTA apical surgery where re-treatment is
  - not feasible (will be too destructive)
  - or retreatment has failed
  - or extruded material is causing irritation

- Consider MTA pulp regeneration
  - For immature permanent teeth
  - If it fails, consider MTA barrier placement (apexification).

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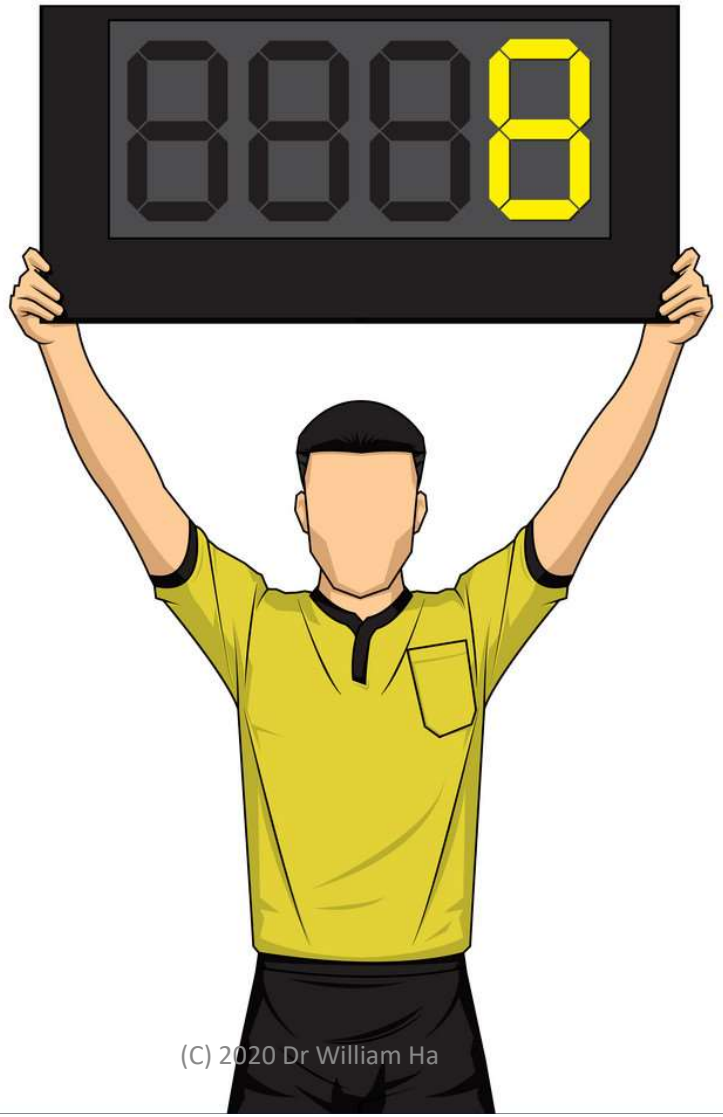
Extra Time



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TheraCal LC (Bisco)

"Light Cured MTA"

Composition: Portland cement, Polyethylene glycol, dimethacrylate, MEHQ, AeroSil 200, Bis GMA, camphorquinone, barium sulfate, EDMAB.

No water in liquid ie. cannot release calcium hydroxide

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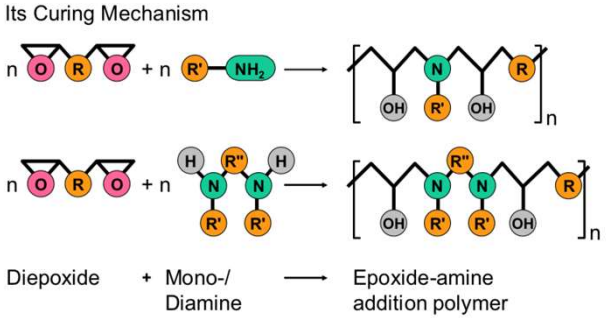
Camilleri 2014

AH Plus (Dentsply Sirona)



- Epoxy-resin sealer
- The most commonly used material
- The most commonly tested material
- Two forms, hand mixed and auto-mixed

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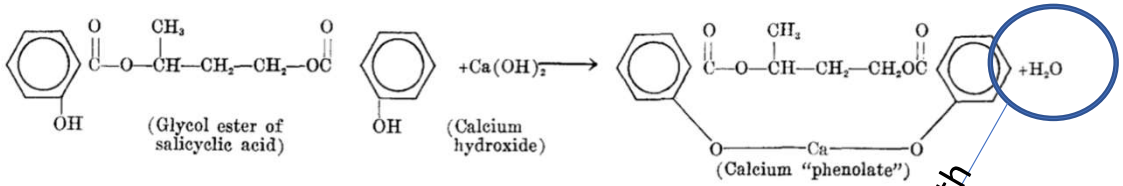
Dentsply 2005

MTA Fillapex (Angelus)



- MTA Fillapex is essentially Sealapex mixed with MTA powder (13%)
  - It is hardly "MTA"
- It is a flowable endodontic sealer and should not be used for endodontic repairs of teeth or for pulp therapy.

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MTA Fillapex vs AH Plus

Property	AHPlus	MTA Fillapex
Clinical Success	Many and long studies	Lab studies
Radiopacity	Better	Worse (Bicheri 2013, Lee 2017)
Film Thickness	Better	Worse (Zhou 2013)
Flow	Worse	Better (Lee 2017)
Cytotoxicity	Better	Worse (Silva 2013, da Silva 2017)
Skin implantation	Better	Worse (Tavares 2013)
Bond strength	Better	Worse (Baechtold 2014)
Wetting (adhesion)	Worse	Better (Ha 2018)
Antibacterial activity	Worse	Better (Kuga 2013)
Solubility	Better (Less soluble)	Worse (Faria-Junior 2013) and fails standard (Borges 2012) (More Soluble)

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TotalFill BC Sealer (FKG)

- Also known as iRoot BC Sealer and Endosequence BC Sealer

- It is dry calcium silicate powder (similar to MTA) mixed with a waterless thickening agent
- It’s a single syringe so the paste is not mixed with a second paste or powder. It needs moisture to leak into the sealer to set

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AH Plus vs Total Fill BC Sealer

Property	AH Plus	BC Sealer
Clinical Success	Commonly used in endodontic literature	Case Reports
Radiopacity	Better	Worse (Candeiro 2012, Lee 2017, Tanomaru-Filho 2017)
Cytotoxicity	Equal or Worse	Equal or Better (Poggio 2017 or Willerhausen 2011)
Implantation (skin)	Worse	Better (Zhang 2015)
Implantation (bone)	Equal	Equal (Zhang 2015)
Sealing Tests	Better	Worse (Ulusoy 2011)
Wetting (adhesion)	Worse	Better (Ha 2018)
Antibacterial activity	Similar	Similar (Zhang 2009)
Push-out Strength	Better	Worse (Gade 2015)
Flow	Mixed reports	Mixed reports (Lee 2017, Tanomaru-Filho 2017)
Solubility	Better (Less soluble)	Worse, fails standards (More soluble) (Borges 2012, Tanomaru-Filho 2017)
Volumetric change	Better	Worse (Shrinks) (Tanomaru-Filho 2017)
Setting time	Better	Worse (Tanomaru-Filho 2017)

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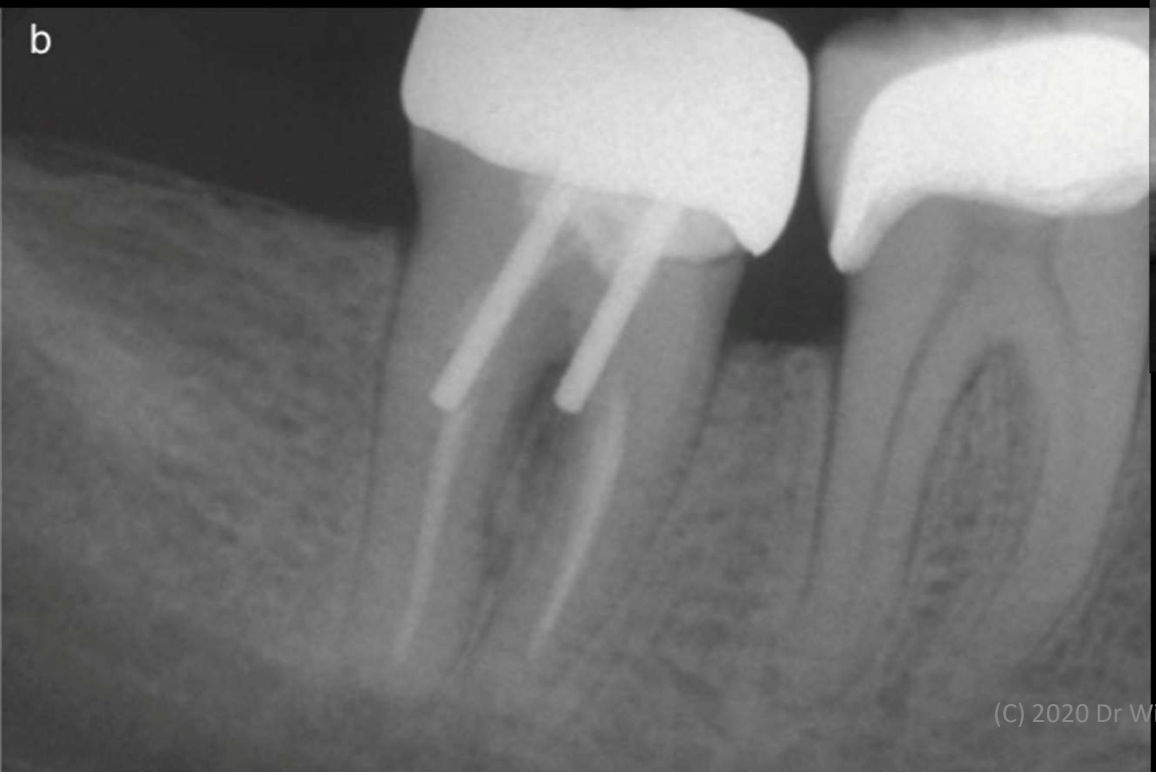
Part 6: Prosthodontic Perforations



