

# Linking Research to Clinical Practice

## Prevention of Root Caries

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**The purpose of Linking Research to Clinical Practice is to present evidence based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application.**

**Tan HP, Lo EC, Dyson JE, Luo Y, Corbet EF. A randomized trial on root caries prevention in elders. J Dent Res. 2010;89(10):1086–1090.**

**Objective:** Root caries is common in institutionalized elders, and effective prevention methods are needed. This clinical trial compared the effectiveness of 4 methods in preventing new root caries.

**Methods:** Twenty-one residential homes were surveyed. Three hundred and six healthy elders having at least 5 teeth with exposed sound root surfaces were randomly allocated into 1 of 4 groups: individualized oral hygiene instruction (OHI), OHI and applications of 1% chlorhexidine varnish every 3 months, OHI and applications of 5% sodium fluoride varnish every 3 months and OHI and annual applications of 38% silver diamine fluoride (SDF) solution.

**Results:** Two-thirds (203/306) of the elders were followed for 3 years. Mean numbers of new root caries surfaces in the 4 groups were 2.5, 1.1, 0.9 and 0.7, respectively (ANOVA,  $p < 0.001$ ).

**Conclusion:** SDF solution, sodium fluoride varnish and chlorhexidine varnish were more effective in preventing new root caries than giving OHI alone.

### Commentary

Root caries is prevalent in elderly populations worldwide. In the U.S., estimates for root caries prevalence in individuals over age 75 have exceeded 50%, and 25% for people over age 65. Dental hygienists are seeing more elderly patients in practice, and are also working or volunteering in senior

centers, assisted living complexes and long-term care facilities. The U.S. Department of Health and Human Services indicates that, because U.S. adults are keeping their teeth longer, more are at risk for root caries. Gingival recession caused by normal aging, vigorous tooth brushing and periodontitis puts root surfaces especially at risk. It is interesting to note, however, that root caries prevention differs from coronal caries prevention. If practitioners make the same recommendations for patients at risk for root caries, the interventions might not be as effective. Dentin is more susceptible than enamel because it has less mineral content and is more soluble. Elderly individuals also have higher rates of risk factors, such as medication-induced xerostomia.

This study tested 4 different interventions for prevention of root caries in institutionalized elders. Subjects ( $n=306$ ) were living in 21 residential and nursing homes in Hong Kong and had at least 5 teeth, no serious medical problems and the ability to perform basic oral hygiene procedures after instruction. They were examined at baseline and randomly assigned to 1 of 4 groups: water (control), chlorhexidine varnish, sodium fluoride varnish or silver diamine fluoride solution (SDF). The random assignment of subjects to groups decreased the potential for researcher bias, and the large sample size drawn from many facilities increased power of the results. All subjects in all groups received oral hygiene instruction (OHI) for tooth brushing and use of fluoride toothpaste and dental treatment as indicated (scaling, restorative, extractions and prosthetic work) after initial examination. These elements of the research design were included to control extraneous variables, like poor oral hygiene

or existing active carious lesions, which might have influenced the impact of the interventions and, thus, the outcomes. The primary outcome of the study used to measure effectiveness of the preventive agents was new caries on exposed root surfaces. Clinical outcomes were monitored over 3 years for 203 subjects. Long-term results are valued in research because dental professionals and patients need to have confidence that the intervention (in this case caries prevention) will be effective over time. All measurements of new root caries surfaces were made by an independent examiner, someone other than the person who made group assignments and applied preventive agents. This blinded design is intended to eliminate researcher bias in measurement of the outcomes. Additionally, subjects did not know to their group assignment, so this study was actually double blinded. All of these study elements increase the quality of evidence that this study is able to contribute to our knowledge about prevention of root caries.

