Root Surface Caries
Understanding and Managing these lesions

This is the epidemic that is coming with the retiring boomers

Images courtesy of Assoc Prof FE Martin

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By the end of tonight I hope you will be able to:

1. Describe the nature of dental caries as an Non-Communicable Disease
2. Describe the 4 key risk factors, identify the two responsible for transforming the biofilm, and the 3 that are modified each time with effective oral hygiene
3. Describe the 3 key roles of the dental team
4. Describe the prevalence, incidence, clinical appearance, and professional management of root surface lesions
5. Describe the best evidenced-based home treatment
Dental caries has been defined in one dental text book as:-

“A progressive, microbial disease affecting the hard parts of the tooth exposed to the oral environment, resulting in demineralization of inorganic constituents and dissolution of the organic constituents, thereby leading to cavity formation”

There are problems with this definition: In small groups of 2 or 3

1. Identify what the key issues are....
2. What are likely clinical consequences if this definition were accepted uncritically?
“Dental caries” is a preventable, multifactorial, life-style associated, microbial, chronic non-communicable disease (NCD) affecting individuals with their biology, their attributes, their health related behaviours, in their cultural, socio-economic, and physical environment.

The patho-physiology of “Dental caries” occurs when there is unbalanced dynamic process involving repeated cycles of demineralisation and remineralisation in a biofilm which results in the net loss of mineral from the dental hard tissues.

The sign that a person is experiencing the disease of “Dental caries” is a lesion under the biofilm in the dental hard tissues of enamel, dentine, or cementum exposed to the oral environment.
Understanding the nature of dental caries
Fejerskov and Manji Model of Dental Caries (1990)

Outer circle includes the individual (who has a mouth with teeth)

Inner circle Caries Dynamics (pathophysiology) at the level of the exposed dental hard tissues in the organ of the mouth

SALIVA (flow rate)
- PLACQUE ACID pH
- TOOTH CALCIUM PHOSPHATE
- BUFFER CAPACITY
- SUGAR CLEARANCE RATE

SALIVA (composition)
- DIET Composition Frequency
- MICROBIAL SPECIES
- FLUORIDE

Social class

Time

Income

Lesion under the biofilm which may arrest or progress

Knowledge

The dentition changes from deciduous to permanent but the person exposed to the risk factors is the same

The individual includes:
- Schooling
- Income
- Knowledge
- Behaviours
- Attitudes
- Ethnicity culture

Inner circle Caries Dynamics (pathophysiology) at the level of the exposed dental hard tissues in the organ of the mouth

Outer circle includes the individual (who has a mouth with teeth)
The best evidence we have of living with dental plaque

3 plaque trajectories

DMFS

Mean MT

% of subjects with 1+ sites with >= 4mm LOA

Broadbent JM, Thomson WM, Boyens JV, Poulton R
Dental plaque and oral health during the first 32 years of life
JADA 142:415-426, 2011
Sugar exposure and reduced saliva flow can alone or together transform a gingivitis causing biofilm into a cariogenic one.

Takahashi N and Nyvad B
The role of bacteria on the caries process; ecological perspectives
Remember each generation of bacteria only live for about 15 minutes.
Acid production within mature plaques

![Graph showing pH changes over time for different days.](image)

This is also a good example of how the mature (thick) plaques exposed to sugar have become dominated by cariogenic LB and MS.

Fig. X.17. Effect of a sugar rinse on the pH of plaque of different ages measured by microelectrodes built into an extracted tooth. With the older plaques the pH fall begins during the sugar rinse, reaches lower values and returns more slowly than with the 1-day-old plaque.

Salivary velocity and sugar clearance vary markedly in different parts of the mouth.

Many of the most prescribed medications alone or in combination reduce saliva flow.

**Saliva production and hyposalivation**

Dry lower lip with a tissue and time the appearance of mucous from the minor salivary glands

- < 30 seconds = Normal
- 30-60 seconds = Some reduction
- 60+ seconds = Reduced saliva flow means pH likely to be lower than 6.0

Many anticholinergic medications can reduce salivary flow. Note frothy saliva, and sticky mucosal surfaces…
The pH scale is a log scale so each drop of 1 unit = 10 x more acid

Critical pH 5.5 for enamel is approx 70 x more acid...

Erosion occurs at pH 3 & below. Topical fluoride at safe concentrations provides no protection from erosion

Critical pH 6.0 for dentine/cementum is 10 x more acid...

