ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 5, Issue – 3, May - 2022, Page No. : 288 - 294

Fluoride Varnishes in Pediatric Dentistry - A Clinical Update

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Citation of this Article: Nayanlata Saxena, Deepak Viswanath, Swapnil Jaiswal, Dipti Bhagat, Palini Pradhan, Pallavi Goswami, "Fluoride Varnishes in Pediatric Dentistry - A Clinical Update", IJDSIR- May - 2022, Vol. – 5, Issue - 3, P. No. 288 – 294.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Fluoride is the most effective, safest, and cost-efficient method of preventing dental caries. The increased emphasis on preventive-based dentistry has resulted in the fast development of newer and more novel treatment methods aiming at disease prevention at an earlier stage. Fluoride varnishes, together with patient and parent education, are quickly becoming a key component of prevention-based programmes in this setting. Fluoride varnishes bond to enamel, and the calcium fluoride generated after application serves as a long-term fluoride reservoir. It has been discovered that four treatments each year or three weekly applications once a year are beneficial. This review article lays emphasis on the implementation of fluoride varnishes in pediatric dentistry.

Keywords: Fluoride, Caries, Fluoride Varnish, Topical Fluoride

Introduction

Dental caries is a multi - factorial condition which causes tooth demineralization in both children and adults. Although untreated dental caries can advance, it can be prevented, reversed, or halted in its early stages. Dental caries is being treated with a newer approach of prevention and minimal invasive treatment following early diagnosis of the disease. [1]

Fluoride has played a key role in the significant decline in the prevalence and severity of dental caries When applied topically, Low fluoride levels in plaque and saliva hinder the demineralization of sound enamel and promote the remineralization of demineralized enamel. Fluoride also prevents dental caries by inhibiting cariogenic bacteria's metabolic activities. High fluoride levels, such as those achieved with topical gels or varnishes, cause a transient coating of calcium fluoride-like substance to form on the enamel surface. When the pH drops in reaction to acid production, fluoride is released and becomes accessible to remineralize enamel or impair bacterial metabolism. [2]

Fluoride varnishes comprise of 22,500 mg/L F in an alcohol and resin base solution. When applied to dry teeth, they develop a waxy coating that adheres to the teeth until worn away by chewing or brushing. [3] Fluoride varnish is a concentrated fluoride-based natural tree resin (colophony or rosin). The fact that the resin foundation in which the fluoride is suspended is tenacious in its adhesion to teeth is a prominent feature of varnish, allowing for longer fluoride-enamel interaction over time. The majority of fluoride varnish formulations include 2.26 % fluoride from a 5 % sodium fluoride (NaF) suspension in an alcoholic solution of natural varnish components.[4]

To deliver fluoride to those living in non-fluoridated locations, a NaF solution for topical application to teeth was devised in the 1940s. To enhance the contact duration between fluoride and enamel, the first fluoride varnishes were introduced in the 1960s (Duraphat® NaF varnish) and 1970s (Fluor Protector® silane fluoride varnish). Schmidt proposed a technique of putting NaF in a natural colophony base that could attach to tooth surfaces even when saliva was present. Further, Duraphat was the name given to this substance after further development and registration.[5]

Despite the fact that it has been widely used in Europe for over 25 years, its clearance by the Federal Drug Administration (FDA), a regulatory body of the United States government, did not happen until 1994. The FDA has approved varnish as a "device" for use as a cavity liner and desensitizing agent, placing it in a category of medications and devices that "offer little risk and are subject to the lowest degree of regulation." Because caries prevention is a drug claim rather than a device, the FDA considers the use of varnish in dental caries prevention to be "off label," a frequent practice in medicine. They are later recommended by the American Dental Association due to rigorous clinical researches confirming the efficacy and safety of varnish.[3,4]

