The role of oral hygiene

Dr. SZ. Mohebbi, DDS, PhD
Community Oral Health Department,
School of Dentistry, Tehran University of Medical Sciences

دانشگاه علوم پزشکی تهران
Tehran University of Medical Sciences

outlines

- Introduction
- Some theoretical considerations
- The biological effect of tooth cleaning
- The clinical effect of tooth cleaning
- The effect of professional tooth cleaning
- The effect of dental flossing
- Concluding remarks

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Introduction

- Motivation and instruction in oral hygiene form the basis of school-based caries-preventive programs.

- 80% of 11-year-old schoolchildren in Scandinavia report that they brush their teeth at least twice a day .

- Daily tooth brushing with fluoride toothpaste is believed to be the primary reason for the caries decline observed in many populations since the 1970s

introduction

- In a systematic review, Sutcliffe (1996) proposed a more balanced view :

‘there is **no unequivocal evidence that good oral cleanliness reduces caries experience**, nor is there **sufficient evidence to condemn the value** of good oral cleanliness as a caries preventive measure’.

- Effect of fluoride in the paste
- Many patients do not develop cavities, in spite of the fact that they perform poor oral hygiene

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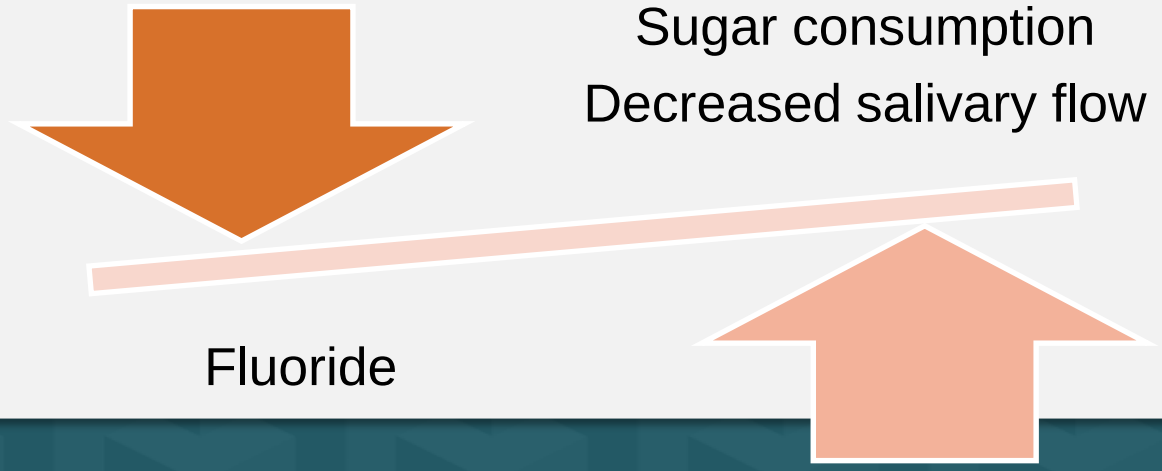
Some theoretical considerations

- Biofilms are necessary but not sufficient cause of dental caries
- Caries are multifactorial disease in nature
- oral hygiene?



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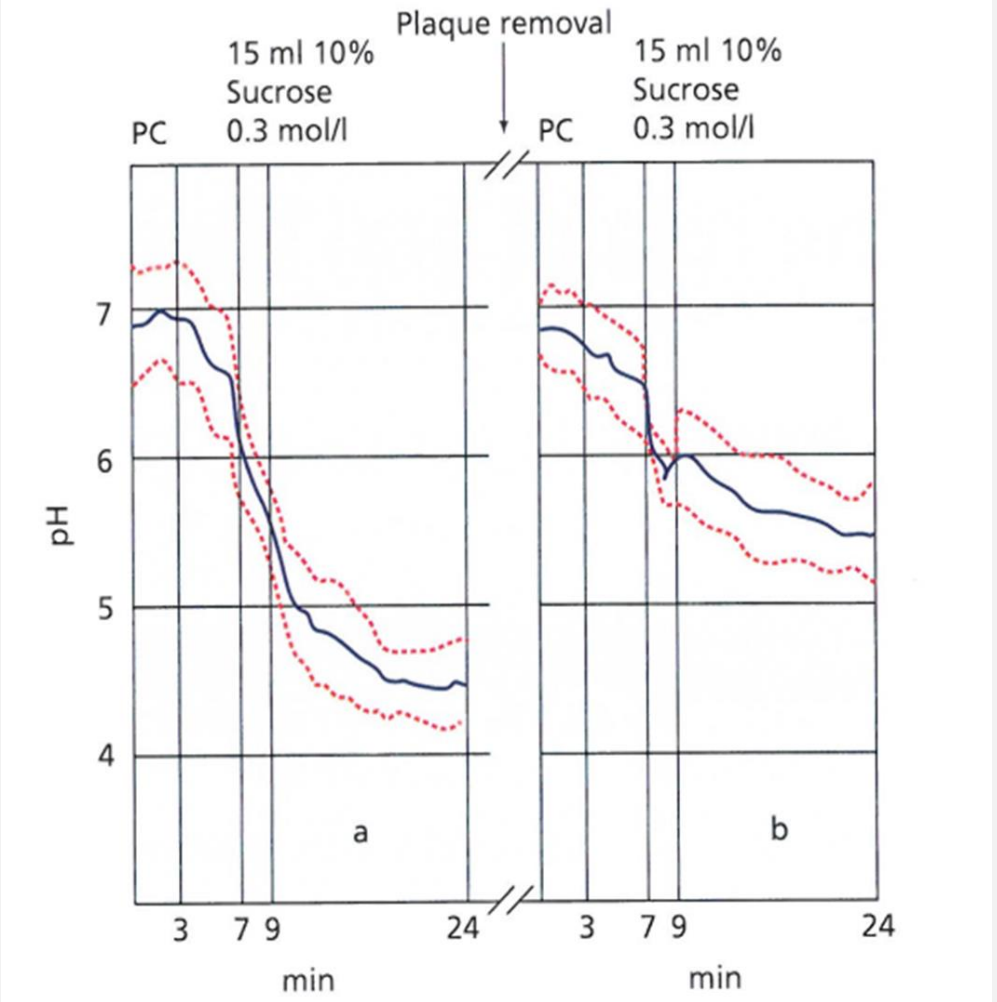
The biological effect of tooth cleaning