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Baba & Goodacre 2014

Incidence of perforations

TABLE 1. Patients' Age, Sex, Total Number of Teeth, and RCT Number Versus Perforation Presence

	Number of patients (%)	Average age (y)	Number of male patients (%)	Number of female patients (%)	Average number of teeth per patient	Average of root canal–treated teeth per patient
With perforations	101 (5)	41.2* (SD = 15.6)	52 (51)	49 (49)	26.87 (SD = 4.52)	5.505* (SD = 3.83)
Without perforations	1901 (95)	35.85* (SD = 15)	958 (50)	943 (50)	28.12 (SD = 4.93)	2.36* (SD = 2.85)
Total	2002	36.1 (SD = 15.1)	1010 (50)	992 (50)	28.06 (SD = 4.92)	2.52 (SD = 2.99)

SD = standard deviation.

*$p < 0.05$.

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Tsesis 2010

Table II. Frequency of perforations in relation to root surface location, aetiology and distribution

	Perforation location					Aetiology		Distribution of cases	
Location	Buccal	Lingual	Mesial	Distal	Total	Endodontic treatment	Post preparation	Study group	Extracted
Furcation					7	3	4	2	5
Cervical	3		2	3	8	3	5	7	1
Midroot	8	1	12	4	25	9	16	21	4
Apical	8	1	5	1	15	11	4	13	2
Total	19	2	19	8	55	26 (47%)	29 (53%)	43	12

*Thirty-one cases repaired, four cases recalled without treatment.

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Kvinnsland 1989

Table III. Endodontic treatment procedures leading to root perforation

Treatment procedure	No. teeth*
Attempting to locate canal orifices	6/26 (23)
Attempting to negotiate calcified canals	11/26 (42)
Root canal instrumentation	9/26 (35)
Total	26/55 (47)

*Percentages are shown in parentheses.

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Kvinnsland 1989

Problems of Perforation

- Provides point of leakage to –and from – the PDL and can result in inflammation

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Irrigation into Perforations

- 6 out of 40 articles on NaOCl extrusion involve perforations

Study	Tooth	Gender	Radio graph	Pulp status	Periapical lesion	Reduced resistance to extrusion (except periapical lesion)	Destruction of apical constriction	OCI %	Needle type–size	Proclaimed cause: Needle wedging	High flow rate	Over-instrumentation	Perforation	Periapical lesion	Other	Reviewers' comments on the cause
Becker *et al.* (1974)	13	F	✓	Vital				5.25	25G	✓	✓					
Grob (1984)	22	F		Nonvital	NA		✓	3	NA			✓				
Patterson & McLundie (1989)	14	F		Nonvital				1	25G						NA	
Reeh & Messer (1989)	11	F	✓	Nonvital	✓			1	NA				✓			
Sabala & Powell (1989)	25	M	✓	Nonvital	NA			5.25	NA						NA	Suspected perforation (radiograph)
Neaverth & Swindle (1990)	22	F	✓	Vital				2.5	NA				✓			
Becking (1991)	27	F	✓	NA	NA	Maxillary sinus		NA	NA						NA	
	35	M		NA	NA			NA	NA						NA	
Gatot *et al.* (1991)	11	F		Nonvital	NA			5.25	NA						NA	
Joffe (1991)	23	F		NA	NA			5.25	NA	✓						
Ehrich *et al.* (1993)	16	M	✓	Nonvital		Maxillary sinus	✓	5.25	Open-ended – 23G			✓				
Cymbler & Ardakani (1994)	21	F		Nonvital	✓			2	NA						NA	
Tosti *et al.* (1996)	24	F		NA	NA			NA	NA						NA	
	12	F		NA	NA			NA	NA						NA	
Hulsmann & Denden (1997)	23	M	✓	Vital			✓	3	NA			✓				
Kavanagh & Taylor (1998)	15	M	✓	Nonvital	✓	Maxillary sinus		NA	NA		✓				Volume, concentration of NaOCl	Suspected perforation (radiograph)
Juárez & Lucas (2001)	14	M		NA	NA			NA	NA						NA	
Hales *et al.* (2001)	24	F		Vital				5.25	Open-ended – 23G	✓						
Balto & Al-Nazhan (2002)	11	F	✓	Nonvital	✓			1	25G	✓	✓					
Gemhardt *et al.* (2004)	34	F	✓	Vital		Cervical perforation		5.25	Open-ended – 28 G				✓			
Witton & Brennan (2006)	12	F	✓	Nonvital	✓	Fistula		NA	NA		✓			✓		
Witton *et al.* (2006)	15	F		Nonvital	✓			NA	NA		✓			✓		
Bowden *et al.* (2006)	37	M		Nonvital	✓			NA	NA		✓			✓		
Schwerin & Gerlach (2007)	11	F		NA	NA			NA	NA				✓			
Thiessen *et al.* (2007)	16	F	✓	Nonvital	✓			2.5	NA						NA	
Crincoli *et al.* (2008)	13	F		NA				NA	NA						NA	
Farren *et al.* (2008)	24	F		NA	NA			NA	NA						NA	
Pelka & Petschelt (2008)	22	F	✓	Nonvital	✓		✓	3	NA		✓			✓	Apicoectomy	
Zairi & Lambrianidis (2008)	15	F	✓	Nonvital		Maxillary sinus	✓	2.5	Closed-ended		✓	✓				
Baldwin *et al.* (2009)	23	F	✓	Nonvital	✓		✓	1	27G			✓				
Doherty *et al.* (2009)	31	F	✓	Nonvital	✓	Cervical perforation		NA	NA				✓			
Markose *et al.* (2009)	16	F		NA	NA			5.5	NA						NA	
Sermeño *et al.* (2009)	13	F		NA				5	NA		✓					
Braitt *et al.* (2010)	21	F	✓	Coronal-nonvital, apical-vital				1	NA						Horizontal root fracture	
Lam *et al.* (2010)	13	F		Vital				NA	NA						NA	
Singh (2010)	15	F	✓	Nonvital	NA			NA	NA						Intentional extrusion	
Wang *et al.* (2010)	23	F	✓	Nonvital				2.5	25G				✓			
	47	F	✓	Vital				2.5	25G						NA	
Chaudhry *et al.* (2011)	34	F		NA	NA			5.25	NA				✓			
	23	F		NA	NA			2	NA						NA	
	21	F		NA	NA			1	NA						NA	
	34	F		NA	NA			NA	NA						NA	
Lee *et al.* (2011)	21	F	✓	Nonvital	✓	Cortical bone perforation	✓	NA	NA		✓					Suspected over-instrumentation (radiograph)
Tegginmani *et al.* (2011)	21	F	✓	Nonvital	✓		✓	3	NA			✓			Root resorption	
Behrents *et al.* (2012)	25	F	✓ + CBCT	NA		Apical fenestration	✓	3	NA						Not documented	
Paschoalino *et al.* (2012)	28	F		Vital				1	NA	✓					Needle beyond the apical foramen	

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Fig. 1 Necrotic based ulcer adjacent to the mandibular left canine and premolars

Fig. 2 Further breakdown of necrotic ulcer. Arrow points to exposure of mental nerve

Chaudhry 2011, Boutsiokis 2013

Perforation prevention – finding canals

- Orifice barriers can prevent bacterial leakage to the root canal obturation that would otherwise lead to periapical inflammation.
  - However, tooth coloured materials can be difficult to identify from dentine and a perforation can be created when searching for the root canal obturations

