

DENTAL FUNDAMENTALS

ENDODONTICS

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OBJECTIVES

- TO COVER THE WHOLE OF ENDODONTICS IN 90 or so MINUTES.
- TO CONSIDER SOME OF THE ASPECTS THAT MAY BE CRITICAL TO IMPROVING OUTCOMES.
- TO CONSIDER SOME CONCEPTS AND TECHNIQUES THAT MAY HELP ACHIEVE THESE AMBITIONS.
- MAKE ENDO SEXY
 - 1 . Diagnosis
 - 2 . Treatment planning
 - 3 . Clinical tips
 - 4 . Rotary instrumentation
 - 5 . Question time!

Unconscious Incompetence

You don't know that you don't know how to do something.

Conscious Incompetence

You know that you don't know how to do something and it bothers you.

Conscious Competence

You know that you know how to do something and it takes effort.

Unconscious Competence

You know how to do something and it is second nature; you rock at it.

Senility

IS'S ABOUT DOING
OUR BEST

AND REFLECTING
ON OUR
ACHIEVEMENTS



DOES IT MATTER? PART 1 (!)

AUTHOR	COUNTRY	% SATISFACTORY
KUMAR 2012	IRELAND	49% SINGLE 17% MULTIROOTED
MATIJEVIC 2011	CROATIA	35%
PETERS 2011	HOLLAND	56%
CHEN 2007	USA	26%
ER 2006	TURKEY	33%
ELFTHERIADIS 2005	GREECE	53%
PECULIENNE 2006	LITHUANIA	29%
CHUEH 2003	TAIWAN	30%
LUPI-PEGURIER 2002	FRANCE	31%
HAYES 2001	UK	13%
DE MOOR 2000	BELGIUM	43%
KIRKVANG 2000	DENMARK	43%
DUMMER 1998	UK	10%

DOES IT MATTER PART 2?

Longitudinal studies link technical quality & healing outcome

A 20-year follow-up study of endodontic variables and apical status in a Swedish population

M. Eckerbom¹, L. Flygare² & T. Magnusson^{3,4}

¹Department of Dentistry, KFSA & B.C. Riyadh, Kingdom of Saudi Arabia; ²Department of Maxillofacial Radiology, Sönderby Sjukhus, Luleå, Sweden; ³Department of Stomatognathic Physiology, The Institute for Postgraduate Dental Education, Jönköping, Sweden; and ⁴School of Health Sciences, Jönköping University, Jönköping, Sweden

INTERNATIONAL ENDODONTIC JOURNAL

The official journal of the British Endodontic Society and the European Society of Endodontology

[Explore this journal >](#)

Original Article

Ten-year follow-up of root filled teeth: a radiographic study of a Danish population

L.-L. Kirkevang , M. Væth, A. Wenzel



[View Issue TOC](#)



Clinical Oral Investigations

December 2012, Volume 10, Issue 6, pp 1519-1626

The association between complete absence of post-treatment periapical lesion and quality of root canal filling

Authors

[Authors and affiliations](#)

Yu-Hong Liang, Gang Li, Hagay Shamesh , Paul R. Wesselink, Min-Kai Wu

DOES IT MATTER PART 3

AND, GUESS WHO'S GOT THE HIGHER SUCCESS RATES...

[Explore this journal >](#)

Outcome of primary root canal treatment: systematic review of the literature – Part 1. Effects of study characteristics on probability of success

Y.-L. Ng, V. Mann, S. Rahbaran, J. Lewsey, **K. Gulabivala**



A prospective study of the factors affecting outcomes of nonsurgical root canal treatment: part 1: periapical health

Y.-L. Ng, V. Mann, K. Gulabivala



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A prospective study of the factors affecting outcomes of non-surgical root canal treatment: part 2: tooth survival

Y.-L. Ng, V. Mann, K. Gulabivala

First published: 2 March 2011 [Full publication history](#)



DOES IT MATTER PART 4

We're not far behind...

INTERNATIONAL ENDODONTIC JOURNAL

The official journal of the British Endodontic Society and the European Society of Endodontology

[Explore this journal >](#)

Ten-year outcome of root fillings in the General Dental Services in England and Wales

P. J. Lumley, P. S. K. Lucarotti, F. J. T. Burke

First published: 12 May 2008 [Full publication history](#)

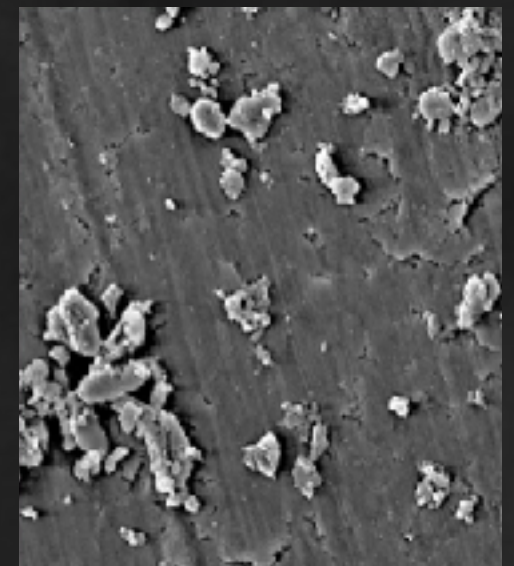
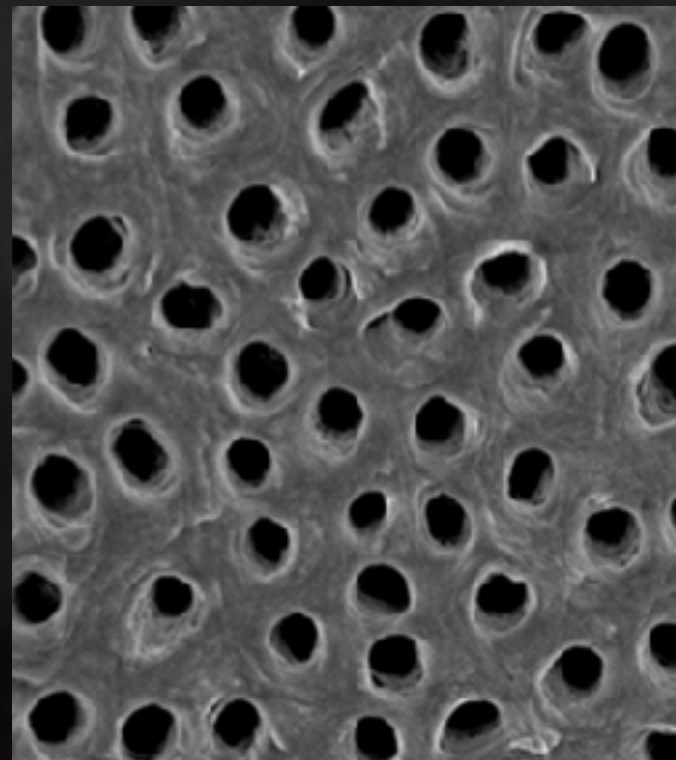
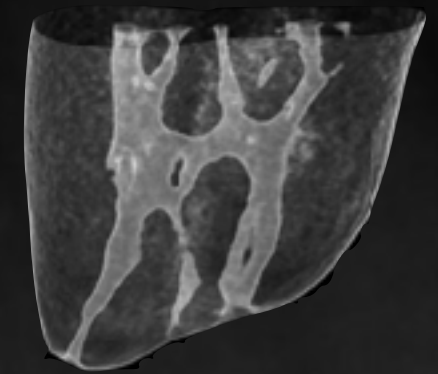
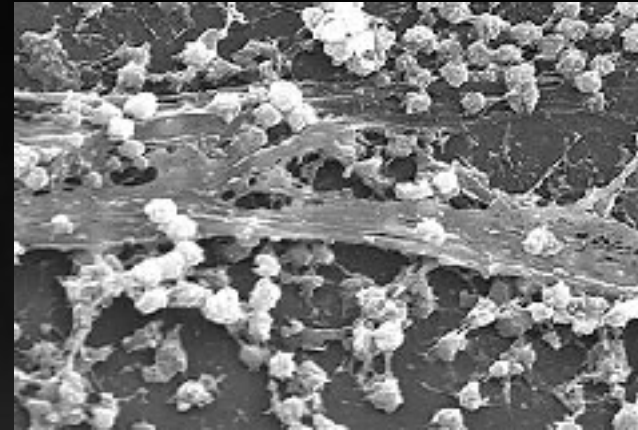
DOI: 10.1111/j.1365-2591.2008.01402.x [View/save citation](#)



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Volume 41, Issue 7
July 2008
Pages 577–585

THE BIG CHALLENGES

- **Macro anatomy**
- **Apical anatomy**
- **Biofilm**
- **Smear layer**
- **Micro anatomy**



PULPAL DIAGNOSES QUICK REMINDER

- Reversible pulpitis



RESTORE & MONITOR

- Irreversible pulpitis

- Pulpal necrosis

- Periapical periodontitis



INITIATE ENDO

- Cracked teeth
- Perio-endo lesions
- Trauma
- Root resorption



SUCCESS OF ENDO!

BIOFILM IS IMPORTANT

- -VE culture at obturation: 94% healing at 5 years (Sjogren 1997)
 - -Ve culture at obturation: 72% healing at 2-2.5 years (Fabricius 2006)
-
- +Ve culture at obturation: 68% healing at 5 years (Sjogren 1997)
 - +Ve culture at obturation: 21% healing at 2-2.5years (Fabricius 2006)

DENTINE HYPERSENSITIVITY

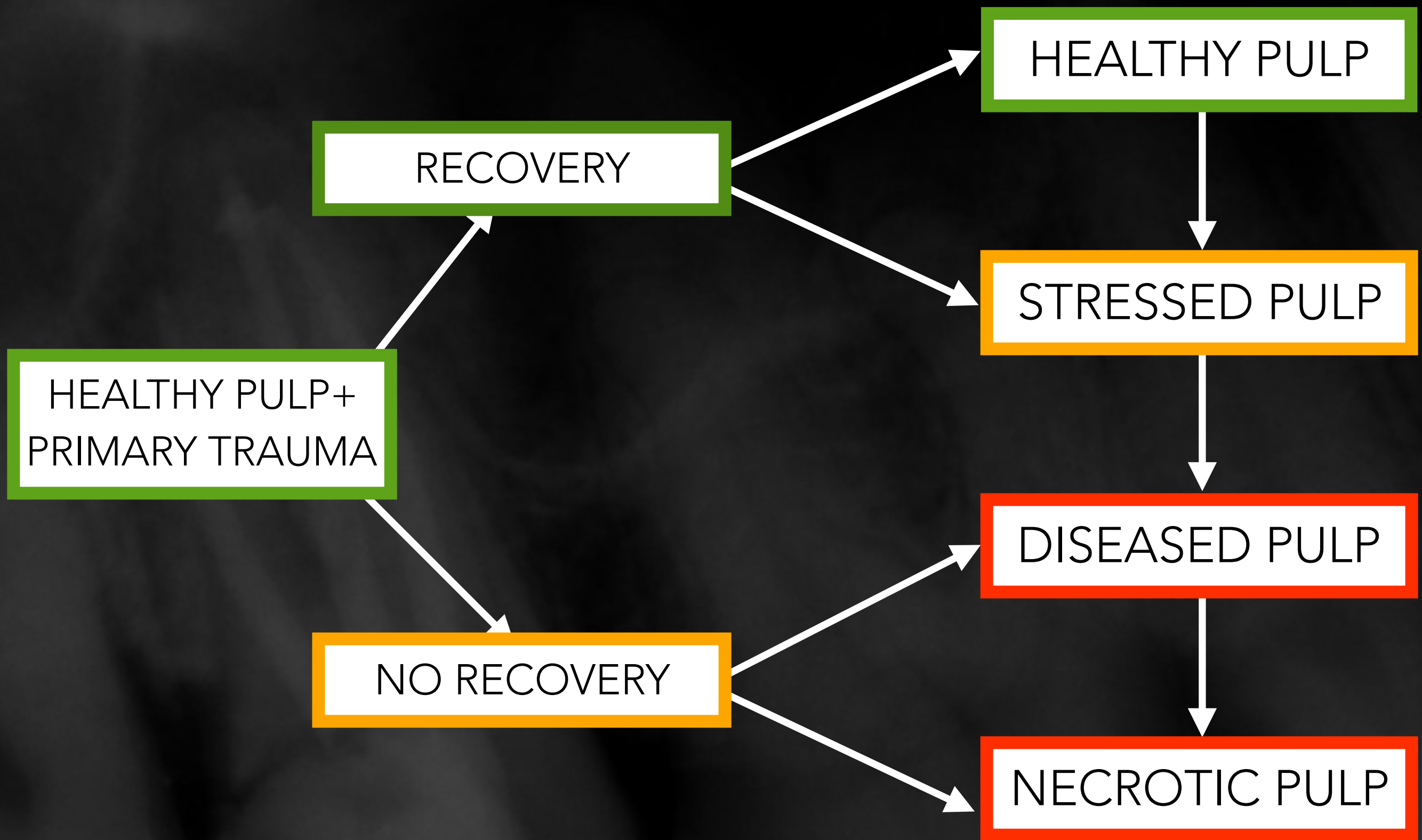
- Brannstrom 1986: hydrodynamic theory: temperature, chemical and mechanical stimuli create osmotic changes in the dentinal tubules.
- Short, sharp pain where no other dental defect or pathology is present.
- Pain? YES!
- Pulpal pathology? NO!