Critical pH 5.5 for enamel is approx 70 x more acid....
VIPEHOLM STUDY conclusions on diet

1. Sugar in solution at mealtime does not increase the incidence of carious lesions.
2. Sugar in sticky form at mealtime increases the incidence of carious lesions.
3. Sugar in sticky form between meals increases the incidence of carious lesions.
4. The incidence of carious lesions decreases if sugar in sticky form is eliminated.
5. Even when sugar in any form is limited as much as is practically possible, a few subjects will still develop carious lesions.
Total amount of sugar consumed each day is now best predictor

Table 3. Ranking of dietary variables according to their bivariate correlation with two-year fissure caries increment

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+0.143*</td>
<td>Total sugars (weight)</td>
</tr>
<tr>
<td>+0.129*</td>
<td>Total sugars, excluding lactose (weight)</td>
</tr>
<tr>
<td>+0.118</td>
<td>Items &gt; 10 per cent sugars (weight)</td>
</tr>
<tr>
<td>+0.116</td>
<td>Sweets + chocolate + biscuits + cake + puddings (weight)</td>
</tr>
<tr>
<td>+0.115</td>
<td>Items &gt; 60 per cent sugars (weight)</td>
</tr>
<tr>
<td>+0.112</td>
<td>Foods &gt; 10 per cent sugars (weight)</td>
</tr>
<tr>
<td>+0.111</td>
<td>Sweets (weight)</td>
</tr>
<tr>
<td>+0.108</td>
<td>Sweets + chocolate (weight)</td>
</tr>
<tr>
<td>+0.108</td>
<td>Hot sugared drinks (excluding tea) (frequency)</td>
</tr>
<tr>
<td>+0.103</td>
<td>Lactose (weight)</td>
</tr>
<tr>
<td>+0.102</td>
<td>Milk (weight)</td>
</tr>
<tr>
<td>+0.101</td>
<td>Items &gt; 1 per cent sugars (weight)</td>
</tr>
<tr>
<td>+0.099</td>
<td>Items &gt; 10 per cent sugars (frequency)</td>
</tr>
<tr>
<td>+0.099</td>
<td>Sweets + chocolate + biscuits + cake + puddings (frequency)</td>
</tr>
<tr>
<td>+0.098</td>
<td>Foods &gt; 1 per cent sugars (weight)</td>
</tr>
<tr>
<td>-0.101</td>
<td>Time between last food &gt; 10 per cent sugars and bed</td>
</tr>
</tbody>
</table>

Only statistically significant correlations are shown (*p < 0.01, the remainder p < 0.05).

Since the widespread use of fluoride toothpaste in an unfluoridated area

Rugg-Gunn et al. *Archives of Oral Biology* 29:983-992, 1884

See also: Sheiham et al. *BMC Public Health* 14:863-871, 2014
A study of 600 children from mainly disadvantaged families showed the importance of keeping the time before bed sugar-free.

The children who had sugar sweetened drinks or foods before bed had greatly increased experience of carious lesions:

- On average 3 x more for the deciduous teeth
- On average 4 x more for the permanent teeth

Levine RS
Caries experience and bedtime consumption of sugar sweetened food and drinks – a survey of 600 children
Criteria for Plaque Index (Silness & Loe, 1964)

3 = thick plaque is visible along gingival margin (no need to probe)
2 = plaque is visible along gingival margin, with or without air drying (no need to probe)
1 = following air drying, plaque is not visible, but can be picked up with an explorer
0 = following air drying, plaque is not visible and cannot be picked up with an explorer

Notes:
1. If an index tooth is missing, score the nearest tooth in that sextant. If there are no teeth in the sextant, enter X.
2. If the plaque thickness varies along the gingival margin, score according to the worst situation.
3. The overall score is the sum of the 12 surface scores (maximum of 36).

Date: 26-9-07
Score: 22 / 36

Creamy = Approx 5+ days old
Clear visible = Approx 2-4 days old

Visible biofilm indicates where the brush and therapeutic agent, e.g. Fluoride toothpaste haven’t been for some time

Evans RW Pakdaman A, Dennison PJ, Howe ELC
The Caries Management System: an evidence based preventive strategy for dental practitioners. Application for adults
Australian Dental Journal 2008; 53: 83-92
Fluoride ion and the early enamel lesion

- Plaque acids
- Ca\(^{2+}\)
- PO\(_4^{3-}\)
- F\(^-\)

↓ demineralisation
↓ acid production by bacteria
↑ remineralisation

Image courtesy of Prof Murray Thomson
What difference does fluoridated water make

