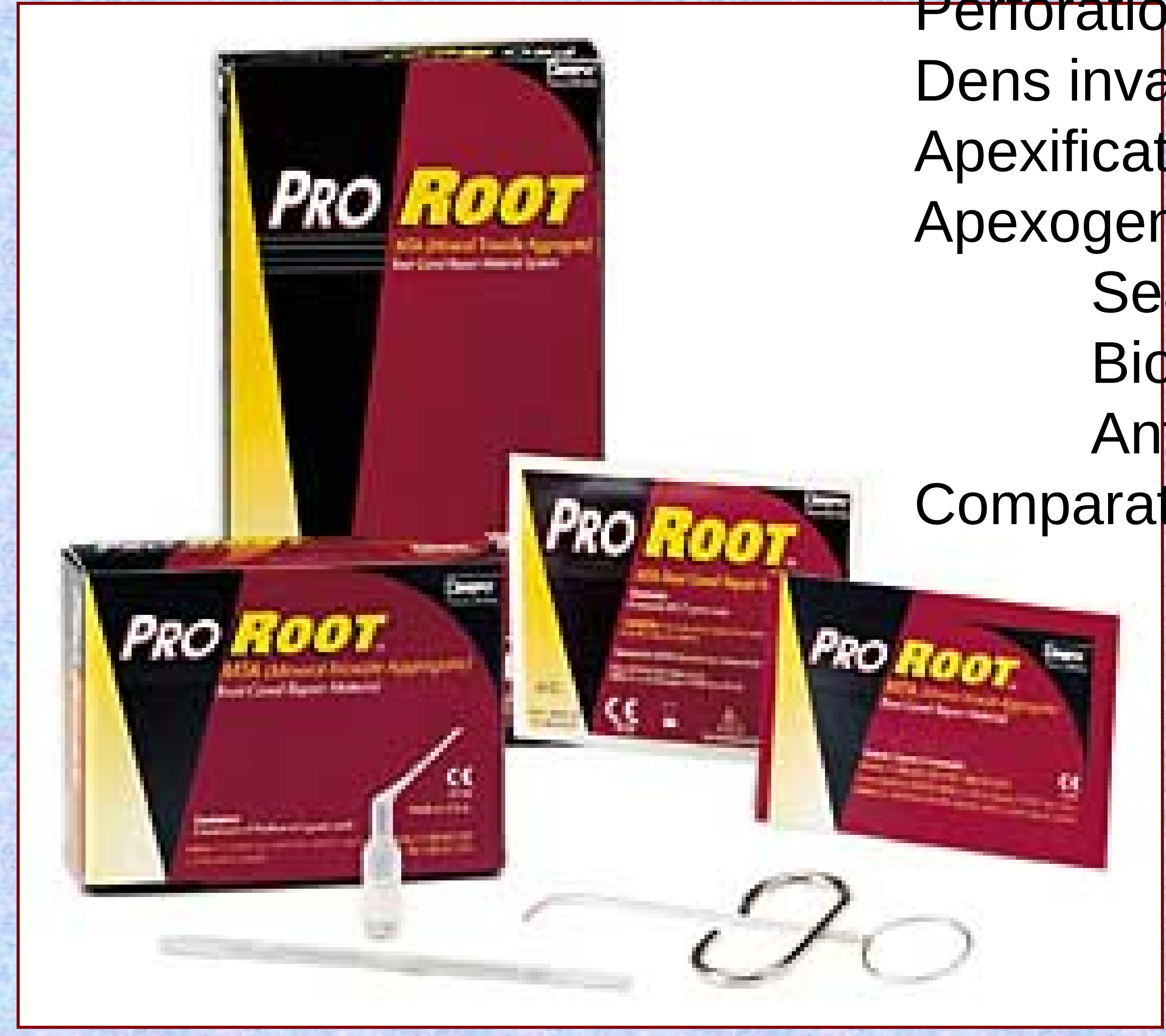


Retrograde fillings
Perforations
Dens invaginatus
Apexification
Apexogenesis
- Sealing
- Biocompatible
- Antimicrobial

Comparative studies

Aust Endod J. 2003 Apr;29(1):43-4

A comparative analysis of Mineral Trioxide Aggregate and Portland cement.

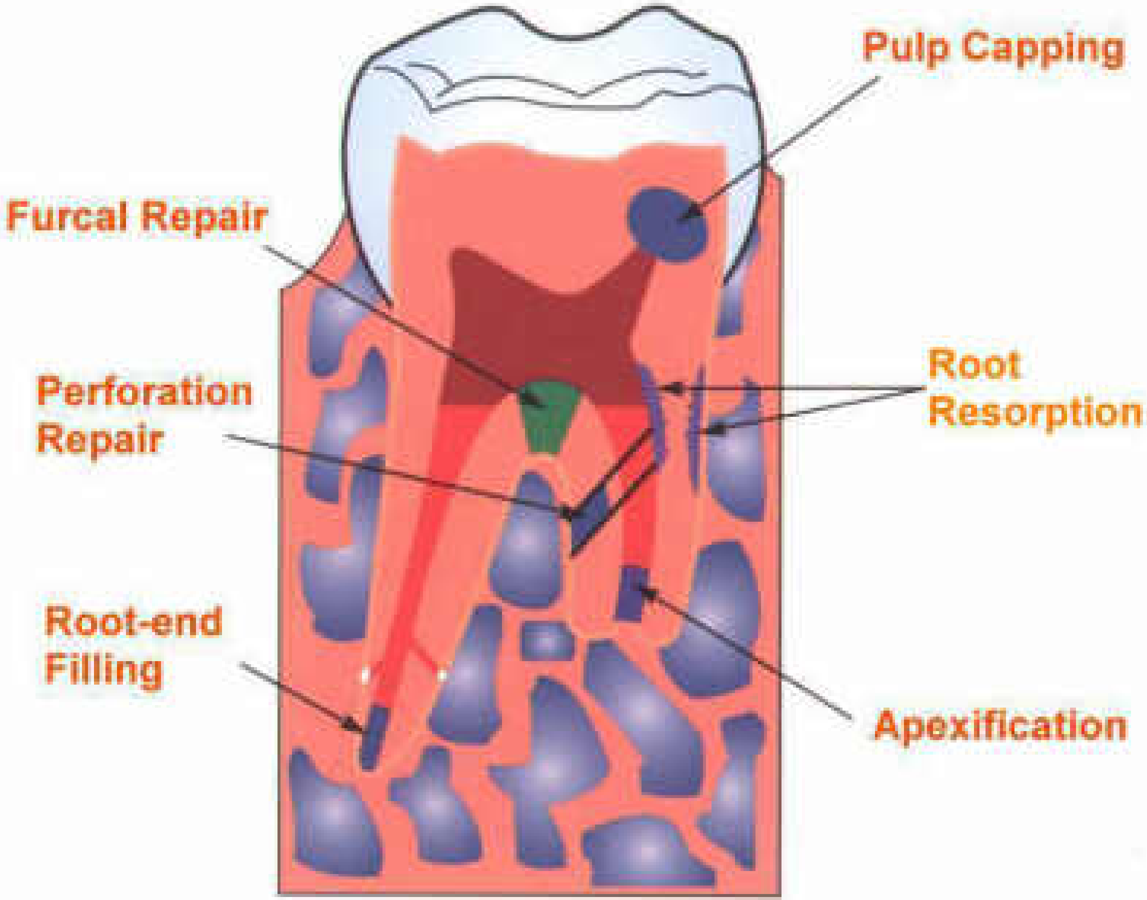
Funteas UR, Wallace JA, Fochtman EW.

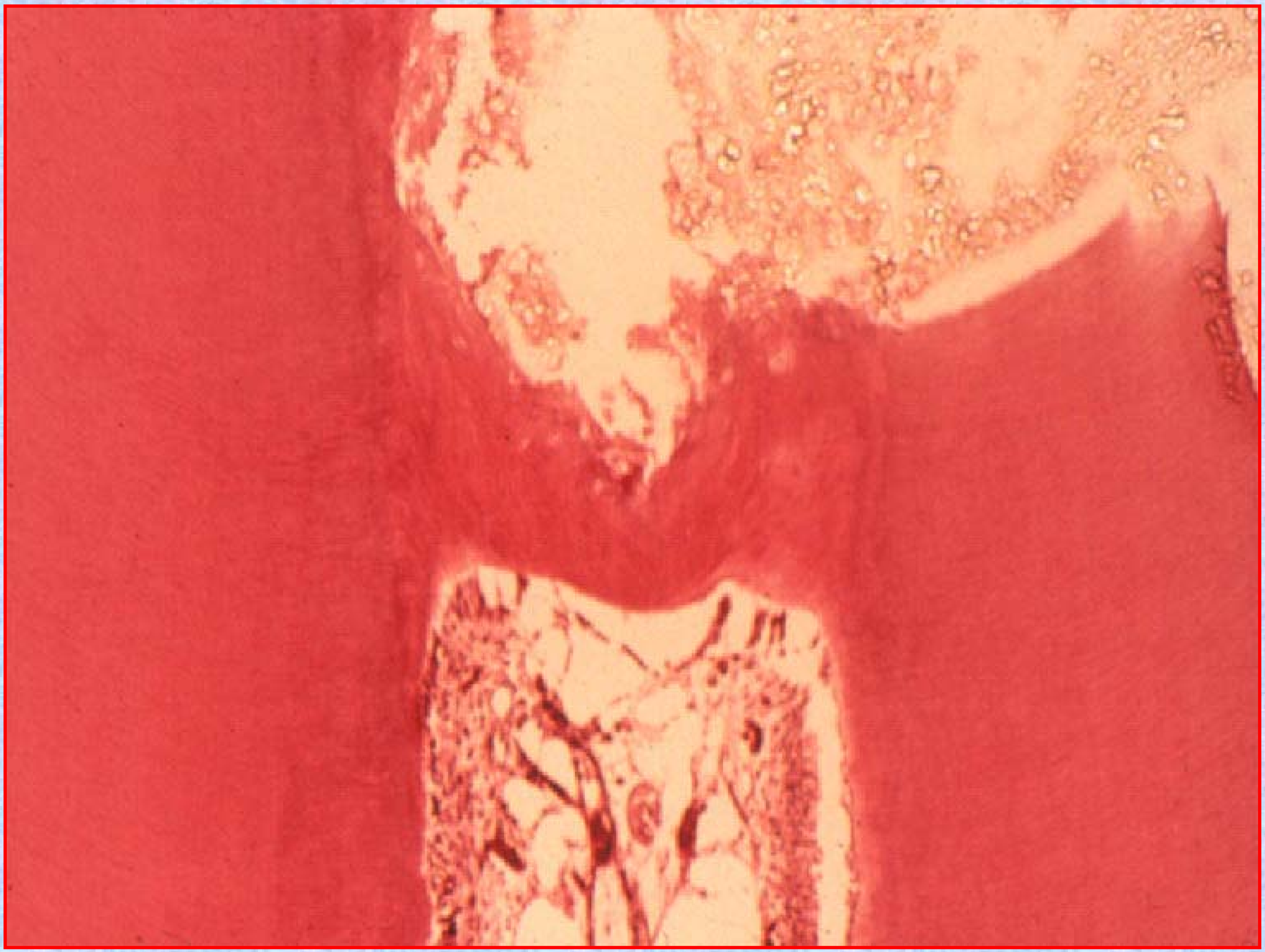
The purpose of this study was to compare the composition of Portland cement and Mineral Trioxide Aggregate (MTA). Samples of MTA and Portland cement were analysed for fifteen different elements by inductively coupled plasma emission spectrometry (ICP-ES). Comparative analysis revealed there was significant similarity except there was no detectable quantity of Bismuth in Portland cement. Quantitative results are given in both parts per million (p.p.m.) and wt%. <u>*It was concluded that there is no significant difference between the 14 different elements in both Portland cement and MTA.*</u>

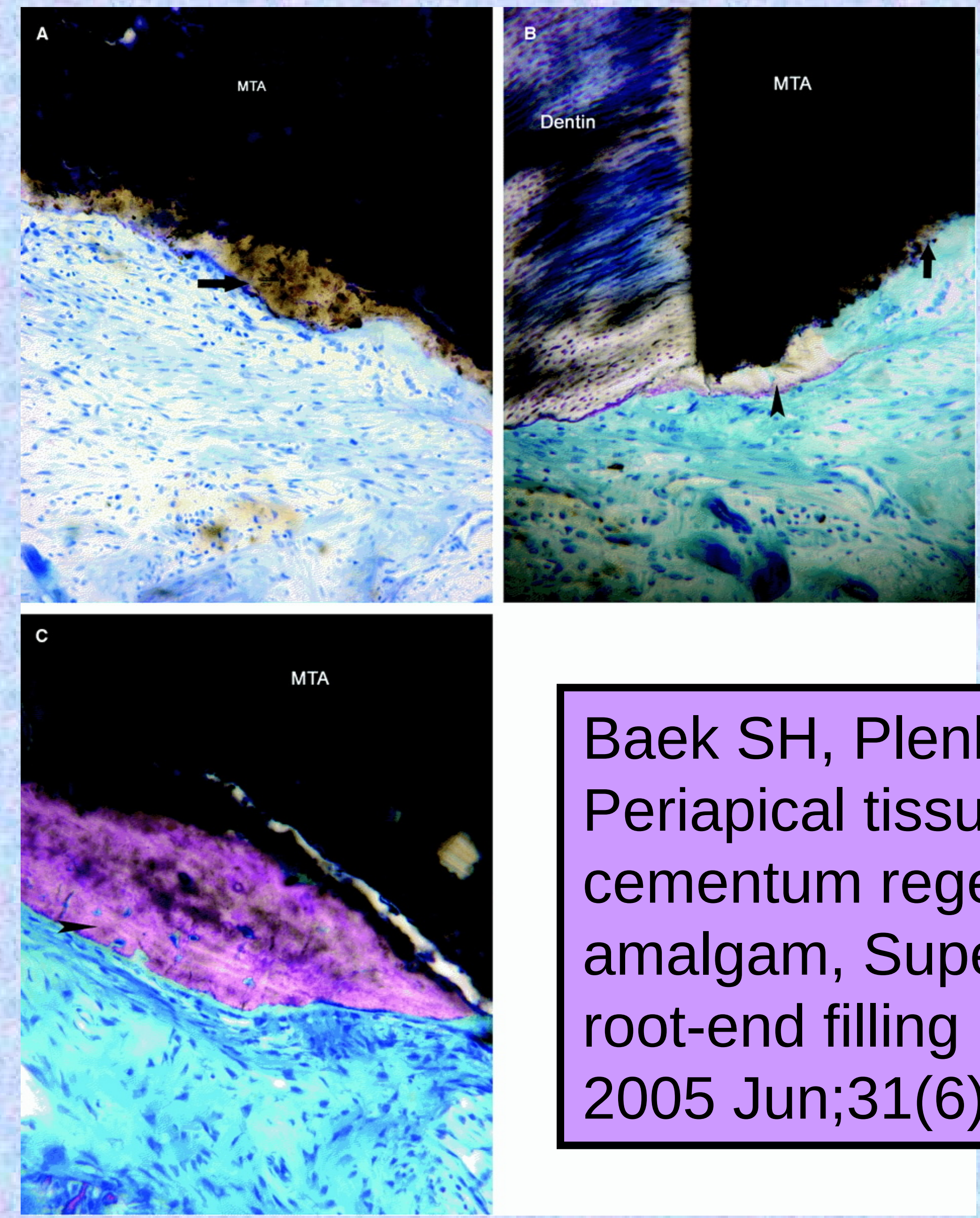
Portland Cement is produced by mixing chalk or limestone with clay or shale either using wet or dry process. The blended raw materials are fed into a kiln at 1400°C and a clinker is formed which is cooled and ground with a small amount of gypsum to form a familiar grey powder. Portland cement reacts chemically with water (hydration) to form four main compounds (Tricalcium silicate, Dicalcium silicate, Tricalcium aluminate and Tetracalcium aluminoferrite) plus other minor compounds, including sodium and potassium oxides known as alkalies. The chemical compounds form a crystalline ‘gel’ which grows and interlocks to stiffen the cement paste and then carries on to gain strength. The speed of the reaction is effected by temperature (thus the need for accelerators in winter and retarders in summer) and heat is given off by the reaction itself. It is called Portland cement because of its resemblance to the Portland stone quarried in Dorset.

(http://www.nationwidepremixed.com)

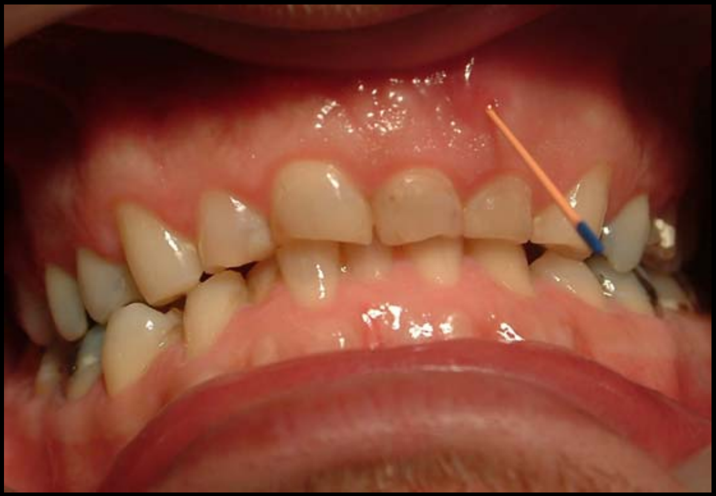
Clinical Applications of MTA





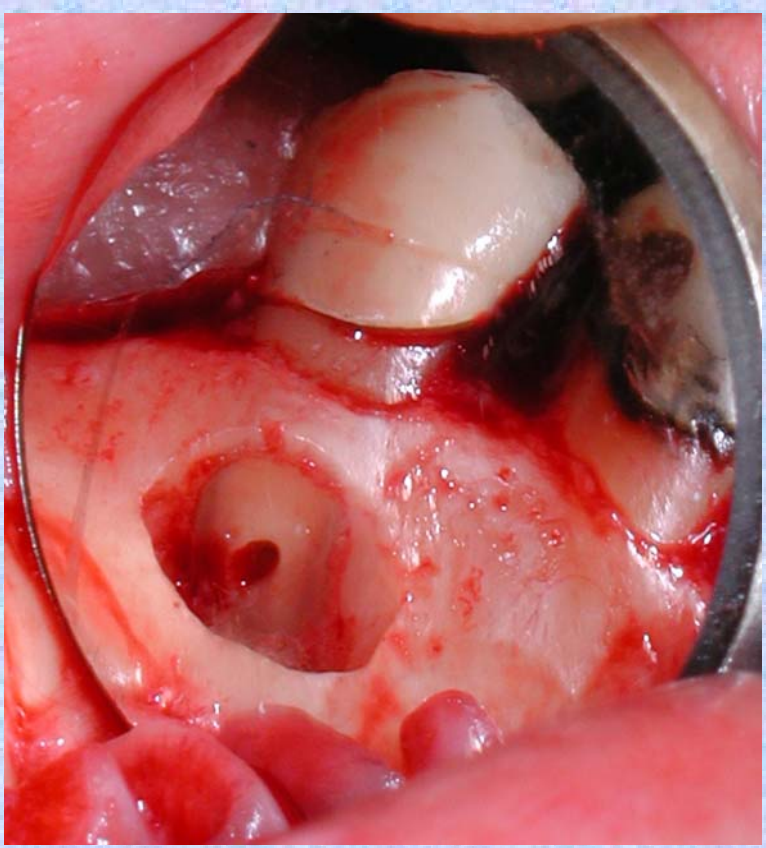


Baek SH, Plenk H Jr, Kim S. Periapical tissue responses and cementum regeneration with amalgam, SuperEBA, and MTA as root-end filling materials. J Endod. 2005 Jun;31(6):444-9.