THE STRESSED PULP

ABOU RASS 1982

- Vital pulp subject to repeated damage such as operative trauma and pathology.
- Clinical, not histological state
- May be asymptomatic but deteriorate rapidly
- Should be identified before further restorative treatment provided.

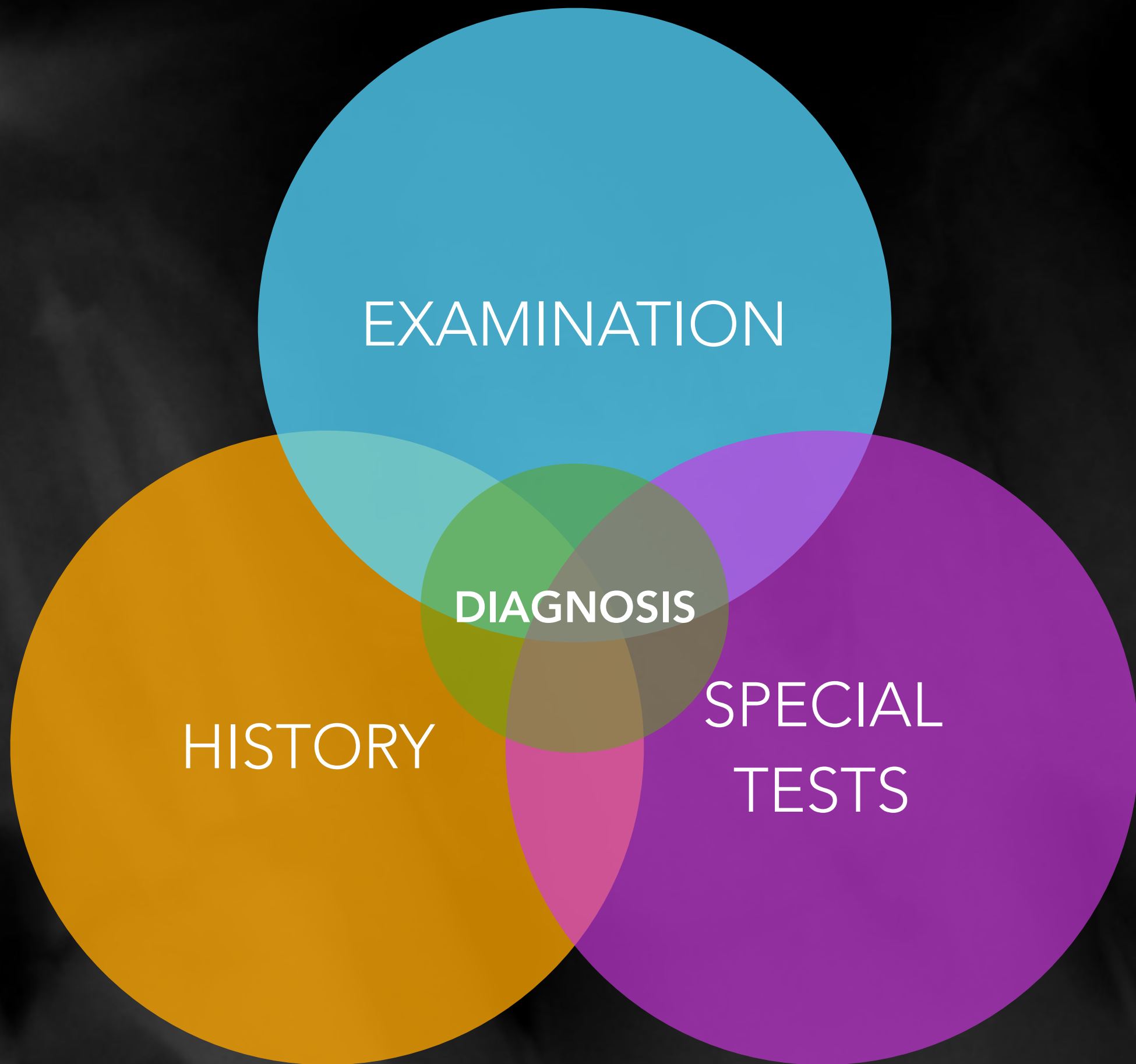




THE PULP

THERE IS A POOR CORRELATION BETWEEN CLINICAL INFORMATION AND THE HISTOPATHOLOGICAL STATUS OF THE PULP (SELTZER ET AL. 1963A, 1965).





PAIN HISTORY

LIKELY PULPAL STATE

ACUTE PAIN, SHORT LIVED, INITIATED BY HOT, COLD,
SWEET AND MECHANICAL STIMULATION
MAYBE RELIEVED BY DESENSITISING TOOTHPASTES

DENTINE HYPERSENSITIVITY

ACUTE PAIN, SHORT LIVED, INITIATED BY HOT, COLD,
SWEET.
USUALLY EASILY LOCALISABLE.

REVERSIBLE PULPITIS

INTENSE, RADIATING PAIN HARD TO LOCATE.
MAY OCCUR SPONTANEOUSLY.
WORSE AT NIGHT OR WHEN LYING DOWN
MAYBE EXACERBATED BY HOT AND COLD
MAY BE TENDER TO BITE ON

IRREVERSIBLE PULPITIS

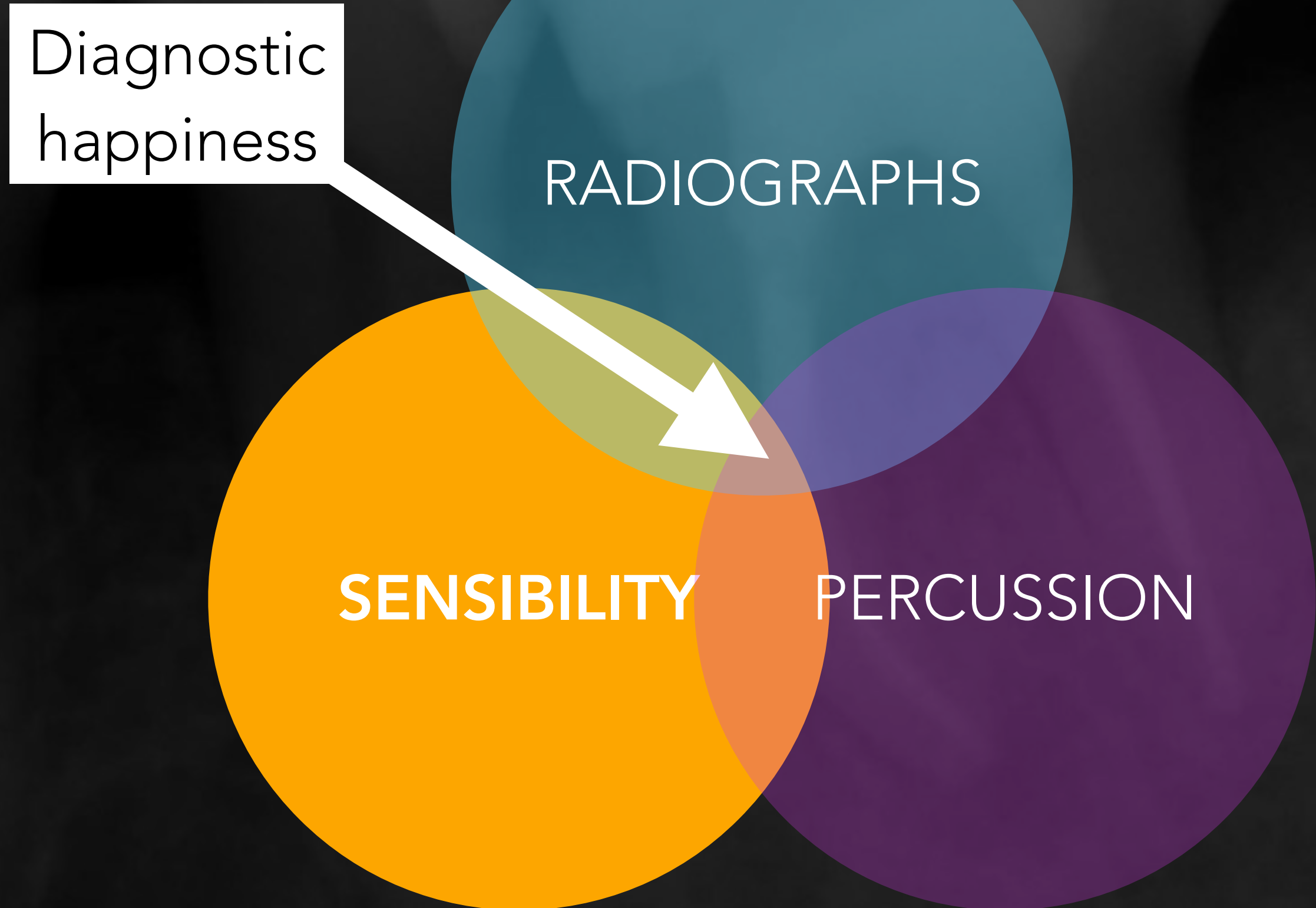
HISTORY OF TA THAT SPONTANEOUSLY SETTLED
DISCOMFORT TO CHEW OR HOT DRINKS/FOOD

PULPAL NECROSIS

DULL THROBBING ACHE
TOOTH HURTS TO BITE ON
HOT DRINKS MAY EXACERBATE PAIN
MAY COMPLAIN OF GUM BOIL

APICAL PERIODONTITIS

SPECIAL TESTS



SPECIAL TESTS			LIKELY PULPAL STATE
RADS	PERCUSSION	SENSIBILITY	
NO OVERT PATHOLOGY MAY BE BONE LOSS MAYBE EVIDENCE OF TS;	-	+++	DENTINE HYPERSENSITIVITY
MAY BE CARIES	-	+++ RESULTING IN SHORT, SHARP	REVERSIBLE PULPITIS
LOOK FOR DEEP CARIES/ RESTORATIONS EVIDENCE OF STRESSED PULP	MAY BE SLIGHTLY TENDER	+++++ RESULTING IN DEEP THROBBING	IRREVERSIBLE PULPITIS
LOOK FOR DEEP CARIES/ RESTORATIONS EVIDENCE OF STRESSED PULP	MAYBE SLIGHTLY TENDER	- (NEURAL TISSUE MAY PERSIST)	PULPAL NECROSIS
LOOK FOR LOSS OF LD, WIDENING OF PDL OR FRANK RAREFYING/ CONDENSING OSETITIS	+++	- (NEURAL TISSUE MAY PERSIST)	APICAL PERIODONTITIS

PARTIAL NECROBIOSIS

HISTOLOGY & SYMPTOMS

- Neural and/or vascular tissue persists in part of a tooth that has otherwise become necrotic.
- Evidence of reversible pulpal pulpitis, irreversible pulpitis and necrosis!
- Ultimately gives mixed messages about health of the tooth.
- Maybe a sign of missed anatomy!