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Yamauchi 2006

Orifice Barriers – Seal /Microleakage

Amalgam	Non-Flowable CR	Flowable CR	GIC	RMGIC	Geristore	MTA	Biodentine	CEM	Polycarboxylate	IRM	Super EBA	Cavit	Author
		Worst		Best		Middle							Rashmi 2018
						Similar	Similar	Similar					Ramezanali 2017
						Similar		Similar					Moghadam 2017
			Similar			Similar		Similar					Zarenejad 2015
		Best		Worst									Parekh 2014
		Best							Worst				Bayram 2013
	Worst		Worst			Best							Yavari 2012
		Middle	Worst	Middle		Best							Ghulman 2012
		Similar				Similar						Similar	Bailon-Sanchez 2011
Middle				Best	Worst	Middle							Zakizadeh 2008
		Middle	Middle	Best		Worst							Parolia 2008
		Best				Worst						Worst	Jenkins 2006
		Worst		Worst								Best	Sauaia 2006
										Worst	Worst	Best	Pisano 1998
Best												Worst	Roghanizad 1996

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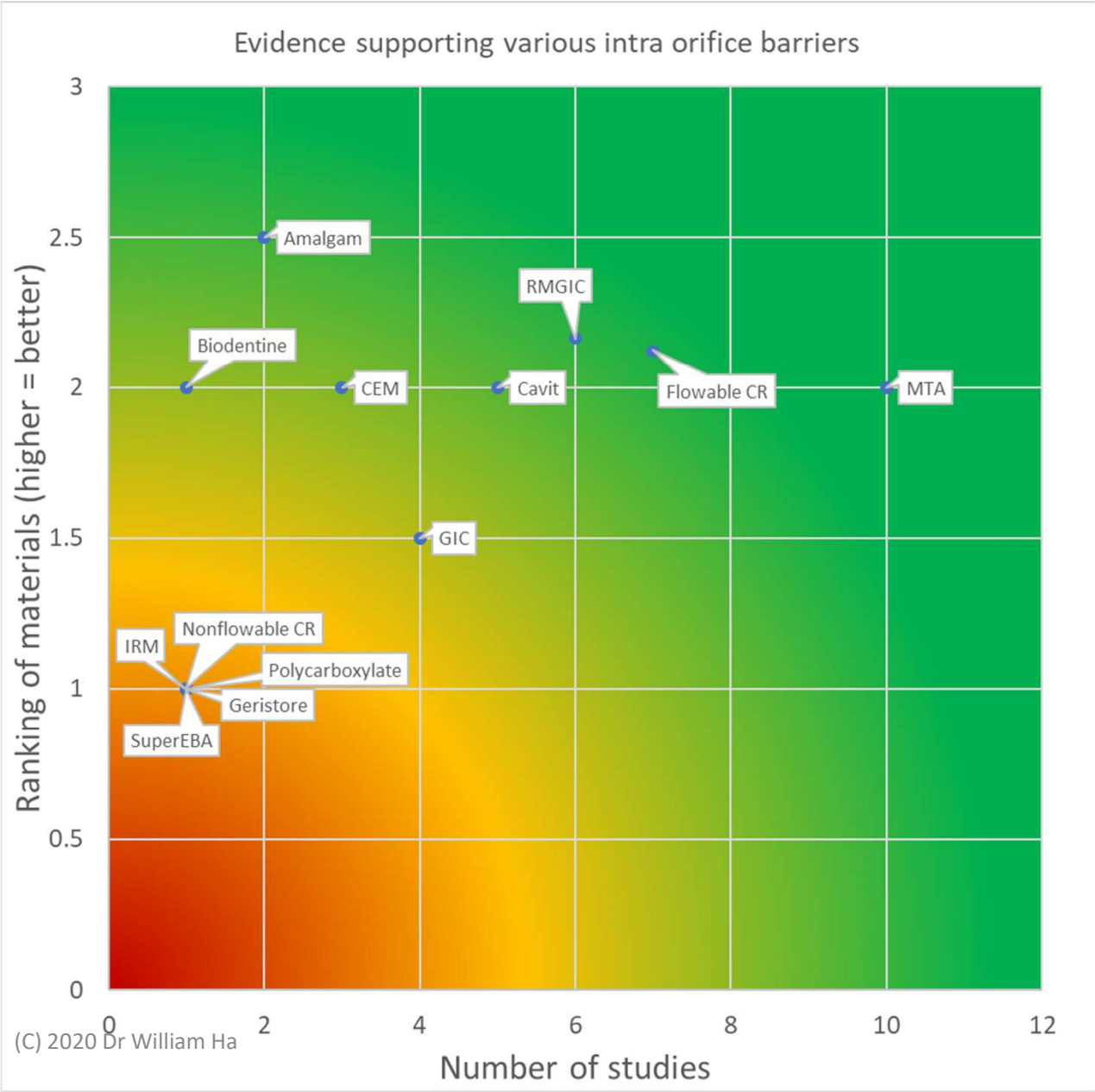
Some of the best orifice barriers, are difficult to remove or can be difficult to discern from dentine

The prosthodontist should advise the endodontist if a post-space is intended.

The endodontist should be able to identify if a post is required and advise the prosthodontist if placing a post would be difficult.



Perforation prevention – removing gutta percha – keep your drill centered

- Know the angulation of the canal and root
  - Keep your radiograph on screen, the root angulation may not match the clinical crown
  - You are more likely to identify curvatures if the radiograph stays on-screen
  - If the root is curved, don't go past the curvature
- Soften the GP
  - Use the heat tip
  - Don't use solvents as it can dissolve some apical GP and compromise the seal
- Know the dimensions of the canal
  - Using a drill smaller than the gutta percha will keep it centered
  - Use an endodontic rotary file, possibly a re-treatment file (D1 then D2)
  - Once the post depth is reached with the rotary files, then move onto the post-prep drills or gates glidden drills
  - Start with the smallest diameter and move up in size