5 year radiographic study of enamel lesions

in **fluoridated** area = 104.4 months (95% CI 75.7-??) or **8.33 years to reach dentine**
in **non-fluoriated** = 17.9 months (95%CI 15.5-36.0) or **1.5 yrs to reach dentine**

compared with the non-fluoride group, those exposed to water fluoridation were **56% less likely**
to experience dentine caries
compared with the low risk group, the moderate and high risk groups were 3 and 5 times, respectively, more likely to experience dentine caries


Fluoridated water makes a significant difference!
Therapeutic topical agents (medicaments) for oral care

Arrest enamel, dentine, and root lesions -ve charge

- Paste & Sensitivity GEL, no antibacterial 5000 ppmF
- Anti-bacterial CHX paste 0.12% CHX, gel 0.5% CHX

Do not use within 2 hours

- Sodium lauryl sulphate is in the paste or gel

Pyrophosphates reduce supra-gingival calculus
- Triclosan antibacterial reduces gingivitis, MS & LB 1100ppmF

And now emerging evidence of the addition benefits of arginine fluoride toothpastes in arresting early enamel and dentine lesions

Increase biofilm Ca\(^{2+}\) & PO\(_4\)\(^{-}\)
How effective is fluoride toothpaste?

The overall lesion-inhibiting effect was 24% (95% 21% - 8%) that is the 24% fewer carious lesions developed in the group using a fluoride toothpaste from the pooled results of 70 trials.

This effect was independent of the fluoride status of the domestic drinking water.

This does not mean that F water has no additional effect!

The Cochrane Database of Systematic Reviews
Fluoride toothpastes for preventing dental caries in children and adolescents
Marinho VCC, Higgins JPT, Sheiham A, Logan S
What difference does concentration of fluoride make?

An additional 8% lesion inhibiting effect per 1000 ppm increase in the F concentration

e.g. Neutrafluor 5000 Plus
   5000 ppm F
   24 + 32 = 56%

This effect was independent of the fluoride status of the domestic drinking water

This does not mean that F water has no additional effect!

The Cochrane Database of Systematic Reviews
Fluoride toothpastes for preventing dental caries in children and adolescents
Marinho VCC, Higgins JPT, Sheiham A, Logan S
F-paste concentration & relative effectiveness of 5000+

Treatments with 5000 ppm F IN VITRO significantly enhanced remineralization and inhibited demineralization in deep enamel lesions

<table>
<thead>
<tr>
<th>F-paste concentration</th>
<th>No. of 45 min acid attacks in an artificial mouth where Remin = Demin in R2 lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-F paste</td>
<td>2</td>
</tr>
<tr>
<td>500 ppm F</td>
<td>4</td>
</tr>
<tr>
<td>1500 ppm F</td>
<td>7</td>
</tr>
<tr>
<td>5000 ppm F</td>
<td>10</td>
</tr>
</tbody>
</table>

“Clinically, this would result in a shift in the caries balance, where a higher number of cariogenic episodes per day would still not lead to dental caries.”

ten Cate JM, Buijs MJ, Chaussain Miller C, and Exterkate JAM
Elevated Fluoride Products Enhance Remineralization of Advanced Enamel Lesions
What difference does an extra brushing occasion make?

An additional **14%** lesion inhibiting effects per extra brushing occasion

e.g. 3 x daily using a 1000 ppm F = 24 + 14 = 38%

This effect was **independent of the fluoride status** of the domestic drinking water

*This does not mean that F water has no additional effect!*

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The Cochrane Database of Systematic Reviews
Fluoride toothpastes for preventing dental caries in children and adolescents
Marinho VCC, Higgins JPT, Sheiham A, Logan S
What difference does swishing & not rinsing make?

A study by Sjogren K et al (1996) showed that a 60 SECOND swish of the saliva and toothpaste after brushing was even more effective than a 0.05% Sodium Fluoride rinse in raising the fluoride levels of plaque between the teeth for up to three hours after rinsing.

Swishing a mix of toothpaste and saliva after brushing is the simplest way to enhance the plaque fluoride and raise the fluoride concentration of the oral environment.

Post-brushing rinsing for the control of dental caries: exploration of the available evidence to establish what advice we should give our patients
British Dental Journal 212: 315-320
The Four Key Caries Risk Factors

**Fluoride Factor**
- F-H2O? Filters?
- F - Conc. of Pastes?
- Brush, swish, spit?
- Swallows not spits
- Rinses?

**Saliva Factor**
- Reduced Flow?
- Lower pH?
- Calcium & Phosphate Substitutes needed?

**Plaque Factor**
- Oral care effective?
- Cariogenic biofilm?
- Age/Thickness?
- Anti-bacterials Needed?

**Diet Factor**
- Oral care possible?
- Sugar substitutes?
- Amount of sugar?
- Consistency?
- Frequency?
- Timing?

Effective oral care modifies 3 key risk factors with just one behaviour.