- Even after carefully performed plaque removal**, teeth are never clean from a microbiological** view
- Bacteria will often be retained in surface irregularities



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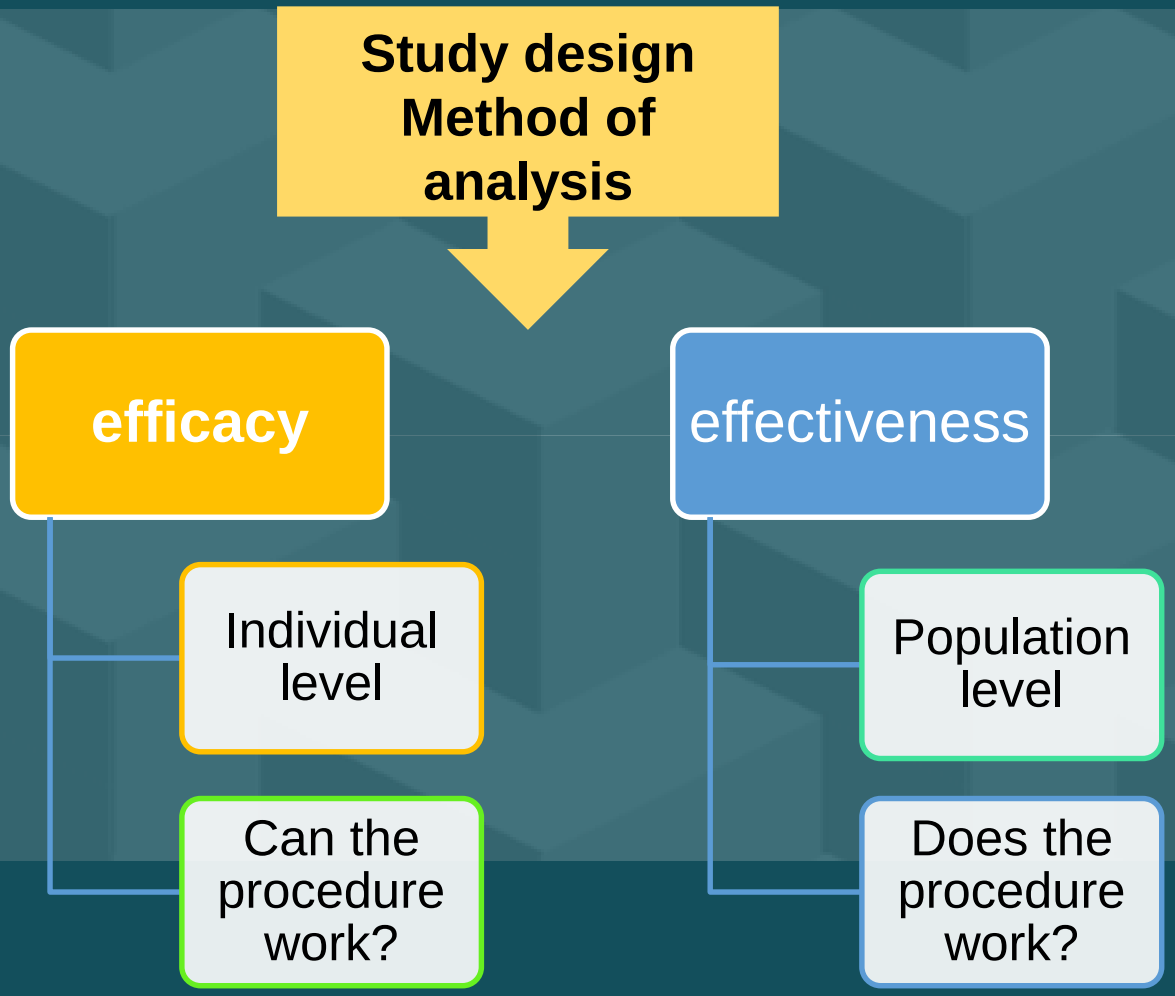
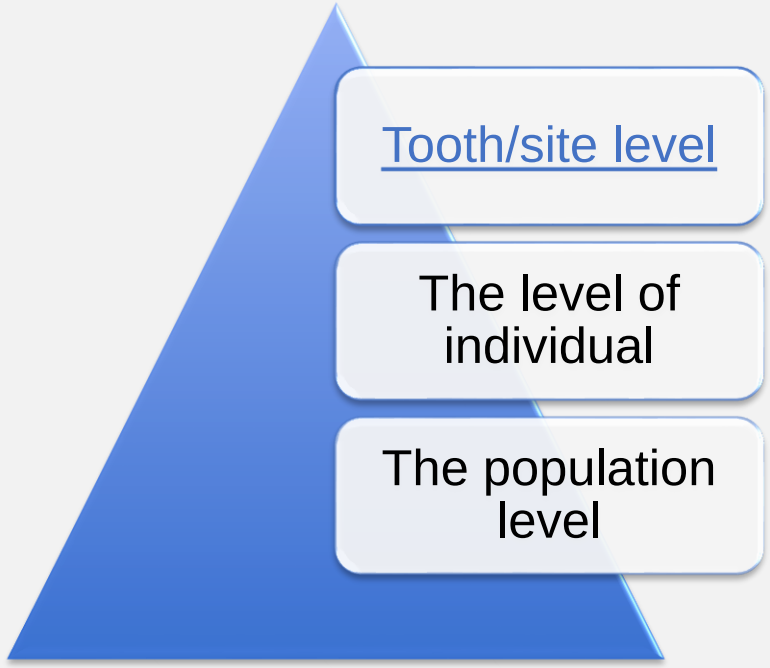

Study design
Method of analysis
efficacy
effectiveness
Individual level
Can the procedure work?
Population level
Does the procedure work?



Oral hygiene effect

In Vivo/tooth level

●In a study conducted in dental students by von der Fehr et al. (1970), it was shown that withdrawal of oral hygiene procedures for 23 days led to the emergence of whitish, opaque, non- cavitated enamel lesions along the gingival margin of the teeth. **White spots**

●After 30 days of careful oral hygiene (possibly using nonfluoride toothpaste) and daily mouthrinses with 0.2% sodium fluoride (NaF) the clinical appearance of the enamel had almost returned to pre-experimental levels **(reversible).**

These observations have been confirmed by other studies showing that improved oral hygiene, including daily use of fluoride toothpaste, favors the arrest of active enamel and dentin caries lesions

Tooth site level

Orthodontic bands

Mechanical biofilm removal is the main factor responsible for the arrest of the lesion

Figure 5.25 Clinical features immediately after removal of orthodontic appliances and cleaning. The orthodontic treatment had lasted for 2 years. Note the marked gingival reaction and the characteristic chalky surface appearance of the active enamel lesion.