SAYING NO TO TREATMENT

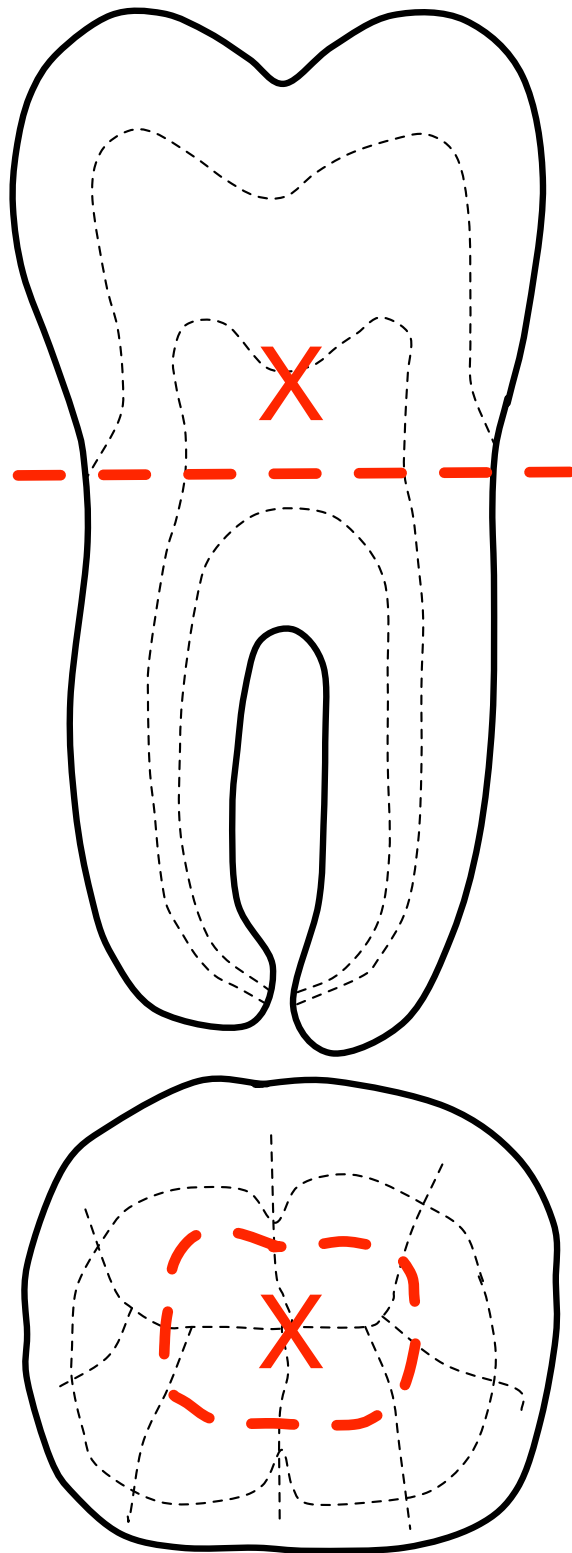
1. Just say no, or at least, not now!
2. Undertake treatment consenting thoroughly to the risk of further pain.
3. Treat multiple teeth.





ACCESS

A) THE PULP: KRASNER AND RANKOW 2004

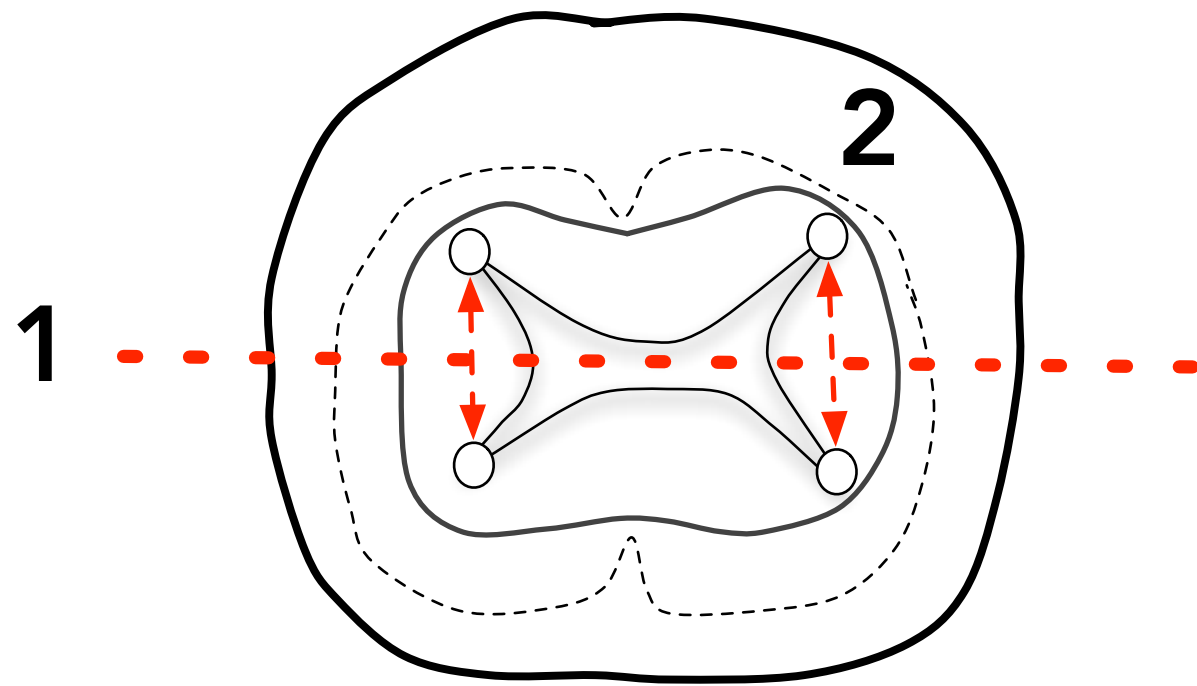


- Law of the CEJ
- Law of centrality
- Law of concentricity

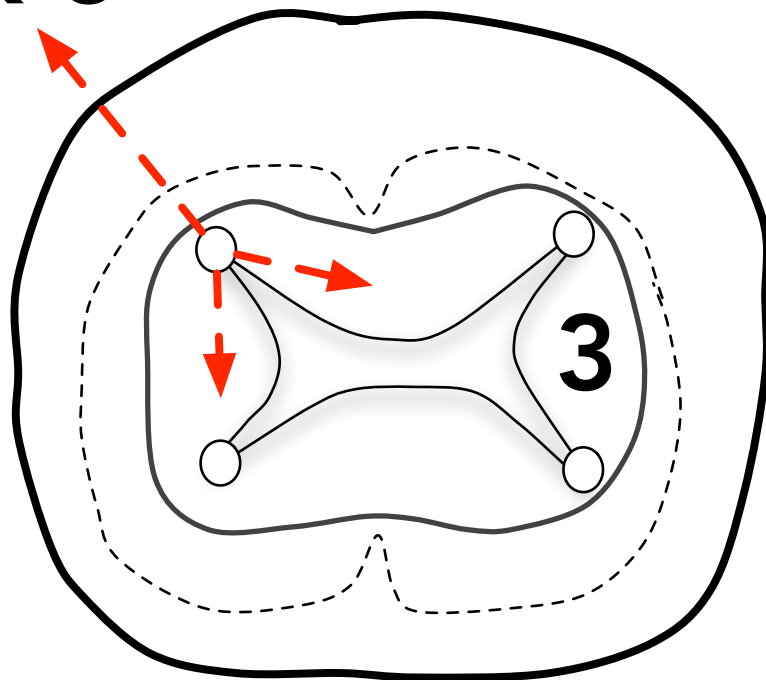
- Access before rubber dam
- Keep checking
- Don't go further than the CEJ
- Stay in straight line with tooth
- Take an x-ray if in doubt
- Remove the pulp chamber roof!

Tooth	Maxilla	Mandible
1	1 (100%)	1 (1 foramen 58%)
2		2 (1 foramen 40%) 2 (2 foramina 1.3%)
3	1 (100%)	1 (94%) 2 (6%)
4	1 (6.2%) 2 (90.5%) 3 (1.1%)	1 (1 foramen 73.5%) 2 (1 foramen 6.5%) 2 (2 foramina 19.5%)
5	1 (40.3%) 2 (58.6%) 3 (1.1%)	1 (1 foramen 85.5%) 2 (1 foramen 1.5%) 2 (2 foramina 11.5%)
6	Mesio buccal root 1 (1 foramen 38%) 2 (1 foramen 37%) 2 (2 foramina 25%)	Mesial Canal 1 (1 foramen 13%) 2 (1 foramen 49%) 2 (2 foramina 38%) Distal Canal 1 (70%) 2 (28.9%)
7	Mesio buccal root 1 (1 foramen 63%) 2 (1 foramen 13%) 2 (2 foramina 24%)	Mesial Canal 1 (1 foramen 13%) 2 (1 foramen 49%) 2 (2 foramina 38%) Distal Canal 1 (1 foramen 92%) 2 (1 foramen 5%) 2 (2 foramina 3%)