Technique of Application

Fluoride varnish can be applied with a disposable brush. Varnish can be used before or after professional prophylaxis, as well as after brushing with a toothbrush. Compressed air or dry gauze should be used to dry the teeth before application. Fluoride varnish can be applied to entire tooth surfaces or to specific areas that are more susceptible to caries (i.e., decalcified sites or maxillary anterior teeth in children at risk for early childhood caries). Because the varnish sets upon contact with the oral fluids, there is no need to wait for it to dry before discharging the patient. Eating and drinking should be withheld for at least 30 minutes after the varnish has

been applied. Brushing should be delayed until the next day in order for the varnish to stay in touch with the teeth for as long as feasible. Fluoride varnish can be administered ranging to once - four times a year. Although one application per year has been found to be beneficial, the American Dental Association advises at least two applications per year, or once every six months. For patients with high risk of caries, three-month applications are suggested. Some recommend dations of use are shown in table 1& 2[1,5]

Three application frequency patterns appear to exist: [5]

1. Once every six months
2. A single application is done four times each year.
3. Over the course of one week, three applications.

Table 1: AAPD recommendations for fluoride therapy (2021) [2]

- Evidence-based studies demonstrate that using fluoride for caries prevention and control is both safe and effective in lowering dental caries prevalence.
- Evidence-based evaluations indicate that fluoride dietary supplements are beneficial in decreasing dental caries and should be explored for children who drink fluoride-deficient (less than 0.6 ppm) water.
- Evidence-based evaluations indicate the efficacy of professionally administered topical fluoride treatments such as 5% NaFV or 1.23 % F gel formulations reduces caries in children at risk.
- Evidence-based reviews show that fluoridated toothpaste reduces dental caries in children, with the benefit being stronger in children with a higher baseline level of caries, a higher fluoride concentration in the toothpaste, a greater rate of usage, and supervision. For youngsters under the age of three, using no more than a smear or a rice-size quantity of fluoridated toothpaste may reduce the incidence of fluorosis. Children from three to six should use as little as a pea-sized quantity of fluoridated toothpaste.
- Evidence-based assessments reveal that prescription-strength home-use 0.5 percent fluoride gels and pastes, as well as prescription-strength home-use 0.09 percent fluoride mouth rinse, are beneficial in decreasing dental caries.
- Evidence-based analyses support the use of 38 percent silver diamine fluoride in primary teeth as part of a thorough caries treatment programme for the prevention of cavitated caries infections.

Table 2: Recommendations/ Guidelines for the use of fluoride varnish [4]

AAPD (American Academy of Pediatric Dentistry)	Recommend application of 5% fluoride varnish at least once every six months in children highly susceptible of caries
ARCPOH (Australian Research Centre for Population Oral Health)	Recommends restricting professional fluoride application to fluoride varnish for children under the age of ten. The varnish should be used on children who are at a high risk of developing caries.
EAPD (European Academy of Pediatric Dentistry)	Recommends using fluoride varnish (1000-56,300 ppm F) 2-4 times every year by a dental expert to prevent caries in both primary and permanent teeth. Prior to application, any obvious deposits of dental plaque should be removed, and a thin layer of varnish

	using a little amount of varnish should be applied. The implementation can be performed by someone who isn't a dentist. The quantity might be maintained to a minimum by restricting application to high-risk areas. Children should be told not to eat or drink for 20-30 minutes after applying the varnish. Fluoride varnish is helpful in preventing caries in both primary and permanent teeth, according to the EAPD. (The level of evidence is 1++, and the recommended grade is A.)
NZGG (New Zealand Guidelines Group)	Recommends using fluoride varnish on children that are at high risk of acquiring caries. To keep below the potentially dangerous dosage, the amount of 5% sodium fluoride varnish used should not exceed 0.25 mg (ptd). Fluoride varnish can be administered to all erupting teeth every six months. Healthcare practitioners who have received sufficient training can administer the application to high-risk children over the age of 12 months.
Public Health England	Supports qualified health practitioners using fluoride varnish. All children above the age of three should have 2.2 % fluoride varnish applied twice a year, according to the standards (grade 1 evidence). Fluoride varnish should be used twice a year or more to all children with a high caries risk (grade 1 evidence).
SIGN (Scottish Intercollegiate Guidelines Network)	Fluoride varnish decreased caries incidence for target populations in most trials, according to SIGN recommendations. Between research, the magnitude of the impact varied greatly. (Evidence Level 1++) Fluoride varnish should be applied at least twice a year to all children, according to the guidelines. (A-grade recommendation)