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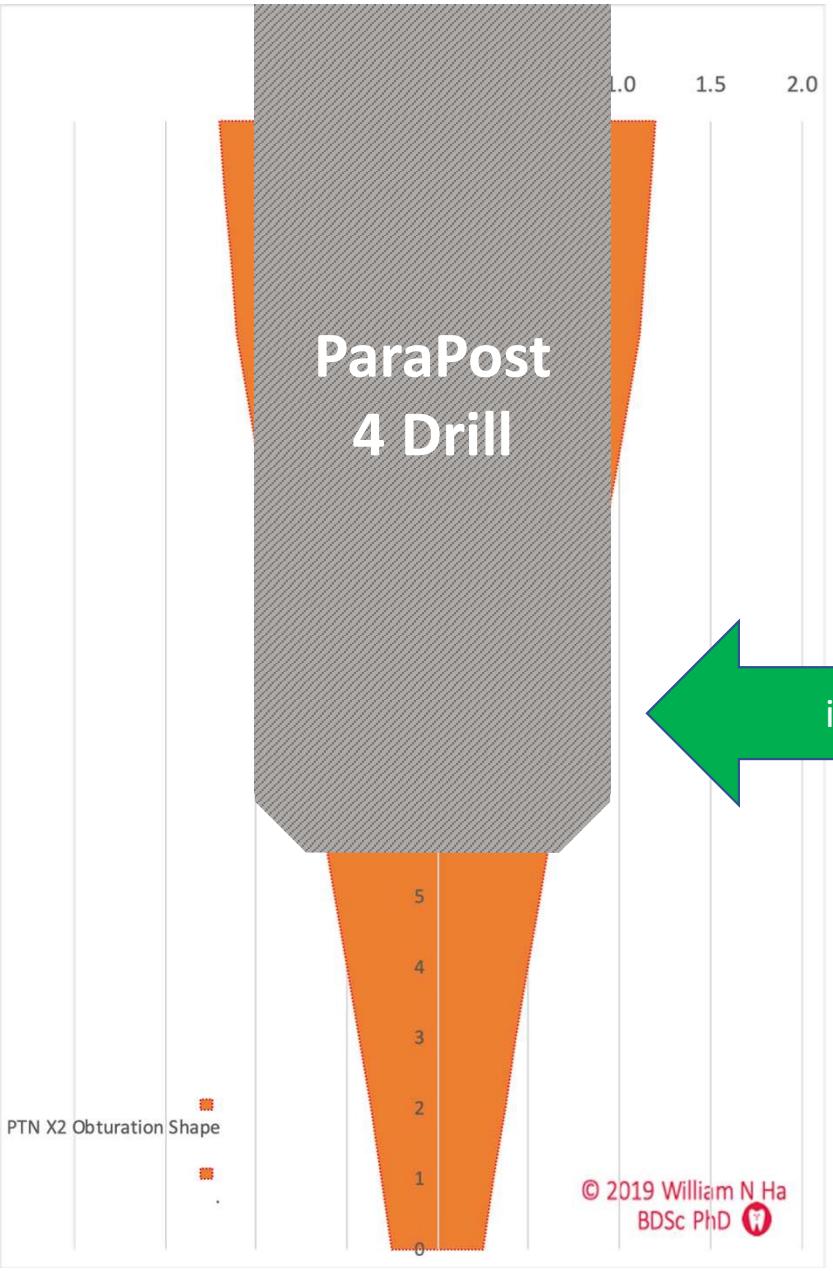
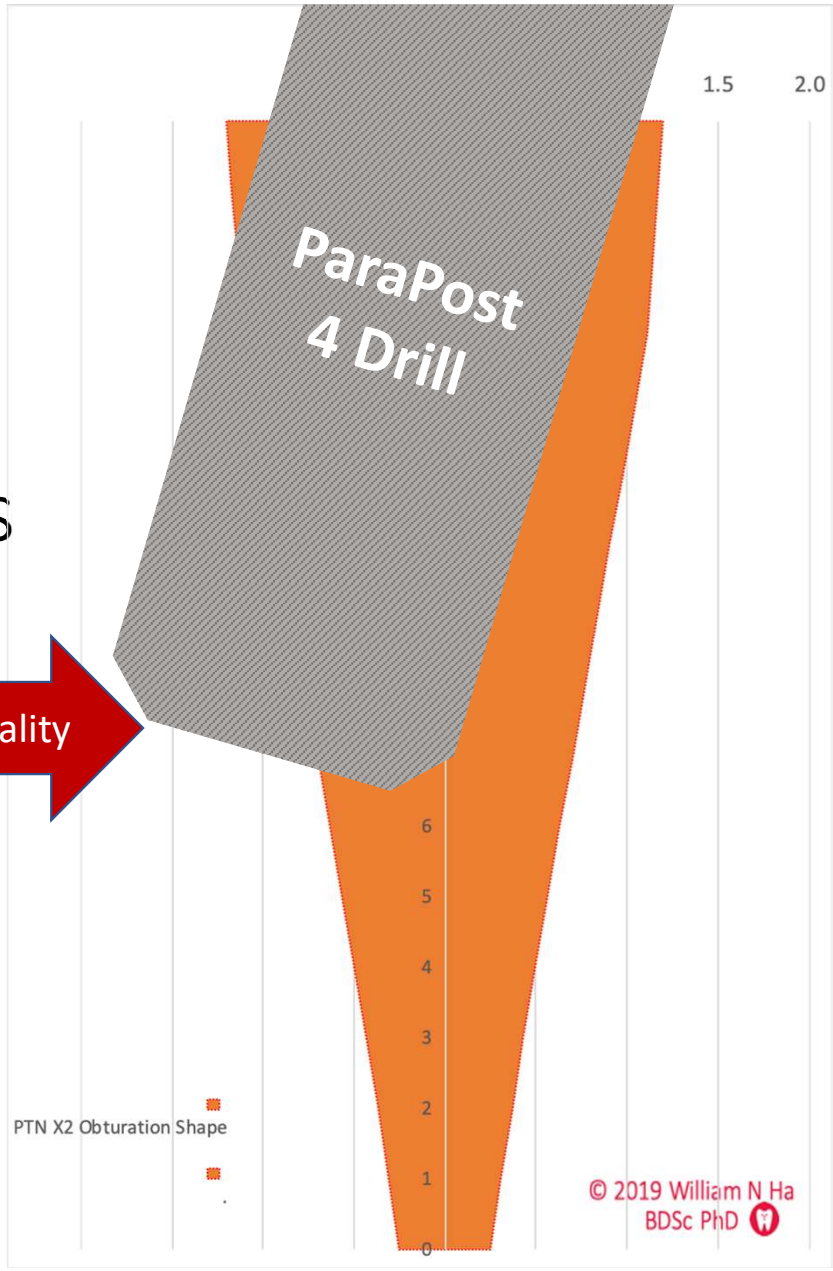
Torabinejad 2008, Nayyar 1980

The problem with preparing post spaces through GP using Post Drills



ideal

Perforation reality



If GP has not been removed, there is NO path of least resistance for the drill

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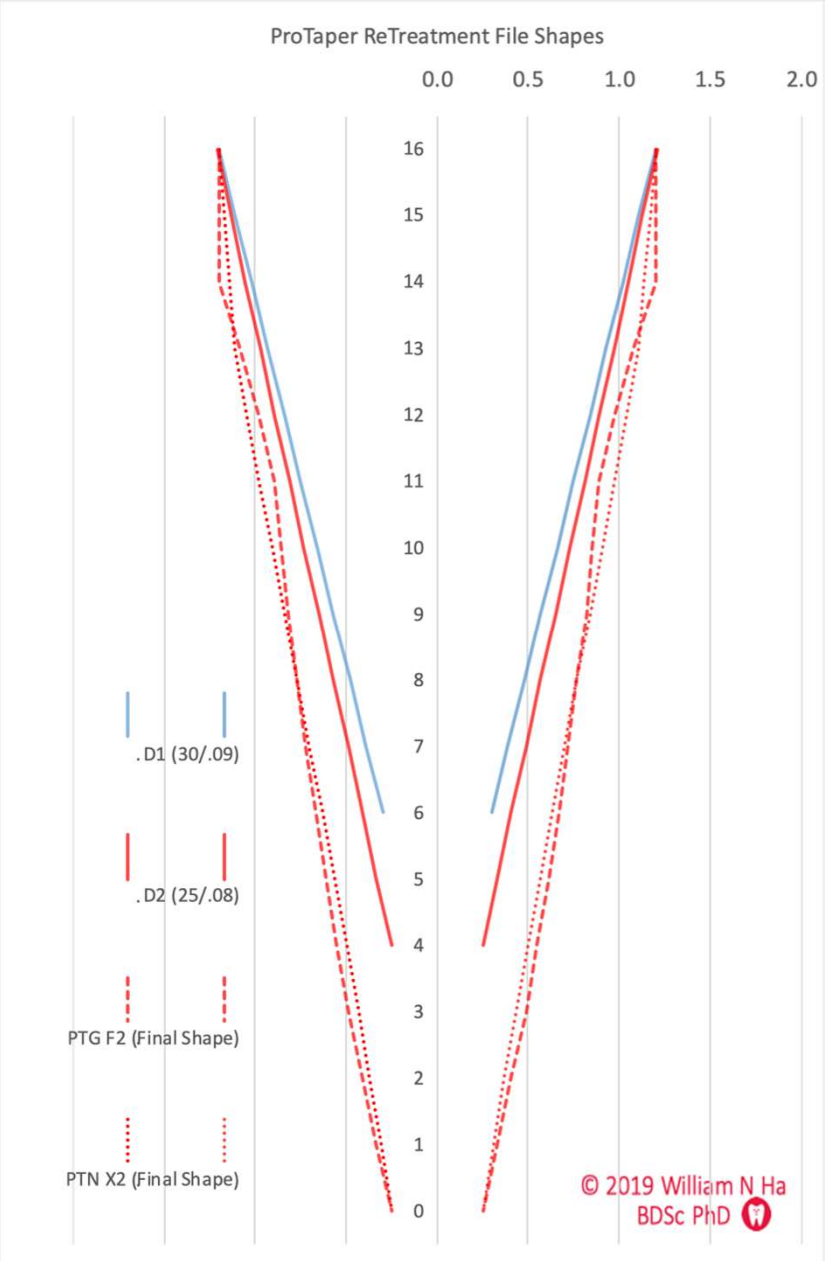
ProTaper ReTreatment Files

- Use the D1 (30/.09) to the intend post-preparation depth or 6mm short of the end of the obturation, whichever comes first.
- Use the D2 (25/.08) to the intended post preparation depth. Don't bother if the D1 reached the post prep depth.

- Standard rotary files can be used and can be just as effective. However, they are usually 21mm or longer.
- ProTaper ReTreatment files are:
  - D1 is 16mm long
  - D2 is 18mm long
  - Therefore, access is easier

- Creates a path of least-resistance for post-preparation drills.