B) THE CANALS: KRASNER AND RANKOW 2004



4, 5 & 6



1. Law of symmetry 1

2. Law of symmetry 2

3. Law of colour change

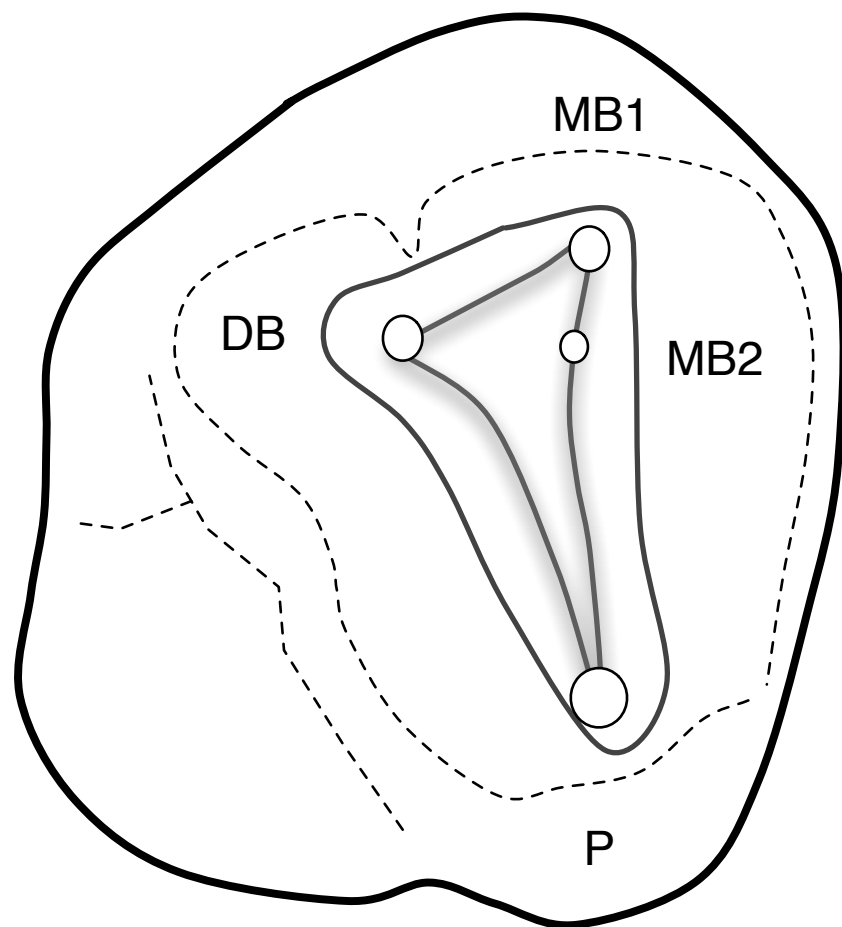
4. Junction of floor and wall

5. Angles of floor and wall

6. Terminus of
developmental lines

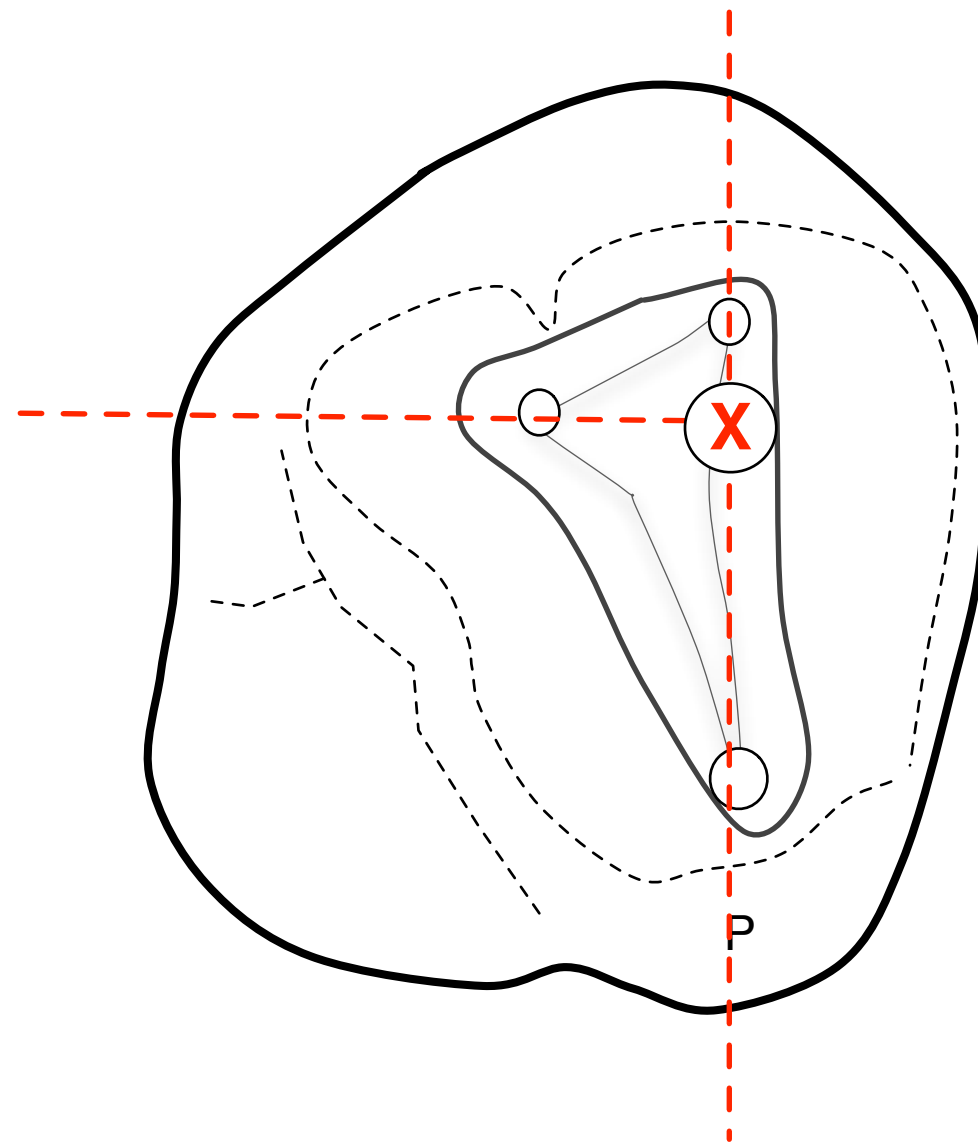
EXCEPT UPPER 6S

BUCCAL



MESIAL

BUCCAL



MESIAL

1. GOOD PRE-OP RADIOGRAPH

- Allows anatomical assessment
- Allows estimation of curvature
- Allows estimation of patency
- Allows estimation of length



2. INITIAL PREPARATION

- Remove interfering metallic restorations if possible
- Scout the canal
 - Psychological advantage: you know you're in the system
 - Facilitates coronal flaring
 - Most of the bacteria reside in the pulp chamber (Shovelton 1964)
 - No need to transport them apically



3. CROWN DOWN

- Coronal widening minimises file binding coronally which may impede instrumentation to the apex
- Reduction of curvature before WL determination improves accuracy
- (Improves irrigation, straight-line access, minimises transportation and instrument binding = torsional fatigue)

4. APEX LOCATOR

- Check the batteries
- Dry pulp chamber and check for metallic interferences
- Use a file that contacts the walls
- Take it to patency: zero zero (Nekoofar 2006)
- Subtract 0.5mm



5. OPTIONAL WL RAD

- EAL reading is unstable
- EAL reading does not move in synchrony with the file
- EAL flashes intermittently
- EAL jumps
- EAL gives no reading

Consider using other methods (El-Ayouti 2009)

5. COMPLETE PREPARATION

- *Well, why not?*

6. APEX LOCATOR AGAIN

Optional stage if any doubt about curvature, apical preparation or the feel of the apex.

Consider a radiograph with files in situ if further doubt.

7. CONE FIT RADIOGRAPH

- Confirm length
- Confirm shape
- Last chance to assess anatomy

8. DOWN PACK RAD

Last chance saloon.

Optional stage if any doubt about curvature, apical preparation or feel of the apex.

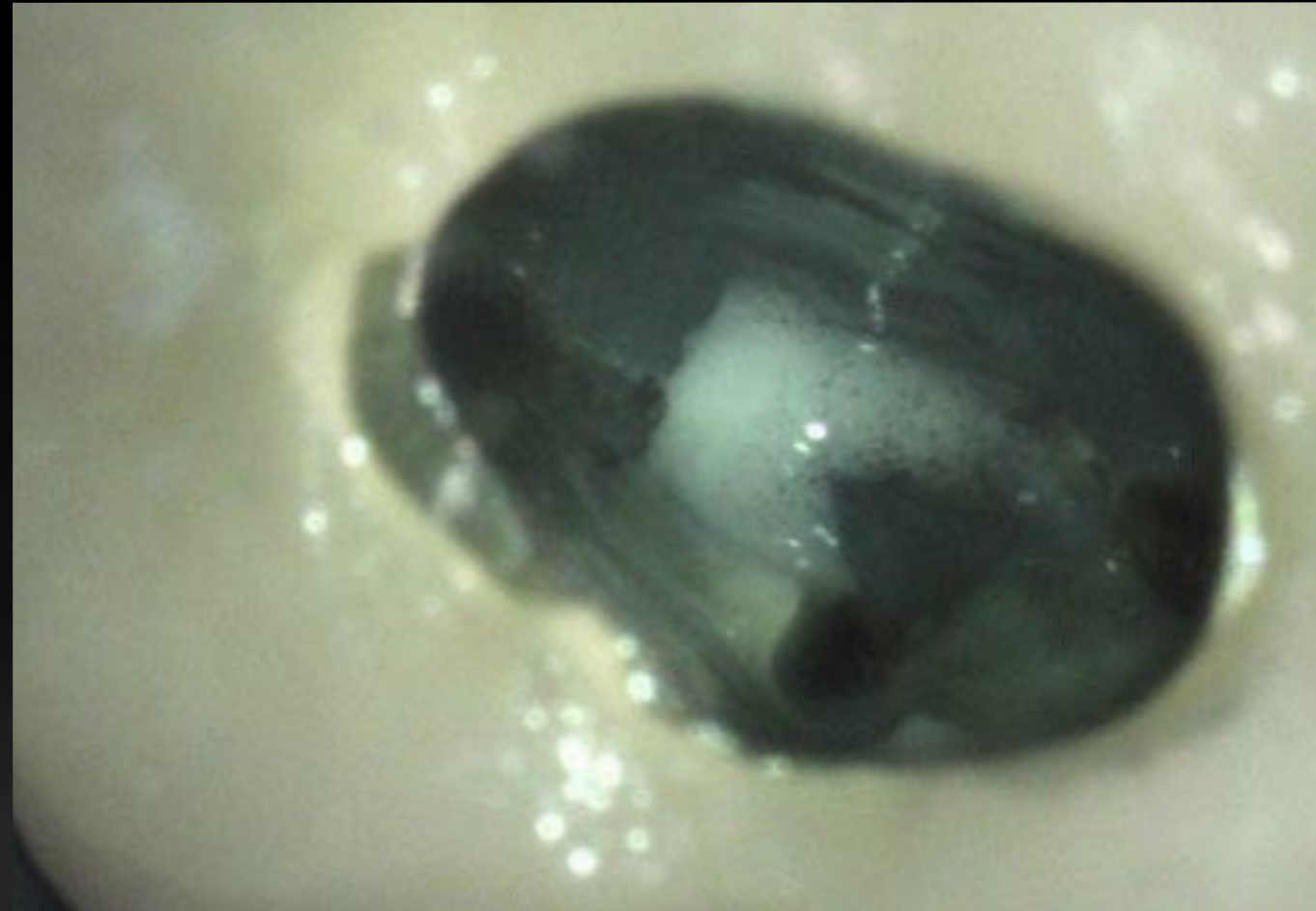
IRRIGATION

A close-up photograph of a dental irrigation tip, which is a white plastic nozzle. The tip is partially inserted into a blue dental tray. Inside the nozzle, there is a dark, irregular, and somewhat gelatinous mass, possibly a blood clot or a piece of debris. The background is slightly blurred, showing the blue tray and some other dental equipment.