These are the 2 key risk factors that change the ecology of the inflammatory biofilm into a cariogenic one.

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The way we think tends to be the way we act
Untangling our confused thinking when we use the term “Dental Caries”

In dentate individuals, at any number of sites, the normal inflammatory oral biofilm may transform and become dominated by aciduric and acidogenic micro-organisms including fungi (This implies a whole population approach, universal access to affordable care)

The demin/remin cycle under the oral biofilm may become unbalanced resulting a net loss of mineral at any time in a person’s life when one or more of the key risk factors is modified

Risk Factors are associated with Disease Risk (i.e. the risk of new or progressing carious lesions)

Carious Lesions are only Risk Indicators (i.e. signs and symptoms of the disease)
Reconstructing conventional terminology

It is **incorrect** to say:

- “That tooth has dental caries.”
- OR “That tooth root has dental caries”.

It is **correct** to say:

- “This is someone **with dental caries** because that tooth has a cavitated carious lesion.”
- OR “That coronal (e.g. occlusal) surface has a carious lesion.”
- OR “That root surface has a carious lesion”.


Reconstructing conventional terminology

**Coronal caries** – carious lesions in the exposed crowns of teeth

**Root (surface) caries** – carious lesions in the exposed root surfaces of teeth

**Incipient caries** – the least severe visible signs of the disease in the individual. These may be white or yellow/brown lesions of enamel, or darkened patches of the exposed root surface dentine/cementum surface signifying carious lesions

**Active caries** – a carious lesion that is progressing between two points in time (actually it is the biofilm that is active when a lesion progresses and becomes more severe)

**Recurrent caries** - a new carious lesion alongside a sealant or restoration (i.e. the individual has ongoing disease)
Managing the disease of dental caries throughout a person’s life
Q. What is the responsibility of the Dental Team?
A. To help the patient manage this chronic microbial disease

Q. How do we know we have disease under control?
A. No new carious lesions (signs of the disease)
No progression of existing carious lesions

Q. How do we achieve this?
A. Essentially, it’s the patient’s (or carer’s) management of the biofilm in ongoing collaboration with the Dental Team.

This really is the only way we know if we have the disease under control.
Q. How do we achieve this?

This is not achieved by using a handpiece as our primary “weapon”
The most important concept for managing the biofilm diseases of dental caries & periodontal diseases...

At home, each day, the patient does most of the treatment of the disease by means of effective oral care. This disrupts the accessible biofilm and delivers the topical medicaments to help keep the gums and teeth healthy (and treat non-cavitated carious lesions)
Dental Team’s 3-fold role

1. Patient empowerment for treatment at home

Motivating, empowering and upskilling the patient’s daily management of the cariogenic biofilm via motivational behaviour change which may include any or all of the following:–

- oral hygiene coaching
- use of fluoride toothpastes
- fluoride rinses
- anti–bacterials
- calcium and phosphate replacement if needed e.g. casein peptides, calcium sucrose phosphate, tri–calcium phosphate etc
- diet measures
- therapeutic chewing gums
Dental Team’s 3-fold role

“Bringing the cariogenic biofilm back to the surface – where, in turn, it can be managed by the patient” Edwina Kidd 2010

2a. Non-operative treatment in the clinic

• professional cleaning, polishing, removal of biofilm traps (can’t correct gingival recession)
• application of topical fluoride
• application of sealants and protective coatings
Dental team’s 3-fold role

"Bringing the cariogenic biofilm back to the surface – where, in turn, it can be managed by the patient”  Edwina Kidd 2010

2b. Operative treatment in the clinic

Management of cavitated carious lesions

• re-contouring (if required) of root surface lesions, primary incisors

• sealing off or restoring cavitated lesions including Hall’s technique for primary molars
Dental team’s 3-fold role

3. Monitoring the outcomes

- the outcomes of the patient’s daily treatment by modifying the balance of risk factors at home
- and our own treatments in the clinic

Currently, though, our policies, computer systems, and payments are focused on treating the signs and symptoms of the disease. At present a course of dental care is “complete” at the end of operative treatment of carious lesions or replacement of previous repair. As an integral part of a course of care, we do not monitor the dental tissues to see if any new lesions have developed or existing lesions have arrested or progressed ....
Treating the signs & symptoms is mostly non-invasive and mostly at home. In the clinic some treatment is non-invasive and some is operative..... Sealants & restorations only bring the bio-film back to the surface to be managed by the patient at home!