Figure 5.26 After 3 months with careful oral hygiene the gingival tissues have recovered and the active lesion has been completely arrested. The white appearance of the lesion has diminished markedly due to polishing away of the eroded outermost enamel surface.

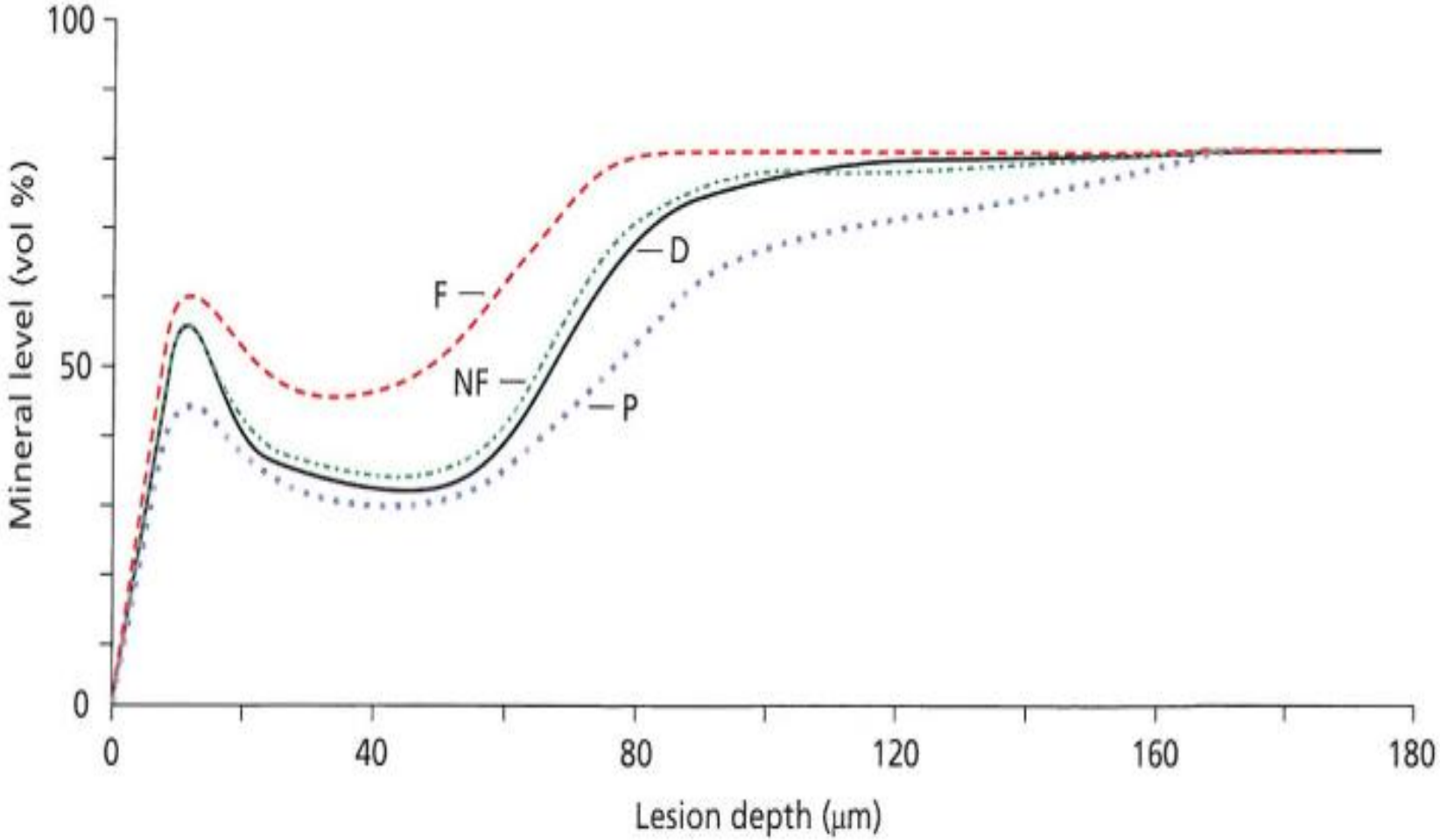
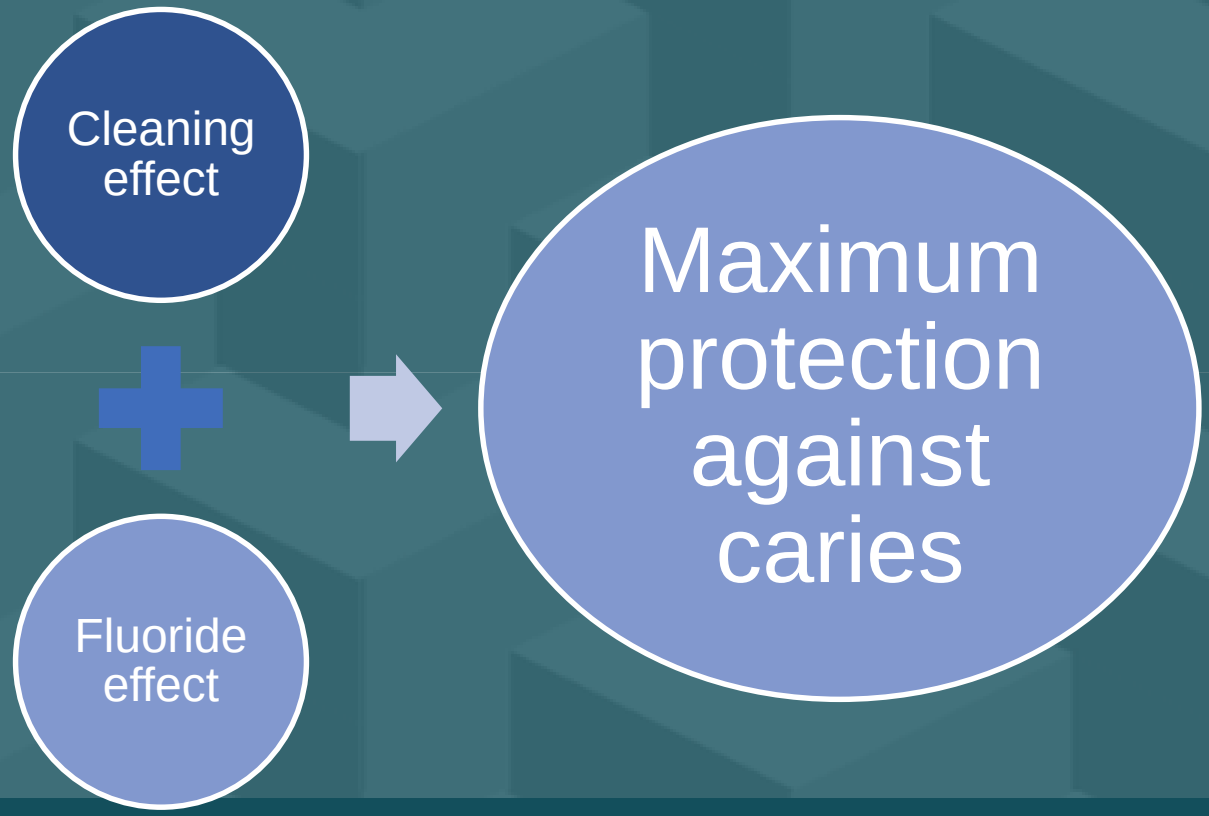