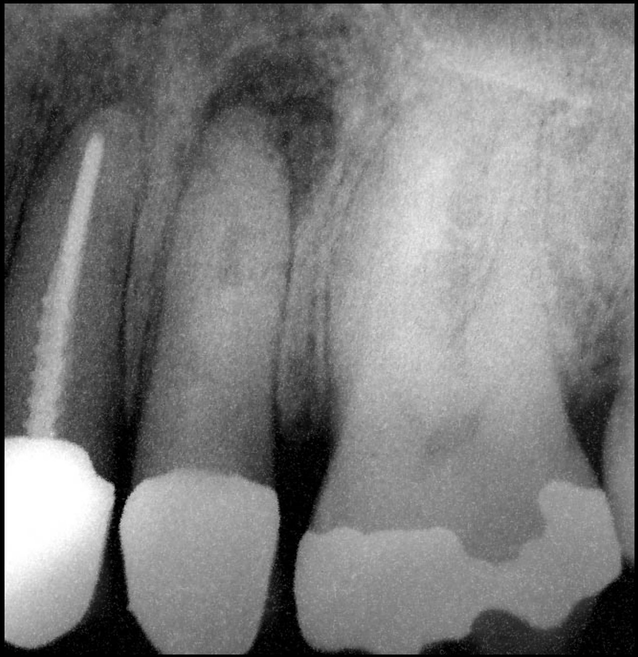


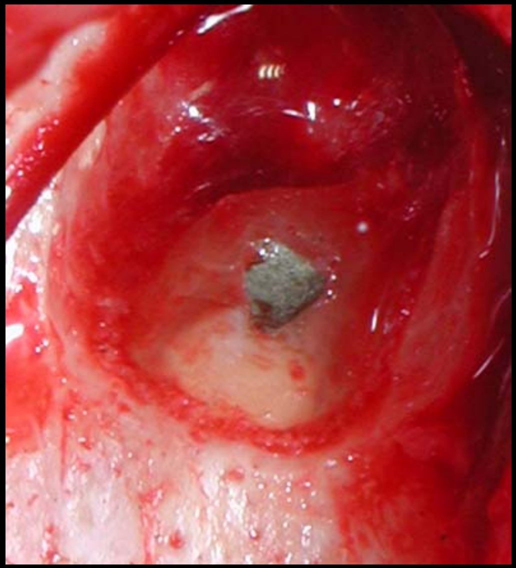



Sanjabi



Sanjabi

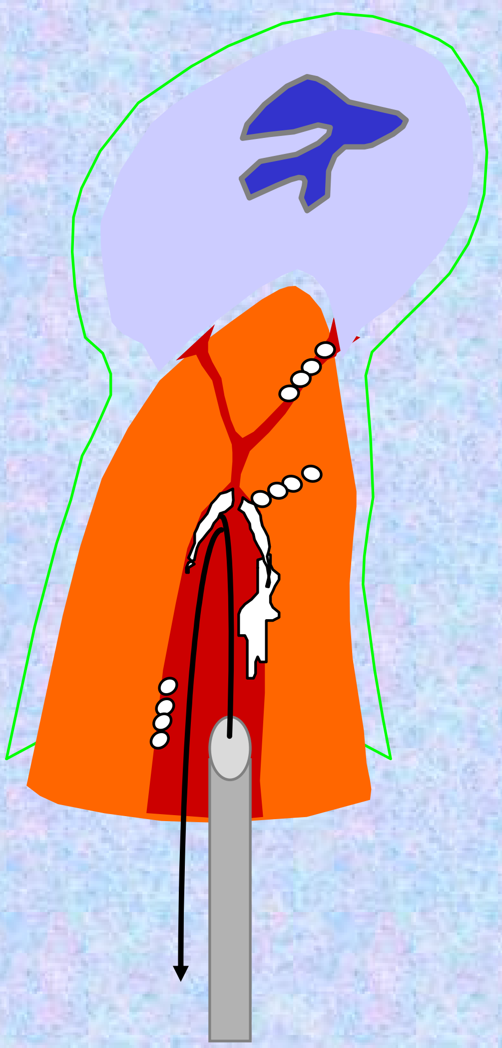




Rikvold

Root canal medicaments

Dag Ørstavik
2006



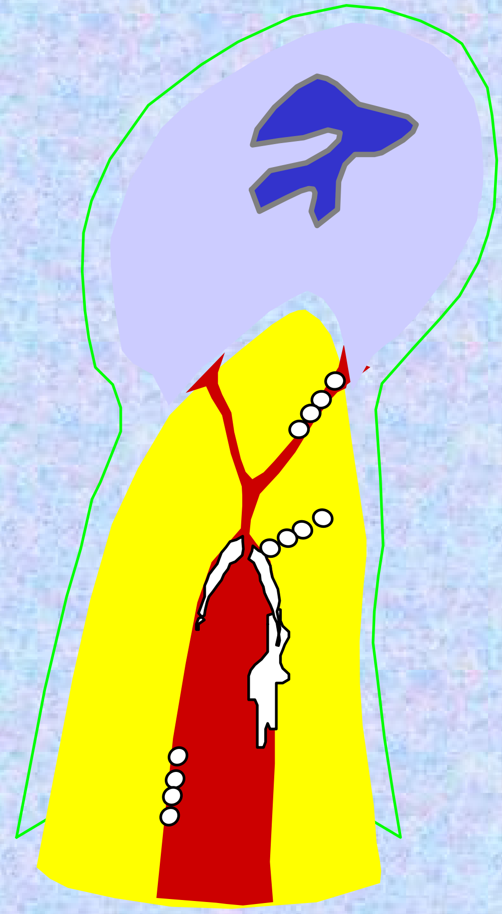
Endodontics is:

Prevention or treatment of apical periodontitis

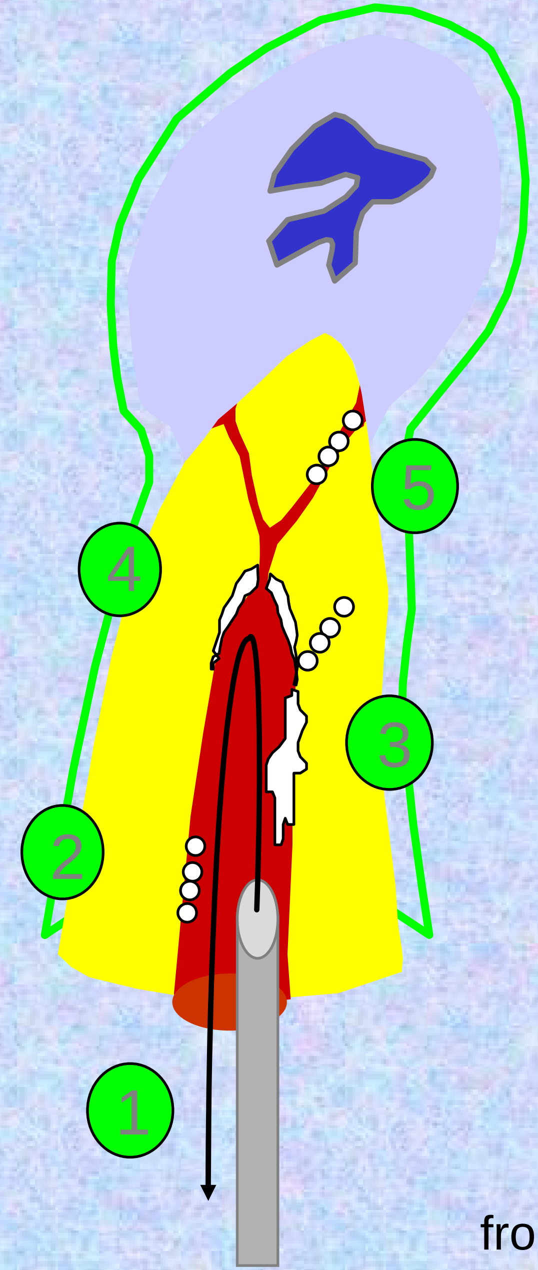
which in practice means

Protection against or ***elimination of root canal infection***

Irrigation, medication and root filling are all means towards this end



Ørstavik 1988



(1) Wetting of the canal walls and removal of debris by flushing.

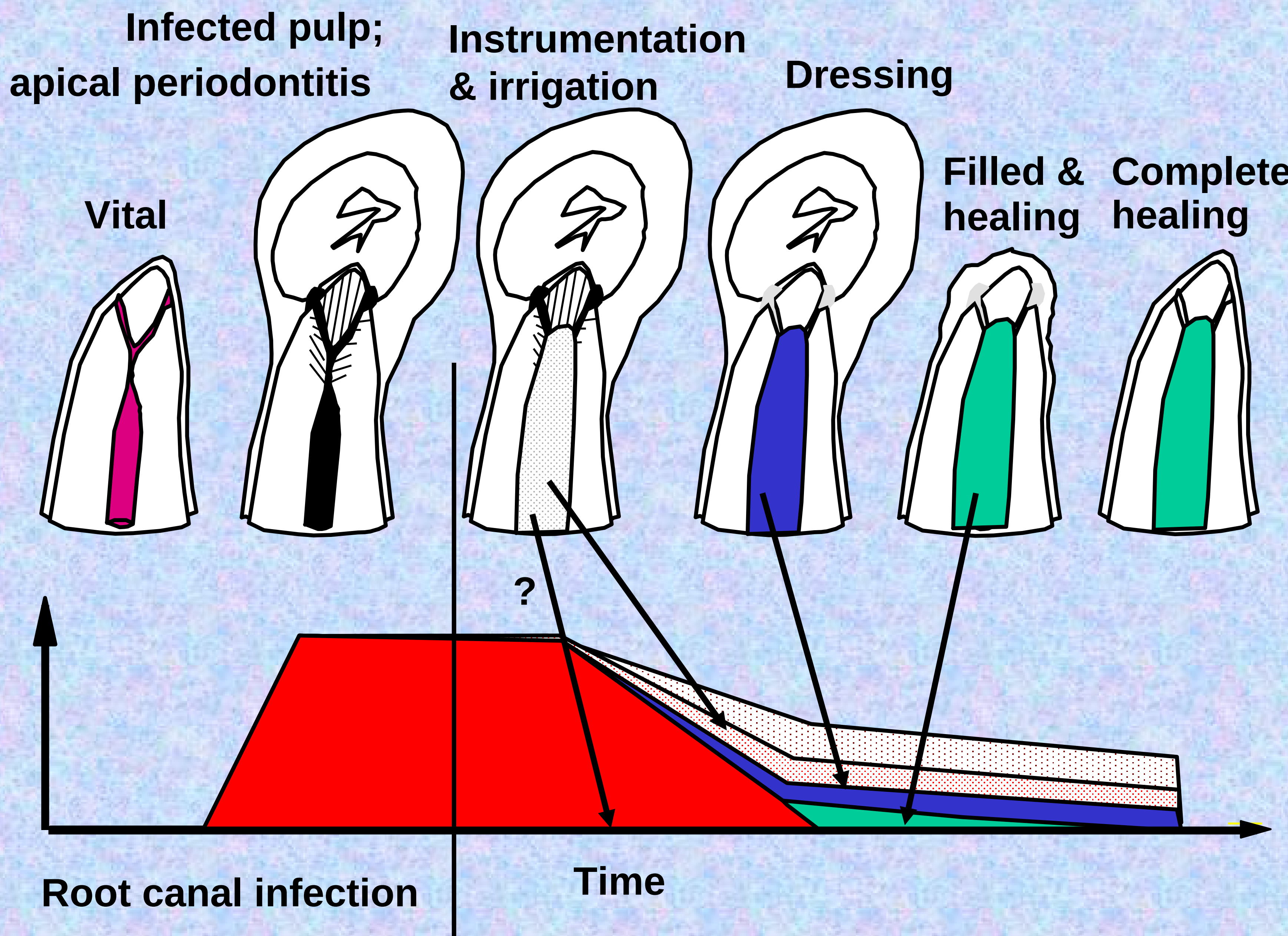
(2) Destruction of microorganisms.

(3) Dissolution of organic matter.

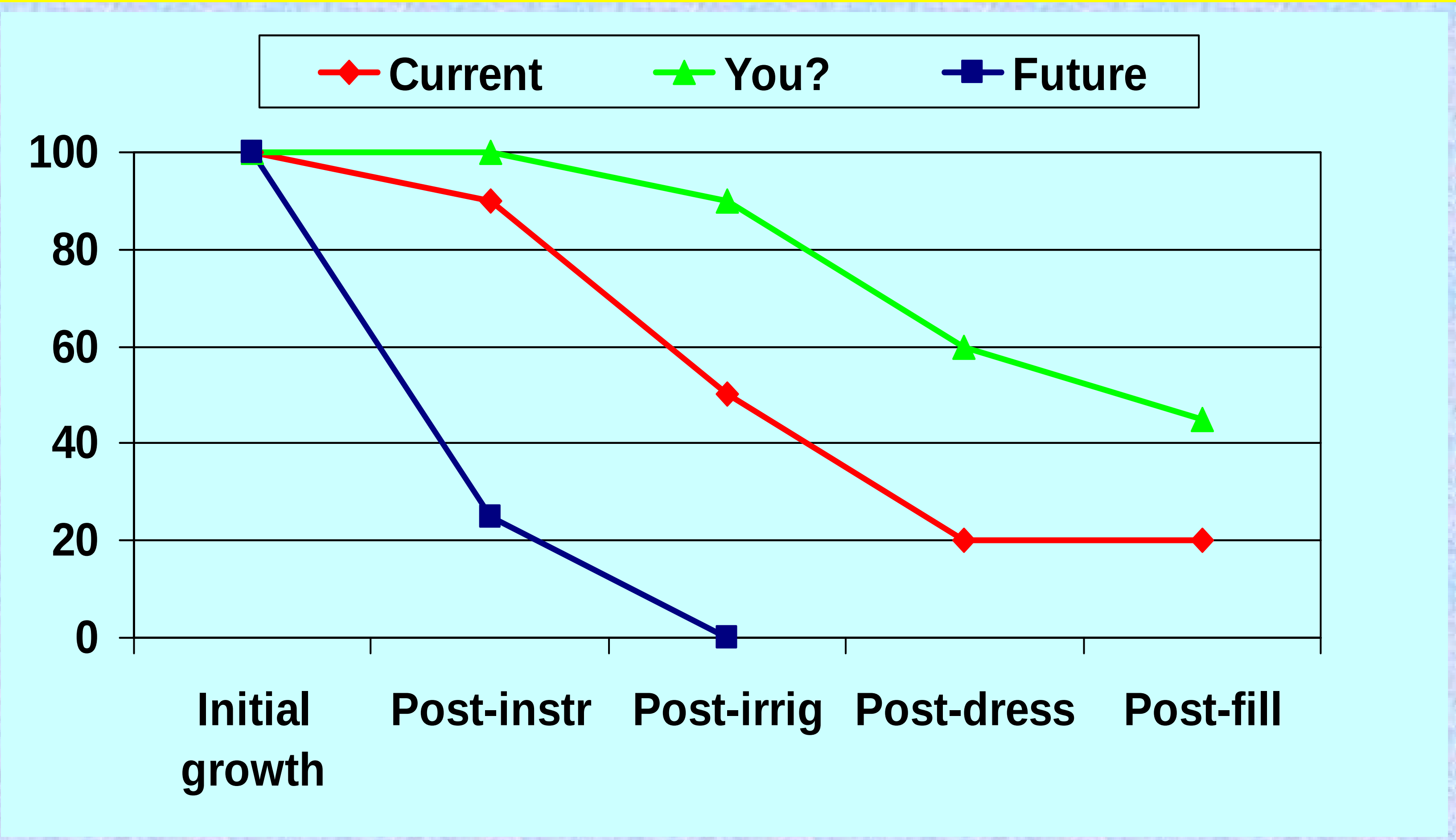
(4) Removal of smear layer and softening of dentin.

(5) Cleaning in areas that are inaccessible to mechanical cleansing methods.

from Sundqvist & Figdor, in 'Essential Endodontology, 1998

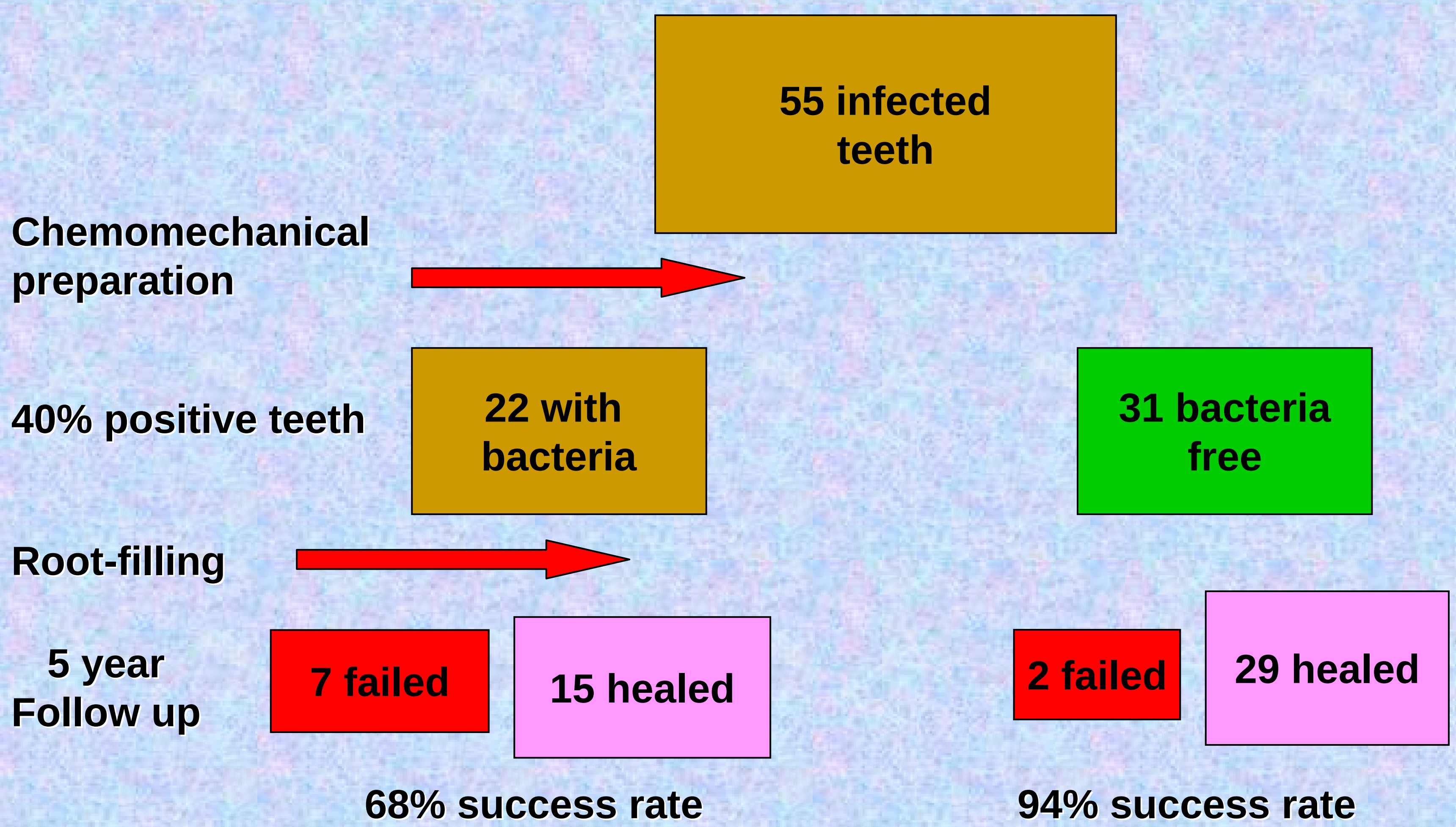

Infected pulp;
apical periodontitis
Instrumentation
& irrigation
Dressing
Vital
Filled &
healing
Complete
healing
?
Root canal infection
Time

What do we want to achieve?

