

Review Article

Effect of Fluoride Varnish in Caries Reduction among Children and Adolescents: A Review

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Abstract

Caries is one of the major ailments faced globally due to increased consumption of refined carbohydrates, despite health education measures taken to curb the initiation and progression of caries in both children and adolescents. Its origin is multifactorial and continues to be a burden in spite of major advances in prevention and management techniques. Many preventive measures have been suggested and used in different ways to arrest the progression or prevention of caries. Numerous fluoride compounds with varying concentrations and duration of application have been used over time. The present article is focused on the review of the Medline archived literature to assess and understand the effect of fluoride varnish in caries prevention among children and adolescents in the United states. Many of the

published studies examined the effects of different fluoride products on caries prevention. The authors reviewed the exclusive literature of fluoride varnish in the reduction of caries in children and adolescents. The review also critically analyses the existing publications for the robustness of evidence and briefly discusses established guidelines used for the prevention of caries.

Keywords: Caries; Fluoride Varnish; Prevention; United States of America

1. Introduction

Fluoride varnish was introduced way back in 1960s and is widely used in European countries and Canada since the 1970s for caries prevention. As with other forms of topical fluoride the fluoride varnish protects the tooth by

reducing demineralization and promotes its remineralization. Fluoride varnish was developed to increase its contact time with enamel. It has been used in the United States in the last two decades [1]. Duraphat (2.2% F) and Fluor Protector (0.1% F) were the most commonly used fluoride varnishes in early 2000 [2]. Fluoride varnish is an effective and proven tool for the prevention of dental caries in children and adolescents [3, 4]. Due to the ease of use, acceptability, and efficacy of the varnish, it makes an important primary preventive measure in high caries risk children [5]. It adheres to the tooth surface and prolongs the contact time between fluoride and enamel thus improving the uptake of fluoride. The use of fluoride tooth paste along with fluoride varnish application was found to be more effective than when the fluoride tooth paste was used alone. Varnish application reduces the risk of fluoride over ingestion and has greater patient acceptance [2]. Frequency of application depends on the caries risk. Biannual application of fluoride varnish can result in a reduction of 38% in caries over two years [2]. There has been an increase in third party reimbursement for fluoride varnish applications in high-risk children and adults. The recommendation to use fluoride varnish as a caries preventive measure has been adopted by many nations across the world. The versatility of the fluoride varnish prompted us to search the existing literature for the review of current evidence. This paper also critically reviews published systematic reviews, meta-analysis, and advances associated with caries reduction using fluoride varnish.

2. Materials and Methods

The literature search was performed in Medline database using the following Search criteria (fluoride varnish [Title/Abstract] AND caries reduction [Title/Abstract]) AND (children [Title/Abstract] OR adolescents [Title/Abstract]) without any date and language restrictions. The available literature was

grouped into meta-analysis, systematic reviews, and clinical trials (randomized, controlled, single-arm, parallel group, etc.) for the ease of discussion. Bibliographic data was thoroughly screened and relevant full text articles were obtained for critical analysis.

3. Results

The search resulted in 153 articles according to the search criteria. These articles were grouped according to the scope of review. Among them, only twelve articles exclusively discussed the use of fluoride varnish. Thirty-three articles discussed comparative studies and trials associated with the preventive strategy using various other fluoride products.

4. Discussion

Earlier review of the literature indicated incomplete evidence for the efficacy of most measures used for caries prevention, except for fluoride varnishes [6]. The effectiveness of topical fluoride depends on the concentration of fluoride, the frequency and duration of application, and the specific fluoride compound used [6]. Later both pit and fissure sealants and fluoride varnishes were shown to be effective in caries prevention so several studies have compared both these means in the prevention of caries. Many randomized controlled trials (RCTs) [8-27] and systematic reviews [28-39] were performed to understand the evidence for caries prevention using fluoride products. Fernández-Barrera et al's RCT is an ongoing study being conducted to learn the cost effectiveness of pit and fissure sealants and the fluoride varnish application for preventing caries in six to eight-year-old school children in Mexico. Poulami Mishra et al. [38] stated that only a small number of publications with widely varied methodologies were reported on the effect of fluoride varnish on Early Childhood Caries (ECC) [38]. They argued that those studies failed to report any possible