Findings indicated all of the active ingredient interventions were more effective at preventing root caries than OHI alone (with the water control). Average numbers of new root caries after 3 years in each group were:

- OHI and placebo (water), 2.5 new lesions
- OHI and applications of 1% chlorhexidine (CHD) varnish every 3 months, 1.1 new lesions
- OHI and 5% sodium fluoride varnish every 3 months, 0.9 new lesions
- OHI and 38% SDF solution every 12 months, 0.7 new lesions

The clinical significance of just over 1 new lesion (1.1 in CHX varnish) versus almost 1 new lesion (0.9 in sodium fluoride varnish and 0.7 in SDF solution) over 3 years may not be significant, but the comparison of 1 new lesion to 2.5 new lesions every 3 years would be clinically significant in terms of oral health and costs of dental care.

Fluoride in any form is estimated to prevent coronal caries by 35% and root caries by 22%. However, the evidence for fluoride varnishes in adults is incomplete. Several authors and speakers recommend fluoride varnish treatments every 3 months for adults with high caries risk, but evidence to support effectiveness of fluoride varnish has been generated from studies conducted primarily with children and adolescents for prevention of coronal caries. The results of this study indicate 5% sodium fluoride varnish also can be effective for root caries prevention in institutionalized elders. Additionally, findings support use of 1% chlorhexidine varnish applied professionally every 3 months. Studies on

the effect of chlorhexidine in caries prevention are limited, and studies of chlorhexidine varnish, once again, have been primarily conducted in populations of children and adolescents. Chlorhexidine varnish has limited effectiveness on pit and fissure caries, where sealants have been shown to be effective, but may have promise in prevention of root caries in adults. More studies are needed. The 5% sodium fluoride varnish and a 1% chlorhexidine/thymol varnish are available in the U.S., however, the SDF solution is not available.

Application of fluoride varnish 4 times a year for elderly patients seen in practice settings aligns well with 3 month periodontal maintenance intervals recommended for many elders with high caries risk or periodontitis. The other interesting point generated by this research project relates to the use of fluoride varnish in public health or institutional settings where adults are treated. Results support the use of varnishes in clinical and community settings where many dental hygienists are delivering preventive oral hygiene instruction and oral health services to older adults. Prevention of root caries will continue to be an important aspect of dental hygiene care, and its importance is likely to increase as the elderly population grows in the U.S.

**Vale GC, Tabchoruryl CPM, Del Bel Cury AA, Tenuta LMA, ten Cate JM, Cury, JA. APF and dentifrice effect on root dentin demineralization and biofilm. J Dent Res. 2011;90(1):77–81.**

Because dentin is more caries-susceptible than enamel, its demineralization may be more influenced by additional fluoride. We hypothesized that a combination of professional fluoride, applied as acidulated phosphate fluoride (APF), and use of 1,100 ppm fluoride dentifrice would provide additional protection for dentin compared with 1,100 ppm fluoride alone. Twelve adult volunteers wore palatal appliances containing root dentin slabs, which were subjected, to biofilm accumulation and sucrose exposure 8 times per day during 4 experimental phases of 7 days each. The volunteers were randomly assigned to the following treatments: placebo dentifrice (PD), 1,100 ppm fluoride dentifrice (FD), APF+PD and APF+FD. APF gel (1.23% fluoride) was applied to the slabs once at the beginning of the experimental phase, and the dentifrices were used 3 times per day. APF and FD increased fluoride concentration in biofilm fluid and reduced root dentin demineralization, presenting an additive effect. Analysis of the data suggests that the combination of APF gel application and daily regular use of 1,100 ppm fluoride dentifrice may provide additional protection against root caries compared with the dentifrice alone.

## Commentary

Evidence indicates fluoridated toothpaste has preventive effects in children and adults for both coronal and root caries. For root caries, fluoride has been shown to promote remineralization and inhibit demineralization. Higher concentrations of fluoride appear to be required for prevention of root caries than coronal caries. Thus, daily home use of 5,000 ppm fluoride gels, polishes and dentifrices are recommended for adult and elderly patients with root exposure rather than, or in addition to, over-the-counter dentifrices with 1,000 or 1,100 ppm fluoride. For coronal caries prevention, the combination of fluoride dentifrice with other topical fluoride treatments (gels, rinses or varnishes) has been shown to have modest additive effects in children and adolescents, according to systematic reviews conducted by the Cochrane Collaboration. Additional research is needed to determine cumulative benefits of combining other forms of fluoride treatments with daily toothpaste use in adults. This study was conducted to test whether a combination of professional fluoride, specifically APF and the use of an 1,100 ppm fluoride dentifrice, would provide additional protection for dentin which, as mentioned earlier in this column, is more caries-susceptible than enamel, in comparison to the 1,100 ppm fluoride dentifrice alone.