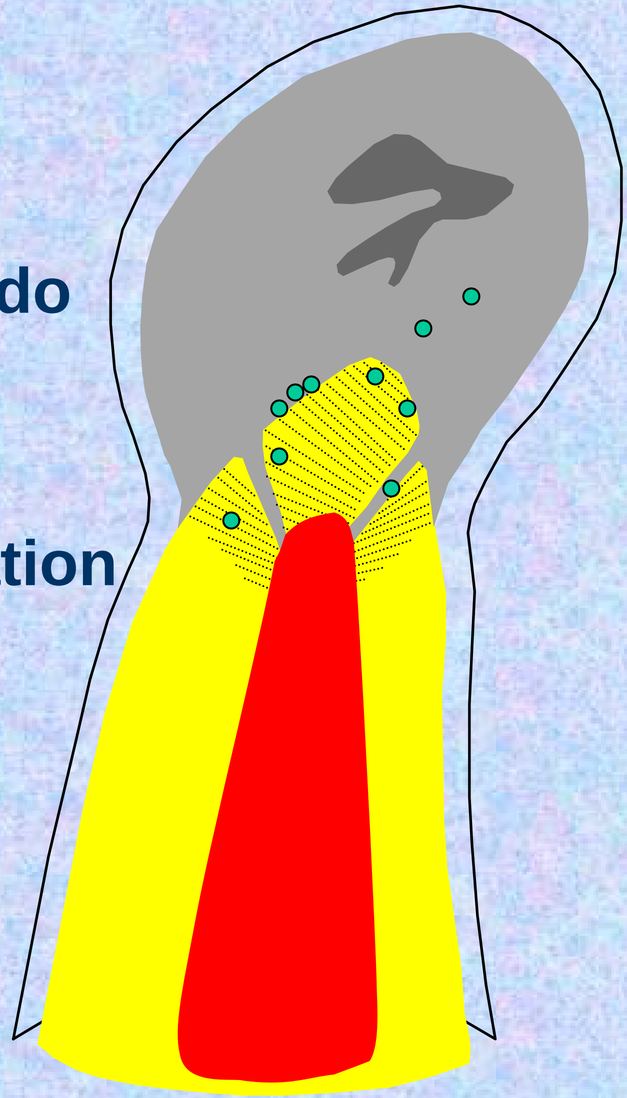


Reduction in canals positive for bacterial growth

Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical peridontitis. *Sjögren et al IEJ 1997*

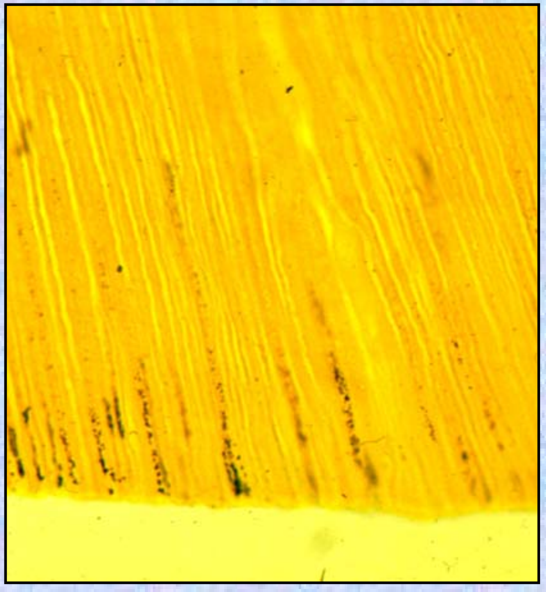


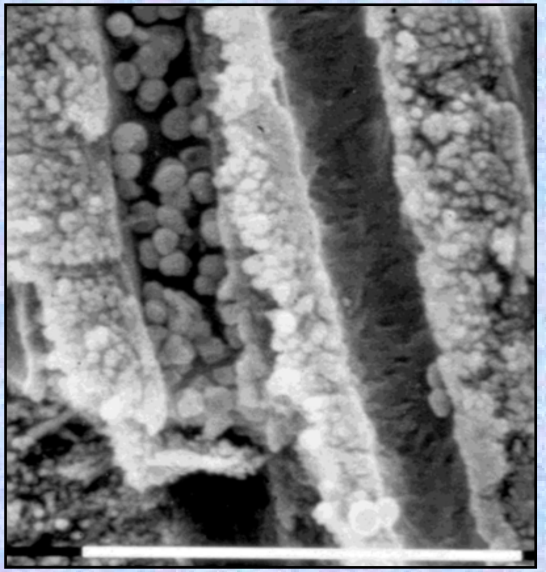
Where are the microbes?



What can we do with them?

Instrumentation
Irrigation
Dressing
Filling





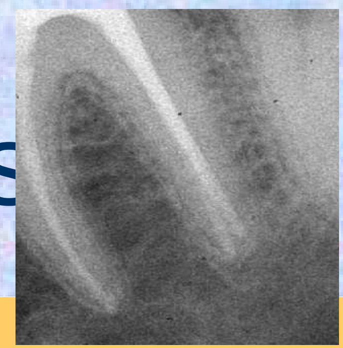
Factors related to mechanical cleansing by instrumentation

- Length: epidemiology: root filling length a measure of instrumentation length

- Shape: taper; retention of canal shape

- Width: bacteriology

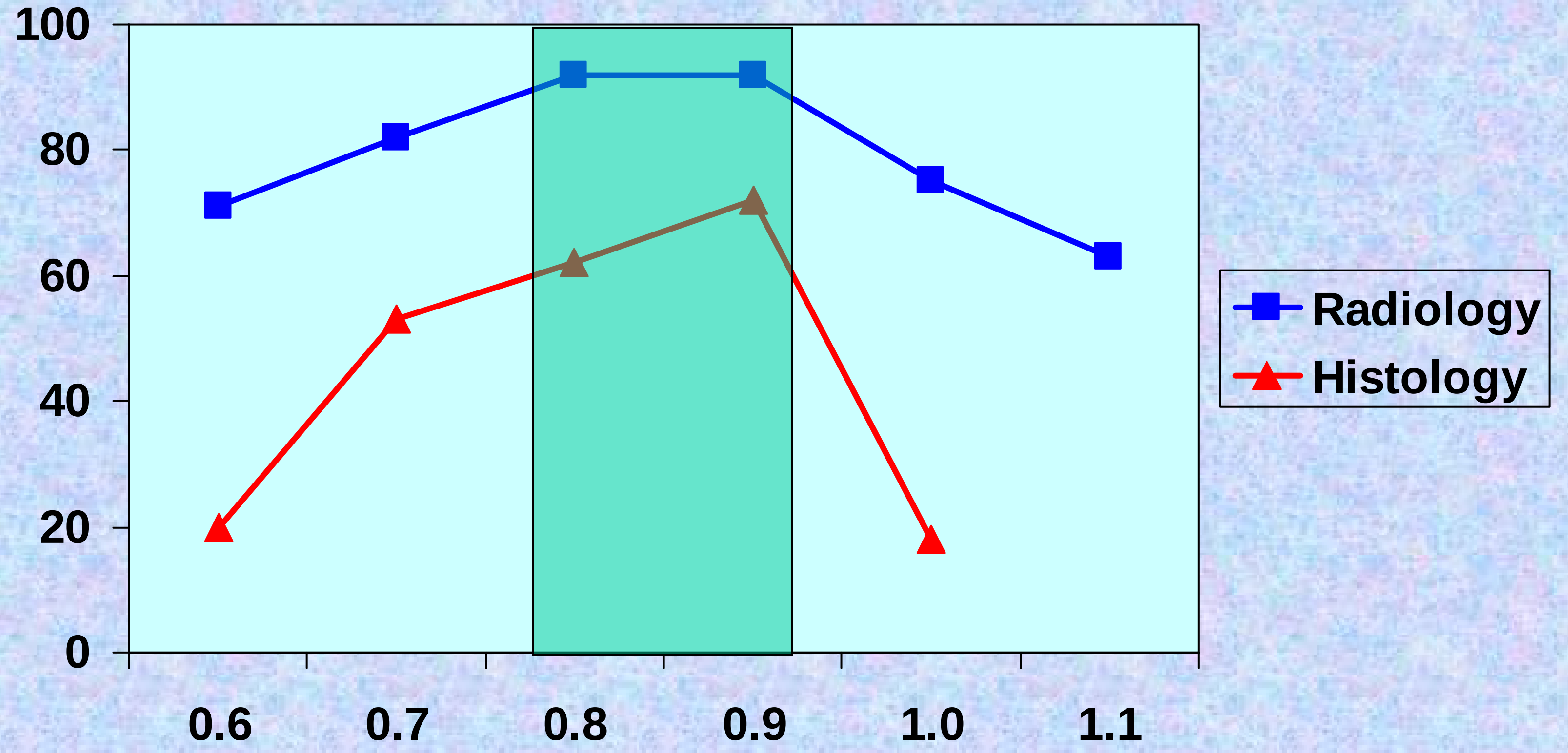
Aspects of ins ntation



No preoperative apical periodontitis: Instrumentation length/overfilling of little importance

Sjögren et al. 1991

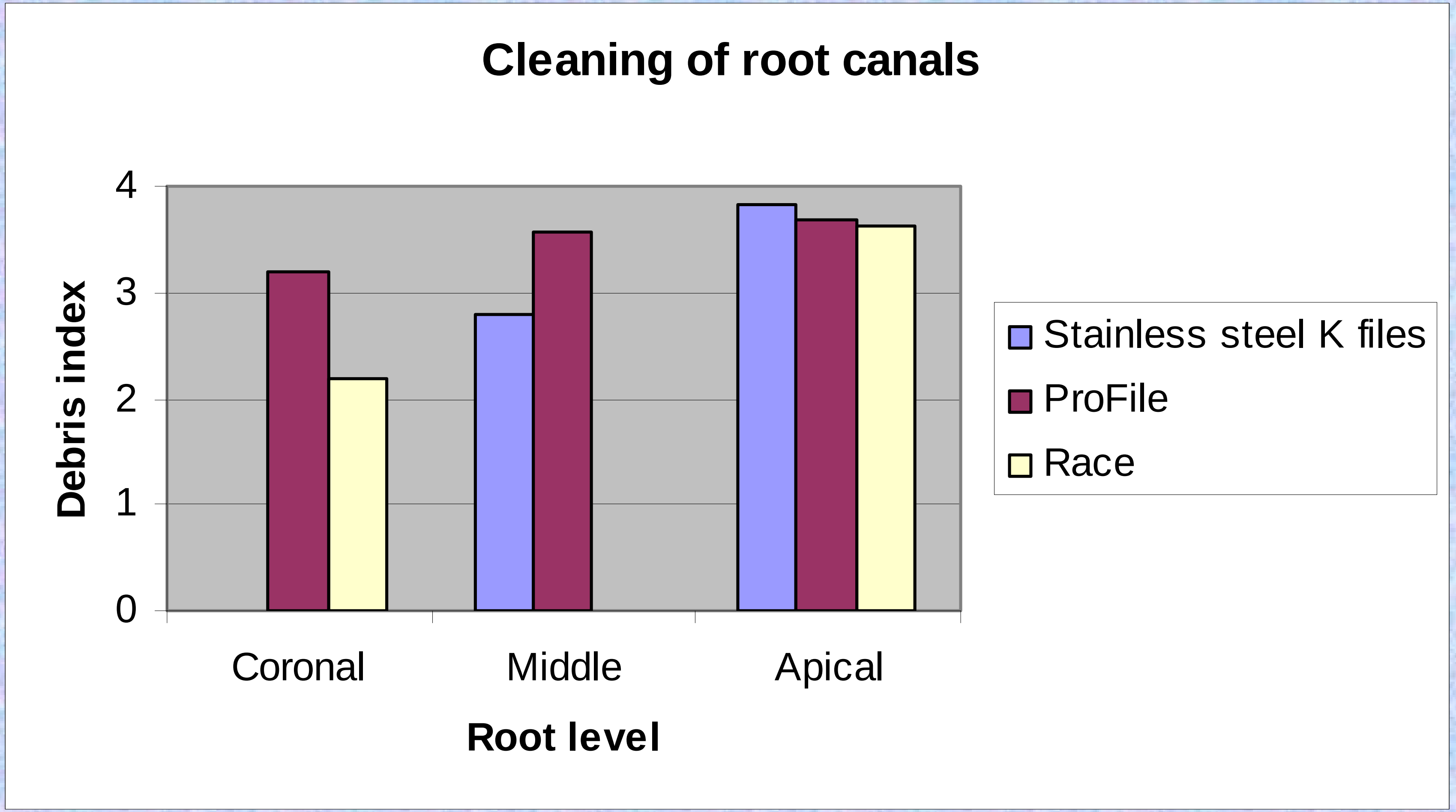
End point of root filling and success



Ketterl 1965

Suppose we get there – how well do we clean? Effectiveness of three instrumentation systems in the cleaning of root canals

Appelstein et al. JOE April 2003, OR 17



Zmener O, Pameijer CH, Banegas G. *International Endodontic Journal*, **38**, 356–363, 2005.

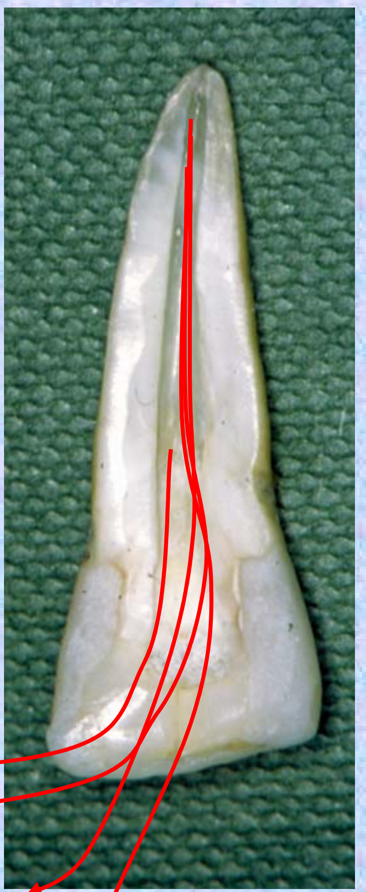
Table 1 Mean (SD) scores of debris removal

Group	***n***	**1 mm**	**5 mm**	**10 mm**
1. AET	15	1.65 (0.20)	1.42 (0.40)	1.33 (0.22)
2. PF	15	1.83 (0.44)	2.00 (0.41)	1.62 (0.33)
3. MI	15	2.03 (0.36)	2.33 (0.38)	1.64 (0.35)

A score 1 was assigned when no debris or isolated small particles (±40 µm) were present. Score 2 indicated that debris covered more than 50% of the canal walls and a score 3 indicated that debris almost entirely covered the canal walls.

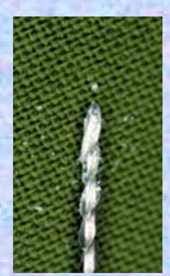
Mechanical cleaning and bacteriological sampling procedures: Complete vs. discrete