	TYPE	ACTION ON FLORA	TISSUE DISSOLUTION	ENDOTOXIN DEACTIVATION	SMEAR LAYER	SUBSTANTIVITY	TOXIC ?	ALLERGENIC ?	COST
HYDROGEN PEROXIDE	PEROXIDE	✓	✗	✗	✗	✗	✓	-VE	£
SODIUM HYPOCHLORITE	HALOGEN IONS	✓✓✓	✓✓✓	✓	✓	✗	✓	-VE	£
IODINE POTASSIUM IODIDE	HALOGEN IONS	✓✓	✗	✗	✗	✗	✗	+VE	££
CHLORHEXIDINE	BISGUANIDE	[✓✓]	✗	✓	✗	✓	✗	+VE	££
EDTA	CHELATING AGENT	✓	✗	✗	✓✓✓	✗	✗	-VE	££
CITRIC ACID	ORGANIC ACID	✗	✗	✗	✓✓✓	✗	✗	-VE	£

KEY PLAYERS

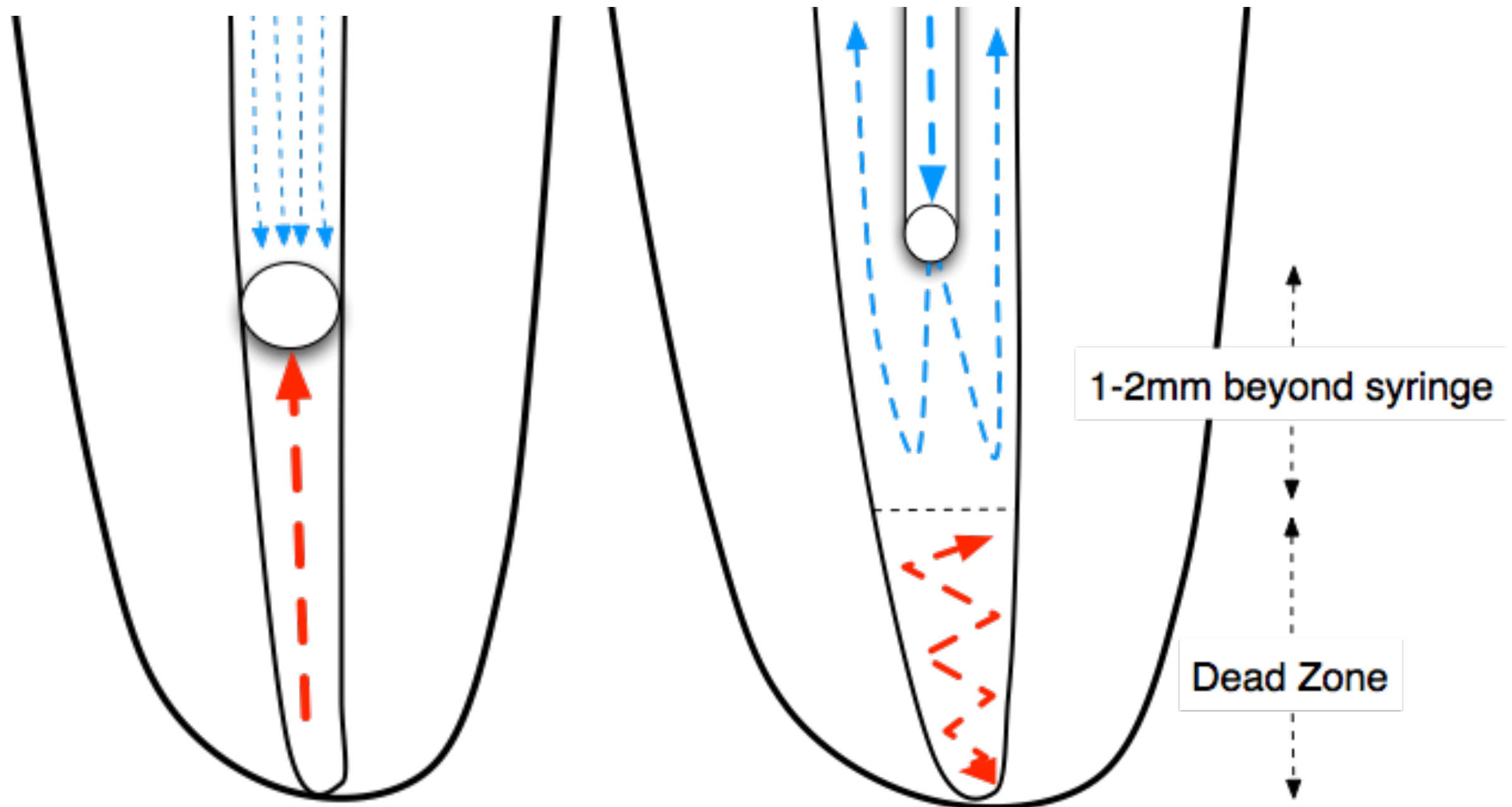
- NaOCl
 - Antimicrobial
 - LPS
 - Tissue dissolving
- EDTA
 - Removes smear layer



WORKING THE IRRIGANT

- Always use NaOCl 2-5.25% (but lots of it)
- Use Luerlok, non end ejecting 30G needles.
- Wider canals = better irrigation (Ram 1977)
- Don't irrigate > 4ml/min (Park 2013)
- Use stopper to go 2mm from apex (Chow 1983)
- Time (>30mins) and irrigant exchange = success
- Avoid needle binding

