

A New Look at Fluoride Varnishes

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Abstract: Fluoride varnishes have been available for over 30 years but there may be clinicians and dental public health practitioners who are unaware of the true level of effectiveness they provide in caries control. Under the headings of effectiveness, ease of application and safety the available evidence is digested and summarized to inform the reader about the indications, method of use and alternative options for caries control.

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Clinical Relevance: This paper provides clinicians and dental health promotion managers with relevant and up-to-date information to assist their decision-making when considering appropriate methods of preventing, controlling and reversing the caries process.

Despite a reduction in the prevalence and severity of dental caries in children and adolescents, many individuals and communities are caries active or are considered to be at high caries risk. Such individuals and communities tend to be more deprived, brush less frequently with fluoride toothpaste, have diets high in sugary foods and drinks and are irregular dental attenders.^{1,2} The cornerstone of any attempt to prevent and control caries should be to encourage brushing twice daily with a fluoride toothpaste and reduce the frequency of sugar intake. However, when faced with such high risk individuals or communities, dental professionals should also consider the use of fluoride varnishes. Recent

publications have provided strong evidence to support the effectiveness of fluoride varnishes.³⁻⁷ This paper will consider the relative merits of fluoride varnishes with other operator-applied preventive procedures in the management of high risk individuals and/or communities.

The choice of any professionally applied fluoride delivery method will depend on a number of factors but primarily these are:

- Effectiveness;
- Ease of application/patient acceptance;
- Safety.

EFFECTIVENESS

The effectiveness of fluoride varnishes in preventing dental caries has been evaluated in numerous clinical trials over the past three decades. The data from these studies have recently been the subject of a number of systematic reviews³⁻⁶ and a Cochrane Review⁷ and

provide the strongest evidence to support the effectiveness of fluoride varnishes in reducing dental caries. There are a number of fluoride varnishes on the market which differ in composition and fluoride concentration (Table 1).

Each review has posed a different question and applied different criteria for studies to be included or excluded from analysis. For example, the Cochrane Review⁷ considered only randomized controlled clinical trials (RCTs) that compared fluoride varnishes with either a placebo or no treatment. The review by Strohmenger and Brambilla⁶ included only studies that compared fluoride varnishes with fortnightly rinses with 0.2% NaF (900 ppm F). A total of 9 RCTs satisfied the inclusion criteria in the Cochrane Review,⁷ 8 of which involved *Duraphat* (22,600 ppm F); three other varnishes, namely *Biofluorid 12* (56,300 ppm F), *Fluor Protector* (7,000 ppm F) and *Lawefluor* (Dental-Kosmetik GmbH, Dresden, Germany) (22,600 ppm F) were each involved in one study. Strohmenger and Brambilla⁶ analysed four RCTs, two of which involved *Duraphat* and two *Fluor Protector*. The review by Helfenstein and Steiner,³ initially included 8 RCTs, but this was subsequently increased to 14, all of which involved *Duraphat* varnish.⁴

Despite differences in protocols, these systematic reviews all concluded that fluoride varnishes have a substantial caries-inhibiting effect in children and adolescents. The Cochrane Review⁷ reported that, when compared with a placebo or no treatment, twice-yearly fluoride varnish applications produced a mean reduction in caries increment of

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| Product name | Concentration ppm F | mg of F applying 0.3–0.5 ml |
|---|---------------------|-----------------------------|
| <i>Duraphat</i> (Colgate Oral Pharmaceuticals, Guildford, UK) | 22,600 | 6.8–11.3 |
| <i>Fluor Protector</i> (Ivoclar-Vivadent, Leicester, UK) | 7,000 1,000 | 2.1–3.5 0.3–0.5 |
| <i>Biofluorid 12</i> (VOCO Chemi GmbH, Cuxhaven, Germany) | 56,300 | 17.4–28.1 |

Table 1. Fluoride concentrations of fluoride varnishes.

33% and 46% in the deciduous and permanent dentitions, respectively. When compared with no treatment or fluoride rinsing,^{3,4} *Duraphat* varnish reduced caries in the permanent dentition by 38%. There were no significant differences between fluoride varnish and fortnightly fluoride rinses.⁶

Other studies, which were not included in these systematic reviews, suggest that fluoride varnishes may also have benefits in addition to simply reducing the incidence of caries. For example, in a 9-month study, 142 children, aged 3 to 5 years, were randomly allocated to have either *Duraphat* varnish applied at baseline and after 4 months or to have nothing applied.⁸ In the varnish group, 81% of active enamel lesions on occlusal, buccal and lingual surfaces had become inactive after 9 months, compared with 38% in the control group. This result suggests that the application of fluoride varnish may be effective in arresting early active enamel lesions in the primary dentition. Another RCT⁹ showed that the biannual application of *Duraphat* varnish reduced the progression of caries in the approximal surfaces of deciduous molars in 33% of subjects, compared with 9% in a no treatment control group.

Finally, a further study¹⁰ examined the effect of applying *Duraphat* varnish four times a year to root surface caries lesions. After one year, the group who had fluoride varnish applied had developed 0.67 new decayed and filled root surfaces, compared with 1.53 in the control group.

EASE OF APPLICATION

A thorough prophylaxis and drying is

not essential prior to the application of varnish but the removal of gross plaque is advisable. Adequate moisture control with cotton wool rolls will suffice as the varnish sets in contact with moisture. Fluoride varnish can be targeted at specific teeth, surfaces or initiation sites and is easy to apply with either a brush, microbrush or cotton tip applicator. Care should be used to ensure that the smallest quantity of varnish is applied. The time required for application is short, ranging from one to four minutes, depending on the number of teeth and surfaces. The procedure causes no discomfort and is well tolerated, even by unco-operative patients.