Growth after extensive reaming: a clinical pilot



Sample

A On admission



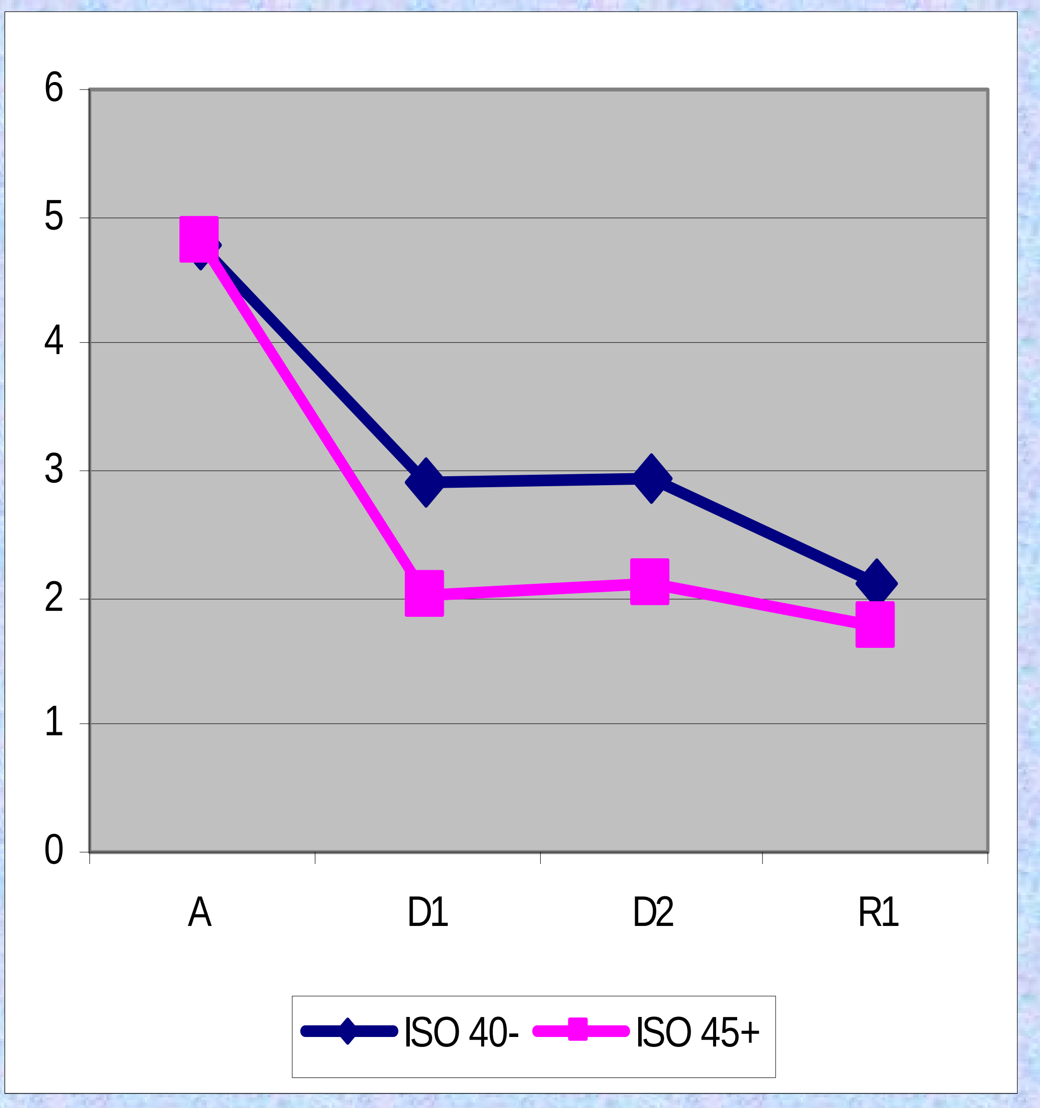
D1 First reamer to bite

D2 Final reamer, complete apical circle

R1 Second appointment, next reamer up

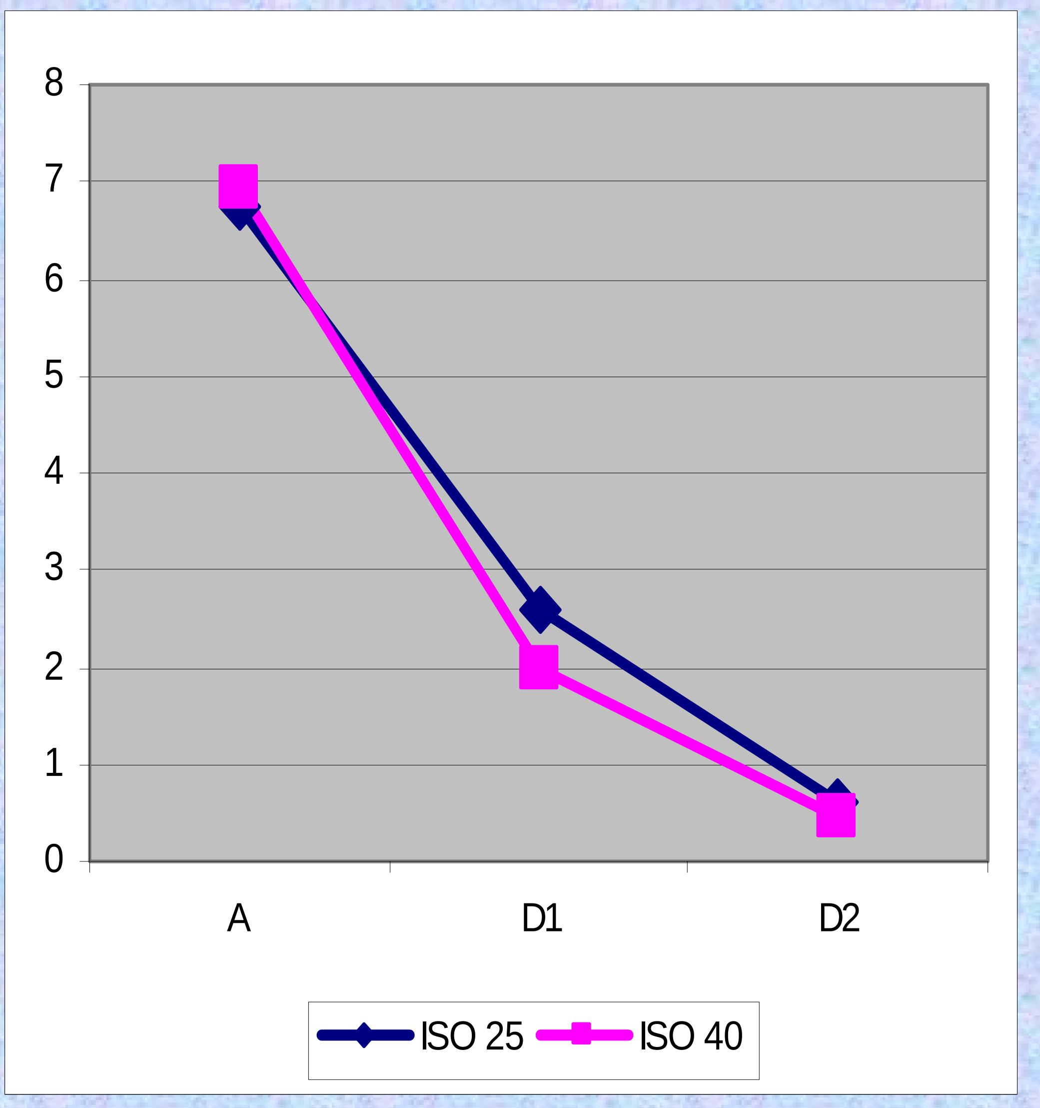
Ørstavik et al. 1991

Growth after extensive reaming: log10 values



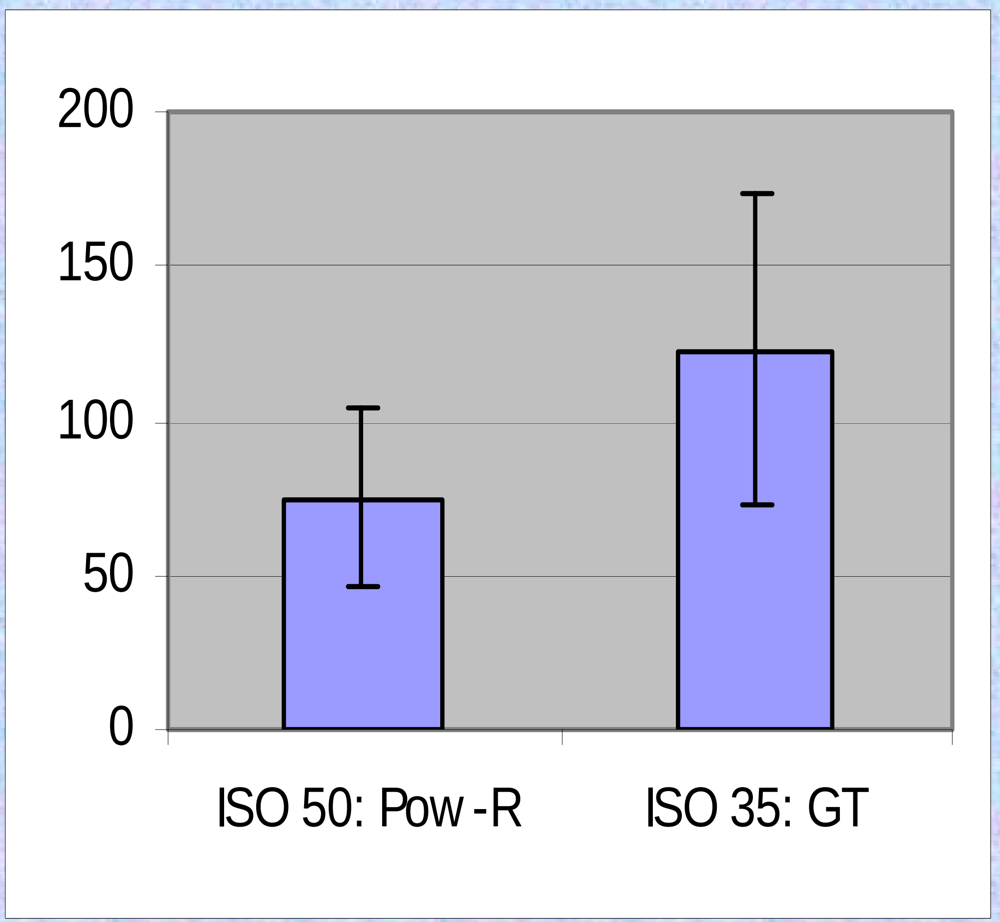
Ørstavik et al. 1991

Growth after extensive reaming: log10 values



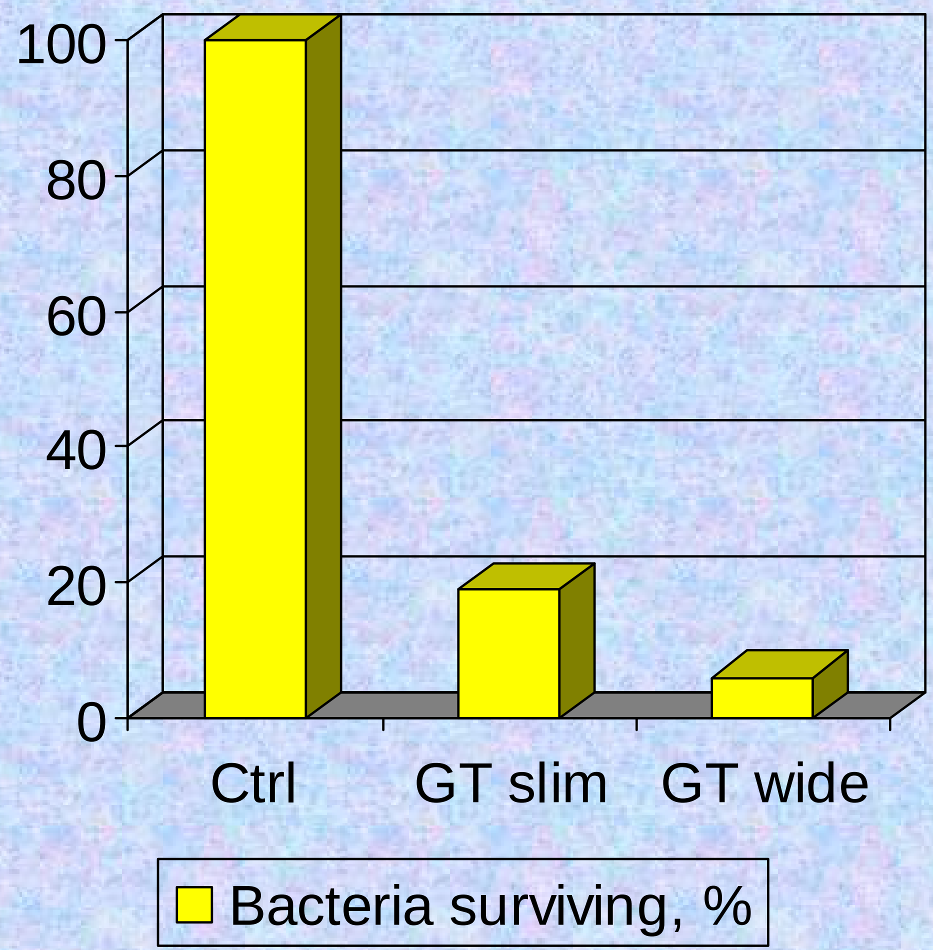
Yared & Bou Dagher 1994

Growth after extensive reaming: Radio-assay



Rollison S, Barnett F, Stevens RH. JOE 2002

Reduction in intracanal bacteria during root canal preparation with and without apical enlargement *(In vitro, E. faecalis)*

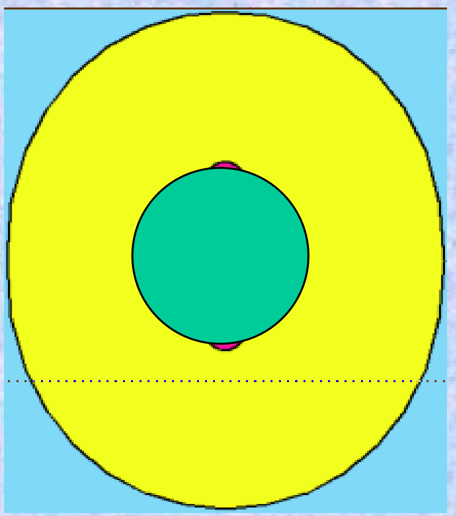


Coldero LG, McHugh S, MacKenzie D, Saunders WP.

Int Endod J. 2002 May;35(5):437-46

Growth after instrumentation: *in vitro; E. faecalis*

Method	**% Red.**
NiTi #30	98.17
NiTi #35	99.50
NiTi #40	***99.57*** *****
GT hand 0.12t	94.17
Profile 0.06t/#5	97.26



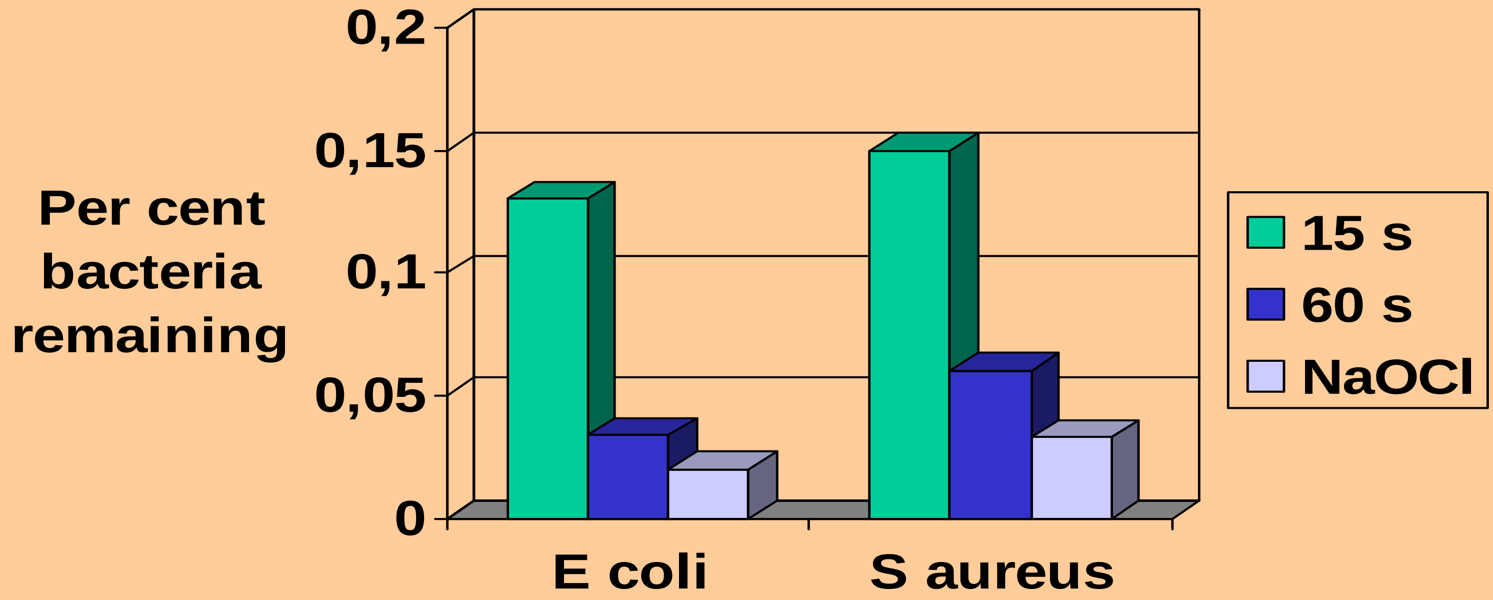
Siqueira et al. 1999

Clinically supported by Shuping, Sigurdsson, Trope, Orstavik et al 1999-2004

Bactericidal effects of 2.94 microns Er:YAG-laser radiation in dental root canals.

Mehl A, Folwaczny M, Haffner C, Hickel R.

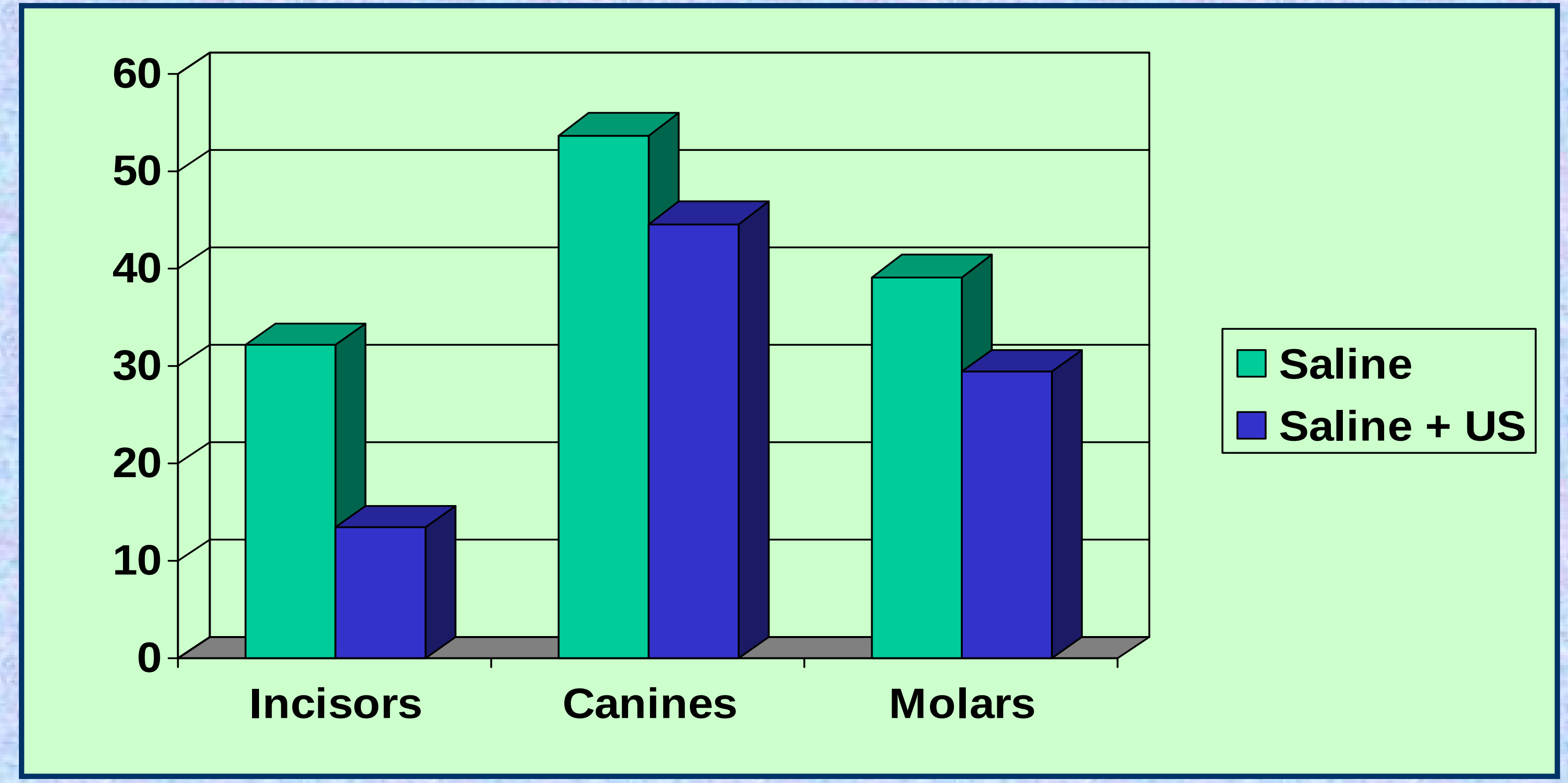
J Endod. 1999 Jul;25(7):490-3

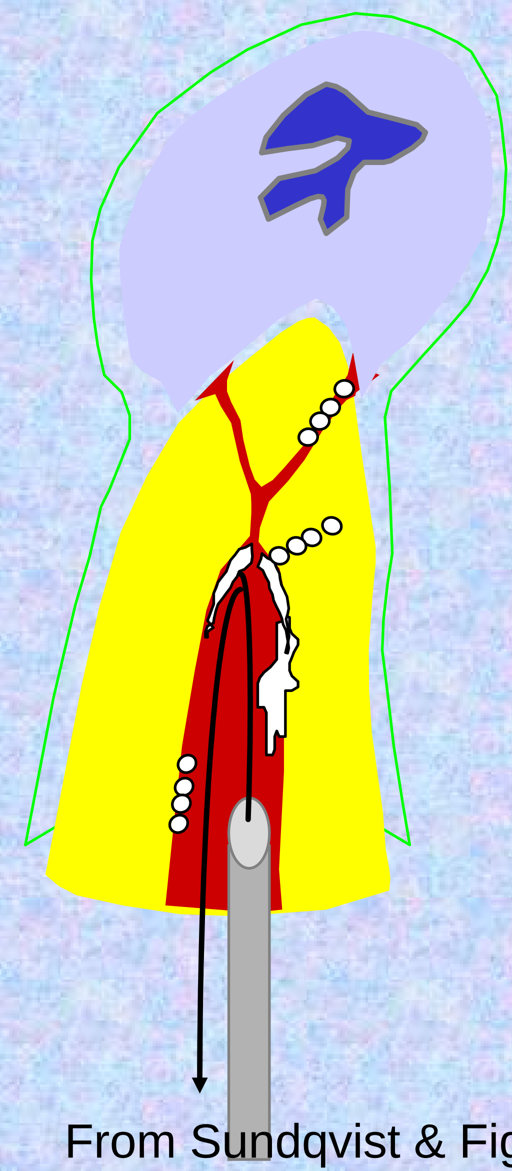


J Endod. 2003 Jan;29(1):12-4.

Bacteriological evaluation of passive ultrasonic activation.

Spoleti P, Siragusa M, Spoleti MJ.