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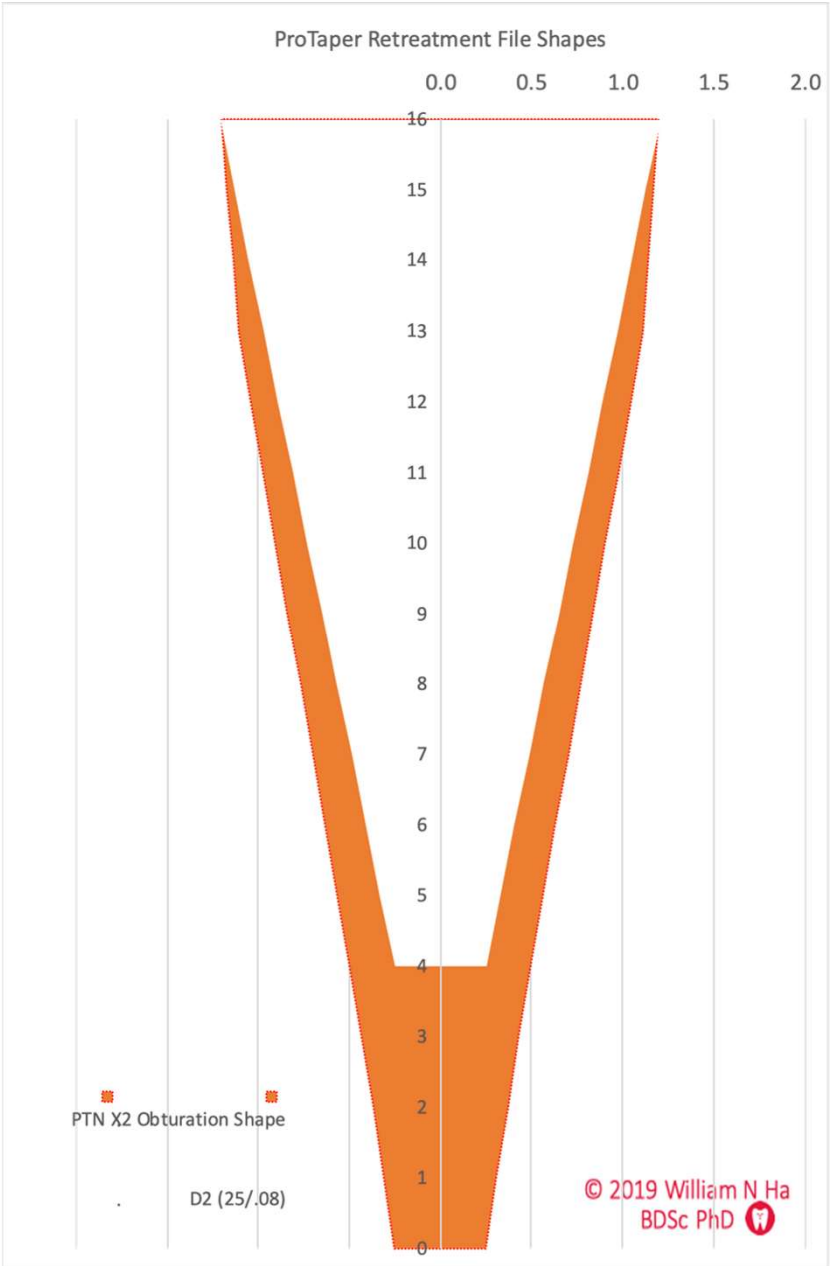

- Removal of the centermost GP creates a path of least resistance for any post preparation drills

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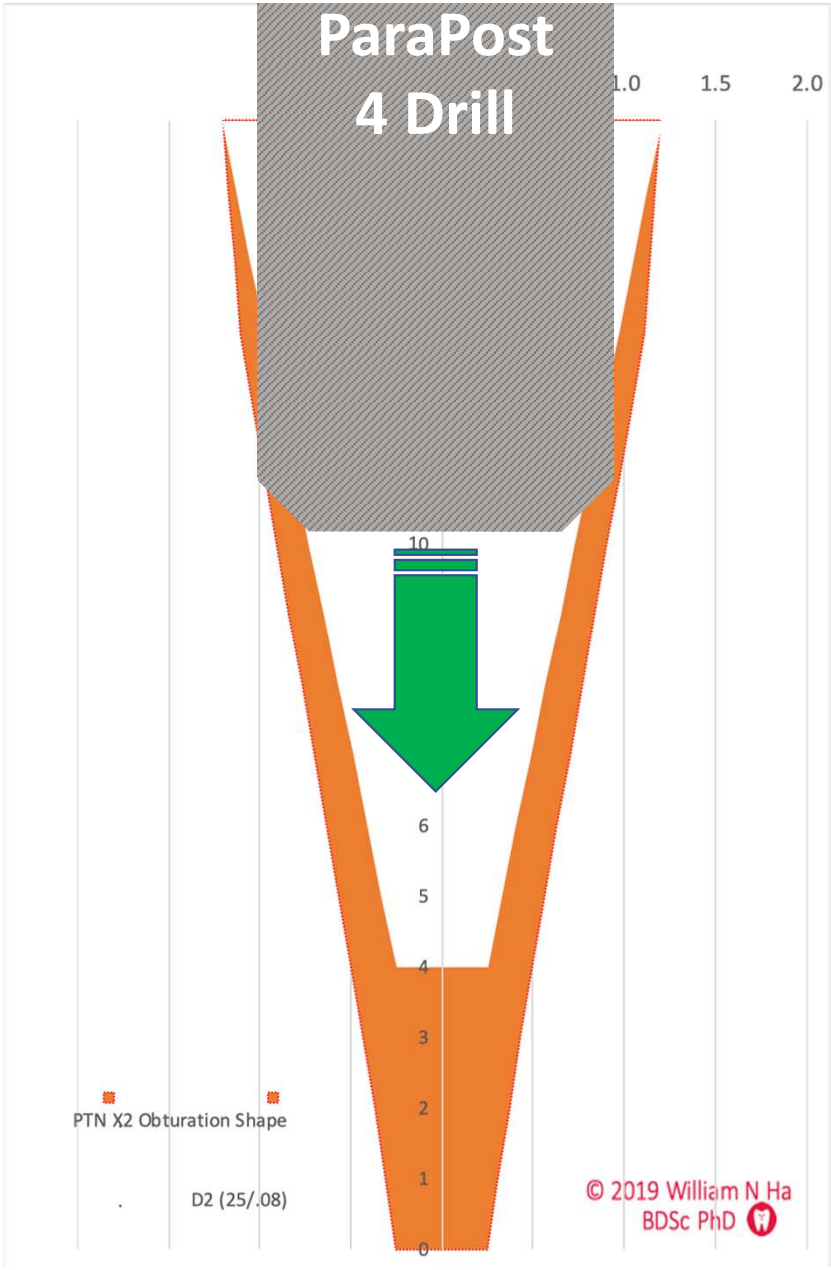

Gates Glidden

- GG burs can be used. Ideally, they should be used after initial use of the ProTaper ReTreatment File so a path of least-resistance is created

- Crown-down the GGs
  - Use the #2 to 7mm short of the apex
  - Then use the #1 to 4-5mm short of the apex
  - Then remove GP / sealer from the walls
  - If required, then start to widen the prep

- This is to remove residual coronal GP that would otherwise divert the path of the GG away from the canal