Figure 15.2 Mineral distribution curves of enamel specimens after different experimental toothbrushing regimens in situ. The mineral content is plotted versus the distance from the outer surface. P: no toothbrushing for 3 months; NF: brushing with a non-fluoride toothpaste for 3 months; F: brushing with a fluoride toothpaste for 3 months; D: artificially demineralized control specimen. From [15]. Reproduced with permission of Karger Publishers.

Twice daily brushing with fluoride toothpaste resulted in 90% reduction in mineral loss compared with the control group that did not brush



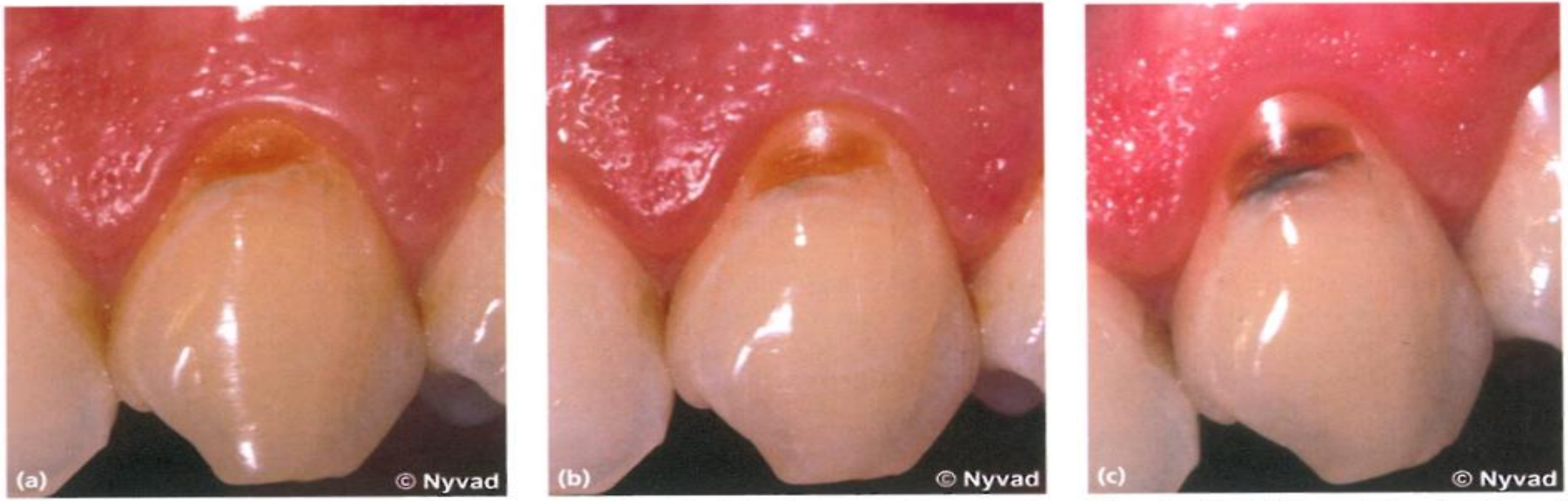
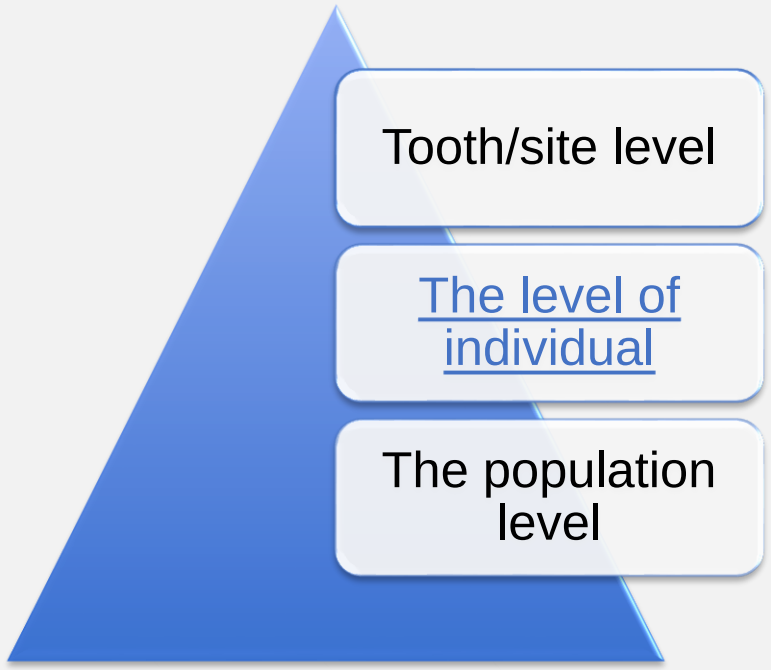


Figure 13.3 Arrest of root-surface caries. (a) Active root-surface caries lesion in upper canine presenting a softened surface. (b) Same lesion after 1 year of nonoperative caries control by improved toothbrushing with fluoride toothpaste. The lesion has turned into an inactive stage as evidenced by the hard and shiny surface. (c) After 4 years the lesion is still inactive and has taken up stain. Note also the inactive lesion in the gingival part of enamel.