Despite mechanical removal of plaque from tooth surfaces, biofilms remain. These biofilms may significantly influence tooth remineralization and demineralization because fluoride ions from toothpastes and dentifrices accumulate in dental plaque where the concentration remains effective for hours after tooth brushing. It is believed that this fluoride retention in biofilm might be one of the main mechanisms for the preventive effect of fluoride toothpastes. The same rationale might reasonably be applied to mouth rinses, although to date, studies regarding fluoride retention in plaque biofilm have focused on dentifrices. It is known, however, that regular use of a fluoride mouth rinse is associated with a reduction in caries in children. It also has been shown that fluoride from either highly concentrated fluoride dentifrices or fluoride mouthrinses has a preventive effect on root caries.

Fluoride gels, including APF, applied twice a year have also been shown to reduce caries in children. The theory behind the cariostatic effect of APF professional fluoride differs from formulations used at home, in that it is applied to a clean tooth surface after professional scaling and/or polishing. The acidic pH is intended to etch the tooth surface to allow for optimal uptake of fluoride, however, evi-

dence does not support APF as more effective than other forms of professionally applied fluoride gels. A concern has been asserted by several authors, speakers and clinicians about the effect of etching by APF on composite and porcelain dental restorations.

Results of this study were based on in situ testing, meaning a situation was created to simulate the effects in the oral cavity of humans over a period of time. It differs from in vitro studies, which are conducted in laboratory settings. These investigators used acrylic palatal appliances with 4 root dentin slabs, comprised of bovine dentin (from cows), inserted into the mouths of adult volunteers. Two of the dentin slabs were treated with APF and removed immediately after its application to assess fluoride concentration. Twelve volunteers were randomly assigned to groups to reduce researcher bias as follows: PD (placebo dentifrice), FD (1,100 ppm fluoride dentifrice), APF+PD or APF+FD. Although the sample size was small, the authors indicated a strong statistical power of 90%.

Volunteers were instructed to wear the appliance all of the time except when eating. Low molecular carbohydrates in the diet (white flour and sugar) are known to be metabolized by oral bacteria and provide a cariogenic challenge to tooth surfaces. To simulate dietary exposure to sugar, the volunteers dripped 20% sucrose solution on the slab outside of the mouth. Participants brushed their teeth and the appliance with the assigned toothpaste after meals (3 times a day). Biofilm was collected on the seventh day of the experiment, 10 hours after the last sucrose exposure and without brushing. The research design attempted to simulate what might happen to human root surfaces in the oral cavity over time.

Results showed APF and 1,100 ppm FD increased fluoride concentration in biofilm fluid and reduced root dentin demineralization. The additive effect was shown to be more effective than either treatment alone. The increased fluoride concentration in biofilm was sustained for 7 days after a single APF application. The authors concluded that the anti-caries efficacy of this combination should be confirmed in real conditions of dentifrice use. Human dentin might respond differently to fluoride than bovine dentin. Actual dietary exposure to low molecular carbohydrates in the mouth might differ from the simulation used in this study. The authors did not discuss the safety of using APF on the root surface, however, surface hardness was improved, and no adverse events were reported. Additional research is needed.

## The Bottom Line

Each of these studies addressed prevention of root caries in adults. This research is important because most evidence for caries preventive methods have been conducted in children and adolescents. In addition, most studies have been directed at coronal caries prevention, rather than root caries. Thus, strong evidence is lacking to support decision making regarding best practices for reduction of root caries in adults.

As the population ages and people keep their teeth longer, root caries prevalence is on the rise. Exposed root surfaces resulting from recession are at risk for caries because dentin is more susceptible to caries than enamel. Recession caused by aging, toothbrush trauma and periodontal disease is common in adults and older adults.