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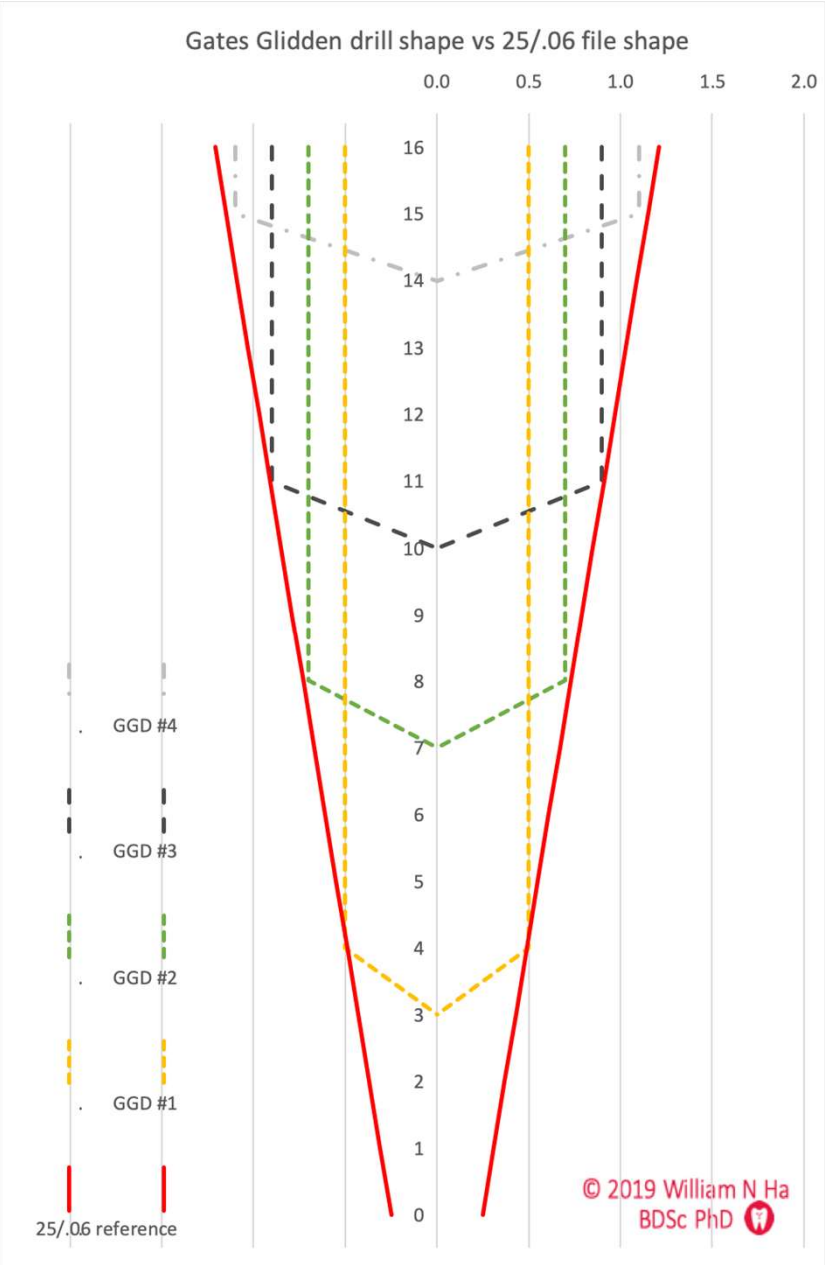
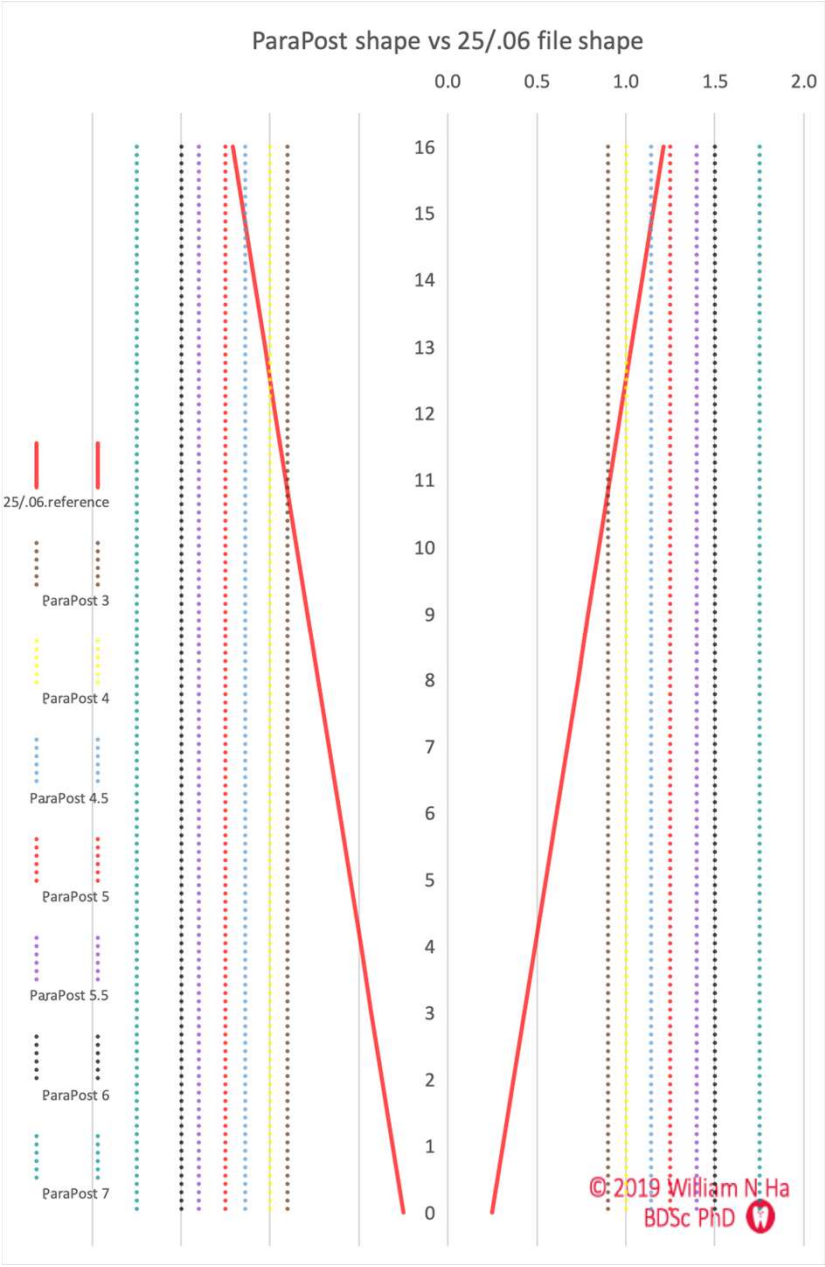


ParaPost Parallel Drills

- All Parapost drills are completely larger than the size of the commonly created root canal obturation shape.
- If a path of least-resistance is not created, it is easy for the drill to not stay centered.
- If PPs are to be used, consider removing all of the gutta percha coronal to the apical seal using endodontic rotaries and the gates glidden.



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Consider using a post system that conforms with the root canal space

	ParaPost Fiber Lux / Fiber White / XP / XH / XT							RelyX Fiber Post			
"Size"	3	4	4.5	5	5.5	6	7	0	1	2	3
Taper (mm/mm)	0%	0%	0%	0%	0%	0%	0%	5%	6%	8%	10%
Apical size (mm)	0.90	1.00	1.14	1.25	1.14	1.50	1.75	0.60	0.70	0.80	1.00

	PTN X2 (25/v.06)	PTN X3 (30/v.08)	25/0.06	30/.04	30/.06
Size (mm)	0.25	0.30	0.25	0.30	0.30
Taper (mm/mm)	Average 7%	Average 6%	Constant 6%	Constant 4%	Constant 6%
Size at 5mm from apical foramen (mm)	0.56	0.65	0.55	0.50	0.60

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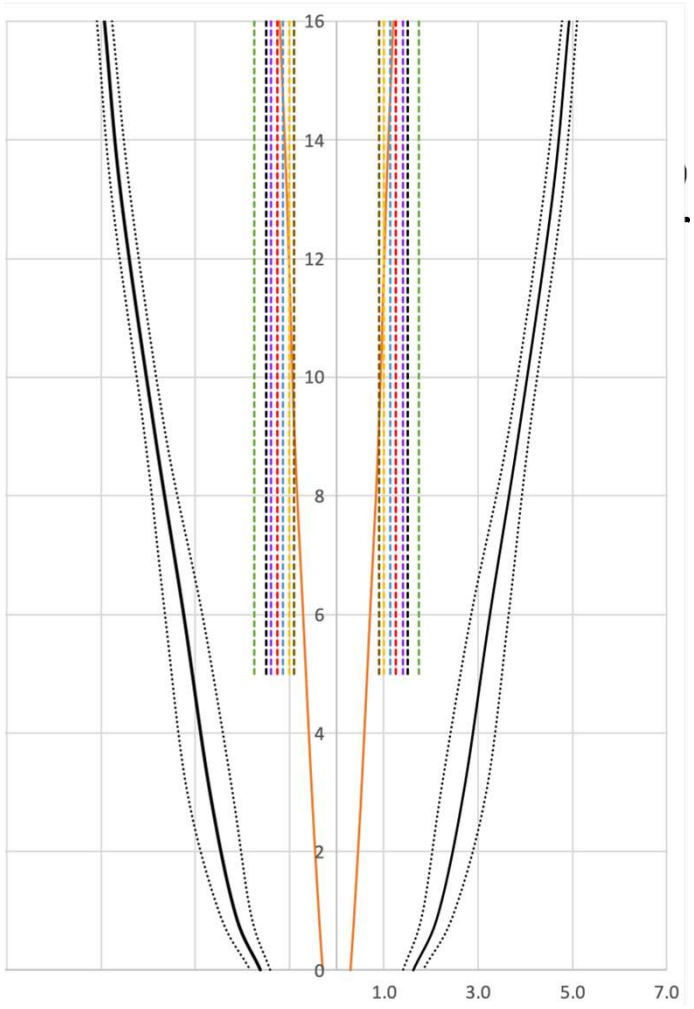
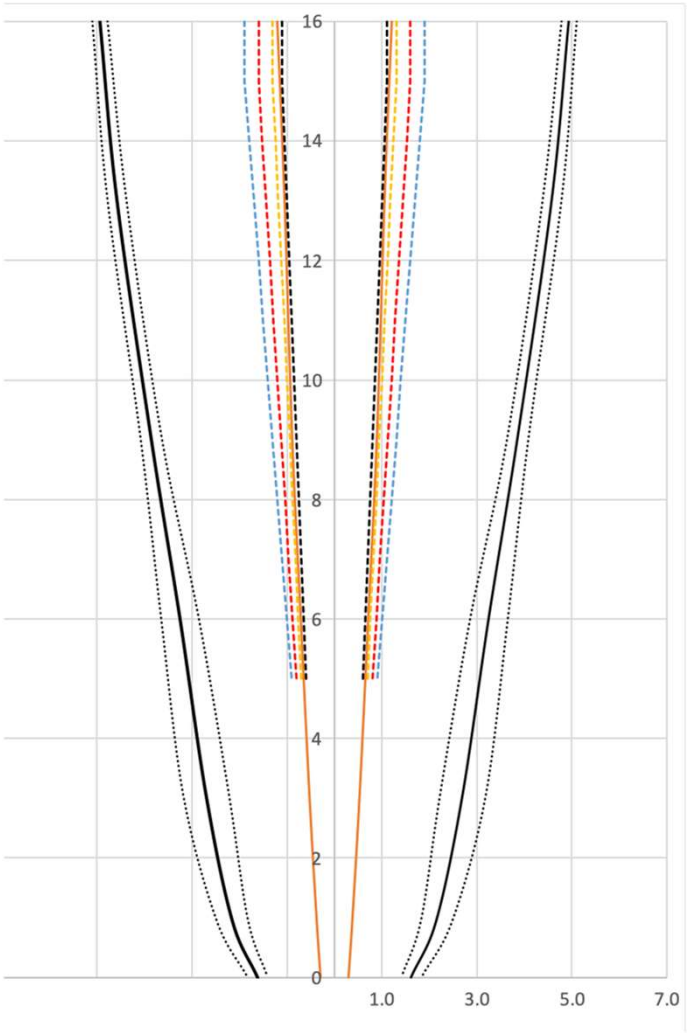
Prefabricated posts in upper lateral incisors