Collectively, studies at the **tooth/site level** have shown that when **meticulous oral hygiene and fluoride toothpaste** are applied together and targeted specifically at sites with a high rate of lesion progression it is possible to control the development and progression of caries. **Thus, tooth cleaning with fluoride toothpaste can be highly efficacious.**



Oral hygiene effect

The effect of daily supervised tooth brushing in groups of 9–11-year-old children over a 3-year period.

Table 15.1 Caries increment (decayed surfaces) during the final year of a 3-year experiment of different preventive measures.

Prophylactic measure	n	New carious surfaces				
		Total	Proximal	Occlusal	Buccal	Lingual
Daily supervised toothbrushing with an NaF dentifrice	57	4.4	2.3	1.6	0.2	0.4
Daily supervised toothbrushing with a non-fluoride dentrifrice	56	8.3	4.7	2.5	0.5	0.6
Fortnightly rinsing with a 0.5% NaF solution	69	6.3	3.3	2.2	0–5	0–3
Fortnightly rinsing with distilled water	71	8.4	4.8	2.3	0.8	0.5
Control	46	9.0	5.2	2.0	0.9	0.8

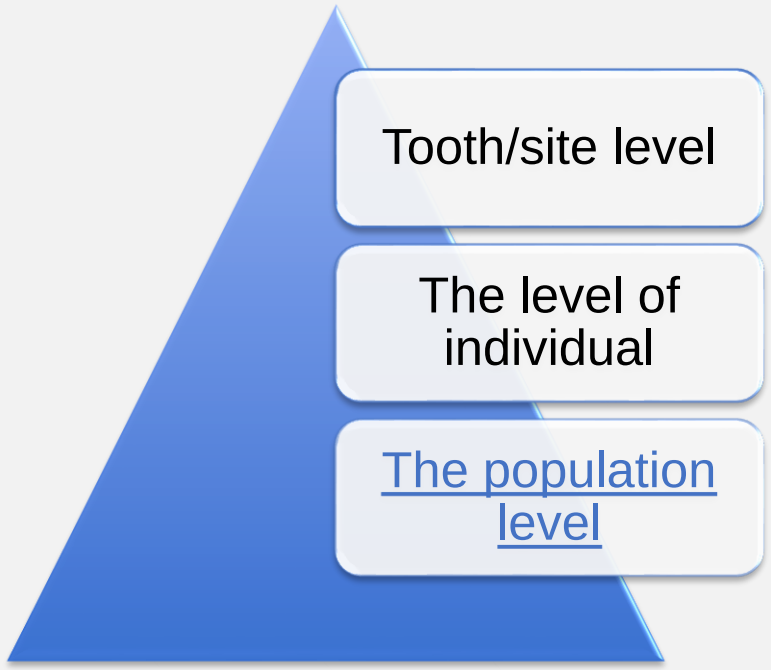
Adapted from [33]. Reproduced with permission of Elsevier.

- Fortnightly fluoride rinses reduced dental caries increments significantly
- Daily brushing with fluoride toothpaste was more efficacious than fortnightly fluoride rinses.
- **Supervised tooth brushing with a non-fluoride toothpaste did not appear to have a detectable effect**

Biofilm removal and fluoride, when acting together, have **an additive effect**

Poor oral hygiene cannot be compensated for by the intensive use of fluorides.

The effect of professional administration of fluorides in the form of gels, rinses or tablets has been shown to be limited in individuals **who do not practice good oral hygiene.**



Oral hygiene effect

The population level

- Self-performed tooth brushing is not particularly effective in controlling dental caries at the population level.
- It is hardly surprising that there is no clear-cut association between oral hygiene and caries in population studies.
- Some researchers believe that the primary purpose of tooth brushing is to serve as a vehicle for the application of fluoride
- ***Tooth brushing is cheap and easy to implement and, when performed properly, has the potential to control both caries and gingivitis.***

Interaction of biofilm with diet

- When sugar consumption is high, biofilm removal can be a powerful method to control the development and progression of caries
- **At low levels of biofilm an increase in the total sugar consumption did not increase the risk of caries notably**.

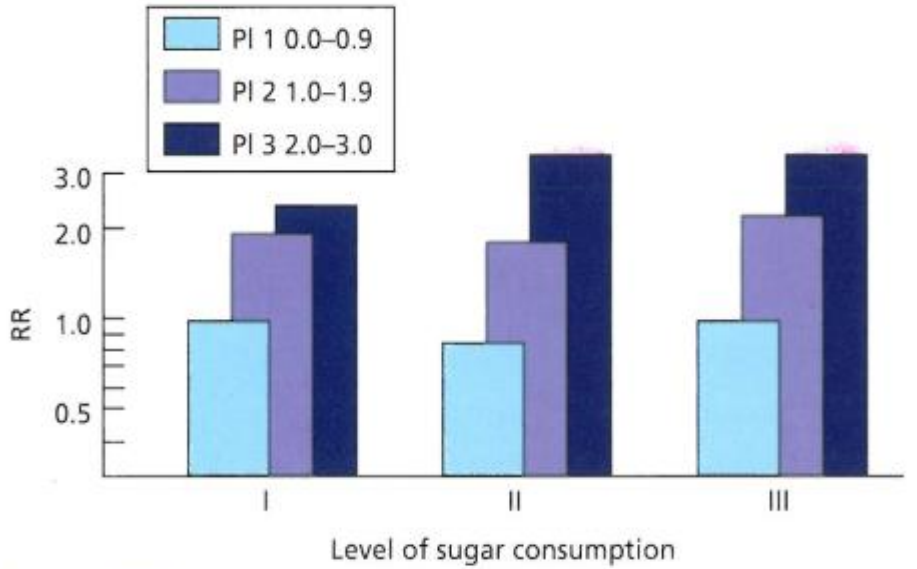


Figure 15.5 Relative risk (RR) of caries at different levels of plaque accumulation and sugar consumption in terms of unit risk for teeth with plaque index PI = 0–0.9, 1.0–1.9, and 2.0–3.0 and low (I), middle (II), and high (III) sugar exposures. Primary teeth; 5-year-olds. From [32]. Reproduced with permission of John Wiley & Sons.