From Sundqvist & Figdor,
’Essential Endodontology’, 1998

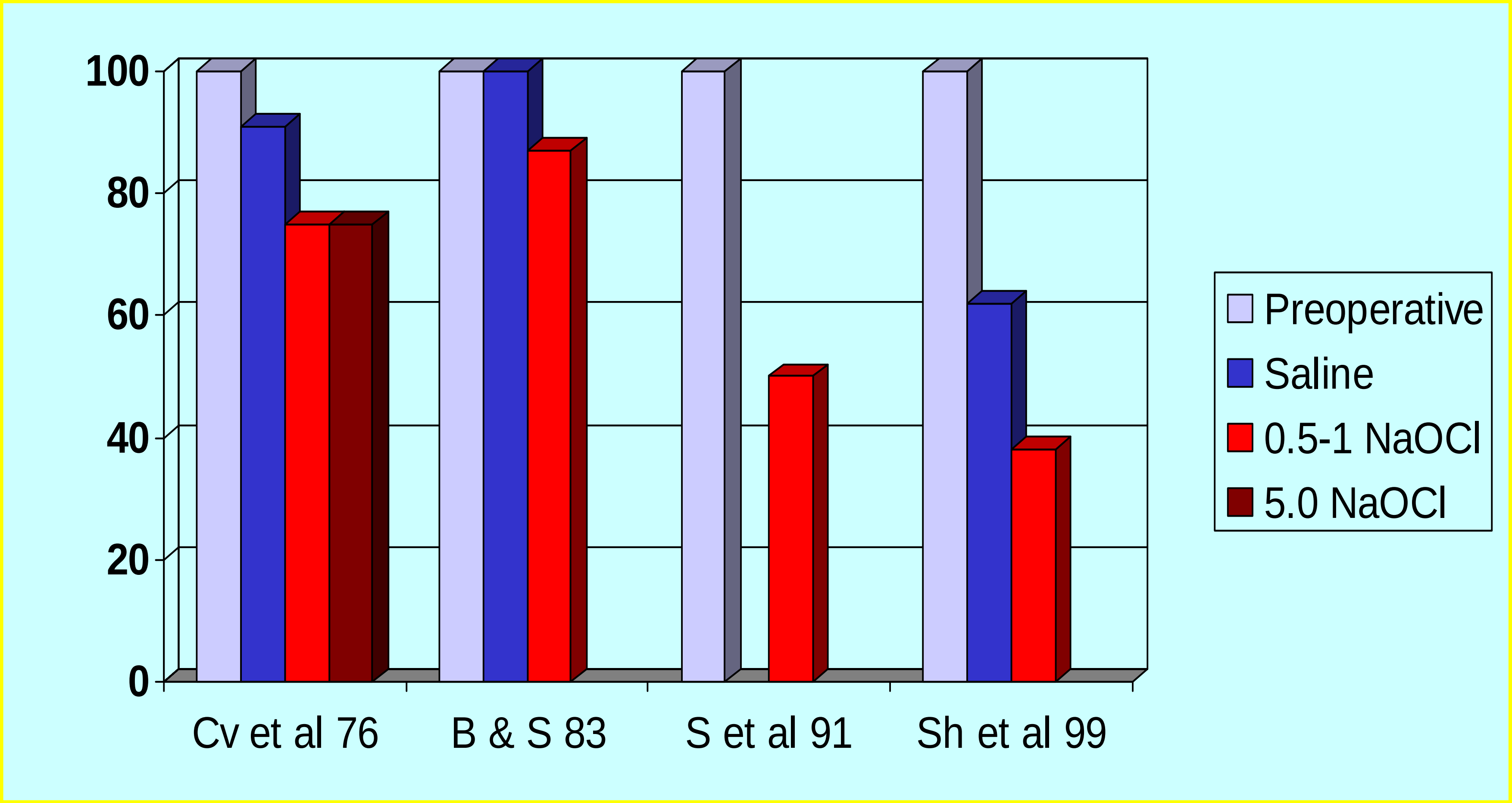
Irrigation: ’real-time’ disinfection

- Sodium hypochlorite
- Iodine-potassium iodide: enterococci?
- Chlorhexidine
- MTAD
  - *M*ix of: *T*etracyclin, *A*cid, *D*etergent

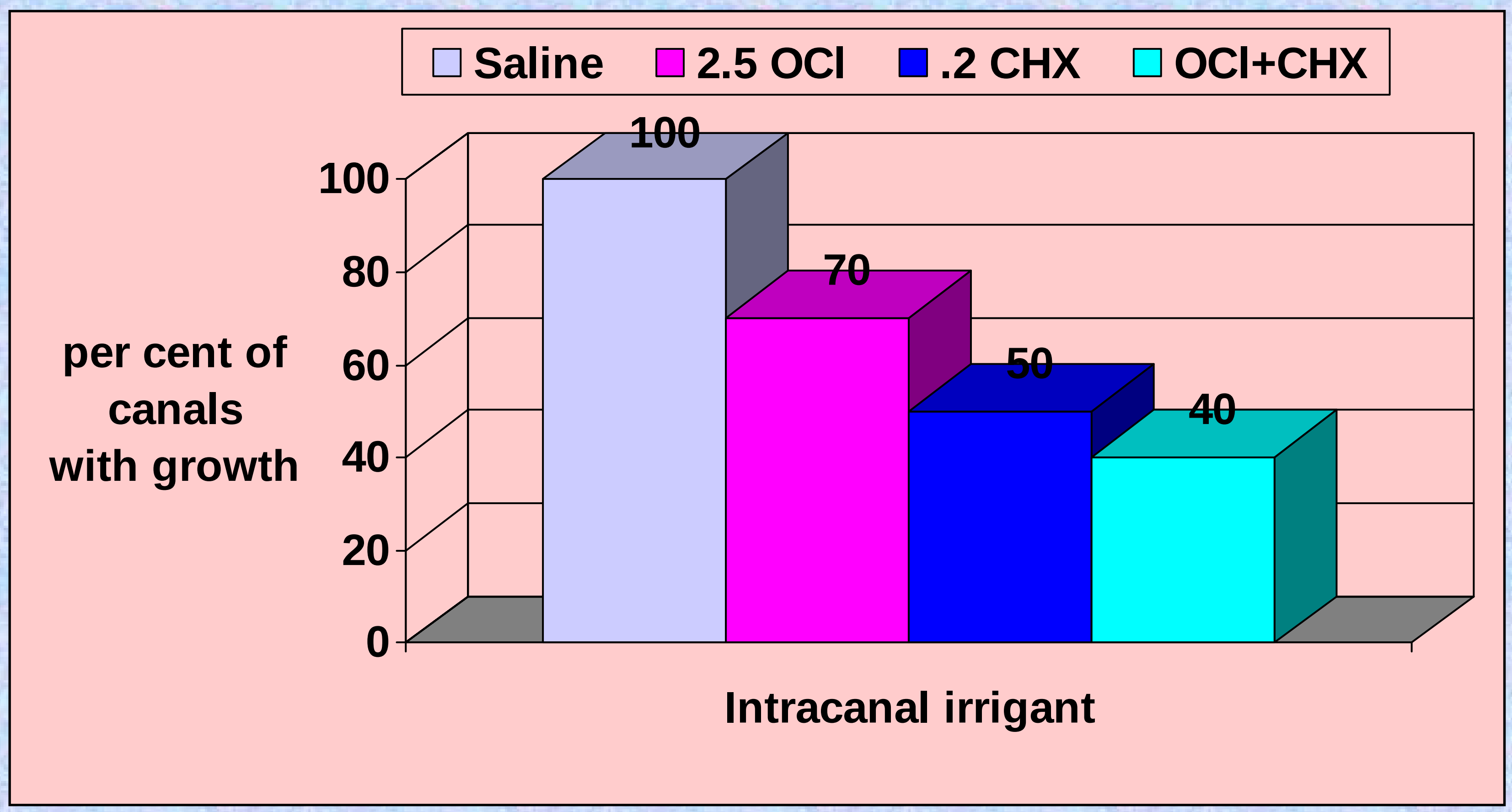
Pro & contra NaOCl

- Pro
  - Strong antimicrobial
  - ’Non-toxic’
  - Dissolves necrotic tissue
  - NB: clinical documentation!
- Contra
  - Concentration dependent
  - Loses effect on storage
  - Corrosive, bleaches fabric
  - Effect deep in dentin?

Clinical effects of NaOCl: teeth with bacteria at end of first appointment



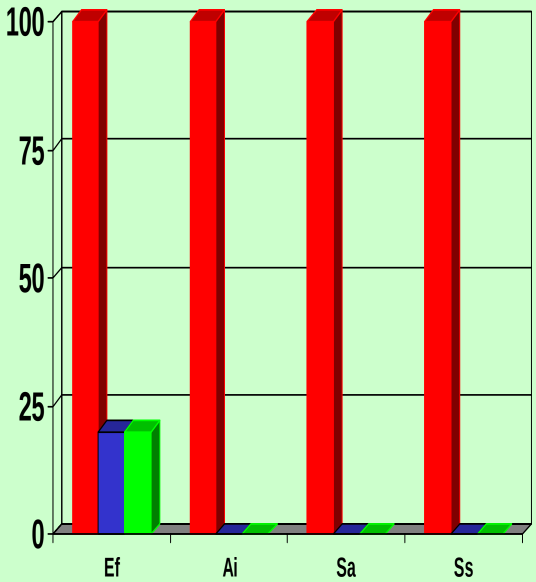
NaOCl & CHX clinically tested



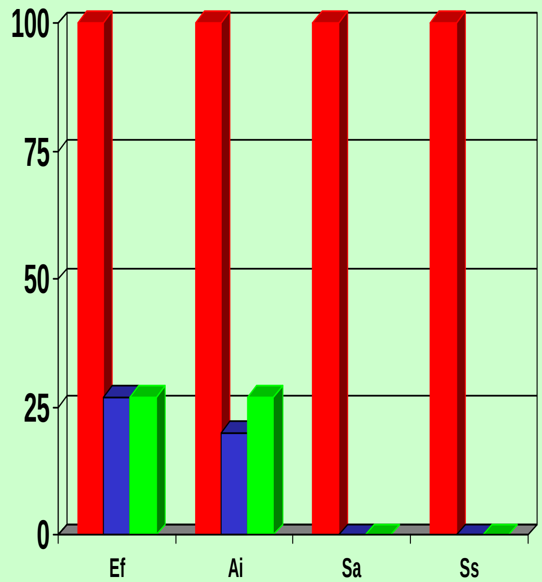
alternate use of CHX and OCl; Kuruvilla & Kamath, J Endod. Jul;24:72-6 1998

Disinfection *in vivo*

Ercan et al J Endod. 2004 Feb;30(2):84-87

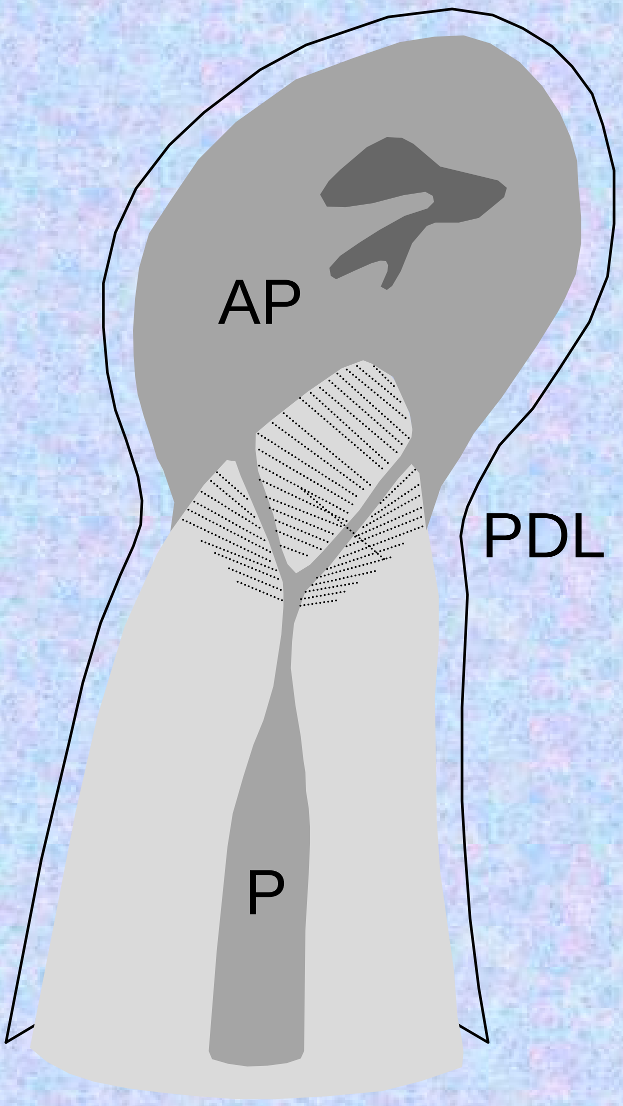


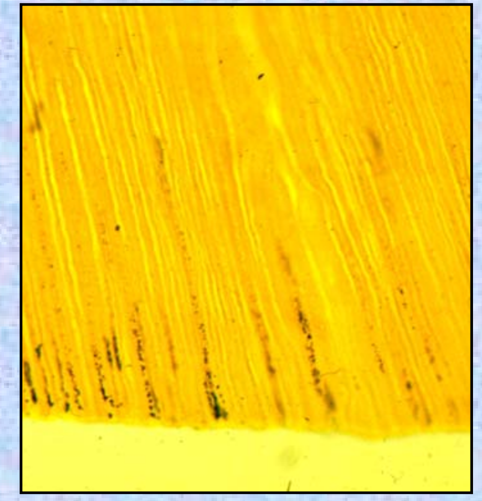
2% Chlorhexidine

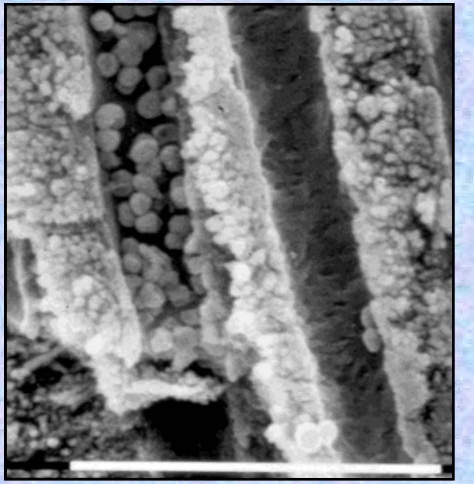


5.25% NaOCl

E. faecalis
A. israelii
S. aureus
S. salivarius

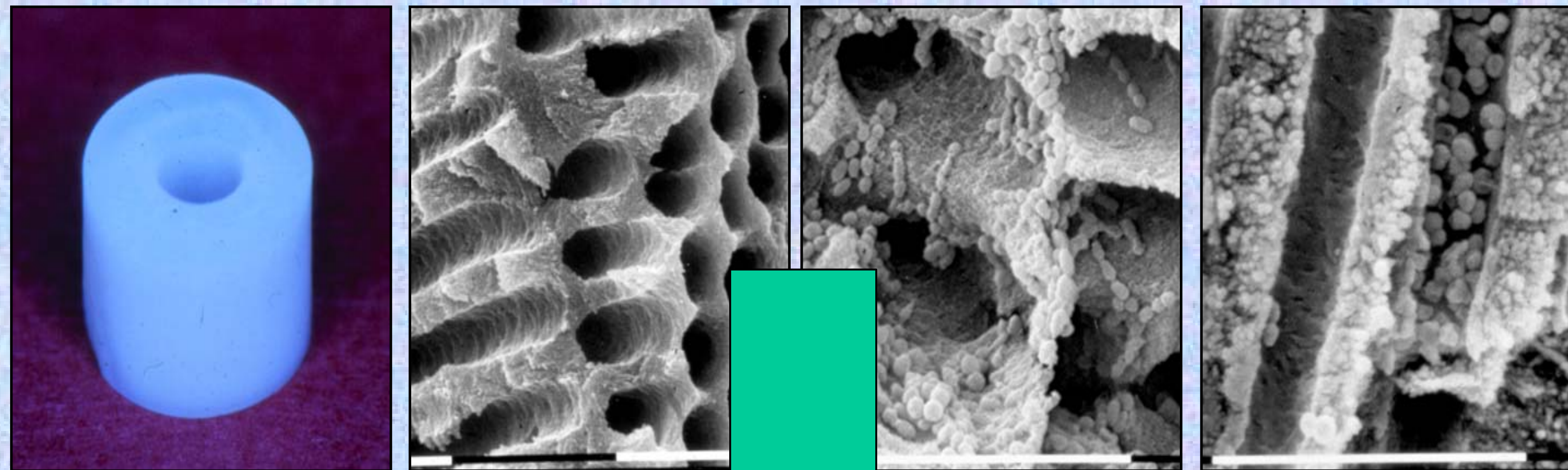


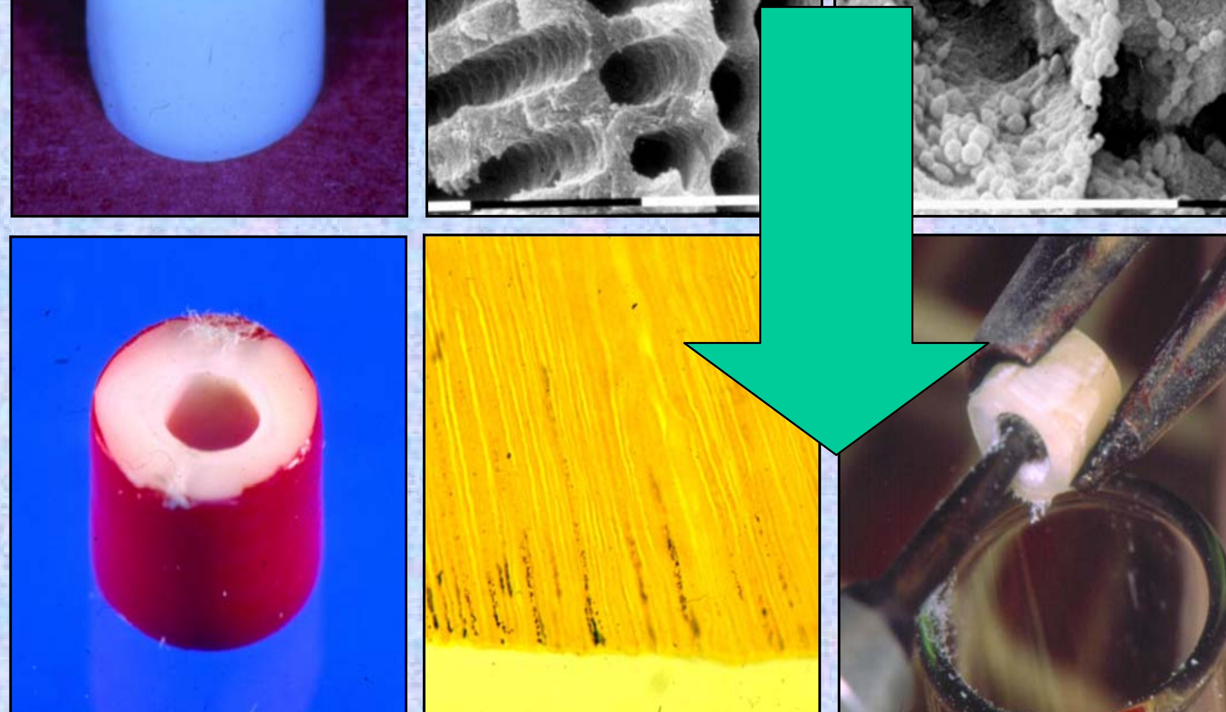




An in vitro model for testing endodontic medicaments

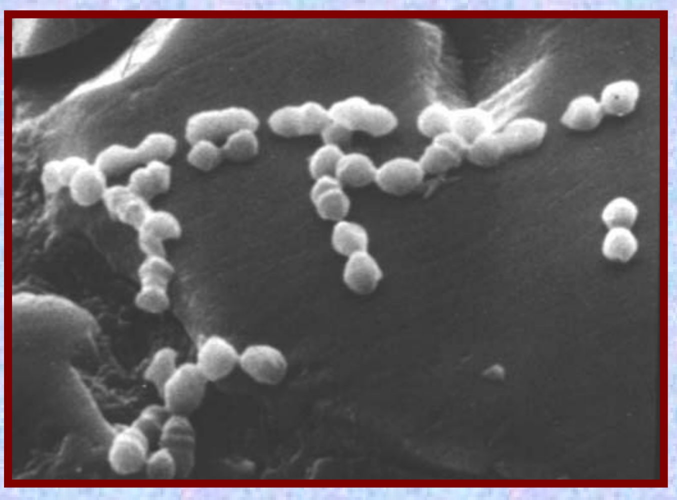
Haapasalo & Orstavik 1987, Orstavik & Haapasalo 1990