It is the disease we aim to control, not just managing the signs and symptoms. The most important part of treatment is to modify the risk factors that maintain the disease in this individual and to help the person manage the biofilm.

© Peter J Dennison
Empowering the Person exposed to the risk factors of this preventable, chronic NCD in his or her cultural, socio-economic, & physical environments

Managing the Lesion (sign of the disease) in the dental hard tissues as a result of the patho-physiology in the mouth and the dental plaque

Person’s characteristics and behaviours

Severity and extent of all lesions & surfaces at risk

Modifying key risk factors using motivational behaviour change & skill development

Lesions non-invasively and operatively in the home & clinics

Lifestyle changes

Lesion changes

Caries Management System
Peter J. Dennison & R Wendell Evans

Australian Dental Journal 54: 374-382, 2009
Managing root-surface carious lesions
“Dental professionals are doing a good job of finding and restoring coronal caries, but they are ignoring more than half of root lesions.”

“Root surface caries” i.e. Carious lesions on the root surfaces

By definition occurs on the root surface of the tooth spreads to undermine enamel at the CEJ

- Early lesions are diffuse & spreading
- Advanced lesions are cavitated & progress towards the dental pulp
A root-surface carious lesion may start at the cementum-enamel margin and spread laterally undermining the enamel as in the 26 shown.

Image courtesy of Assoc Prof FE Martin
“Older people are a caries–active group, experiencing new disease [lesions] at a rate which is at least as great as that of adolescents.”

Thompson WM Brit Dent J 2004; 196: 89-92

“… the overall risk in older age groups has not decreased appreciably. In fact, the caries risk for individuals over 70 years has increased.”

Anusavice KJ Compend Contin Educ Dent 2002; 23: 12-20
Patient Risk Indicators

- Males > females to have root surface lesions in middle age but no difference for older people (attending private practices)
- Employment status – recently unemployed/retired
- Irregular dental attendance (low on dental surveillance)
- Poor general health/medically compromised
- Functional ability e.g. arthritis
- Cardiac arrhythmia is significantly associated with root surface caries
- Cognitive decline
- Nursing home resident 2–7 x more likely to have root caries lesions

Chi DL et al JADA 2013; 114(5):507-516
Kaneko M et al Gerodontology 2013; 28(4):289-95
Patient Risk Indicators

- A diagnosis of progressive dementia
- A high prevalence of patients just diagnosed with Alzheimer's disease (AD) have carious root surfaces
- Especially 80+ years of age who have had a previous history of coronal and root surface carious lesions
- Those still living at home are 70% less likely to develop lesions than those in a nursing home

Ellefsen BS et al Gerodontology 2012; 29(3):194-202
Patient Risk Indicators

• “Nursing home residents (Adelaide study) were very dependent, medically compromised, cognitively impaired, and behaviourally difficult older adults.”
• In 12 months 72.1% of residents developed new coronal and/or root caries lesions
• Mean of 2.5 coronal and 1.0 root surfaces

This is the group where oral care is very difficult and diet becomes critical for protecting oral health

Chalmers JM et al Special Care in Dentistry 2005; 25(2):96-105
Oral care is one of lowest status activities in residential care

Oral care tends to be the associated with other activities (e.g. bathing, dressing, shaving) and tends to be left undone on days when the nursing home is short-staffed.

Oral care usually has the lowest status of all the activities involved in caring for people with special needs in a residential-care setting.

Consequently, it is one of the most sensitive indicators of the quality of residential care.
Oral Health Status Risk Indicators

- **Lifelong coronal caries incidence** is a risk indicator for root surface lesion experience by age 38.

  OR=3.86  
  (286% more likely)

  OR=1.86  
  (86% more likely)

Oral Health Status Risk Indicators

- Clear evidence that Removable Partial Dentures (RPDs) do increase plaque and gingivitis.
- The risk of carious lesions, particularly root caries lesions is 6 x higher in wearers of RPDs.
- RPDs have not clearly been shown to increase the risk of periodontitis.

Dentures are a scaffold for biofilm & there are higher levels of Candida Albicans which is also acidogenic.

Katz RV Am J Dent 1995; 8: 335-41
Prevalence of root surface caries

- Carious lesions on root surfaces are a common manifestation of this disease seen in 60–90% of older adults.
- 15–20% of teeth with recession have root surface lesions.
- Annual incidence of root surface lesions is 0.3 to >1.2 surfaces/year for at least 25% of the population over 60 yrs.
- In a 10 year longitudinal study in Iowa 43% of the study population developed root surface lesions.
- 30–75% decrease in the percentage of the population affected by root surface lesions in fluoridated communities.
- 60–70% of root surface lesions are untreated compared with 10% –15% of coronal lesions.