FREQUENCY OF APPLICATION

In the majority of studies, varnish was applied biannually. Increased frequency of application has been recommended in cases of rampant caries,¹¹ but no benefit has yet been established.¹²

SAFETY

Despite their high concentration of fluoride, such varnishes are considered to be safe since only a small amount (0.25–0.5 ml) should be applied. This represents an exposure and potential ingestion of 3.5–11.3 mg F, which is well below the probable toxic dose of 5mg/kg body weight. The Cochrane Review⁷ concluded that the RCTs provided little information regarding the occurrence of side-effects associated with the use of fluoride varnishes. However, over the past 30 years, over 30 million applications of *Duraphat* varnish have been given with very few reports of any adverse events attributable to the

varnish. Two cases of allergic reactions to the colophony component of *Duraphat* varnish have been reported¹³ and the product should not be applied to individuals with a history of severe asthma.

RATIONALE FOR USE

In General Dental Practice

For children less than 7 years of age, the application of fluoride varnish is the only professionally applied option, since few can tolerate the application of fluoride gel or foam in trays. The use of gels or foams also have the added risk of swallowing high levels of fluoride.¹⁴ The biannual application of fluoride varnish can reduce the incidence of caries in the deciduous dentition⁷ and inactivate early enamel lesions,⁸ thus reducing or delaying the need for restorative treatment.

For older, high risk children and adolescents another option is the professional application of fluoride gel or foam. However, a recent Cochrane Review¹⁵ reported that fluoride gels resulted in a 28% reduction in caries in the permanent dentition which, when compared with the 46% reduction with fluoride varnish, suggests they may be less effective. As noted previously, there is a risk with gels and foams of swallowing high levels of fluoride and they are less well tolerated. Fifty-nine percent of children aged 3–14 years had at least one negative response to the application of a fluoride foam, compared to 14% who had varnish.¹⁶ Thirty-nine percent who had preventive treatment with fluoride foam felt it stimulated a gag reflex, compared to only 17% who had varnish. The Cochrane Review⁷ concluded that there was little data concerning the acceptability of varnish application. A survey of hygienists and patients in the USA¹⁷ compared fluoride varnish and gels with respect to taste, comfort, moisture control and ease of application. All hygienists rated *Duraphat* varnish superior to fluoride gels in every respect and 64% of patients preferred the varnish.

The effectiveness of another professionally applied option, namely chlorhexidine varnish, in reducing caries in high-caries risk individuals has been questioned in a recent randomized clinical trial.¹⁸ After meticulous professional cleaning and drying of the teeth, the varnish (*Chlorzoin*, APO Diagnostics Inc.), containing 10% chlorhexidine acetate and 20% Sumatra benzoin, was applied at weekly intervals during the first month and thereafter at least once a year. This regimen failed to reduce the 3-year caries increment when compared to a placebo varnish. In a study comparing a fluoride varnish (*Fluor Protector* containing 0.1% fluoride) with that of a chlorhexidine varnish (*Cervitec*, Ivoclar-Vivadent, containing chlorhexidine and 1% thymol) every 3 months for 3 years, no significant difference in the increment of approximal caries was observed.¹⁹

An RCT, involving 6–8 year-old children, demonstrated that a light polymerized fissure sealant (*Delton*, Johnson & Johnson, High Wycombe, UK) and biannual application of fluoride varnish were both effective in reducing fissure caries when compared with a control.^{20,21} However, the percentages of first molars that developed fissure caries after 24 months; 45% (control), 28% (varnish) and 11% (sealant) indicate that the sealant was significantly more effective than the varnish. Nevertheless, where isolation is a problem, such as around partially erupted molars or where co-operation is limited, the application of varnish provides an effective, albeit temporary, means of management.

Finally, one RCT provides evidence that suggests that the risk of root caries may be reduced by applying fluoride varnish four times a year to exposed root surfaces.¹⁰

As a Public Health Measure

There are many advantages to the use of fluoride varnishes in community-based programmes targeted at high risk children and adolescents. These are:

- Proven effectiveness;
- Ease of application;

- No need for special equipment or professional prophylaxis;
- Targeted application to specific teeth and/or surfaces;
- Safety and acceptance by young children.

In contrast, the application of fluoride gels/foams, chlorhexidine varnishes and sealants require more sophisticated facilities and equipment and consequently greater co-operation.

The cost-effectiveness of any preventive programme, such as fluoride varnish, will depend to a large extent on the incidence of caries in the community. Clearly, the higher the incidence, the smaller the number of children who would need to be treated to have a measurable health benefit. For example, it has been calculated that 1.4 children would need to be targeted with fluoride varnish to prevent two surfaces per year becoming carious in a population with an increment of 1.6 DMFS/year, compared to 3.2 children if the annual increment was 0.67 DMFS/year.⁷

Cost-effectiveness ratios need to be calculated for the UK; in Canada, the cost per application of varnish was estimated to be \$ (Can) 3.91 and \$4.5 for foam.¹⁶

SUMMARY

Fluoride varnishes provide the dental professional with a simple and effective means of reducing dental caries in high-risk individuals and communities.

AFFILIATION

Robin Davies is an employee of Colgate-Palmolive (UK) Ltd.

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