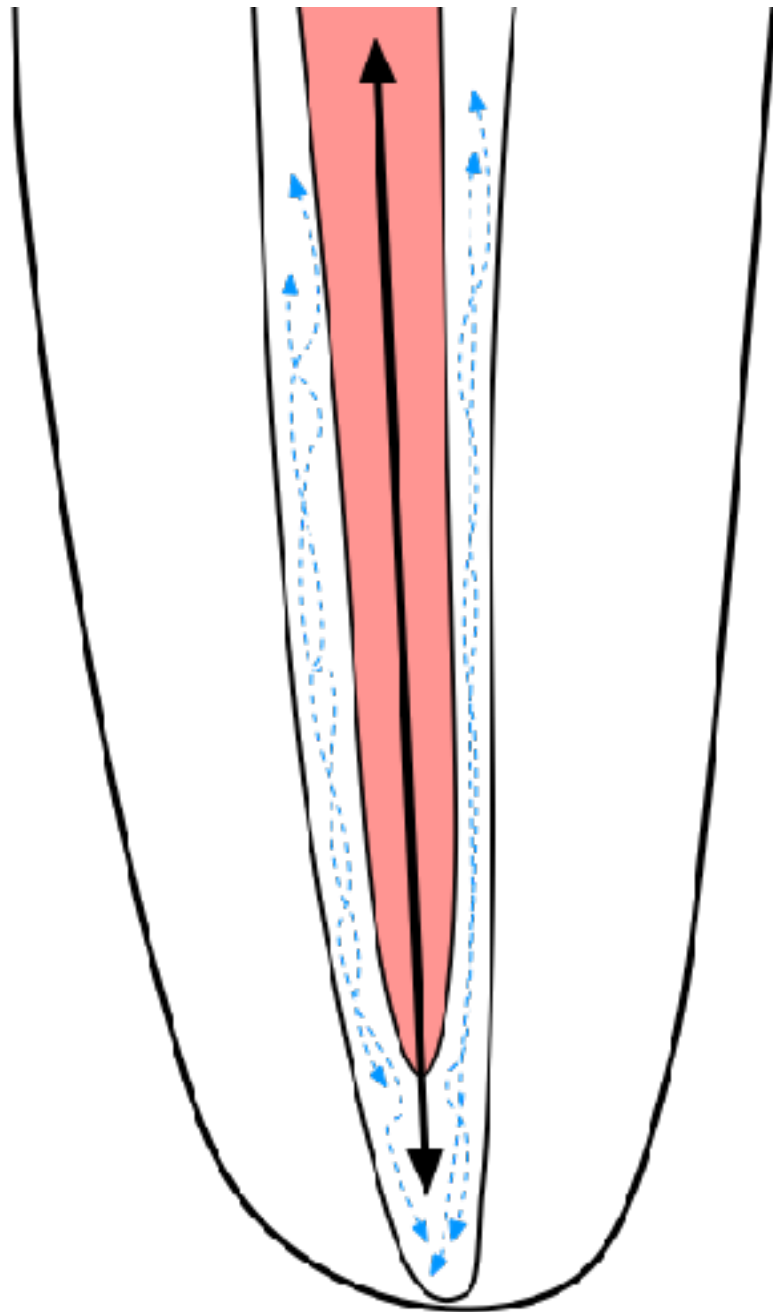
BARRIERS TO IRRIGATION



Tay 2010

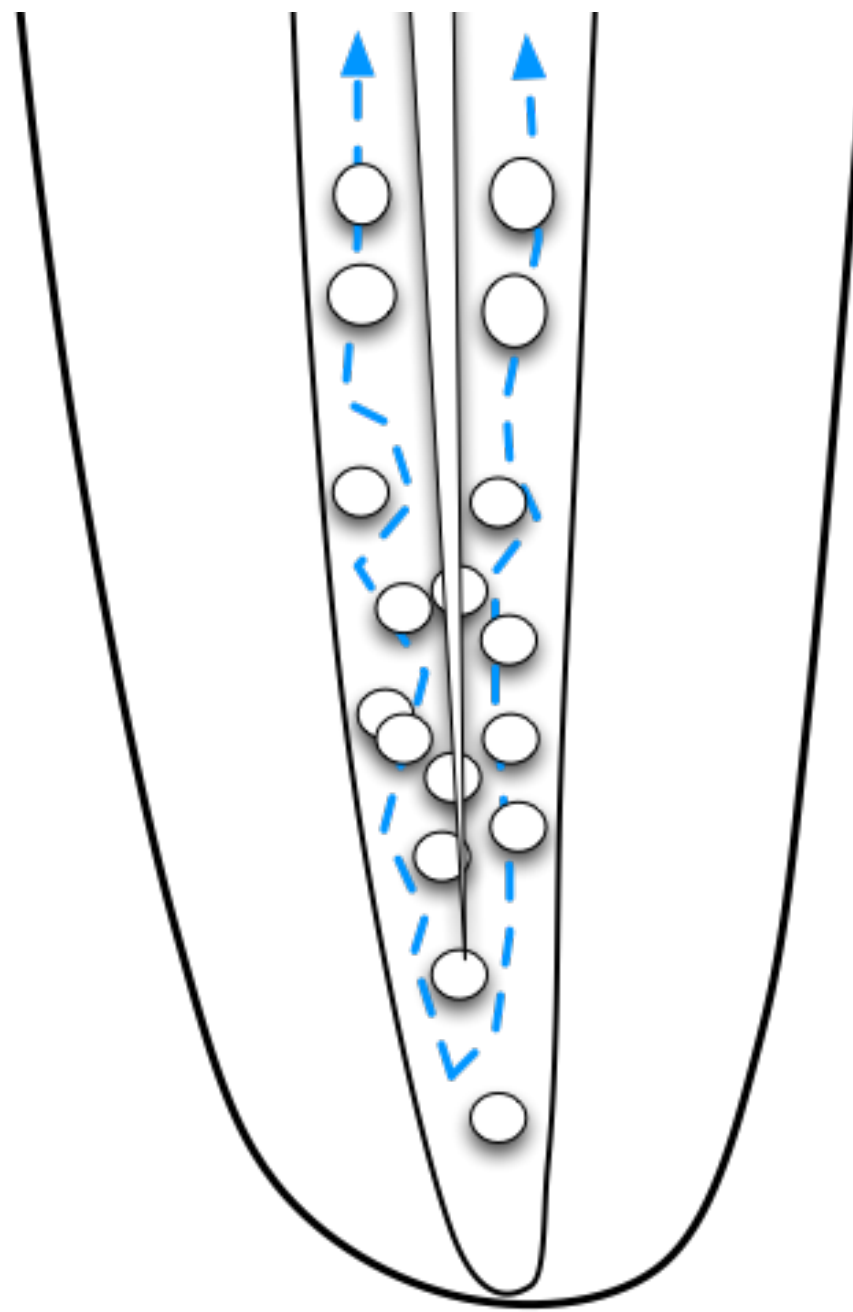
Park 2013

MAKING THE IRRIGANT WORK BETTER



MDP

Bronnec 2010



Sonic/US

Al-Jada 2009

PROTOCOL

ESSENTIAL DESIRABLE

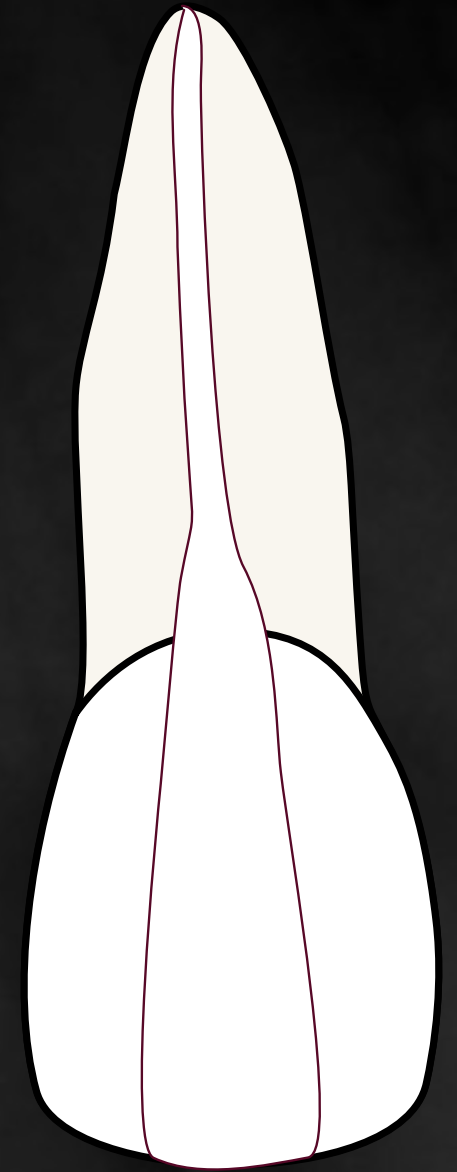
- Use 1-2% NaOCl throughout treatment
- Minimum 30mins irrigation time
- Constantly replenish and agitate
- **Penultimate rinse EDTA** (Consider for retreatment Ng 2011)
- Final rinse NaOCl or...
- **Select retreatment cases: CHX 2%**



INSTRUMENTATION

CROWN DOWN

- Reduced inoculation of endodontic pathogens apically
- Enhanced penetration of irrigants.
- Reduced risk of extrusion
- Less coronal binding
- Reduced loss of length
- Improved apical tactile awareness
- Improved performance of apex locators



Getting to length...

- Always start with a small file!
- Chase and pick, watch-wind small amplitude to length.
- Irrigate with both NaOCl and EDTA regularly.
- Pre curve files.
- Feel for "stickiness"

HAND FILING CONSIDERATIONS

Always pre-curve files based on the estimated geometry of the canal from pre-operative radiographs

Use the pointer on the rubber stopper to indicate the direction of the file curvature

Patency file to prevent apical blockage

Recapitulate and irrigate after each successive file to prevent loss of working length

Push-pull or circumferential filling in straight, wide and/or c-shaped canals

Never force an instrument

Use balanced force in curved canals

HELLO ROTARY

(BUCANAN 2000)

Total control of the root canal shape apex to crown

Limits coronal enlargement (removes the need for
GGs?)

Ensures adequate preparation of the mid 1/3.

Safer apical preparation

Very precise knowledge about taper

Enhanced irrigation

Facilitates obturation: speed and accuracy

WILL NOT COMPENSATE POOR TECHNIQUE

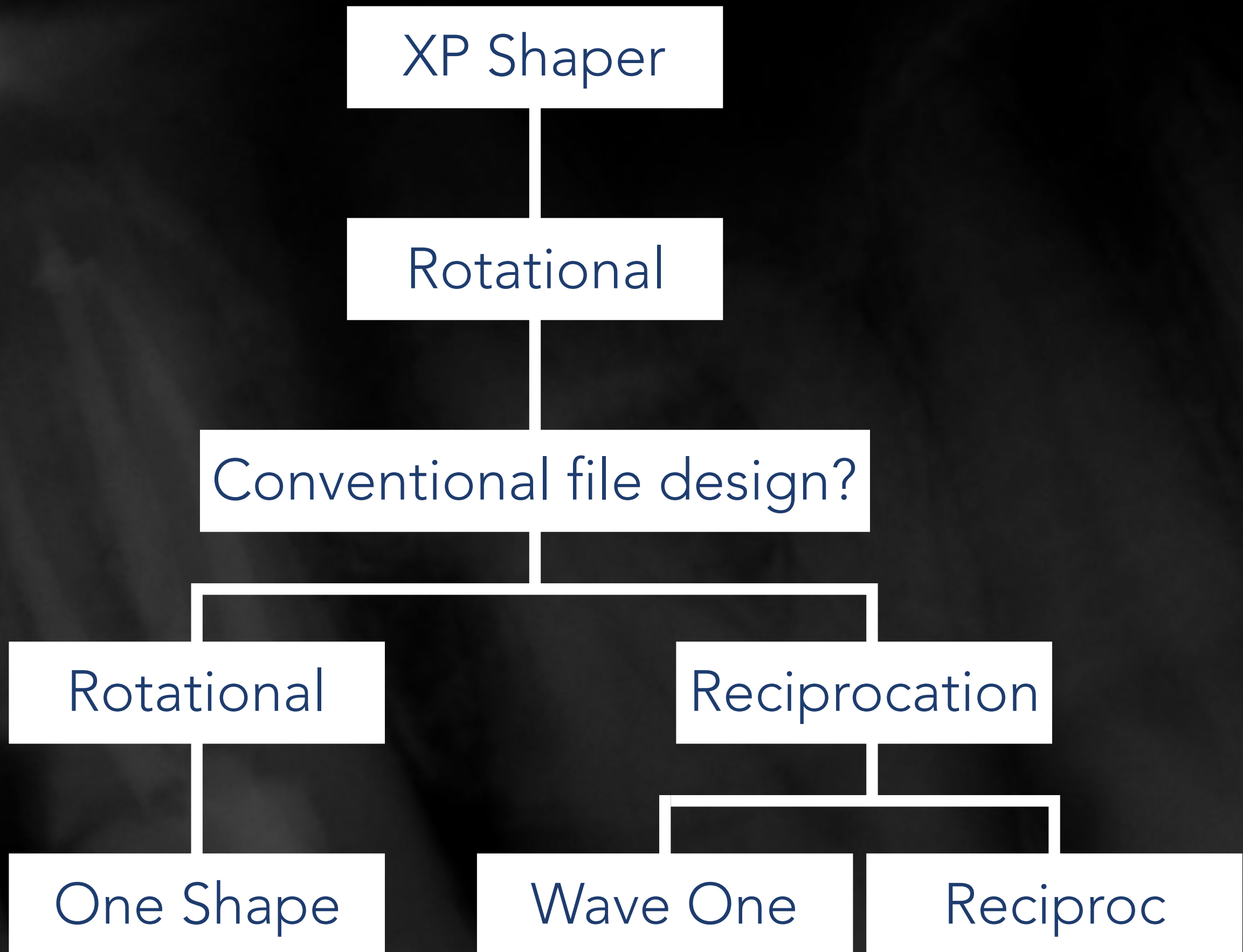
DON'T BREAK THEM...

- Incidence between 2-6% (Crump 1970, Hulsman 1999)
- NiTi: super elastic with shape memory (Walia 1988)
 - but...
- 7 x increase in separation with NiTi (Iqbal 2006)
- Why: cyclical and torsional failure ?
- Maybe reduced in reciprocation motion

ROTARY CONSIDERATIONS

- Glide path to 20 before using rotary or reciprocation
- Following three “pecks”, irrigate and recapitulate
- Clean the instrument flutes
- Use of ISO 10-15 K-flex to WL OR **Fine Files Frequently**
- Prevents debris accumulation, ledging or canal transportation
- Consider patency filing
- Never force NiTi instruments
- Hand file in challenging anatomy cases

SINGLE FILE SYSTEMS & RECIPROCATION



SIMPLICITY IS THE KEY

- **Reduced numbers of instruments**
- **Easier protocols to follow**
- **Reduced cost**
- **May make endo more enjoyable!**
- **With reciprocation reduced risk of torsional and cyclical fatigue**

BUT

- **Not always appropriate**
- **Not necessarily versatile enough**
- **May lead to de-skilling**
- **Consider using in combination with other systems**
- **Still require hand-filing skills!**

OBTURATION



SCHILDER 1974

- Remember **Schilder 1967**; we've created a space, now we've got to fill it!
- We must obturate canals in three dimensions to provide:
 1. Coronal seal
 2. Apical seal
 3. Entombment residual microbes

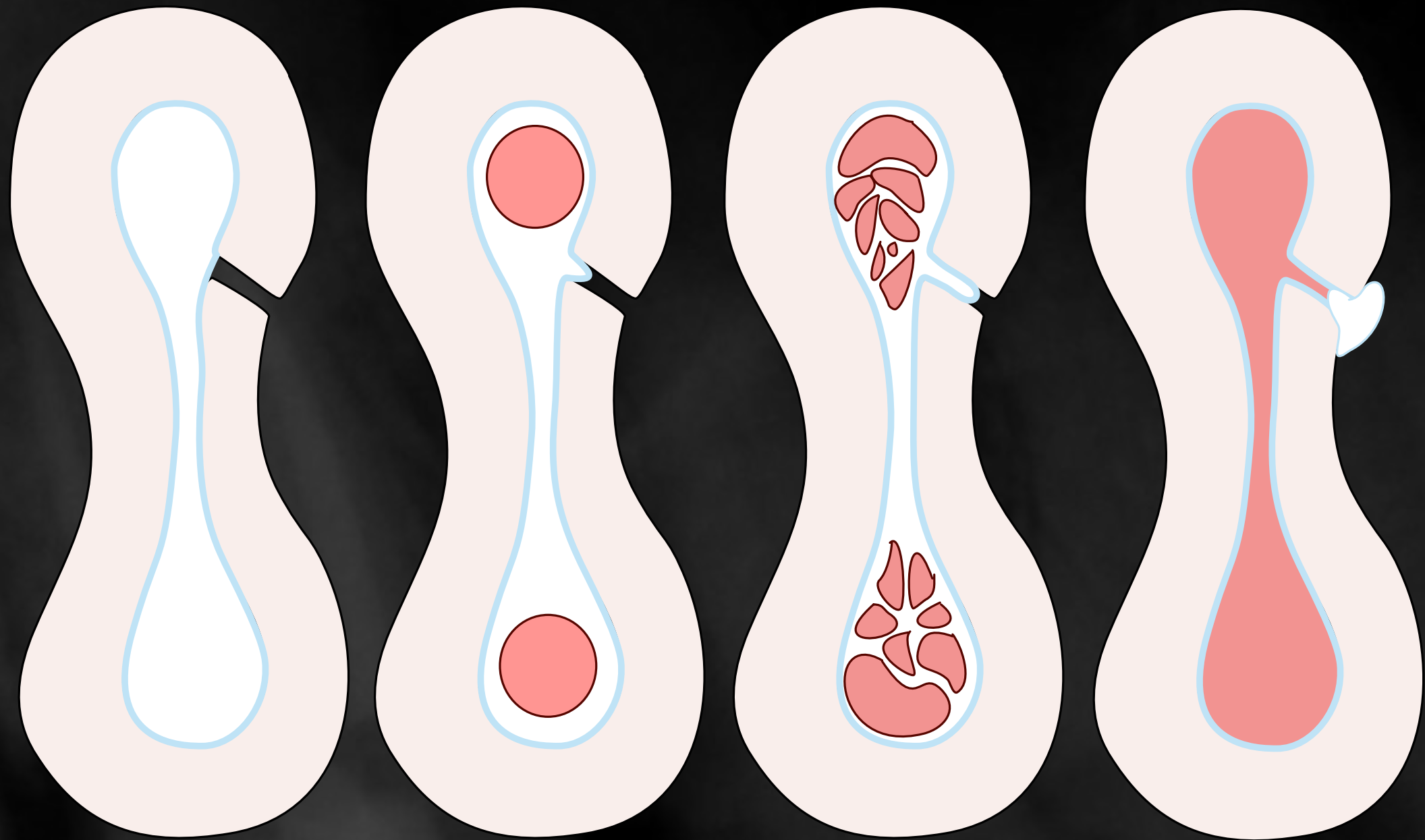
Sundqvist 1998

OPTIMAL OUTCOMES?