Katz RV  Am J Dent 1995; 8: 335–41
Hamasha AA et al Special Care in Dentistry 2005; 25(2):106-10
Annual incidence of root surface carious lesions

From a meta-analysis of 6 studies in 2004

25% of the population of 60+ years on average experienced 1.6 new carious lesions per year (a mean of 1 for crown; 0.6 for root)

People aged 60+ years from South Australia

30.2% of the population developed root surface lesions in 12 months (the upper 95% confidence interval for the meta analysis)

Griffin SO, Griffin PM, Swann JL, and Zlobin N
Estimating Rates of New Root Caries in Older Adults
J Dent Res 83: 634-638, 2004
Progress of root surface lesions

Root surface lesions progress at approximately 2 x the rate of enamel carious lesions due to the lower mineral content of dentine and cementum.

Demineralisation begins at a higher pH
- critical pH for enamel demineralisation is 5.5
- critical pH for cementum and dentine it is around 6.0

Burgess JO Am J Dent 1995; 8: 342-51
Using molecular techniques:

No particular bacteria appear to be consistently associated with root surface lesions...

*Lactobacillus* and *Pseudoramibacter* were notably associated with most root samples.

*S. mutans* played only a limited role.

Species other than *Actinomyces* and *S. mutans* may play a role in the pathogenesis root surface lesions.
Root surface lesion where food impaction occurs with flattening of the interdental papillae

Note the frothy saliva. What time would it take for the minor salivary glands to produce mucous and what pH would you expect?

Strong association – flow rate
Weak–moderate association – buffering capacity
No association – salivary pH

Image courtesy of Assoc Prof FE Martin
Note cavitated biofilm retentive root surface lesion on distal of 21. What options are there to deal with this?

Shallow lesions – excavated, surface recontoured, smoothed & polished + home application of 1% NaF resulted in 100% arrested lesions

Billings RJ et al
Gerodontology 1985; 1: 20-7

By Tooth
Maxilla  incisors > canines > premolars > molars
Mandible  molars > premolars > canines > incisors

F varnish each visit and coat with a GIC if 2mm or less
Saliva factor – what can we recommend

- Limit intake of diuretics e.g. caffeine, alcohol & other, over the counter medications
- Ensure adequate water intake
- Chew gum especially Xylitol-containing gum/sweets; vegetables
- Use casein peptides e.g. GC Tooth Mousse
- Use an alkaline mouthrinse e.g. Bicarbonate 4–5 times a day
- Use oral hydrating gel eg. Oralube, Oral Balance Gel
- Salivary stimulants eg. Pilocarpine as in eye drops

Gene therapy using a viral vector has been successfully done already for patients with radiation dry mouth
**Xylitol reduces new root surface lesions**

**The Xylitol for Adult Caries Trial**

- 3 yr double-blind, multi-center, randomized clinical trial that evaluated the effectiveness of xylitol vs. placebo lozenges in the prevention of new lesions in caries-active adults.

- Participants in the xylitol arm developed 40% fewer new root surface lesions than those in the placebo arm (0.23 vs 0.38 D2FS/year; IRR = 0.60; 95% CI 0.44, 0.81; p < .001)

- There was no statistically significant difference between xylitol and control participants in the number of new smooth, occlusal, or proximal lesions

Fluoride and Chlorhexidine

“Chlorhexidine does not provide a significant effect on the control of coronal or root caries development in the elderly.”

Bretz WA  Evid Based Pract 2007; 7: 158-9

Application of fluoride (high concentration dentifrice or mouthwash) has a positive effect on number of new root surface lesions and their severity.


There is very strong evidence CHX reduces gingivitis and bleeding so it is part of the Australian national oral care standard!
And emerging evidence it helps reduce coronal lesions
Monthly fluoride varnish vs 5000+ toothpaste

75+ year olds at home randomly assigned to one of three groups:

**Gp 1**  Duraphat varnish to active root caries lesions after teeth brushed 1 x monthly by a hygienist.
**Gp 2**  5000 ppm F  2 x daily
**Gp 3**  (control) brushed teeth with 1450 ppm F  2 x daily

At the end of the study, groups 1 and 2 had improved significantly compared with group 3 (p < 0.02). No significant difference was observed between groups 1 and 2 (p = 0.14).