ParaPost (Parallel)

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RelyX Fiber Post

Make everyone's life easier – let the endodontist "leave a post space"

- If the endodontist leaves a post space, they only need to obturate the apical 4-5mm, not obturate the whole canal to the CEJ. The rest of the canal can be filled with CaOH which just be washed out when post impression is performed.

- The prosthodontist will, at most, need to remove any undercuts and possibly need to widen the preparation to facilitate a post. Nevertheless, the risk of perforation occurring will be lower as a low-resistance path has been created.

- Less work for everyone, and less perforations for patients.

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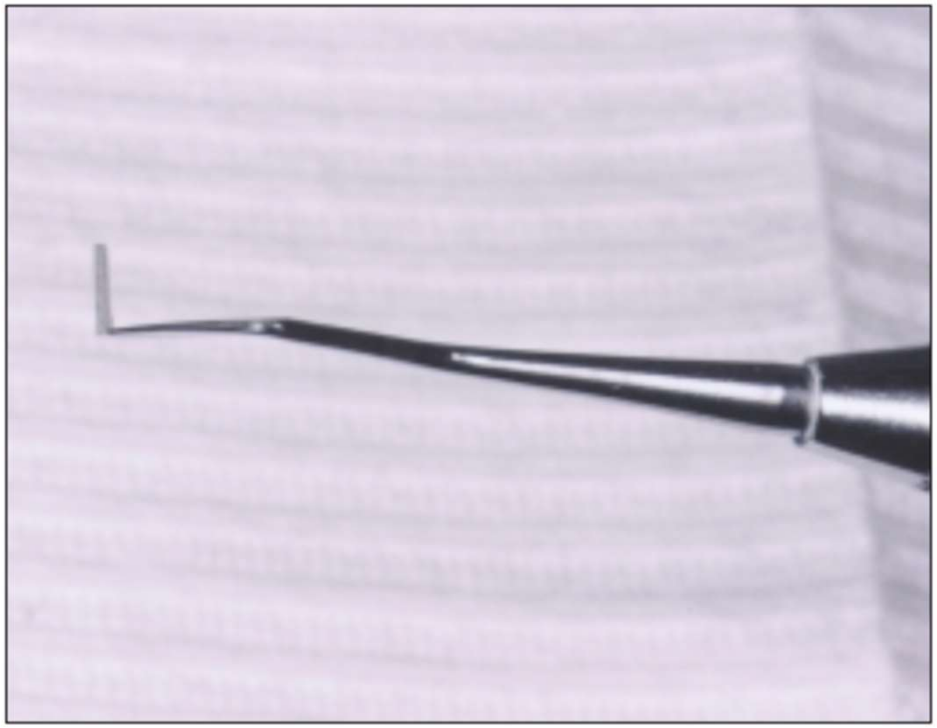
Create pillars of MTA pellets or use an amalgam carrier



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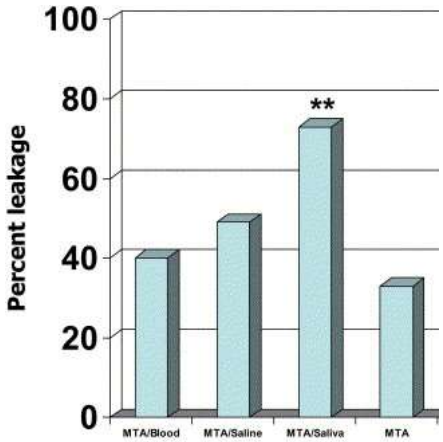
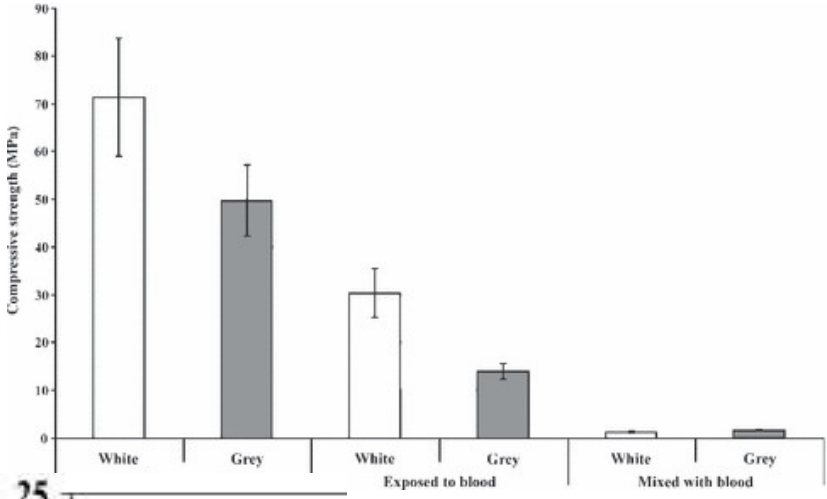
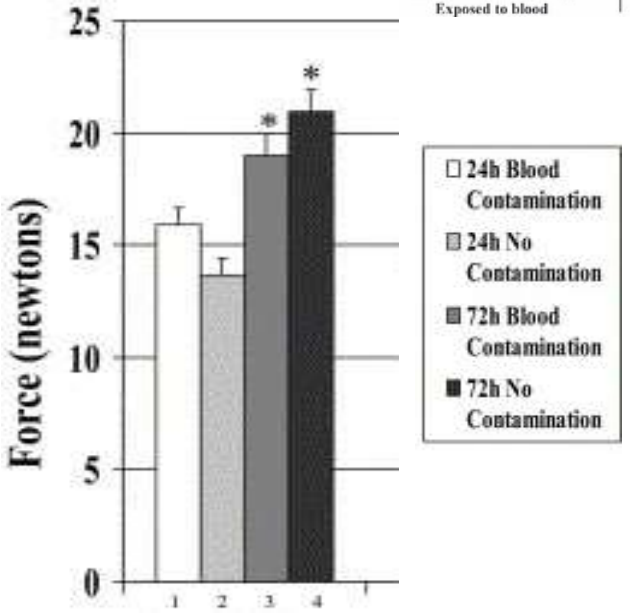
Lee 2000, 2004

Blood and MTA

- Compressive strength and hardness reduces
- Less resistance to displacement
- Increased bacterial leakage







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Nekoofar 2010, Vanderweele 2006, Montellano 2006

Use MTA with as little water as possible

- Reduces porosity and reduces solubility (Fridland 2003, Cavenago 2013)
- Increases the bond strength (Turker 2016)
- Increases radiopacity (Cavenago 2013)
- Increases compressive strength (Basturk 2015)

TABLE 2. Average of solubility recorded for each set of specimens

Ratio Water-to-Powder	Solubility
0.26	1.76
0.28	2.25
0.30	2.57
0.33	2.83

Solubility values were calculated from the weighed residues as a percentage of the initial dry weight of the specimens, following the ISO 6876 standard. All means are statistically different. Level of significance: 0.05.