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Karlstad program

1

Repeated oral hygiene instruction

2

Topical fluoride

3

Dietary counseling

4

professional cleaning of the teeth

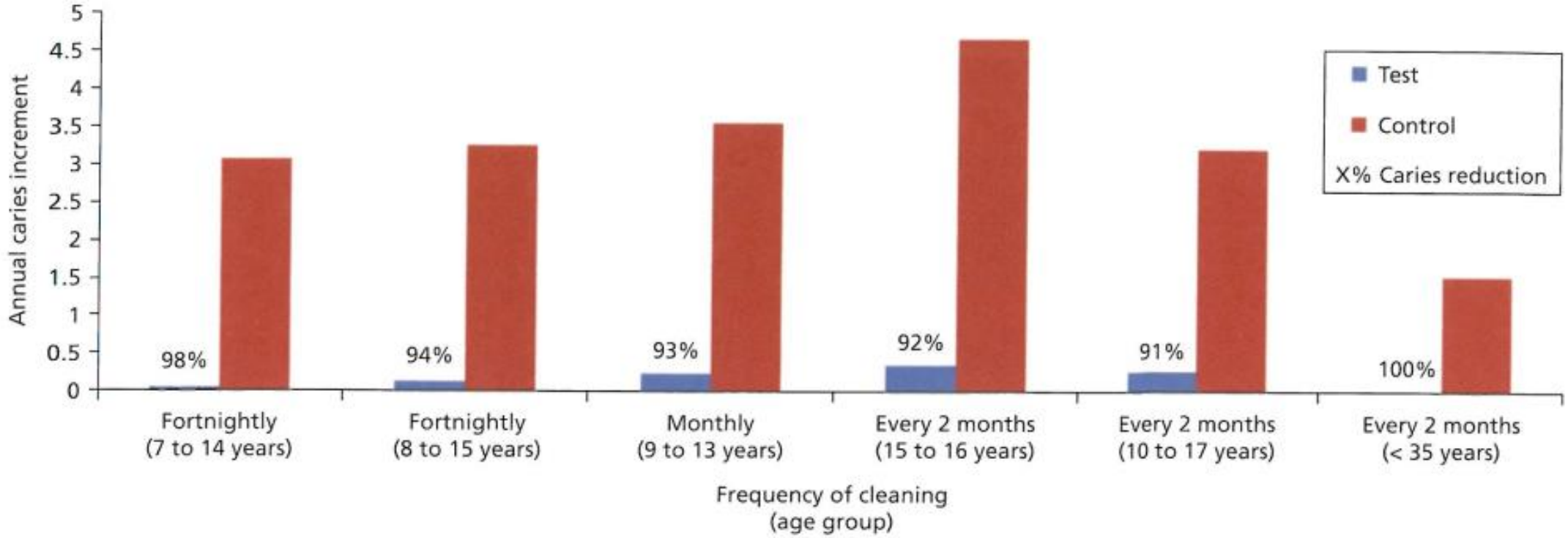

Figure 15.6 The Karlstad studies (1973–1978): annual caries increments at different professional tooth-cleaning frequencies. Adapted from [8].

Professional tooth cleaning

- It should be emphasized that professional tooth cleaning is particularly efficient on tooth surfaces that are difficult to clean, such as approximal surfaces and erupting occlusal surfaces
- Therefore, this rather costly treatment program may be justified in the management of some highly caries-active patients .

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The effect of dental flossing

- While flossing plus tooth brushing may reduce gingivitis compared with tooth brushing alone, no studies have reported that flossing plus tooth brushing is effective for controlling dental caries (Chocrane review)
- The success of interdental cleaning is greatly dependent on the ease of use and patient motivation
- For patients who do not master the flossing technique it is helpful to remember that as tooth brushing improves there may be no advantage to follow it with flossing !!!!!!

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Concluding remarks

- The effectiveness of tooth brushing in caries control (i.e., tooth brushing as normally performed) is not very high.
- However, when the quality of tooth brushing is high (i.e., tooth brushing as it should' be) it can be a very efficacious procedure.
- Tooth cleaning should always be carried out in conjunction with the use of a fluoride toothpaste.

Are antibacterials necessary in caries prophylaxis?

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- The biofilm lifestyle and the rationale for antibacterial intervention
- Biological activity and mode of action
- Vehicles for caries prophylactic agents
- Specific agents
- Other agents proposed for caries prophylaxis, but without documented anticaries effects
- Risk of antibacterial resistance development?
- Concluding remarks and future approaches

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Biofilm

- Dental biofilms, however, are not easily controlled by mechanical means.
- No direct relationship exists between caries development and biofilm mass or salivary and biofilm levels of mutans streptococci

Bacteria properties

- Biofilm bacteria are much less susceptible to antibacterial agents and to the host immune system than when they are planktonic.
- Reduced growth rate of the bacteria due to nutrient limitations or oxidative stress
- Bacteria within a biofilm are phenotypically altered by their ability to turn on and off genes
- Retarded or incomplete penetration of an agent into the biofilm
  - electrostatic or physicochemical properties of the agent
  - electrostatic or physicochemical properties of the biofilm matrix
  - enzymatic degradation of the agent

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Efficacy of antibacterials

- An antibacterial agent is capable of destroying or inhibiting the growth of bacteria by chemical or biological means.
- ***Bioavailability***: the delivery of the agent to the intended site of action in a biologically active form, at effective doses, and for sufficient duration.
- ***Substantivity****:* ability to bind to oral surfaces and its subsequent rate of release from its binding sites

Antibacterial agent binding

The binding strength determines the equilibrium between bound and free-agent molecules and the subsequent release rate from the binding sites