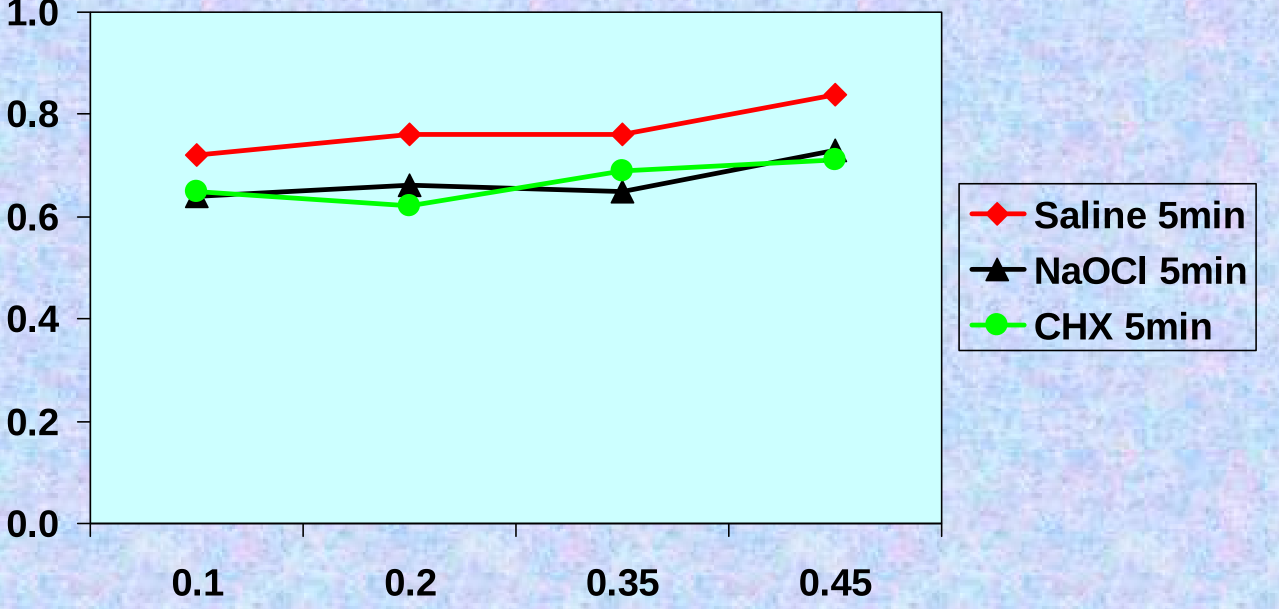




Dentin infection and disinfection
Haapasalo & Ørstavik, 87,90

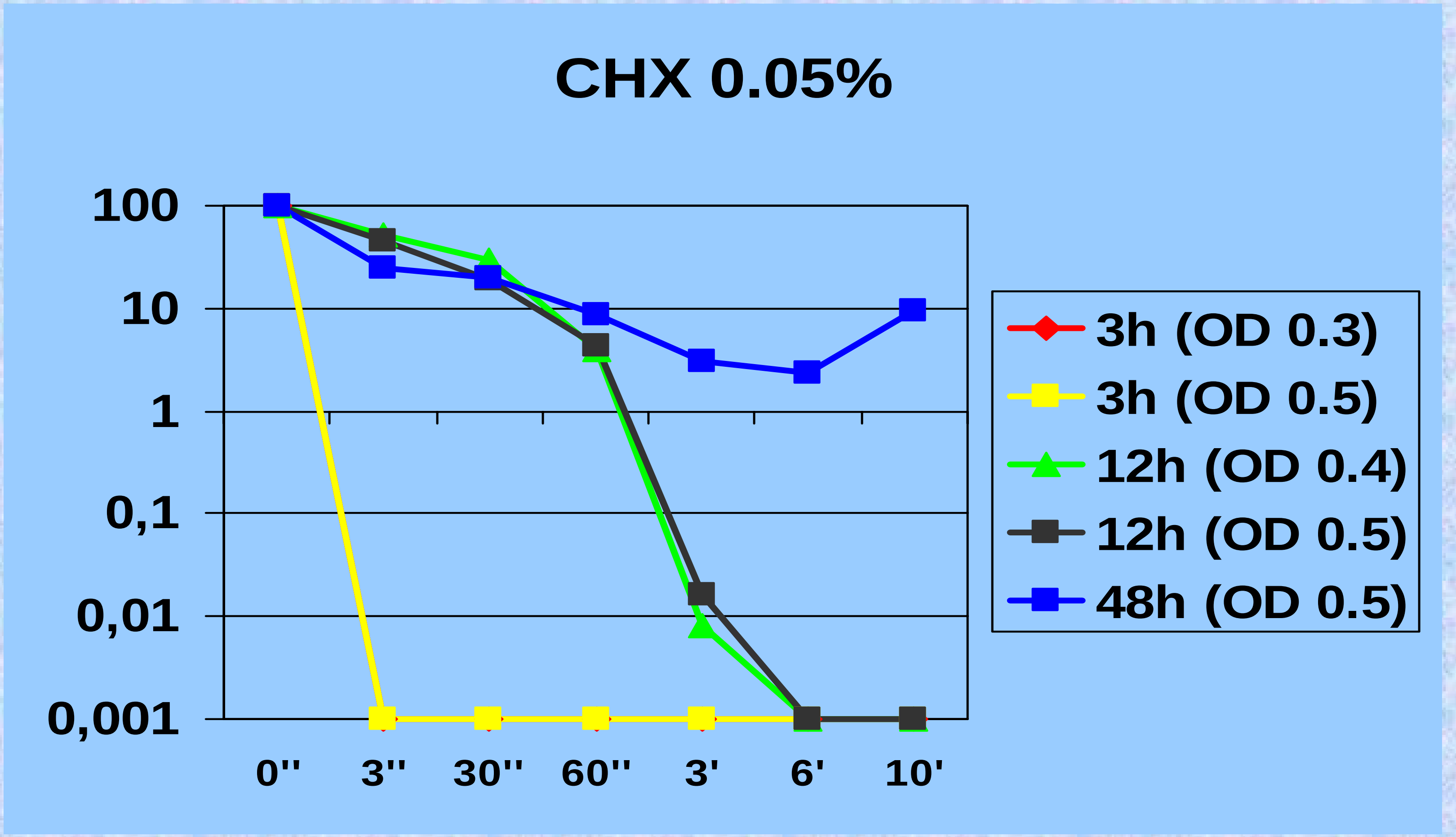
In vitro: Effect of chlorhexidine on enterococci?





Komorowski et al. 2000, Substantivity of Chlorhexidine-Treated Bovine Root Dentin

In vitro: effect of chlorhexidine on starved enterococci

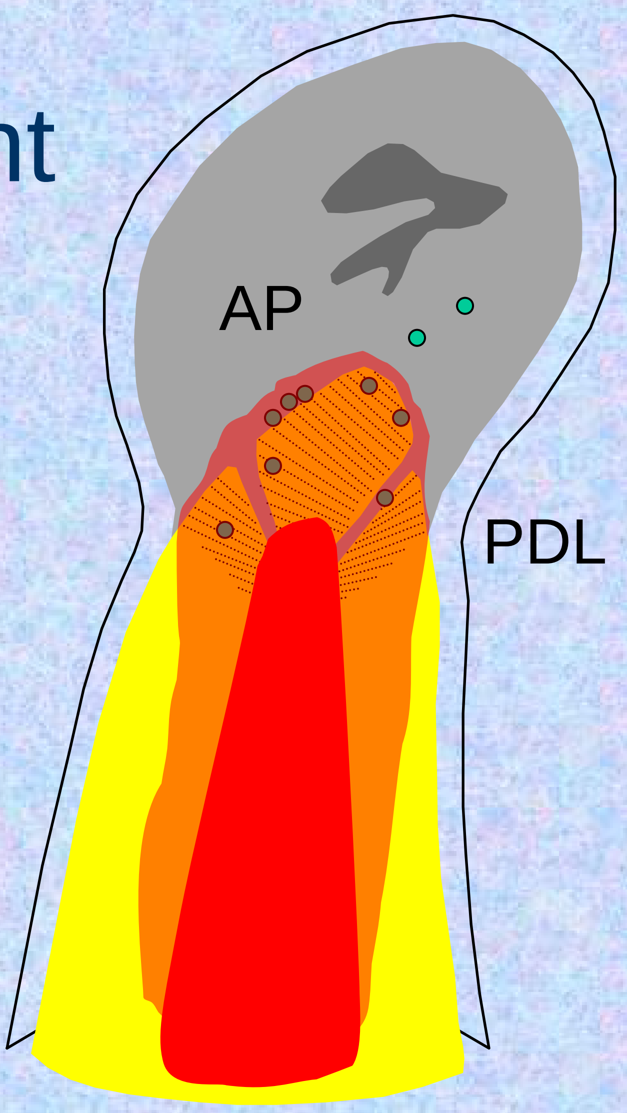


Portenier et al. in prep.

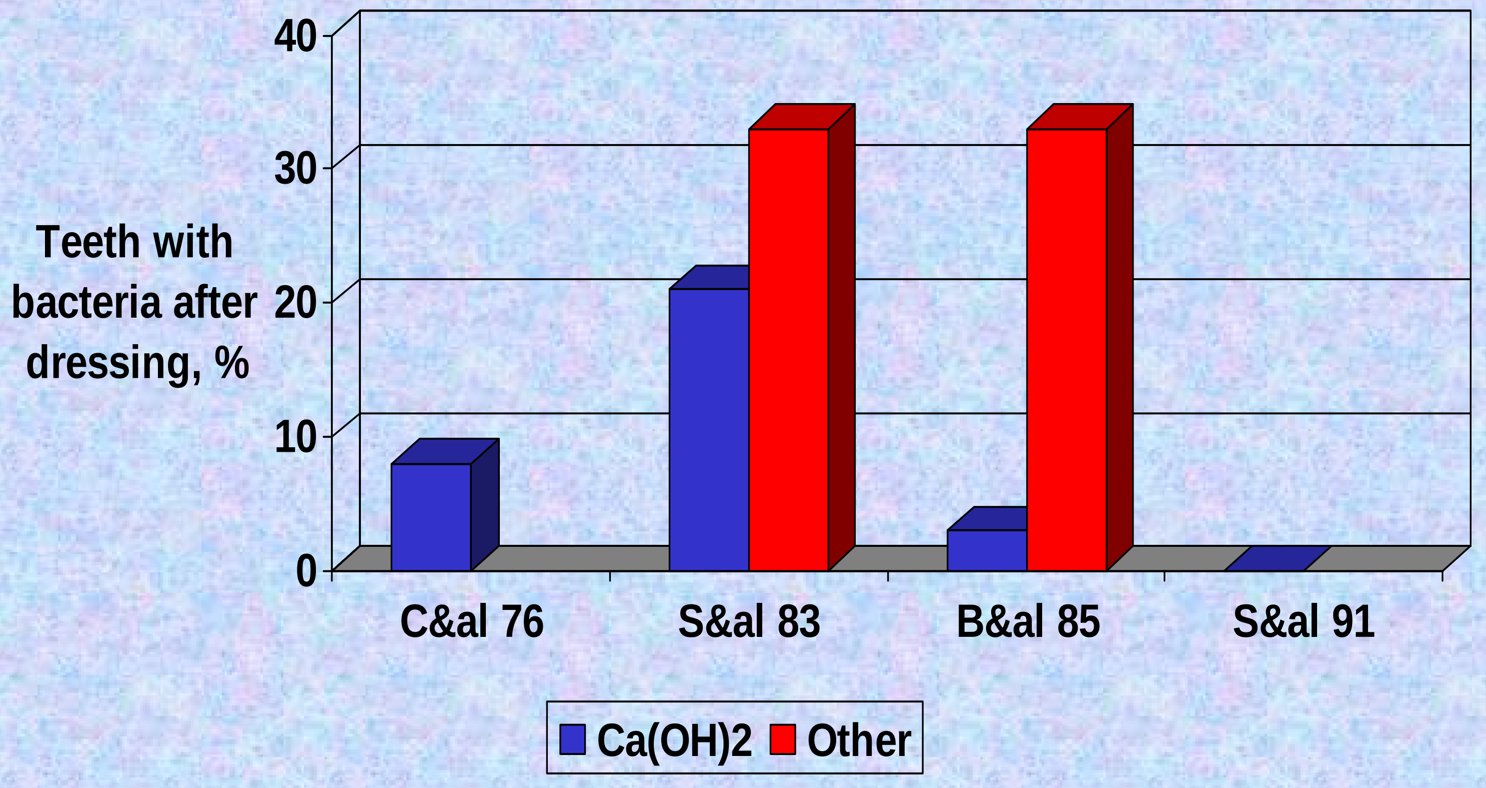
Conclusion on irrigation: NaOCl remains irrigant of choice. Chlorhexidine and MTAD are potential improvements. Stressed bacteria may be very resistant.

Interappointment dressings

1. Kill remaining bacteria
   'Dauerantisepticum'
2. Prevent regrowth
3. Block influx of nutrients



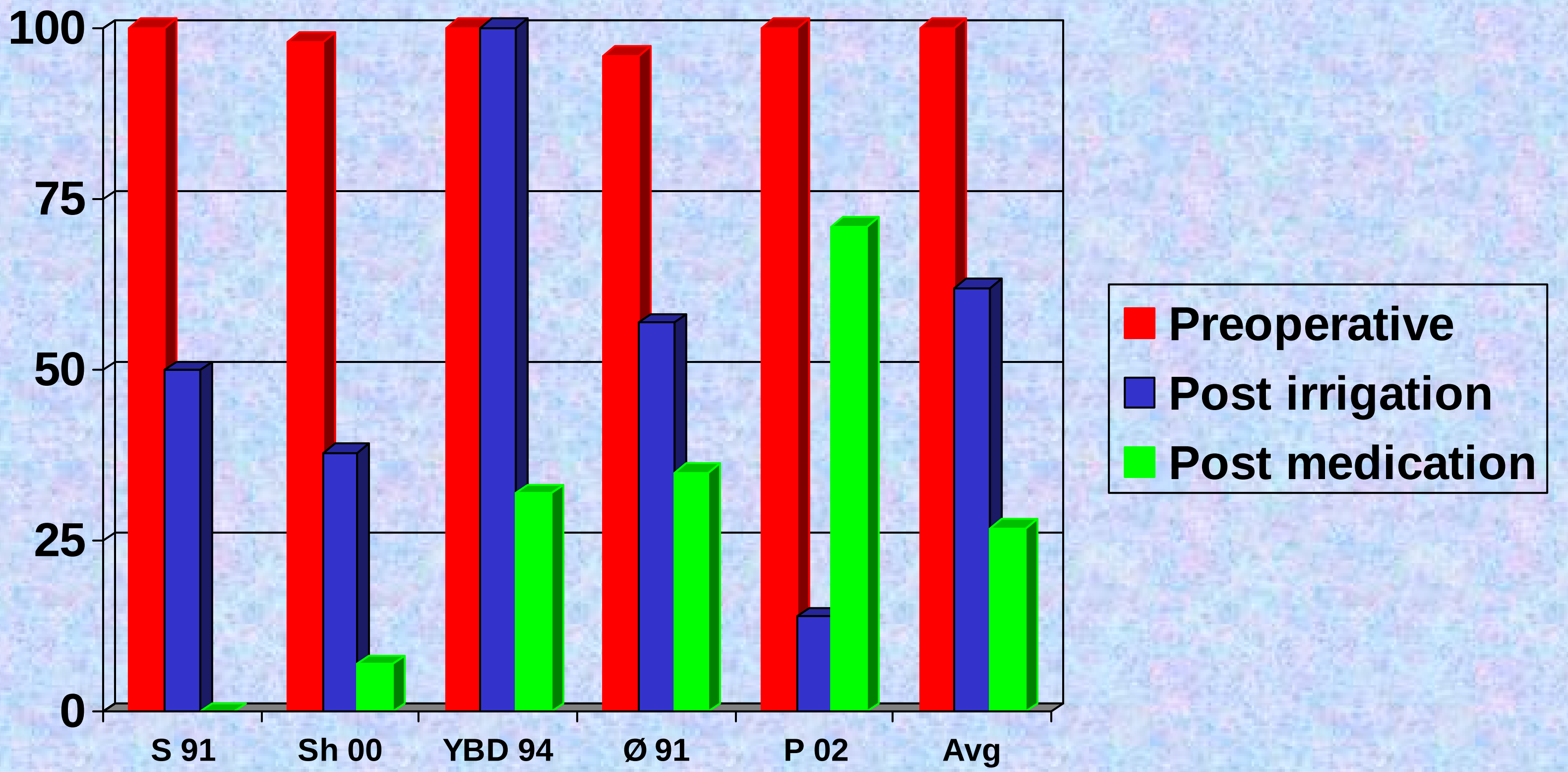
$Ca(OH)_2$ as an antimicrobial dressing



These studies, imperfect as they may be, are the basis for current practice

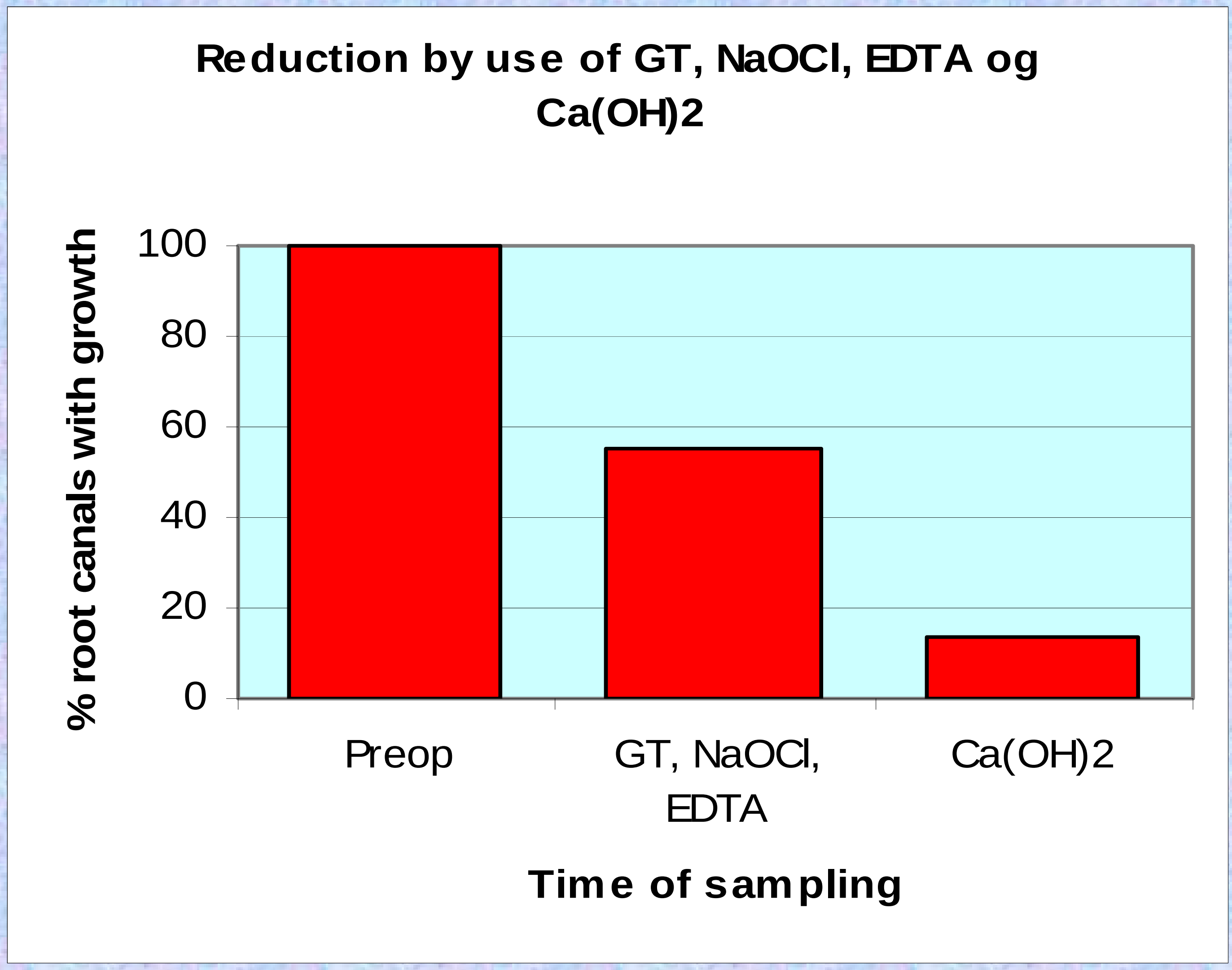
Root canal disinfection: evidence-based practice

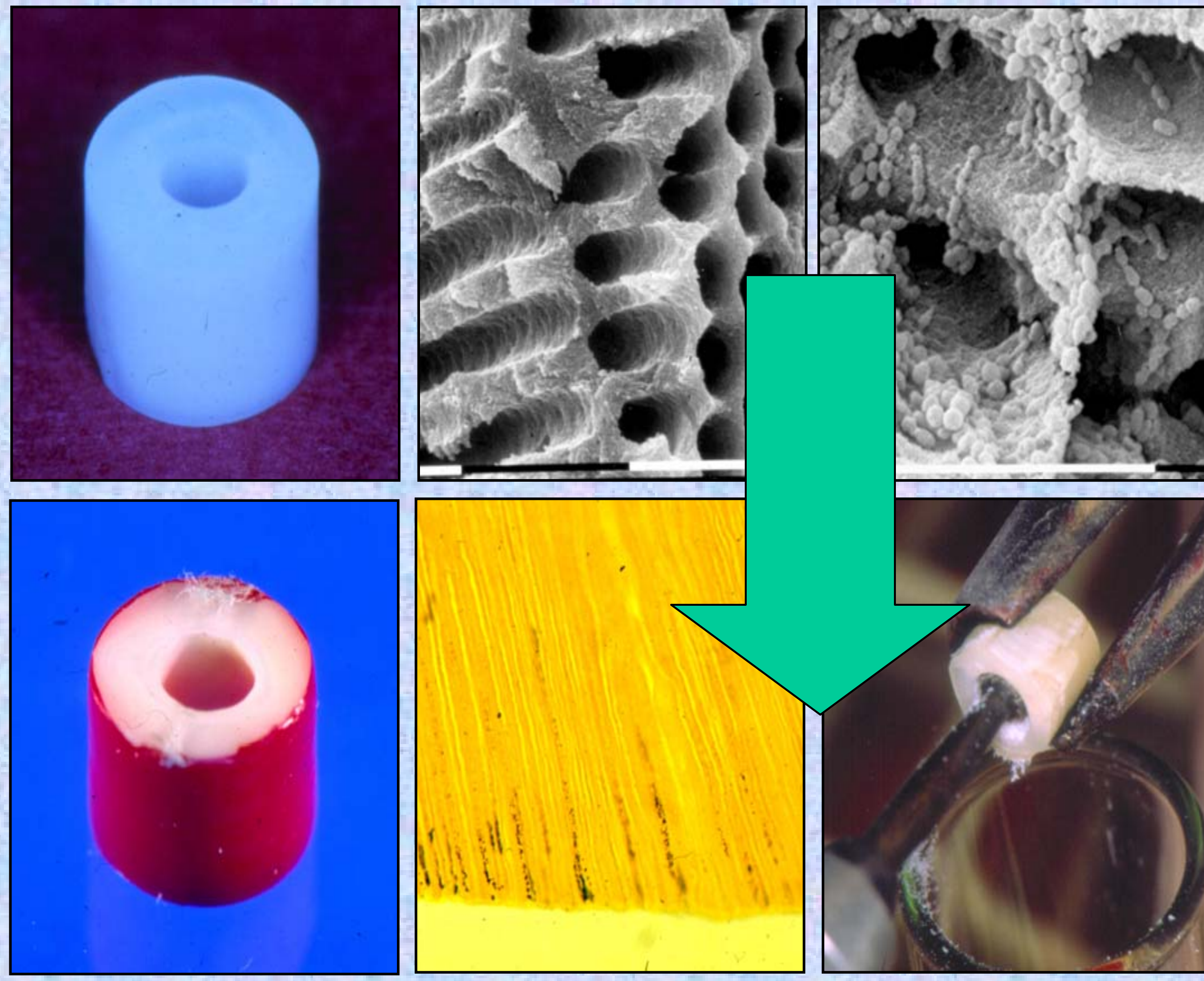
Law A, Messer H. Endod. 2004 Oct;30(10):689-94

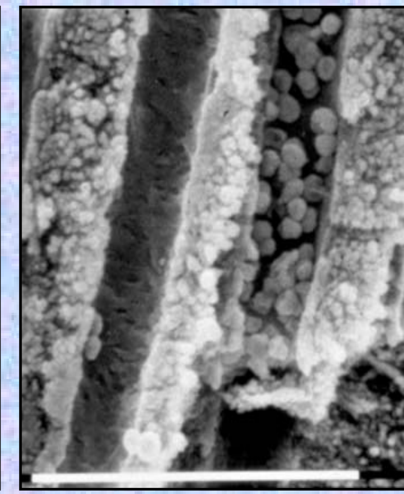


Improvement by new technology?