Amir Azarpazhooh et al.[6]reported in their review that any procedure for the administration of fluoride varnish should be dependent on risk assessment. Previous or present caries experience is the best indication of caries risk. Fluoride varnish has been shown to be effective in reducing dental cavities in children and adolescents (level of evidence I, grade of recommendation A). With two applications in a year, there is strong evidence of effectiveness (level of evidence I, grade of recommendation grade A). There is insufficient data to justify three applications in a short period of time, such as a week or two (level of evidence I, grade of recommendation E). Logistical concerns may also lead to a choice to apply varnish twice a year; in this case, varnish application should be paired with a review of any sealants to assure proper retention (level of evidence I, grade of recommendation A). Fluoride availability in the varnish preparation must be consistent, which cannot be achieved with multidose packets. Dura fluor and Duraphat are the materials of choice at this moment owing to their continued slow release of fluoride.

The following techniques are suggested as a result of their findings: [6]

1. Fluoride varnish should be applied twice a year to predominantly high-risk populations (e.g., people with low socioeconomic status, new immigrants and refugees, all First Nations and Inuit children and adolescents), unless the individual has no risk of caries, as indicated by past and current caries history.

2. For children, single-dose fluoride varnish packages should be used; the varnish from these packages should be thoroughly mixed before application to ensure that any precipitated fluoride is redissolved.[6]

Composition

Most varnishes have similar main ingredients, with a few exceptions (table3,4). Resin (colophony), alcohol, and sodium fluoride are used to make them. Alcohols, such as ethanol or others, are used as solvents to keep the varnish fluid and make it easier to apply. The solvents in the varnish evaporate when it comes into contact with air, and the varnish adheres to the tooth surfaces, extending the period of fluoride exposure. Other chemicals, such as stabilizing agents, adhesion-promoting agents, colorants, modifying agents, and flavouring agents, may be incorporated in addition to these three primary constituents. Calcium–phosphate compounds have recently been added to certain fluoride varnishes to help with remineralization. Enamel Pro (Premier Dental) now contains amorphous calcium phosphate (ACP), and Vanish (3M ESPE) contain tri-calcium phosphate (TCP). [7]

Table 3: Composition of Commonly Available Fluoride Varnishes [7]

Duraphat and Durafluor	**Fluor protector**
5% NaF or 22,600 parts per million fluoride ions (ppm F) with a rosin and ethanol carrier.	contains 0.9% difluoro silane or 1000 ppm on a polyurethane varnish base with ethyl acetate and isoamyl propionate solvents.
comes in a 10 mL tube that is suitable for multiple uses	comes in an ampule that is used for a single (0.4 mL) or multiple doses (1.0 mL)

Table 4: Comparison of The Two Main Types of Fluoride Varnish [7]

	Sodium Fluoride	Fluoride Silane
Commercial name	Duraphat, Colgate Oral Pharmaceuticals, New York, NY, USA	Fluor Protector, Ivoclar Vivadent, Schaan, Liechtenstein
Discovered	in 1960	in 1975
Main component	5% sodium fluoride (NAF) by weight	0.9% difluoro silane by weight
Fluoride concentration ppm	22,600 ppm F	1000 ppm F
Fluoride concentration %	2.26% fluoride	0.1% fluoride
Type	Resin base varnish	polyurethane-based varnish
Available as	10 mL tube suitable for multiple uses	either a 0.4 mL single use or a 1.0 mL ampule for multiple doses
Mechanism of action	-Bacterial inhibition -Fluorapatite formation -Inhibition of	-Bacterial inhibition -Fluorapatite formation -Inhibition of

	demineralization -Enhancing remineralization	demineralization -Enhancing remineralization