Fluoride is the most well-documented and widely used caries preventive agent. Home use of a fluoride toothpaste as an adjunct to mechanical biofilm removal has been shown to significantly reduce both coronal and root caries. Previous research also supports higher concentrations (5,000 ppm) of fluoride than concentrations (1,000 or 1,100 ppm) found in over-the-counter fluoride dentifrices. Additional evidence is needed to confirm the additive benefits of multiple sources of fluoride used at home.

Evidence supporting professional application of fluoride in adults is weak. Nonetheless, use of topical fluorides for adults in dental practices is common. Application of fluoride varnish 4 times a year, coinciding with 3 month re-care intervals, is recommended for patients with high caries risk. Studies assessing combinations and frequencies of home and professional agents effective in controlling root caries in adults also are needed.

These 2 studies addressed this important need. Results of the first study conducted with residents of long-term care facilities indicate that professional application of 5% fluoride varnish can be recommended for older adults. Fluoride varnish combined with oral hygiene instruction (OHI) is more effective than OHI recommending daily tooth brushing with fluoridated toothpaste for reduction of new root caries lesions over a 3 year period. Results also provided support for the use of 1.1% chlorhexidine and 38% silver diamine fluoride solution (SDF) for prevention of new root caries lesions. The second study, using an in situ approach, provided initial data suggesting the combination of APF gel and daily use of 1,100 fluoride dentifrice increased fluoride concentration in biofilm fluid and reduced root dentin demineralization. Both of these studies provide support for an additive effect of multiple delivery mechanisms

of fluoride. Long-term clinical trials are needed to strengthen this evidence. In the meantime, the following conclusions can be drawn:

- There is some evidence to support that sodium fluoride varnish, chlorhexidine varnish and SDF solution are more effective in preventing new root caries than giving OHI for daily tooth brushing with a fluoride dentifrice alone
- Preliminary data suggests that the combination of APF gel application and daily regular use of 1,100 ppm fluoride dentifrice may provide additional protection against root caries compared with the dentifrice alone. However, other agents in professional fluoride gels and safety issues related to use of APF on root surfaces need further study before these results can be adopted confidently in practice

## Summary

Dental hygienists are treating more elderly patients in private practices, community clinics and assisted-living or long-term care facilities. Effective and safe measures for prevention of root caries are needed to address the needs of this population. Well designed, long-term clinical trials that assess the additive effects of combinations of fluoride, alongside the caries-inhibiting effects of other preventive agents (chlorhexidine, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and xylitol) are needed.

Dental hygienists evaluating forthcoming studies can use this comparison of study methodologies to evaluate the strength of the evidence. Findings from in vivo studies with human subjects are more valid than in vitro (lab) or in situ (simulated in a natural environment) studies given appropriate research designs and controls, however, the latter might be more appropriate for early testing needed to establish safety or generate preliminary results supporting efficacy. Trials with larger sample sizes have more statistical power than those employing small sample sizes. Clinical studies conducted in real world settings with randomization, controls, double blind or blind scoring, and over a long time period, are desirable.

Studies evaluating caries risk assessment and protocols also are needed. Despite the low level of evidence for prevention of root caries in adults, some recommendations for clinical practice can be made. Frequency of appointments for preventive dental hygiene services can be adjusted based on caries risk assessment with shorter intervals for patients with high risk. Professional application of 5%

fluoride varnish and recommendations for higher concentration (5,000 ppm) fluoride dentifrice used daily at home may be used to reduce development of new root caries lesions. These measures are easily and safely delivered in the various settings in which dental hygienists treat older adults. Dental hygienists are providing oral health care to elders in long-term care facilities, assisted-living facilities, senior centers, community clinics and private dental offices. The numbers of people in the U.S. over the age of 65 is projected to continue to increase over the next 2 decades, and some predict 1 in 5 elders will live in long-term care facilities. Practical, evidence-based approaches for prevention of root caries are needed. These studies add information to the body of knowledge to strengthen our confidence

in use of some measures while indicating a need for further research in others. No single preventive method will be ideal for all patients in all settings. Effective prevention will depend on more evidence to document effectiveness of various agents and protocols for individuals at low, moderate and high caries risk.

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