McGurkin et al. JOE April 2003, PR 23 Reduction of intracanal bacteria using GT rotary instrumentation, 5.25% NaOCl, EDTA and Ca(OH)2







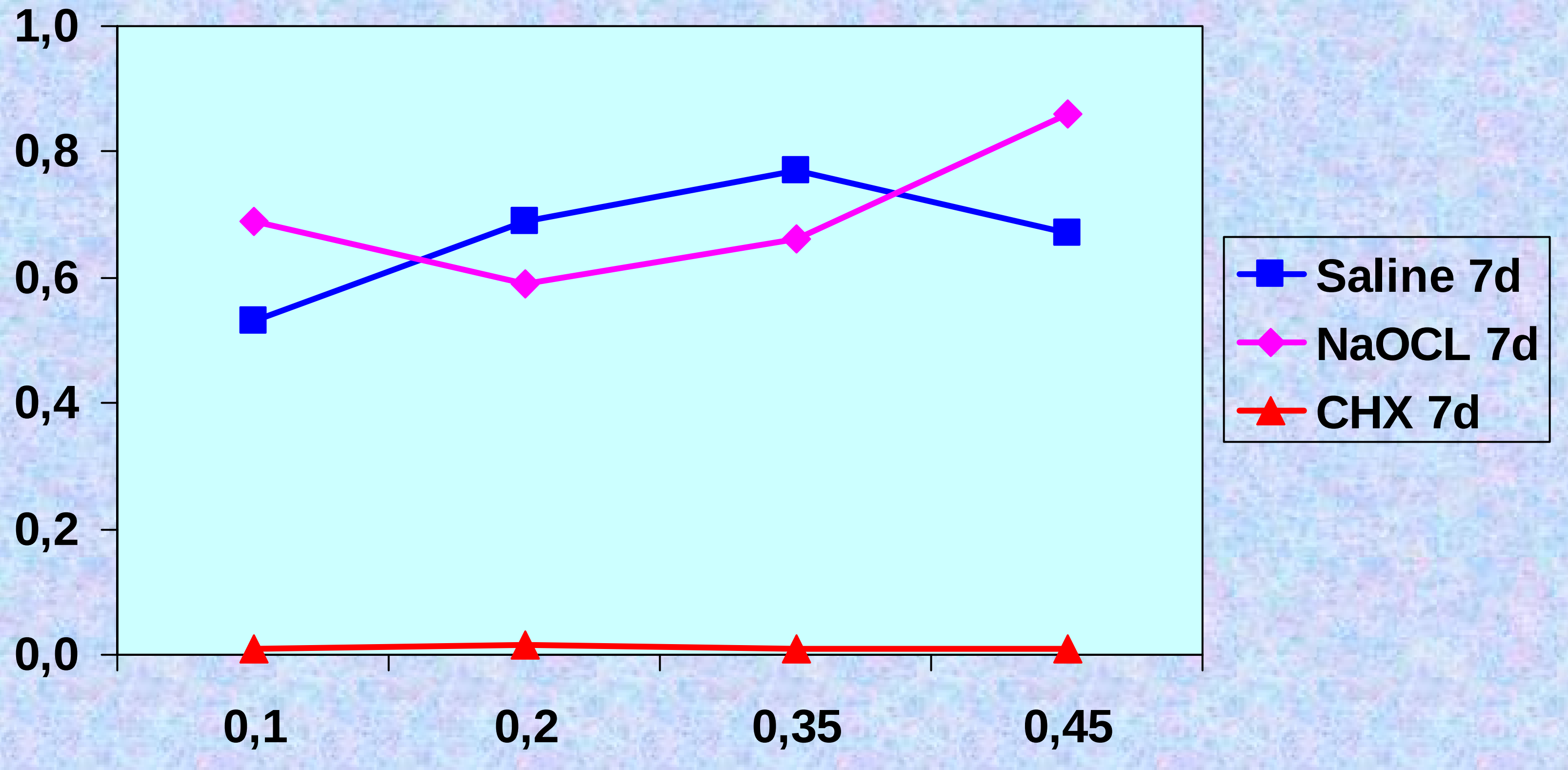
Dentin infection and disinfection
Haapasalo & Ørstavik, 87,90

Disinfection by endodontic irrigants and dressings of experimentally infected dentinal tubules

BACTERIA	MEDICAMENT	SMEAR-	SMEAR+
S. sanguis	CMCP-l	5 min	20 min
	CMCP-v	1 h	1 h
	Calasept	2 h –1 d	4 h
E. faecalis	CMCP-l	1 h	4 h
	CMCP-v	1 d	1 d
	Calasept	> 10 d	

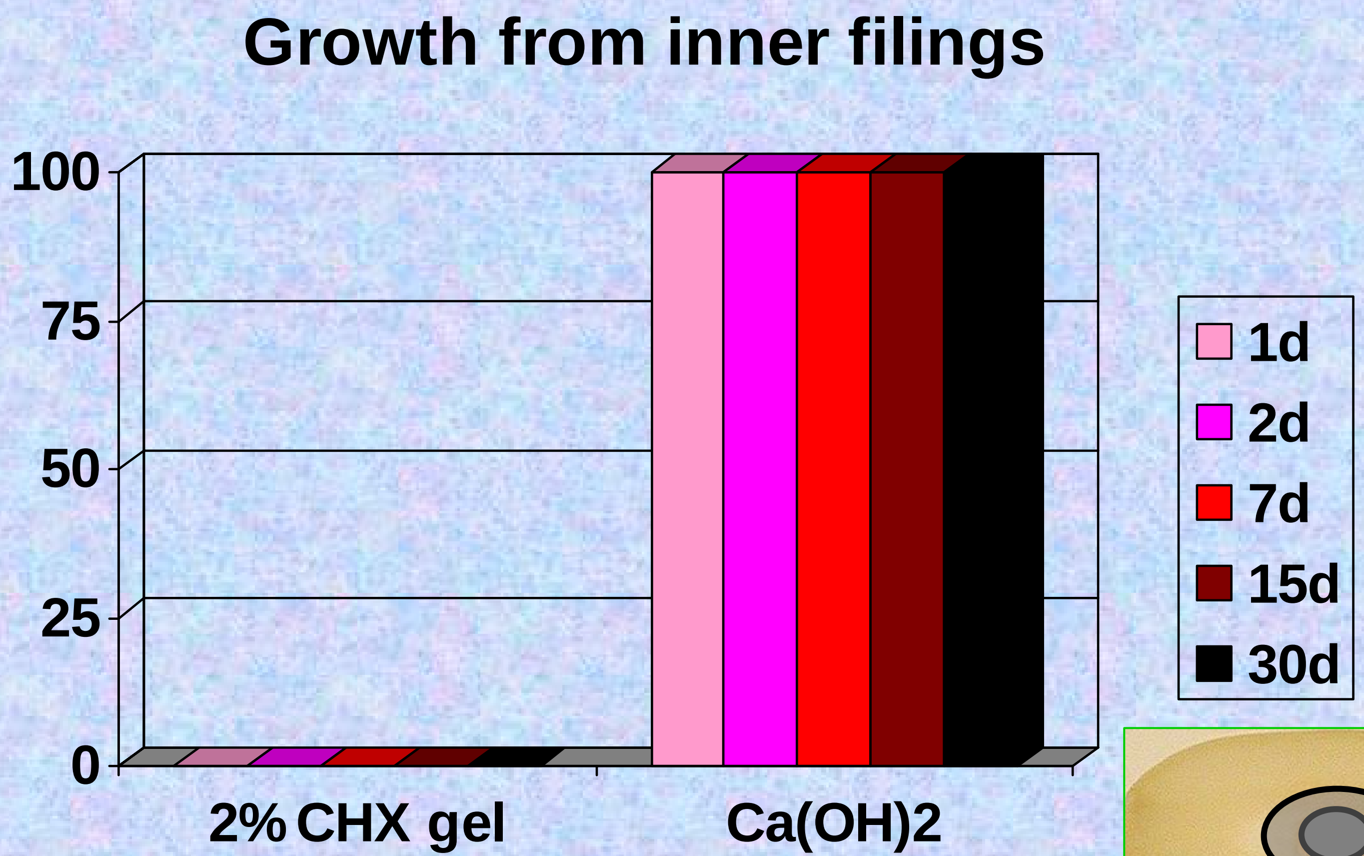
Haapasalo & Ørstavik, 87,90

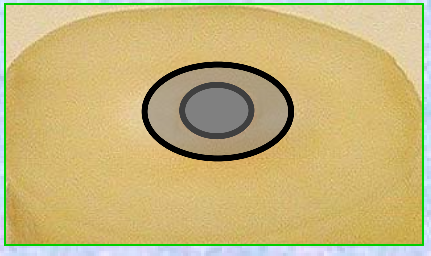
In vitro: Lasting effect by chlorhexidine on enterococci?



Komorowski et al. 2000, Substantivity of Chlorhexidine-Treated Bovine Root Dentin

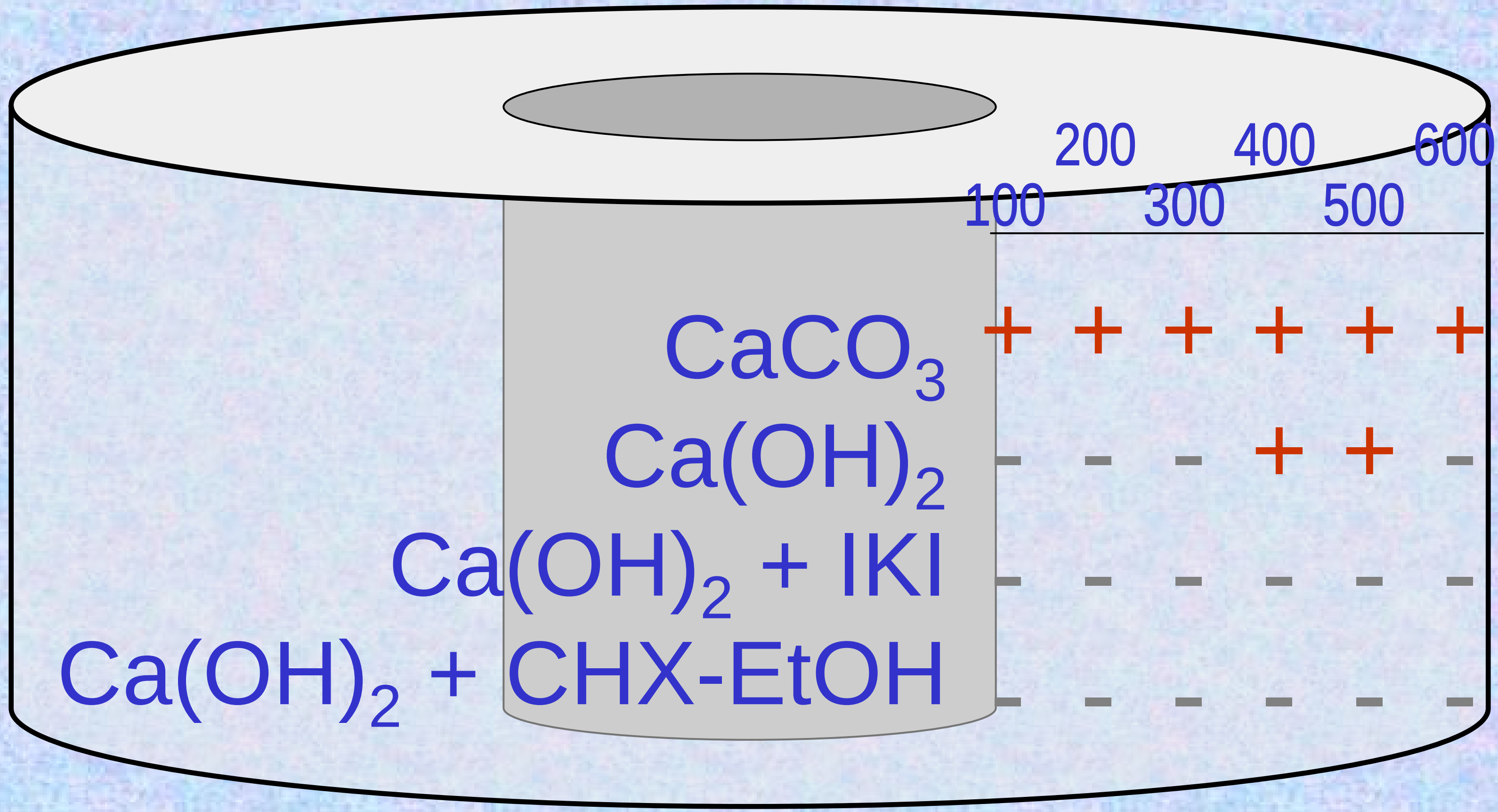
2% chlorhexidine gel and calcium hydroxide; *Enterococcus faecalis; in vitro*.





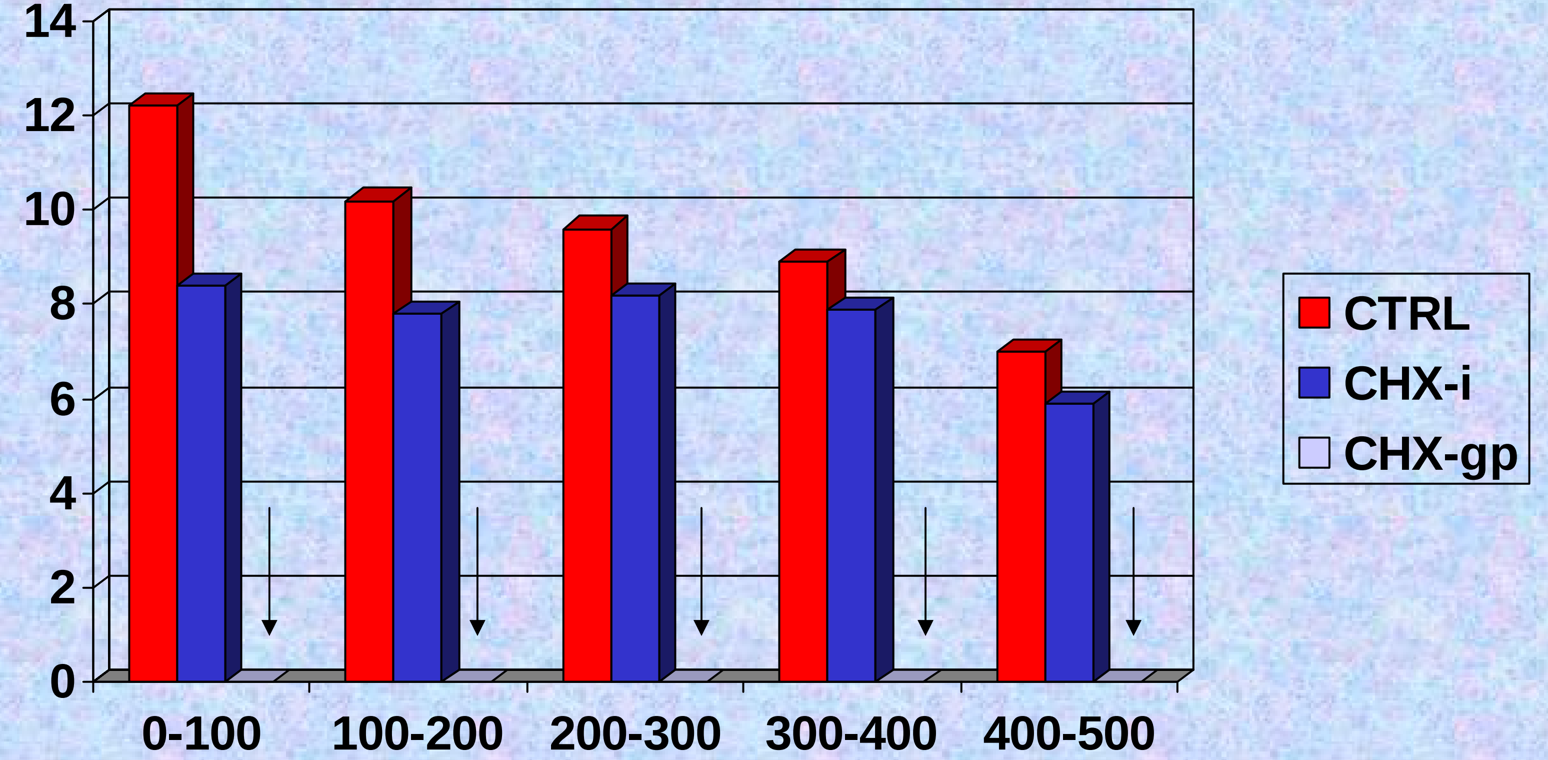
Gomes BP et al., Int Endod J. 2003 Apr;36(4):267-75.

In vitro: Survival of *E. faecalis* in dentin after 4 weeks of dressing



Sirén et al. 2004

In vitro: Antibacterial effect of chlorhexidine in gutta percha: growth after 7 days



J Endod. 2003 Jun;29(6):416-8. Antibacterial efficacy of a new chlorhexidine slow release device to disinfect dentinal tubules. Lin S, Zuckerman O, Weiss EI, Mazor Y, Fuss Z.