- **Maintenance of apical patency.**
- **Proximity to the apical constriction.**
 - Decreasing 12% success for every 1mm short of the apex.
- **Quality of obturation**
 - Voids in the apical 50% worse outcomes.
- **No overextension**
 - Reduces success by 62%

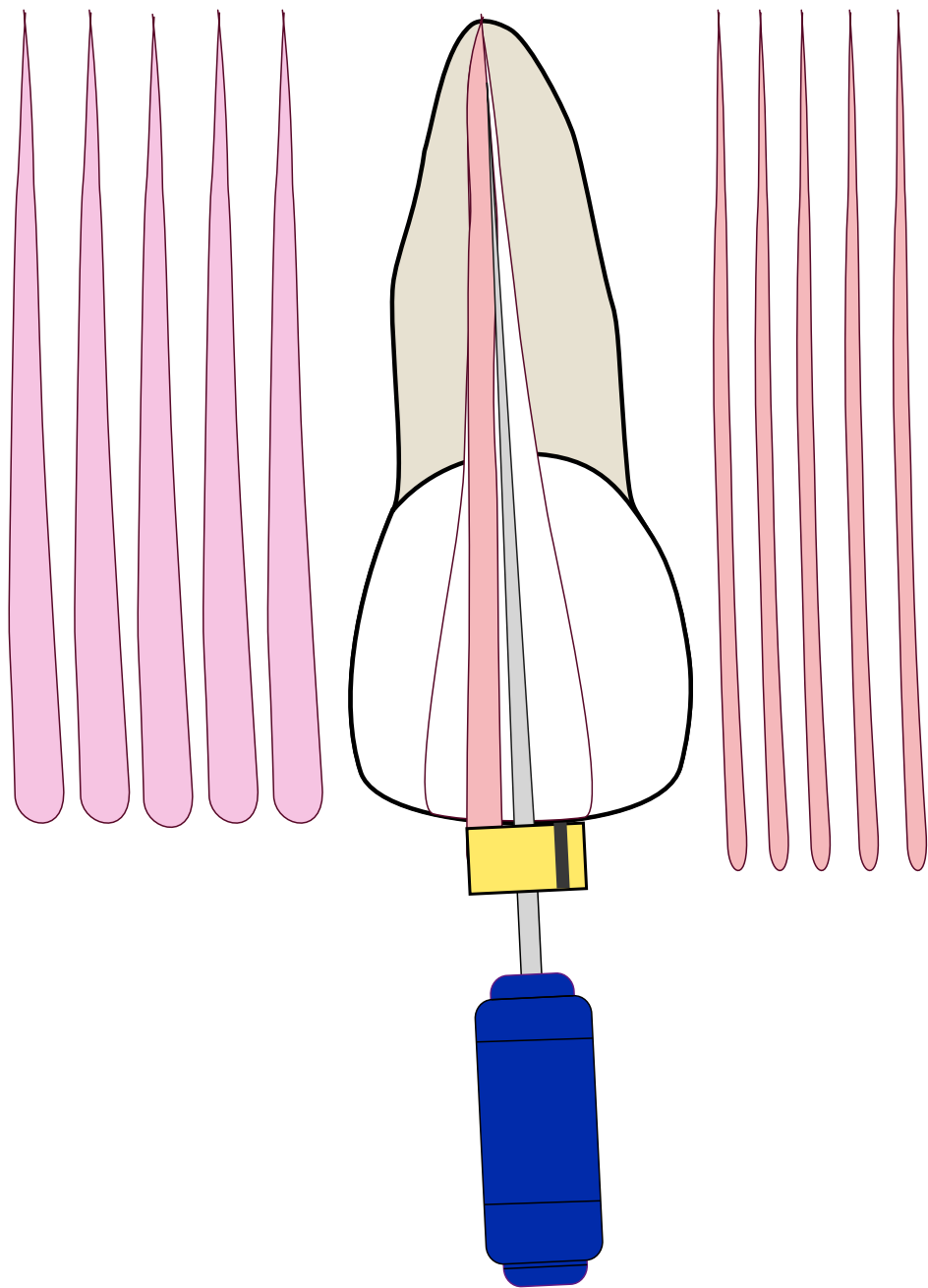
(Ng 2011, Sjogren 1990, Liang 2012, Ng 2008)

TRADITIONAL CONCEPTS



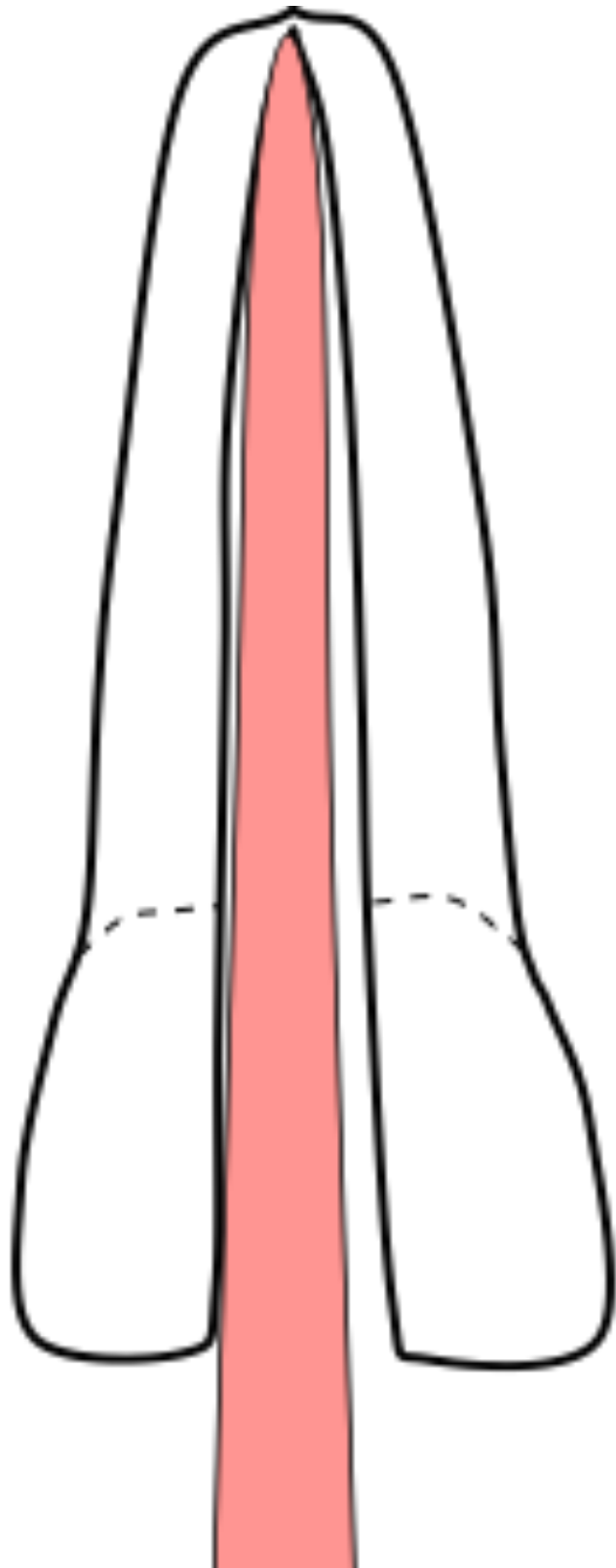
Improving quality of obturation

USING CLC?



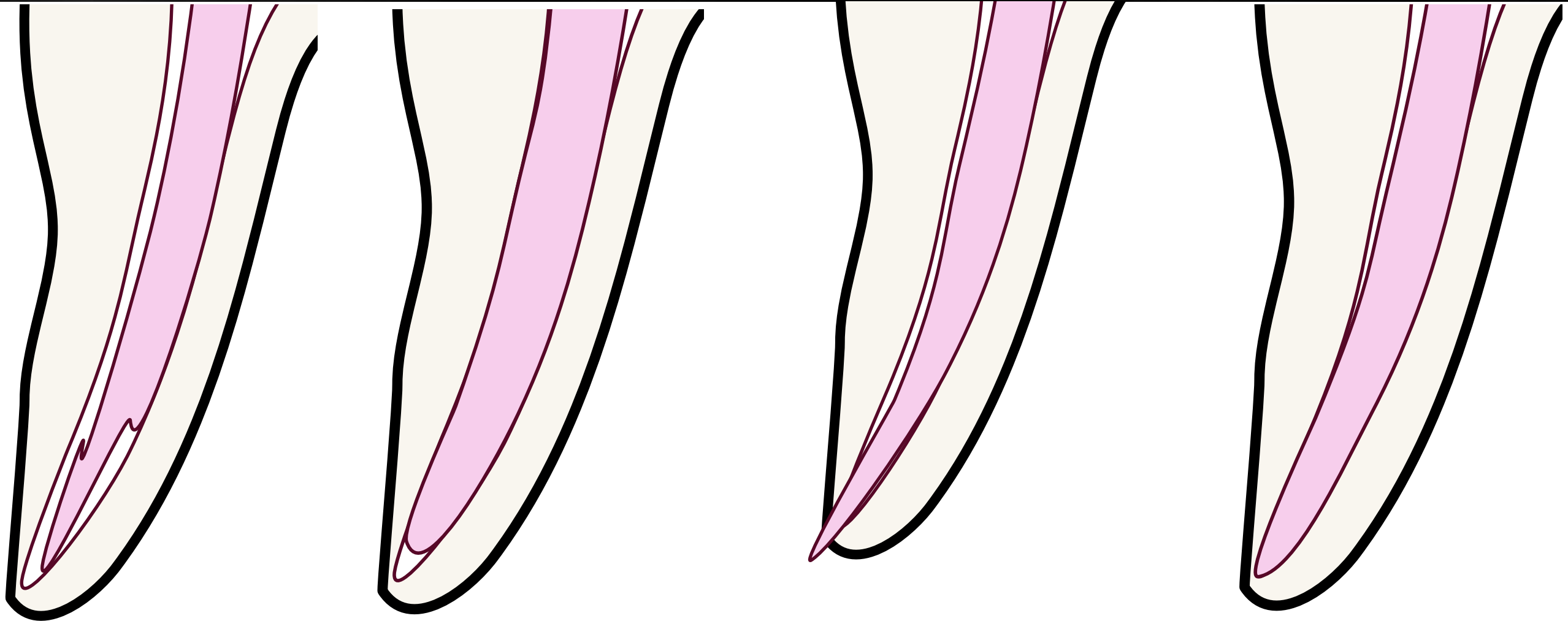
- Optimised if spreader placed within 1mm of the apex.
- (Allison 1981)
- 1-3KG pressure
- Leave 10 seconds
- Rotate and withdraw
- Look at where the spreader was placed!
- Stop when within 3mm of canal orifice
- Remains the gold standard. (Sjogren 1997, Peak 2001, Weinger 2000)

USING SC?



- Rapid, reasonable adaptation.
- Evidently successful
- Easy to perform
- Cheap
- **Even with WVC the apical region (3-5mm) remains single cone (Smith 2000, Weller 1997)**
- Think about your sealer!

REFLECT ON YOU OBTURATION



Point
too
small

Point
too
large

Poor
apical
control

Just
right!