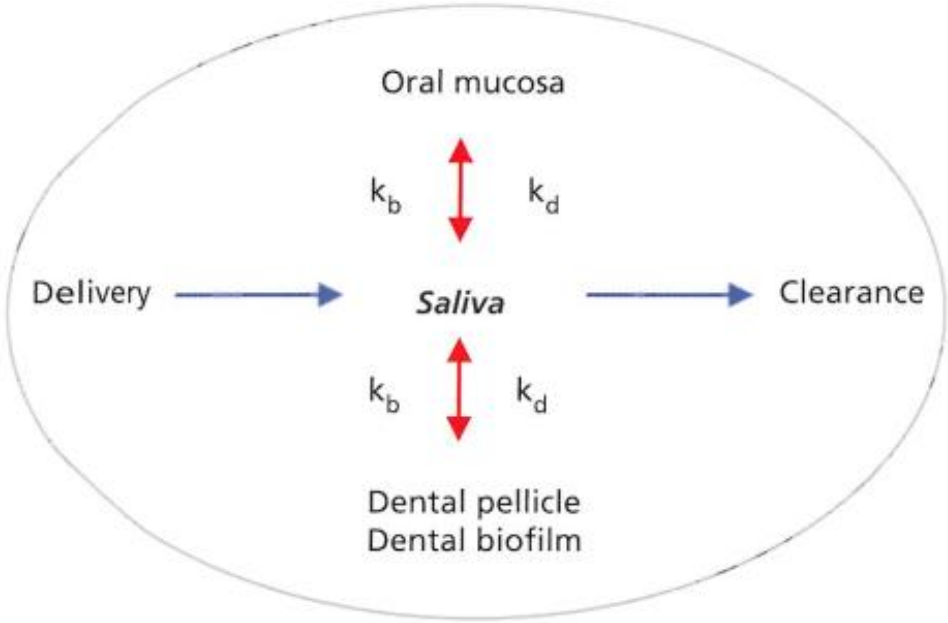
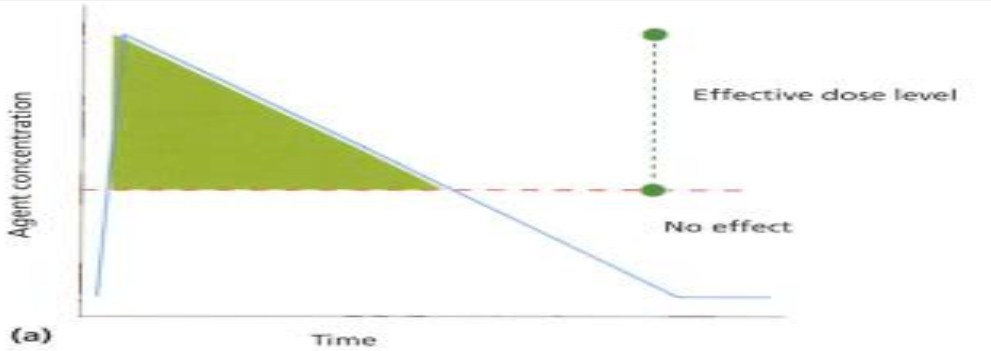


Figure 16.1 Oral delivery, binding, release, and clearance of antibacterial agents in the oral cavity. The agent binds to oral mucosa, tooth surfaces, pellicle, and dental biofilm bacteria according to its affinity K_b and released from its binding site depending on its dissociation constant K_d and salivary clearance rate. The oral mucosa represents the major reservoir for substantive agents. After [50]. Reproduced with permission of Sage Publications.

substantivity



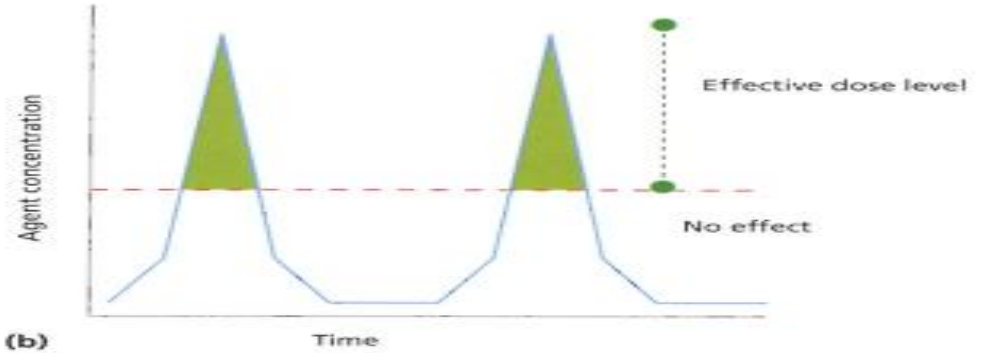


Figure 16.2 Dose curves of (a) an agent with high substantivity and (b) an agent with low substantivity. The horizontal dotted lines represent the effective dose levels. The effective dose–time area (circumscribed between the curves and the dotted lines) may be similar if the low substantivity agent is applied frequently. After [37]. Reproduced with permission of Taylor and Francis.

Table 16.1 Stages and mechanisms of biofilm formation as targets for interference.

Mechanism and stage	Target
Inhibition of bacterial adhesion and colonization	Surface physico-chemical properties Bacterial cell surface components Cell communication
Inhibition of bacterial growth and metabolism	Transport systems Cell wall Metabolic activity Cell viability Cell communication
Disruption of biofilm maturation Detachment of biofilm bacteria	Extracellular polymers: polysaccharides, DNA Cell surface proteins Cell communication Adhesion Co-aggregation and co-adhesion Release of cell surface proteins
Modification of biofilm biochemistry and ecology Replacement	Specific bacterial niche