Dentin penetration: to and from the pulp

’the three (mechanims of protection by dentin) described:

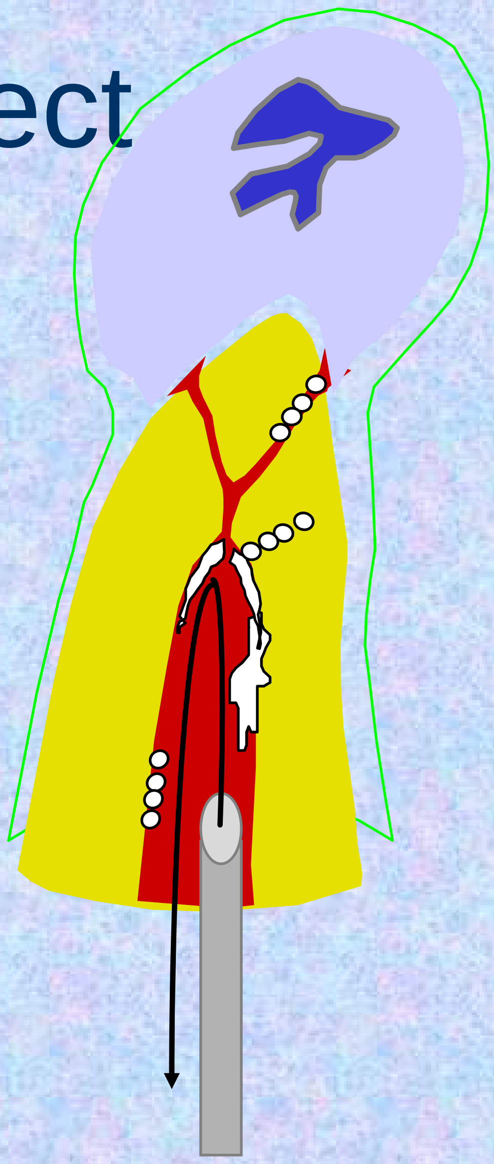
1) diffusion limitation;
2) limited wetness for hydrolysis; and
3) buffering by dentinal hydroxyapatite,

appear to allow the relatively safe use of a wide range of tooth restorative materials’

Influence of dentine on the pulpward release of
eugenol or acids from restorative materials.
Hume WR, J Oral Rehabil 1994;**21**(4):469-73

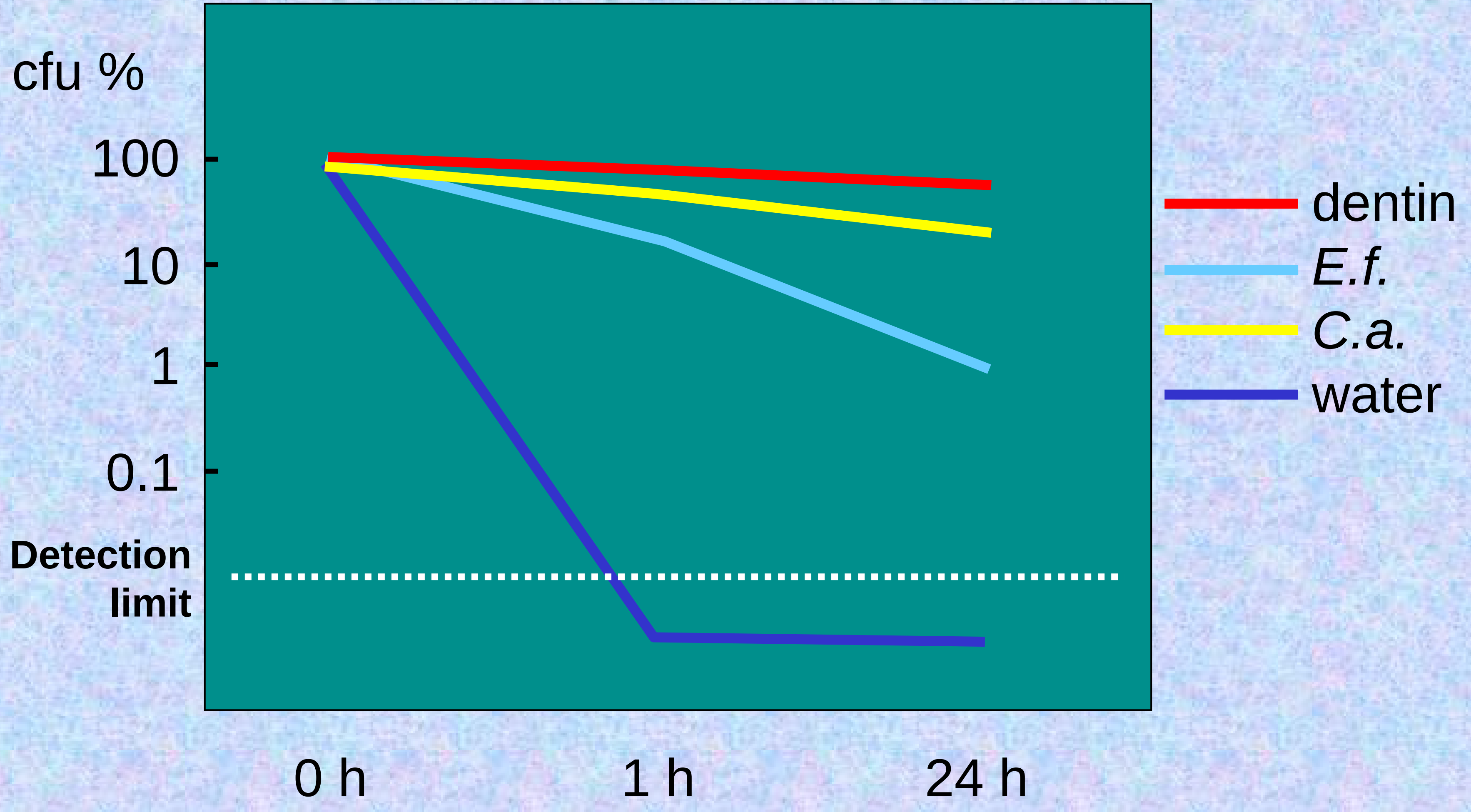
Inhibition of antibacterial effect

- **Pulpal tissue**
- **Smear**
- **Hydroxyapatite**
- **Collagen**
- **Microbes: alive or dead**

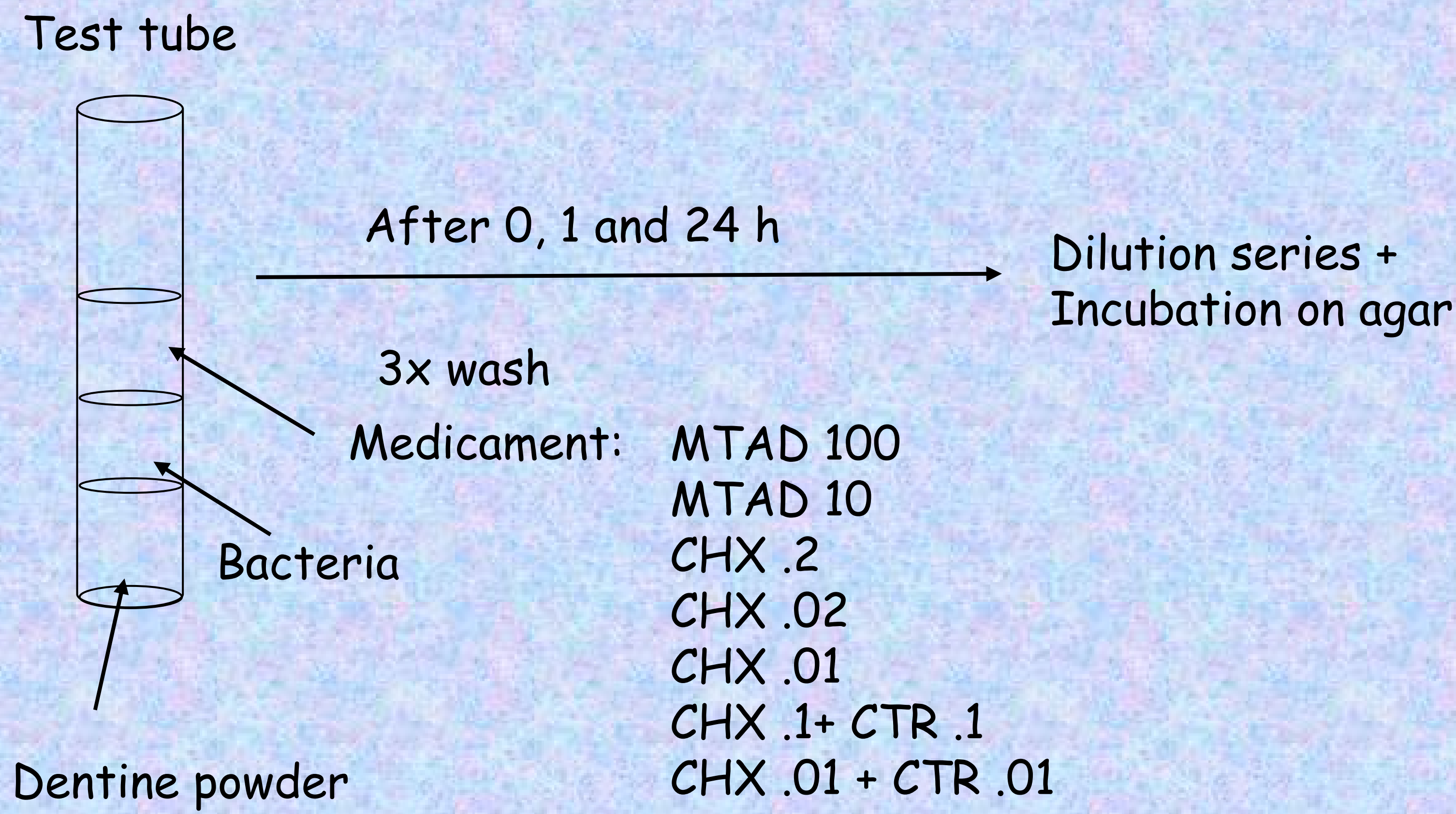


Portenier et al 2003.

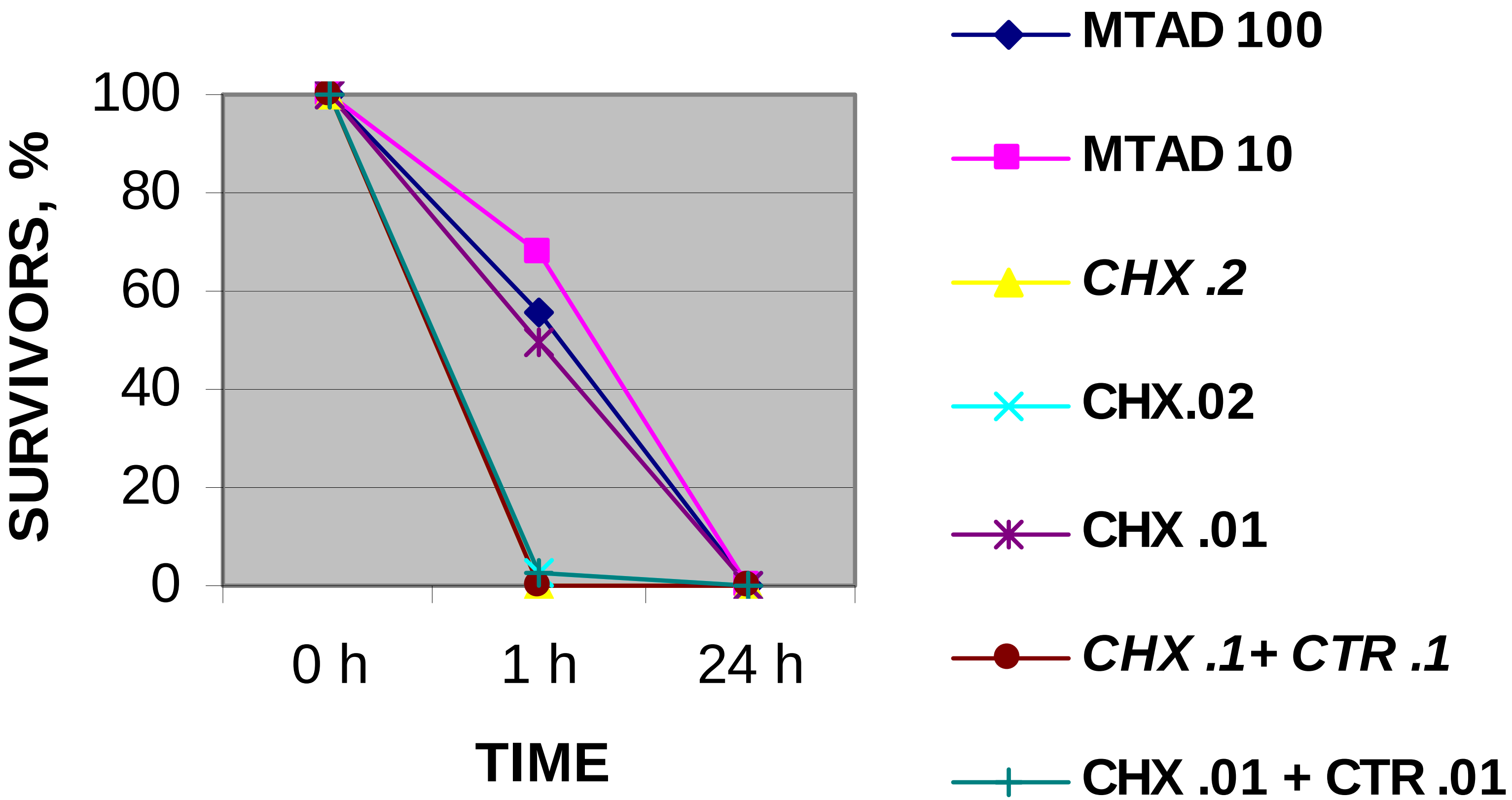
0.1/0.2% Iodine-potassum iodide



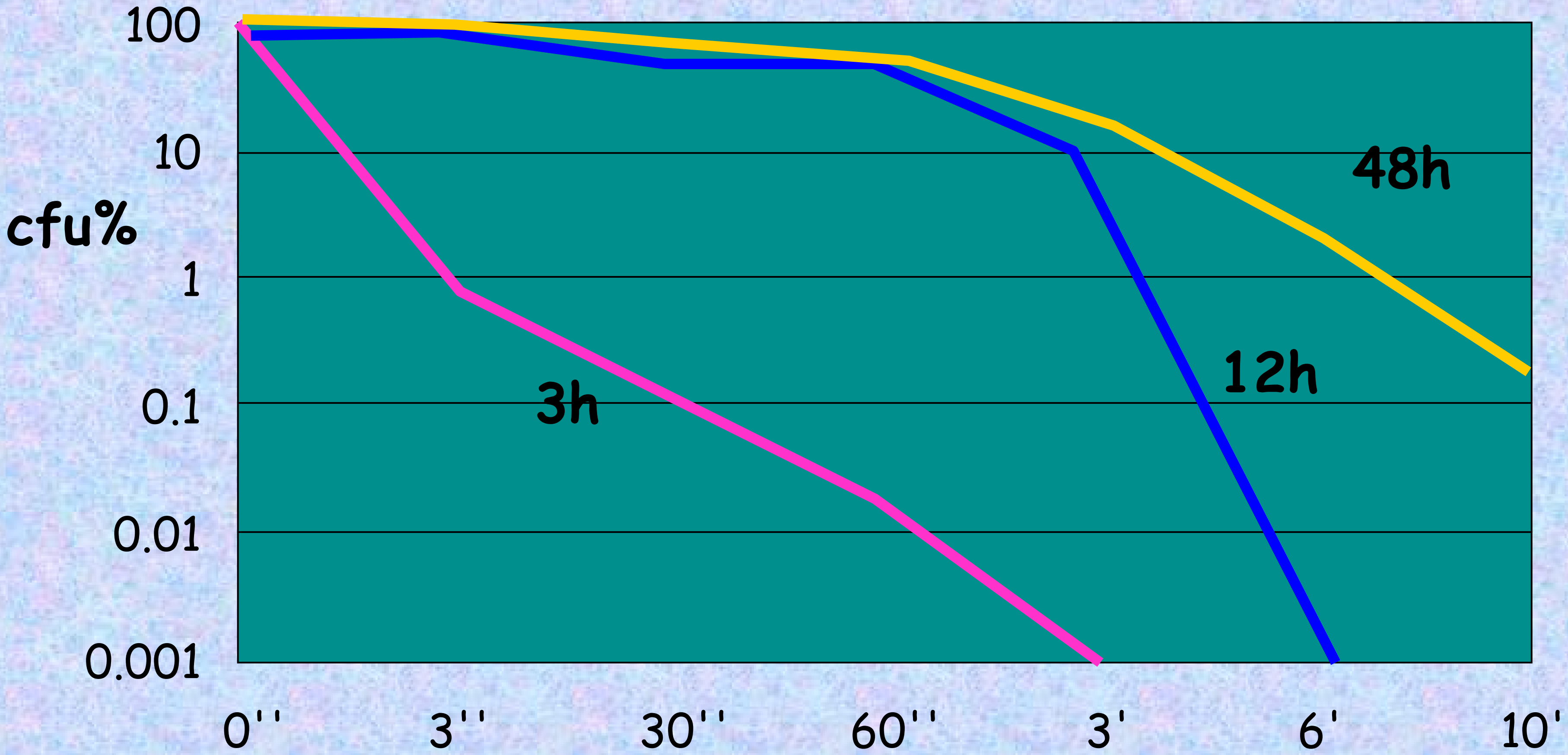
Portenier et al., JOE in press, 2005



Killing of *E faecalis* in the presence of dentin



Effect of physiological state – $Ca(OH)_2$

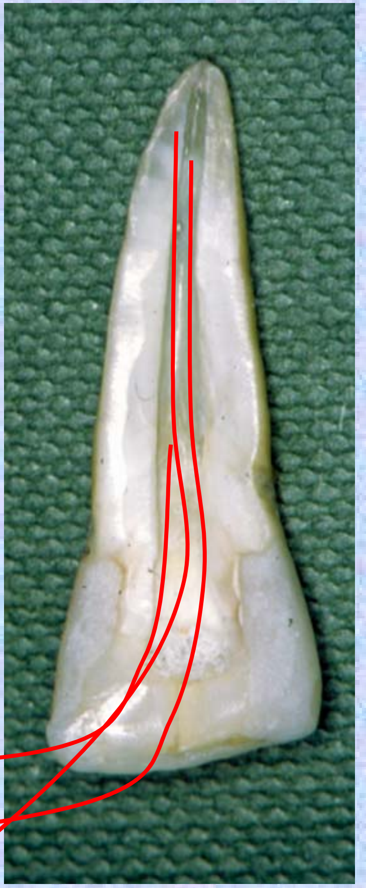


From Portenier et al., 2005

Microbiological Evaluation of One- and Two-Visit Endodontic Treatment of Teeth with Apical Periodontitis: A Randomized, Clinical Trial

Kvist et al JOE 2004

Critical Steps in Microbial Control



Sample	
A	On admission
PI	End of first appointment
PD	Second appointment

INITIAL SAMPLE

POSTINSTRUMENTATION SAMPLE

ONE-VISIT GROUP
the canals were filled with 5% IPI solution for ***10 min***. The IPI was inactivated with 5% sodium thiosulphate and the canals sampled for microorganisms according to the same protocol as earlier described. Finally, root canals were obturated.

TWO-VISIT GROUP
CH was placed meticulously by means of a Lentulo-spiral, and the access cavity sealed with Coltosol®. One week later, root canal instruments and simultaneous irrigation with VMGA I were used to remove the CH.

The postinstrumentation sampling showed reductions of cultivable microbiota. However, ***bacteria were still found in 62% of teeth in the one-visit group and 64% in the two-visit group.***

The ***postmedication sampling revealed residual microorganisms in 29% of teeth in the one-visit group and 36% of two-visit group.***

However, no statistically significant differences between groups were discerned.

Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical peridontitis. *Sjögren et al IEJ 1997*

One visit

55 infected teeth

Chemomechanical preparation

40% positive teeth

22 with bacteria

31 bacteria free

Root-filling

5 year Follow up

7 failed

15 healed

2 failed

29 healed

68% success rate

94% success rate

Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical peridontitis. *Sjögren et al IEJ 1997*

One visit

55 infected teeth

Chemomechanical preparation

40% positive teeth

22 with bacteria

31 bacteria free

Root-filling

5 year Follow up

9 failed

44 healed

83% success rate

Medicament options

- Irrigation
  - NaOCl: + tissue diss, +/- abac & smear, -subst
  - CHX: + abac & subst, - smear & tissue diss
  - MTAD: + abac, subst, smear, - tissue diss, staining ?, (? local antibiotic)
- Dressing
  - $Ca(OH)_2$: + docu, tissue diss, - abac
  - $Ca(OH)_2$ w CHX: + subst & abac, - docu
  - Short term iodine: + abac, - docu
  - Short term CHX: + abac, - docu

Conclusion on dressings: $Ca(OH)_2$ remains substance of choice; but chlorhexidine (and iodine?) shows promise in *in vitro* tests, perhaps in combination with $Ca(OH)_2$

Historical on dressings: Eugenol, creosote, formaldehyde, tricresol-formalin (formocresol), thorium(!)