SEAL THE DEAL

1. TO PROVIDE CORONAL SEAL
2. TO PREVENT FURTHER TOOTH STRUCTURE LOSS
3. TO RESTORE FUNCTION
4. TO RESTORE AESTHETICS



LEAKAGE

- Ray and Trope vs Tronstad
- Mostly in vitro dye leakage studies and not really applicable to the real world! (Strindberg 1956, Swanson 1987, Saunders 1990, 1994)
- Teeth will resist bacterial recolonisation for long periods.
- Khayat 1993: redo endo if exposed to oral environment >3months
- Riccucci 2003: only 7/32 teeth exposed to the mouth had bacterial presence after 3/12.

BULK FILL WITH SDR

- Self-Leveling
- Applied in Increments Up to 4mm
- Light Cured
- Must Place Composite Cap

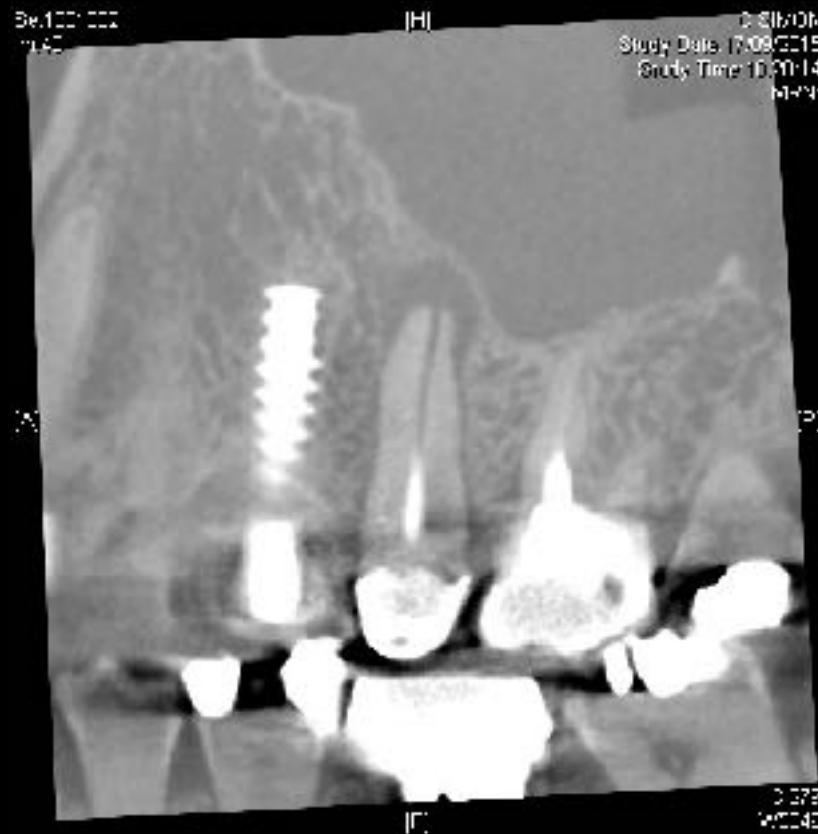


PREVENTION OF FURTHER TOOTH LOSS

- 6 x higher success for molar endo when cuspal coverage is provided (Aquilino 2002)
- Success increases: (Ng 2007, 2008 and 2010)
 - Both marginal ridges (Reeh)
 - Not an abutment
 - Not a last standing tooth



DO I NEED TO CROWN THE TOOTH?



THINK ABOUT...

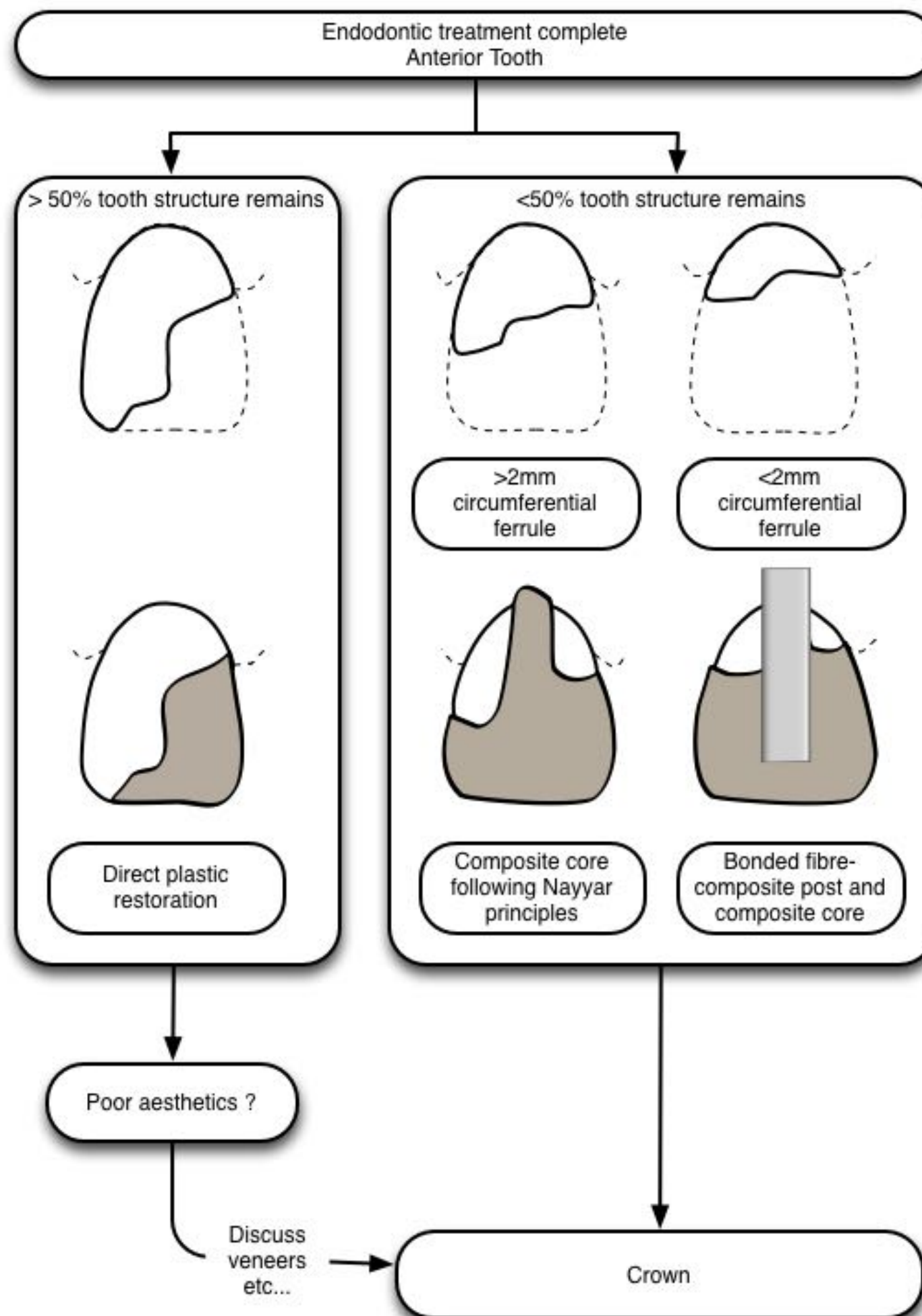
- Pre-existing evidence of heavy loading
- Parafunctional habits
- Guidance
- Opposing dentition
- Prosthodontic requirements
- Patient choice

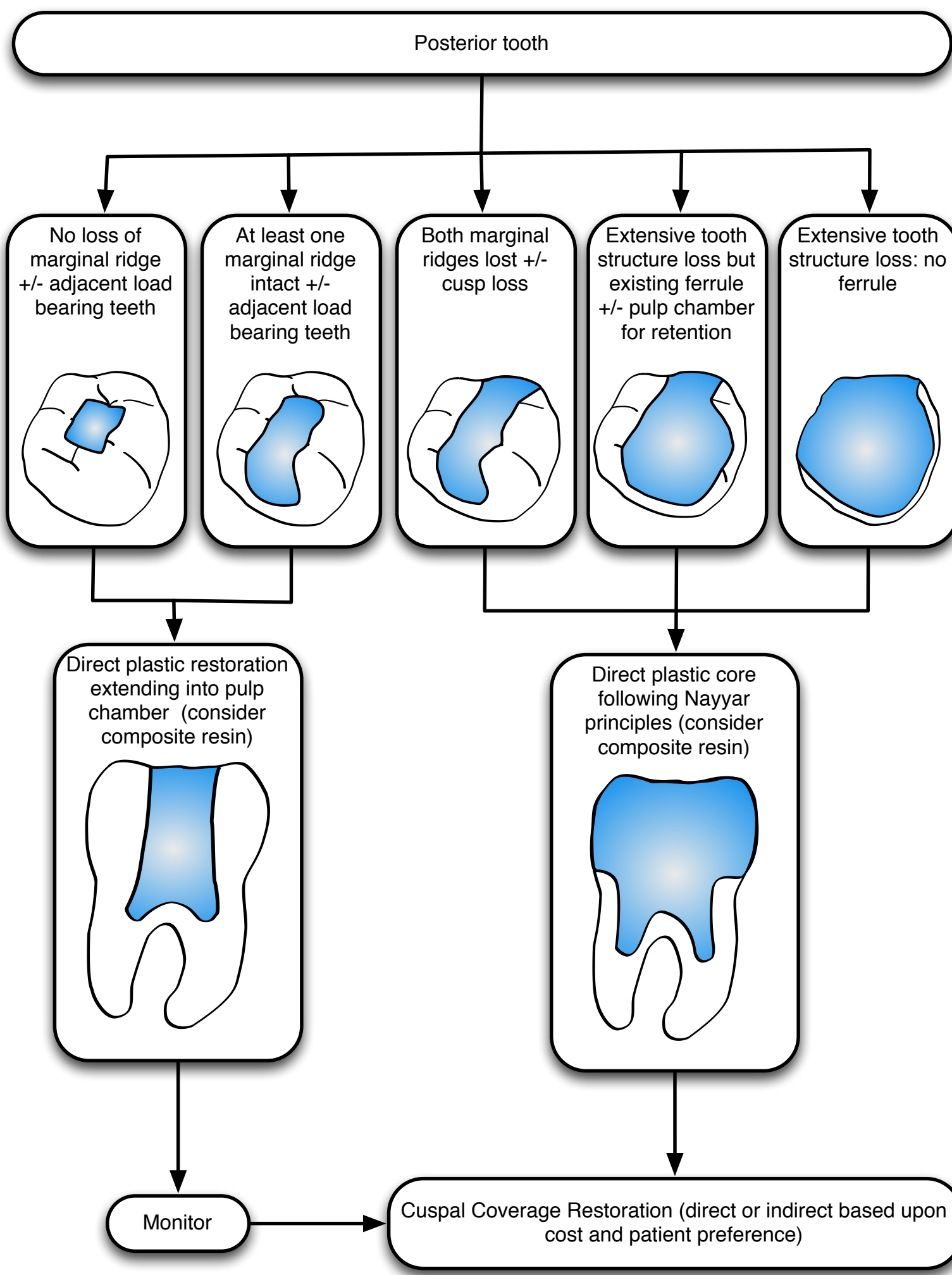


RISKY TEETH

- Premolars
- MOD restorations
- Dentine thickness <2mm
- Endodontical treated?







SUMMARY

1. Good access makes endo enjoyable
2. Accurate WL gives clinicians control
3. Logical instrumentation facilitates irrigation and reduces the risk of errors.
4. Thorough irrigation is the key to improving success.
5. Good obturation seals the deal.

THANKS FOR
LISTENING

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