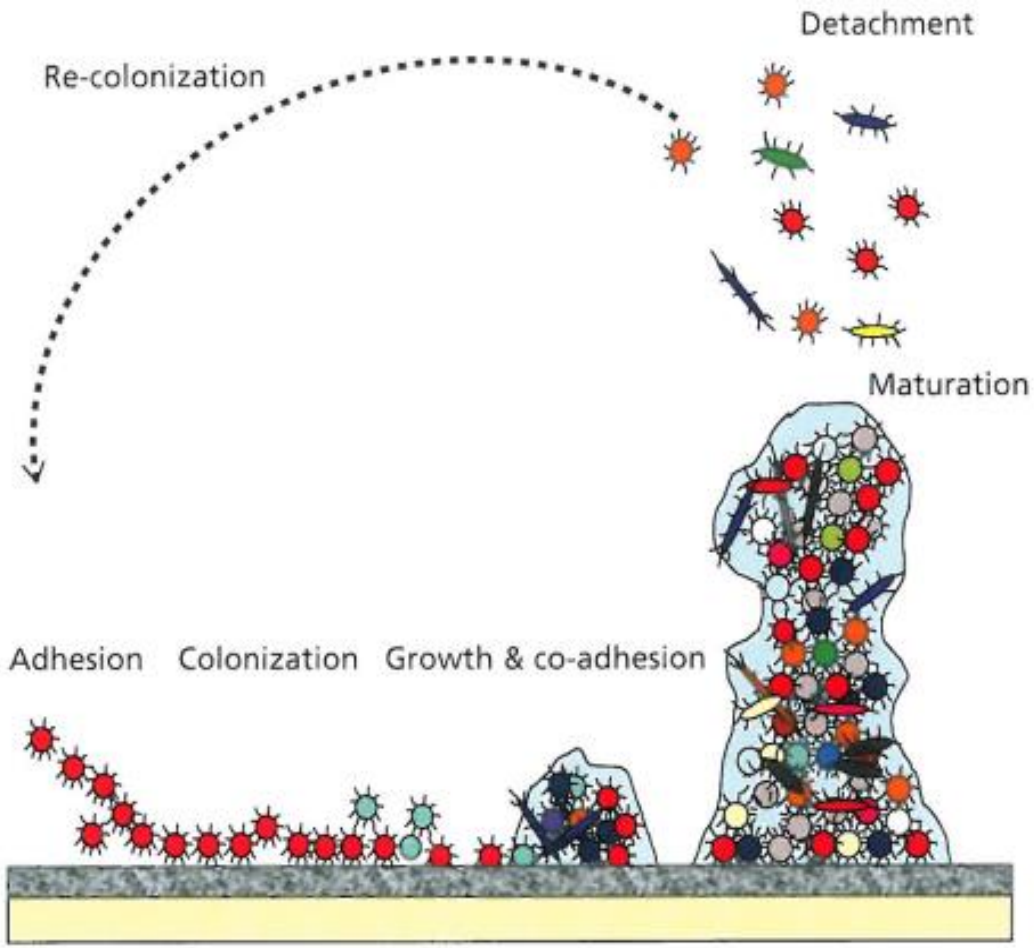


Figure 16.3 Modification of biofilm biochemistry.

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Mouth rinses	sprays	Dentrifrices	Gels	***Chewing gums and lozenges***	***Sustained-release vehicle***
• Water+alcohol • Surfactant+flavor • Compatible with most of agents	• Small doses are required • Good compliance	• Complex formulation • Possible interactions	• Thickened aqueous system • compatible with relevant antibacterial agents	• Longer contact time • Increased in salivation	• Fluoride varnishes and chlorhexidine varnishes • independent of patient compliance.

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Chlorhexidine

- Both hydrophilic and hydrophobic /bactericide and bacteriostatic
- The positively charged molecule may bind to negatively charged groups (i.e., to phosphate, carboxyl, or sulfate groups)
- Spectrum is wide/G+ (MS) and G-
- The bacterial membrane integrity may be disrupted
- Causing leakage of low molecular weight cell constituents and precipitation of cell contents
- Substantivity /clinical anti bacterial effect better
- Reduces the metabolic activity of the dental biofilm
- Inhibition of glucosyltransferase that is essential for bacterial accumulation on tooth surfaces

Local adverse effect

- discoloration of teeth, tongue, restorations and dentures
- soreness and desquamation of the oral mucosa
- taste disturbances

Caries-prophylactic effect

- A single mouth rinse with 0.2% CHX has immediate effect: 80 to 95% decrease in oral bacteria.
- Twice daily mouth rinse inhibit dental biofilm accumulation almost completely (prescribed dosage:10 ml of 0.2%/15 ml of0.12%, 2/daily)
- No or very low cariostatic effect has been found in human studies where the chlorhexidine treatment is carried out as part of the individual's home care. Professionally application of CHX varnish= F varnish
- Intensive prophylaxis with chlorhexidine and fluoride in combination may be indicated in individuals with high caries activity (people with hyposalivation)

Triclosan

- Triclosan is a nonionic antibacterial agent with hydrophilic and hydrophobic properties
- Broad antibacterial spectrum, with activity against both Gram-positive and Gram-negative bacteria and fungi
- Low substantivity (+Gantrez or zinc sitrate to increase subs)
- Modest effect but Triclosan neither enhances nor interferes with fluoride enhanced remineralization and that triclosan-containing toothpastes are at least as good as' fluoride-containing dentifrices without antibacterial additives.
- development of antibacterial resistance

Xylitol

- Xylitol is a sugar alcohol
- Xylitol is non-acidogenic and thus does not promote dental caries
- Data to confirm caries prophylactic effects of xylitol or superiority claims of xylitol over other polyols are lacking
  - Inhibition of biofilm formation
  - Decrease in the number of s.mutans and less gingivitis
  - Reduced adhesiveness through impaired polysaccharide formation

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Cetylpyridinium chloride

- The CPC molecule possesses both hydrophilic and hydrophobic groups
- It is assumed that interaction with bacteria occurs via cationic binding
- The antibacterial activity of CPC is equal to or better than chlorhexidine
- Less antibiofilm activity
  - Less substantivity
  - Less antibacterial activity upon adsorption to surfaces
- There are no data on CPC's ability to prevent dental caries in humans

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antibacterial resistance

- Antibacterial resistance refers to the characteristic of a genus, species, or strain of bacteria enabling it to avoid being killed or inhibited by a defined concentration of an antibacterial agent
- Agents with several targets are considered less likely to induce resistance.
- Presence of sub-inhibitory agent concentrations will increase the risk of resistance development

Intrinsic resistance

- In intrinsically resistant bacteria, the target molecule may be lacking or the agent cannot get to the target
- Complex cell wall in Gram-negatives
- Bacteria may also be equipped with enzymes that can lead to biocide degradation
- Efflux pumps that promote the export of internalized biocides
- Growth rates are usually slow in biofilms, contributing to reduced susceptibility
- bacteria in biofilms are embedded in a polymer matrix

Acquired resistance

- Acquired resistance is the result of mutation and/or acquisition of mobile genetic elements through conjugation, transduction, or transformation
- Altered composition of the outer cell wall
- Mutations in the FabI enzyme involved in fatty acid synthesis
- Efflux pumps

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The antibacterials used often have multiple targets that may overlap with the more specific antibiotic target

Such agents should be used restrictively and only if conventional prophylactic methods are likely to be ineffective

Thank you!