Recent advancements in Fluoride Varnish

To achieve an anti-caries effect with traditional fluoride varnish, numerous applications are required. As a result, light-curable fluoride varnish (LCFV) was introduced as a localized protective varnish for both the dentin and enamel surfaces of the teeth. When compared to traditional fluoride varnish, it has demonstrated improved durability and lifespan. Vanish XT varnish and Clinpro XT varnish are examples of light-curable resin-modified glass ionomer (RMGI) varnishes. These varnishes feature a gradual release of fluoride, which means their impact might last up to six months.[7]

Vanish XT varnish is used to treat hypersensitive teeth and as a sealant for teeth with a high caries risk, such as newly or partly erupted teeth, tooth surfaces close to orthodontic brackets, acid erosion, and non-cavitated lesions. Vanish XT varnish's glass ionomer composition improves tooth structure adherence and fluoride retention. Vanish XT varnish also has the ability to release calcium and phosphate. According to several studies, light-curable RMGI varnishes protect enamel demineralization for longer than fluoride varnish.[7]

Yağmur Lena Sezici et al[8] found that enamel matrix protein, self-assembling peptide, and light-curable fluoride varnishes dramatically decreased fluorescence loss over the course of 21 days. In comparison to Duraphat, Enamel Pro fluoride varnishes, and Emdogain at different time periods, Curo dont and Clinpro XT were successful in reducing fluorescence loss and white spot lesion area.[8]

Hyun-Jung Kim et al[9] in their study revealed that bioactive glass (BAG) containing varnish can aid in restoring demineralized enamel's microhardness and promote hydroxyapatite crystal formation on the demineralized surface. The BAG-containing varnish provides therapeutic benefits such as fast adherence to the enamel surface due to light curing and adequate response time. Under ultrasonication circumstances, the newly generated HAP layer was relatively stable. The use of light-curing experimental BAG varnish in minimally invasive dentistry might be a beneficial technique for promoting remineralization of early carious lesions or demineralized enamel surfaces, with a longer application period and improved ease of usage.[9]

Fluorimax™ contains a 2.5% NaF (11,300 ppm F) concentration that has been found to be beneficial in enamel remineralization and dental acid erosion protection, as well as improved fluoride uptake. It is a hypoallergenic solution that does not contain colophony but rather a colorless dewaxed food-grade shellac with added hydroxyapatite, which will act as the fluoride's carrier. [10]

Advantages

- Varnishes can set quickly when applied to enamel surfaces
- This can remain adhered to the surface for longer time.
- Because fluoride is slowly released, teeth are exposed to a larger fluoride concentration.
- it is easy, quick, and not technique-sensitive in application complete tooth drying is not necessary
- chairside application time is low due to no need of prior prophylaxis
- Varnishes can be utilised with young children, special needs children, and patients with gagging reflux because of their quick setting time. [7]

Disadvantages

- Varnishes containing sodium fluoride can temporarily alter the colour of teeth. This colour change

is just transient, lasting for 24 hours until the varnish's outer layer is removed by brushing.

- The acceptance of patient varnish differs from person to person. The majority of patients are unconcerned with the presence of varnish on their teeth. Some patients, on the other hand, loathe the flavour or feel of the sticky varnish covering on their teeth. To sustain the preventative action of fluoride varnish, it must be reapplied.
- Colophony is a contact sensitizer that may be found in fluoride varnish. Individuals with a documented sensitivity to colophony (rosin) may experience allergic responses (Stomatitis or dermatitis can occur) to fluoride varnish, however this is unusual.
- Fluoride varnish should not be used in individuals with ulcerative gingivitis or stomatitis.

Conclusion

The current perspective of fluoride varnish is that it is easy to apply, takes only a few seconds, and is safe for children and other special needs groups. Fluoride varnishes are an effective and safe method of delivering and retaining fluoride on tooth structure. Furthermore, they are beneficial in slowing the progression of caries by increasing remineralization at the tooth surface and reducing demineralization.

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