side effects of fluoride varnishes [38]. They found that the preventive fraction for 1% fluoride varnish varied from 6.4% to 30% and that for 5% fluoride varnish varied from 5% to 63%. These preventive fractions were influenced by the frequency of application, the duration of study and sample size. They suggested that researchers conduct further trials on the effect of fluoride varnish on ECC, with improved methodology in terms of sample size, randomization, blinding, duration of the study, use of placebos, and accountability for dropouts [38]. There is a great need to study the preventive aspects of ECC as the ability to intervene with the damaging consequences of ECC greatly improves the oral health of vulnerable children.

Ahovuo-Saloranta et al. [36] updated their previously published systematic reviews from 2006 [34] and 2010 [37]. Their study compared the outcome of pit and fissure sealants versus fluoride varnishes among permanent teeth of children and adolescents in preventing caries [36]. They could not draw any conclusive remarks due to scarce and clinically diverse data which made the comparison difficult [36]. Marinho VC et al. [31] meta-analysis showed substantial caries inhibiting effect of fluoride varnish in both permanent and primary teeth. This conclusion was similar to that published previously [28, 30, 32]. They found that fluoride varnish showed relative benefits irrespective of the baseline risk, severity of caries and prior exposure to fluorides. They concluded that the evidence assessed was of moderate quality as it included studies with high risk of bias and considerable heterogeneity [31]. Some of these studies on varnish versus sealants were inconclusive while others showed a substantial benefit for varnish with moderate evidence. Several studies conducted by the same group of researchers over a period of time to study a particular problem might yield identical conclusions as the researchers may be viewing the question at hand from the same perspective. A

recent meta-analysis compared fissure sealant and fluoride varnish on caries prevention in first permanent molars with an exclusive review of published literature [40]. Their findings did not favor one over the other and stated that they found them to be equally effective in caries prevention. The study concludes that the technique sensitivity, accessibility and cost are the critical factors for the selection of either treatment [40]. It appears to be more convenient for the providers from the patient's perspective to use fluoride varnish and pit and fissure sealants as the main line in caries prevention supplemented by at home fluoride dentifrices and fluoride mouth rinses based on the individual patient needs. De Sousa et al in their meta-analysis on the effects of fluoride varnish on dental caries in preschool children argued that fluoride varnish application did not really affect the risk of development of new caries lesions, rather the excessive exposure to sugar puts them at a higher risk of developing new carious lesions [41]. A study of two-year community fluoride program with semiannual applications of fluoride varnish showed that the oral microflora was not significantly altered [42]. Apart from focusing on the preventive aspects of caries by topical application of fluorides equal emphasis should be devoted in assessing the cause of the problem on an individual basis and strong behavioral modification techniques should be employed to alter the dietary habits of children whereby the root causes of the caries can be attacked thus bringing down the overall caries levels substantially during the life time of an individual. Unless the excess sugar consumption and other cariogenic dietary habits are reduced other aspects of caries progression like the oral microflora may not be altered.

4.1 Consensus on the use of fluoride varnish and regimen

In early 2000's the recommendation of use of topical fluoride for caries prevention in the United States was

as follows. For non cavitated smooth surface carious lesions in a moderate caries-risk patient, the appropriate fluoride regimen was a semiannual topical application of a fluoride varnish containing 5% NaF (2.26% fluoride) with 2,600 ppm of fluoride [6]. Along with this, the patient should use a fluoridated dentifrice containing NaF, MFP, or SnF₂ which contains 1,000-1,500 ppm of fluoride twice or thrice daily for at least one minute, and a fluoride mouth rinse containing 0.05% NaF which contains 230 ppm of fluoride once daily for one minute [6]. In the case of a high caries-risk patient the use of several preventive interventions and behavioral modification are required along with the use of topical fluorides [44]. For children over six years of age and adults, both in office and self-applied topical fluoride treatments were recommended [6]. For in office fluoride therapy at the initial visit, an agent with high concentration of fluoride, either a 1.23% APF gel with 12,300 ppm of fluoride for four minutes in a tray or a 5% NaF varnish, should be applied directly to the teeth four times per year. Self-applied fluoride therapy should consist of a daily five-minute application of 1.1% NaF or APF gel (5,000 ppm of fluoride) in a custom-fitted tray [6]. The lower pH of the APF gel enhances penetration of fluoride into the enamel.