TABLE 3. Average of porosity recorded for each set of specimens

Ratio Water-to-Powder	Porosity
0,26	30,25
0,28	35,72
0,30	35,19
0,33	38,39

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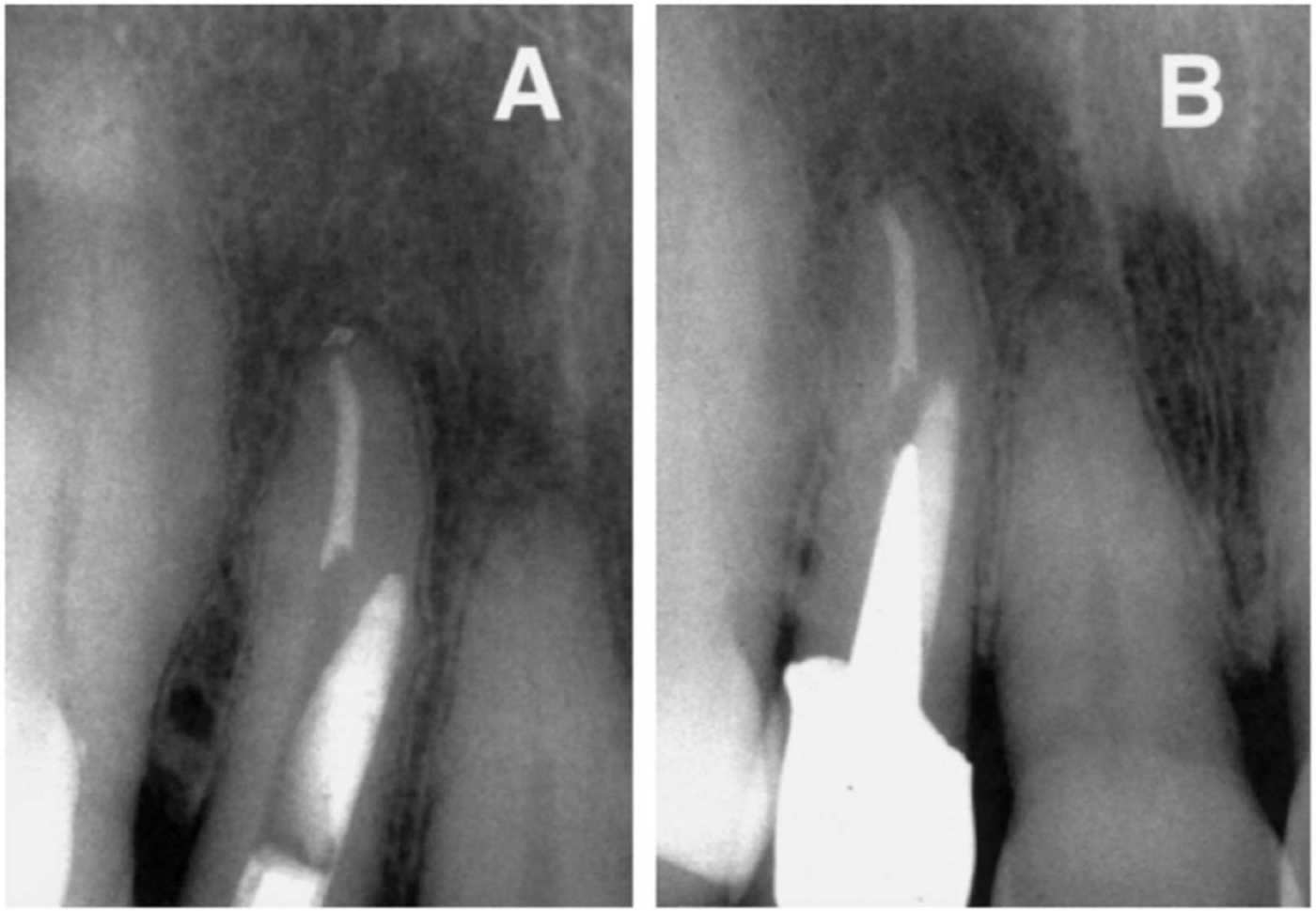

FIG 1. Radiographs of the maxillary right lateral incisor with a lateral perforation. *A*, Postoperative radiograph taken immediately after the repair of the perforation. *B*, Radiograph taken 18 months after perforation repair.

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Perforation repair with MTA

Main 2004

Be aware of Full MTA Obturation

- Pros
  - Better seal than conventional methods
  - Improves strength of root compared to gutta percha obturation methods
  - Condensation of MTA can flow into irregular canal shapes and repairs defects
  - Limits the need to handle multiple materials during obturation which can complicate the obturation technique, particularly if MTA was going to be already going be used to repair a defect.
  - Canals do not always need to be prepared to common taper shapes
- Cons
  - Potential for staining if bismuth oxide variants are used
    - *But it's placement should be limited to below the CEJ, similar with GP methods.*
  - Difficult to retreat
    - *But should you always obturate with failure in mind?*
  - Learning curve for technique
    - *But any new technique has a learning curve*

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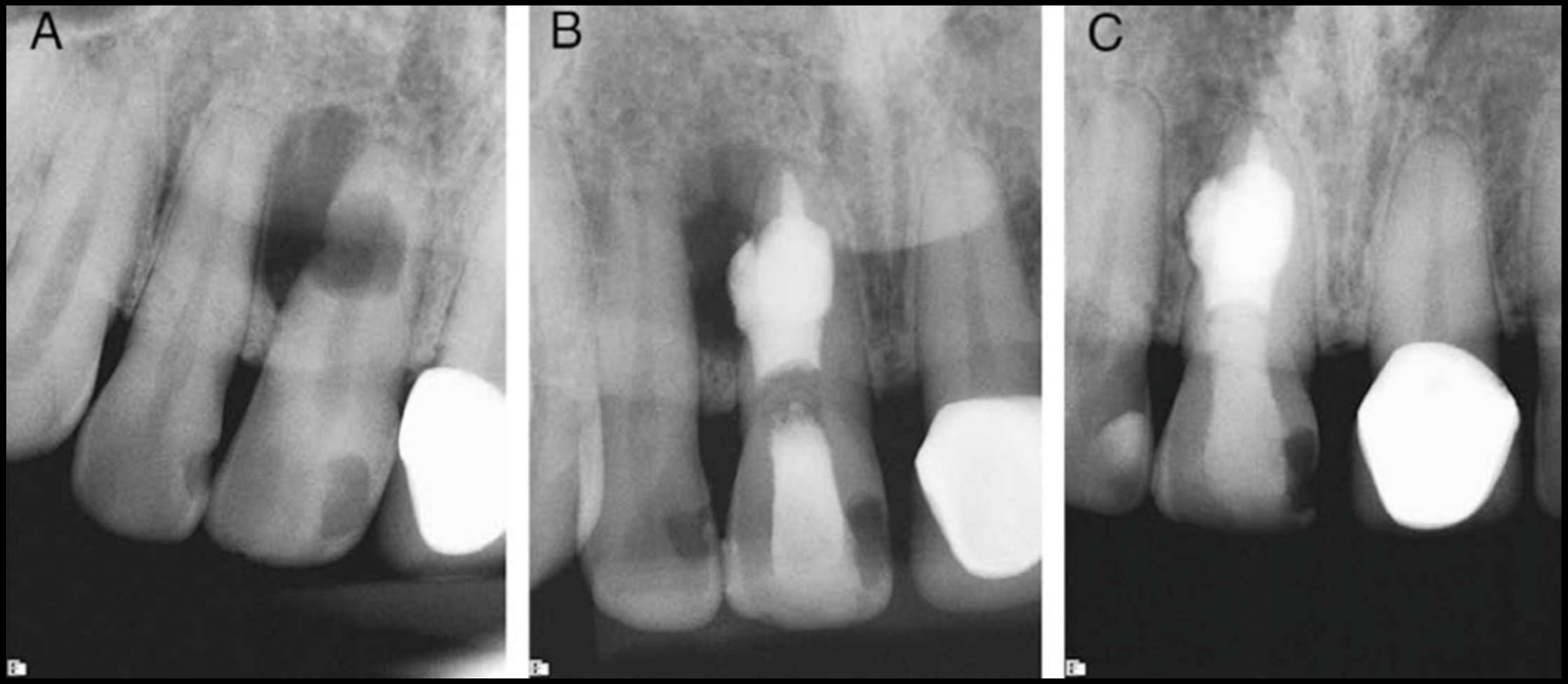
Bogen 2009, 2014

Full MTA Obturation



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Bogen 2009

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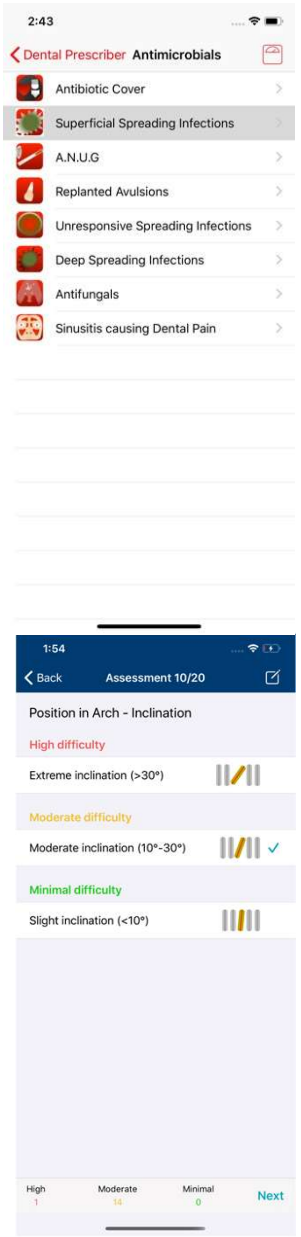

- Download the FREE endodontic case difficulty app
  - “AAE EndoCase” – a training tool to help you calculate case difficulty

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