All the intervention programmes reduced new root surface lesions by

- 80% - Hygienist visit 1 x monthly & Duraphat
- 70% - 5000 ppm
- 50% - 1450 ppm

Ekstrand K et al Gerodontontology 2008; 25(2):67-75
Safety of Duraphat Fluoride Varnish

10 x 4 mm blobs
= 5.6 mg F
(11% of Probable Toxic Dose for 1 yr-old and 6% for 5-6 yr-old)

15 x 4 mm blobs
= 9 mg F
(too much for a toddler and 9% of Probable Toxic Dose for 5-6-yr-old)

Typically 5.2 mg F (range = 0.7 to 14.5 mg F) is applied

Blood plasma levels 3–6 micromolar F/litre (same as 1000 ppm F–paste)

Contrast APF gels blood plasma levels are 5 x more (16–67 micromolar F/litre)

This is the only fluoride product that is safe even with toddlers

Beltran–Aguillar ED et al JADA 131:589–596, 2000
38% Silver Diamine Fluoride (SDF)

Painted on for 1-2 minutes to arrest root surface lesions (Must protect gingivae e.g. with vaseline because it has high pH and will affect mucosa) – this will make lesion go black because metallic silver is deposited – GIC, RMGIC can be placed on top later to obliterate any small defect (Available through SDI)

Image courtesy of Dr Callum Durward

I prefer a 2 mm microbrush holding approx 0.01ml of solution
38% Silver Diamine Fluoride actions

38% SDF contains high concentrations of silver and fluoride ions which arrests root surface dental caries by:-

1. inhibiting the growth of multi-species cariogenic biofilms

2. reducing the demineralization process minimizing the loss of mineral

3. slowing down collagen destruction
# Yearly Silver Diamine fluoride as effective as 3-monthly NaF varnish in a nursing home

In 21 Residential Care Facilities 203 subjects out of 360 were followed up for 3 years in 4 groups (ANOVA p<0.001)

<table>
<thead>
<tr>
<th>Group Description</th>
<th>Mean Increment of Carious Root Surfaces</th>
<th>% Fewer Root Surface Lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Individualised OHI</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>2. Individualised OHI &amp; CHX Varnish 3 monthly</td>
<td>1.1 (57%)*</td>
<td></td>
</tr>
<tr>
<td>3. Individualised OHI &amp; 5%NaF Varnish 3 monthly</td>
<td>0.9 (64%)</td>
<td></td>
</tr>
<tr>
<td>4. Individualised OHI &amp; 38% Silver Diamine Fluoride 12 monthly</td>
<td>0.7 (71%)</td>
<td></td>
</tr>
</tbody>
</table>

* % fewer root surface lesions

Tan HP, Lo EC, Dyson JE, Luo Y, Corbet EF
5000ppm F Paste is **the best** home treatment with 50% more arrested root surface lesions on average than a 1,450 ppm Paste *(High level of evidence)*
The 1.5% arginine containing toothpaste resulted in 21% more arrested lesions on average than a similar 1450 ppm F toothpaste without arginine. 

*(low level of evidence .... still emerging)*

R.J. Wierichs and H. Meyer-Lueckel
Systematic Review on Noninvasive Treatment of Root Caries Lesions
*J DENT RES* published online 14 November 2014
Table 3. Recommendations for Clinicians for use of the most effective root caries preventive agents or combination of agents in general adult population in ascending order of effectiveness.

<table>
<thead>
<tr>
<th>Agents or combination of agents ref</th>
<th># &amp; Types of Studies</th>
<th>Strength of Evidence</th>
<th>1° Prevention (% reduction)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% or 10% or 40% CHX varnish¹⁸,²⁰,²¹,³⁰ 1–3 mo interval</td>
<td>4 RCTs</td>
<td>Moderate strengths, with 4 well done studies</td>
<td>41–57% (vs placebos)</td>
<td>highly effective vs placebo</td>
</tr>
<tr>
<td>22,500 ppm NaF varnish²¹,³⁰ Every 3 mo</td>
<td>2 RCTs</td>
<td>thin, but strong and consistent</td>
<td>56% – 64% (vs no active agent)</td>
<td>highly effective vs placebo</td>
</tr>
<tr>
<td>1,100 ppm NaF toothpaste³ Daily</td>
<td>1 RCT</td>
<td>very thin, a single well done study</td>
<td>67% (vs no active agent)</td>
<td>highly effective vs placebo</td>
</tr>
<tr>
<td>38% SDF solution³⁰ Annually</td>
<td>1 RCT</td>
<td>very thin, a single well done study</td>
<td>72% (vs a near placebo: OHI only)</td>
<td>very highly effective vs a near placebo</td>
</tr>
<tr>
<td>225 ppm NaF rinse¹⁰ Daily</td>
<td>1 RCT</td>
<td>very thin, a single well done study</td>
<td>36% (vs 22,500 ppm NaF varnish)</td>
<td>1/3 more effective vs an agent that was itself highly effective compared to a placebo</td>
</tr>
<tr>
<td>960 ppm SnF₂ gel¹⁰ Every 3 mo</td>
<td>1 RCT</td>
<td>very thin, a single well done study</td>
<td>35% (vs 22,500 ppm NaF varnish)</td>
<td>1/3 more effective vs an agent that was itself highly effective compared to a placebo</td>
</tr>
</tbody>
</table>