The American Dental Association (ADA) has come out with evidence based clinical recommendations for the application of topical fluoride in 2006. The panel recommended application of fluoride varnish in moderate and high caries risk individuals among all age groups and found insufficient evidence to establish the efficacy of NaF varnish versus APF gels [43]. High concentration of fluoride come in direct contact with the tooth structure for several hours in the form of varnish application and sets when it comes in contact with the saliva. In 2013 ADA updated the evidence-based guidelines and recommended only 2.26% fluoride varnish for at risk children less than 6 years of age. For

the other age groups that are at risk either 2.26% fluoride varnish or 1.23% APF gel or home use prescription strength 0.5% fluoride gel or .09 % fluoride mouth rinse could be used [7]. Fluoride varnish of 2.26% for children less than six years old was recommended by ADA as there is less risk of adverse events associated with swallowing [7]. In 2018 ADA published evidence-based guidelines for non-restorative treatment of caries and recommended the following to arrest or reverse non cavitated carious lesions. Sealants and 5% NaF varnish on occlusal surfaces, 5% NaF varnish on approximal surfaces and 5% NaF or 1.23% APF gels on facial or lingual surfaces [50]. A ten-step non-invasive strategy protocol was proposed and adopted for adults [45].

Taylor E et al. developed an interprofessional collaboration model to serve low-income and high-risk children in the U.S [46]. It integrates screening, varnish application and dental referrals using alternative oral health provider approach. This project increased oral health services capacity and patient acceptance for oral health screening and fluoride varnishing. Among dietitians it enhanced oral health services by way of oral health screening and application of fluoride varnish [46]. In low income populations where access to dental care and the utilization of dental care is low, children tend to be seen more by primary care providers than by dental providers so by integrating fluoride varnish applications into primary care visits a lot of community programs have noticed the benefits. Oral health care services enable allied health practitioners with unique opportunities to impact the poor access and unmet needs of high-risk children and adults to improve overall health [46]. In areas where state policies supported the application of fluoride varnish in primary care settings there was significant improvement in the oral health of the children with public insurance [47]. Many care givers seem to have an incomplete or inaccurate

understanding of the fluoride varnish [48]. A study by Oliveira et al. concluded that public health dentists believed that, minimally invasive dentistry by way of fluoride varnish for caries prevention meets the standard of care for primary and permanent teeth in the US [49]. Some of the fluoride varnishes available in the US market are Embrace Varnish, Enamel Pro Varnish, Enamelast Fluoride Varnish, Kolorz Clear Shield Varnish, ProFluorid Varnish, Vanish White Varnish, Vella 5% Sodium Fluoride Varnish with Xylitol [51].

5. Conclusions

Effectiveness, ease of application, and its safety give fluoride varnishes an advantage over other types of topical fluoride treatments, such as gels and rinses. The authors having worked closely with populations that are at a higher risk of developing caries see a greater need on the emphasis of prevention from an early age, which when implemented effectively would save enormous resources in terms of time and money that could be better allocated. With the ADA endorsing the benefits of its use to arrest or reverse non cavitated lesions in almost all areas of the tooth, fluoride varnish applications should be implemented in children with greater enthusiasm by the dental community at large. Though a minimum of two applications per year are sufficient in most cases, a few situations involving kids with special needs, children undergoing orthodontic treatment and those with chronic medical conditions that affect their ability to maintain proper oral hygiene will need more frequent applications. With the fluoride varnish regimen easier to adapt a lot of non-dental settings would be able to implement it thus ensuring the improvement of oral health of a greater number of children. In these unique times that we are now facing the pandemic has become a huge barrier in accessing dental care especially in the low-income populations of the country who are more likely to seek primary care services than dental services and providing the

application of fluoride varnish at primary care facilities will have a huge impact in our efforts to inhibit the adverse effects of dental caries among those vulnerable groups.

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