Look at these last two!
“In moving from a surgical to a medical model in dentistry, rather than repairing incipient lesions mechanically, restoring the equilibrium of ion-exchange can provide a longer-lasting solution. Restorations will need continual replacement; remineralised tooth structure could last a life-time.”

Dark, hard, and shiny is a sign of arrested and non-progressing root-surface lesions. (It is the biofilm that is active) Care needs to be taken with monitoring and home care though because if risk factors change (e.g. saliva flow reduces) the lesions may be again start to soften.

Stahl J and Zandona AF Gen Dent 2007; March/April: 105-11
## Treatment of Carious Root Surface Lesions in CMS

<table>
<thead>
<tr>
<th>Lesion description</th>
<th>Management goal</th>
<th>Clinical and home care</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superficial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard</td>
<td>Maintain arrest</td>
<td>TDTBF*</td>
</tr>
<tr>
<td>Soft</td>
<td>Arrest</td>
<td>TDTBFF**</td>
</tr>
<tr>
<td><strong>Minimal cavitation</strong>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard</td>
<td>Maintain arrest</td>
<td>TDTBF</td>
</tr>
<tr>
<td>Soft</td>
<td>Arrest, and later, if necessary</td>
<td>TDTBFF plus 3-monthly F varnish application</td>
</tr>
<tr>
<td><strong>Deep cavitation</strong></td>
<td>Restore and prevent recurrence</td>
<td>GIC plus TDTBF</td>
</tr>
</tbody>
</table>

* Twice daily toothbrushing using fluoride toothpaste.
** Twice daily toothbrushing using 5000ppm fluoride toothpaste.
*** < 2mm

An extra brushing each day reduces new lesions by 14%
Each additional 1000ppm F reduces new lesions by 8%
GIC protective coatings of root surfaces

Where plaque control is persistently poor one option is to coat root surfaces; and even to fill in interdental spaces with a GIC (e.g. Fuji VII) with a protective coating. The GIC rather than root surface dissolves under the biofilm, and GIC is well tolerated by gingivae.
Limitations in the operative treatment of root surface lesions

- Margins finish in areas with limited access
- Adequate isolation is impossible
- Adequate debridement is difficult to determine
- Adequate restoration placement challenging
- Increased risk of new root surface lesions alongside restorations

And increased risk of a crown breaking off - especially lower incisors!

Burgess JO
Am J Dent 1995; 8: 342-51
ART vs rotary instruments – 2 year study

For root surface carious lesions restored with GIC, using hand instruments only (ART method) was as effective as conventional rotary instrumentation for cavity preparation. Larger restorations had higher failures, usually from dislodgement.

“Most patients are served best by the use of cariostatic resin-modified glass ionomer materials, followed by additional fluoride augmentation.”

Hu IY
Australian Dent Journal 50: 186–90, 2005

Christiansen GJ
Good margins with cavitated subgingival lesions

Works well with subgingival margins & bleeding gums

Needs care not to lose fragments or clip in mouth esp. ecially under IV or GA

Dentsply
AutoMatrix
Kit
“It is the person in his or her living context who has the disease of dental caries. The disease shows up in the dental hard tissues as lesions. The best way of managing lesions of the root surfaces is non-invasively by modifying as many risk factors affecting the person as possible and only restoring those lesions which are already cavitated.”
“This usually involves motivational behaviour change and up-skilling the person or carer in daily oral care using a number of therapeutic agents including a source of calcium and phosphate if the mouth has reduced salivary flow. Most of the treatment will be done by the patient (or carer) at home each day, and most of that which is in the clinic will also be non-invasive.”
“Operative treatment is a last option for cavitated root surface lesions to bring the biofilm back to the surface where it can be managed by the patient with home treatment each day.”
Questions?