



COMPARATIVE EVALUATION OF DIFFERENT FLUORIDE APPLICATION MATERIALS BASED ON THEIR FLUORIDE-RELEASING ABILITY – AN IN VITRO STUDY

Dental Science

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ABSTRACT

Fluoride is an important and effective compound that helps in reducing dental caries. Fluoride is a naturally occurring mineral. Fluoride is absorbed by the teeth and protects against tooth decay. Cavities usually begin as microscopic damage to the tooth, fluoride acts as concrete poured into a crack, protecting against such damage and even reversing early tooth decay. **Aim-** The purpose of this study is to check the fluoride-releasing ability of traditional APF gel and newer sodium fluoride varnish. **Materials-** APF gel, Sodium fluoride varnish, Deionized water, Test-tube. **Methodology-** Samples of both materials were poured in the deionized water in a separate test tube. After 7 and 14 days, this sample was taken to the laboratory and the fluoride ion was checked. **Result-** APF gel released more fluoride ions at the end of 7 days compared to sodium fluoride varnish but after 14 days sodium fluoride varnish released more amount of fluoride ions compared to APF gel.

KEYWORDS

APF gel, Sodium fluoride varnish, Fluoride releasing, Prevention

INTRODUCTION

Pediatric Dentistry places a significant emphasis on preventive measures to combat dental caries, a prevalent concern among children worldwide.¹ Fluoride, a cornerstone in dental caries prevention, has witnessed continuous refinement in application materials to enhance efficacy and safety for young patients. This introduction provides a concise overview of the latest fluoride application materials in Pediatric Dentistry, drawing upon recent research findings and clinical insights.

Fluoride application methods have evolved beyond traditional gels and foams, now encompassing innovative modalities such as varnishes and fluoride-releasing dental materials.² Researchers have explored the use of smart materials and nanoparticles as carriers for controlled fluoride release, promising extended caries protection.³ Understanding these advancements is crucial for practitioners seeking to implement evidence-based and patient-friendly preventive strategies.⁴

Generally speaking, fluoride gel is often used in Pediatric Dentistry to prevent cavities. APF gel is a fluoride gel that contains phosphoric acid to increase its effectiveness in promoting enamel remineralization and preventing caries. APF gel is generally used on teeth during treatment. It is especially useful in Pediatric Dentistry as it can be used easily with little discomfort to the child.⁷

Varnish effectively adheres to the tooth surface and prolongs the contact time between fluoride and enamel, which is important for its effectiveness.⁷

Materials and Methodology

As per the sample size derived from the statistician total 16 samples were taken and they were divided equally into two groups. Group 1: APF gel, Group 2: Sodium fluoride varnish. 16 specimens were prepared by mixing and curing various fluoride application materials according to the manufacturer's instructions and were filled in plastic molds of standardized dimensions. The materials taken for the study were APF gel and sodium fluoride varnish. (Figure 2,3) 16 Cylindrical molds of polyvinylchloride measuring 3mm x 1.5mm in dimension were prepared for the study. Two different fluoride application materials were taken and they were divided into two groups of 8 specimens each. The prepared materials were placed into de-ionized

water in separate glass test tubes. (Figure 1) After 7 and 14 days 5ml of sample from each specimen was carried out for analysis and quantification by Atomic Absorption Spectrophotometer was done to get the values in the designated part per million (ppm) units.



Figure 1: Specimens In The Testubes



Figure 2: APF Gel



Figure 3: Sodium Fluoride Varnish

RESULT

The data was collected and analyzed using IBM SPSS software version 20. The Shapiro-Wilk test was used to determine the normality of the data. ONE WAY ANOVA test was used to compare fluoride ions between 2 groups on various days.

After 7 days, APF gel discharged 159 ions/cm³, while NAF varnish emitted 122 ions/cm³ during the same period. By the end of 14 days, APF gel had released 535 ions/cm³, while NAF varnish surpassed it with a release of 620 ions/cm³. The p-value showed a significant difference. (Table: 1)

Table 1: Comparative Analysis Of Both Materials

APF Gel	Sodium Fluoride Varnish
After 7 days: N =8 159.155000 Deviation – 4.5891360	After 7 days: N =8 122.409000 Deviation – 6.3202680
p-value: 0.002369	
After 14 days: N =8 535.595333 Deviation– 64.6055532	After 14 days: N =8 620.853333 Deviation– 22.1293571
p-value: 0.004628	

DISCUSSION

Pediatric Dentistry is very important in terms of measures to prevent tooth decay and the use of fluoride is a key element in this. This session mainly explores various aspects of fluoride use in Pediatric Dentistry, including applications, mechanism of action, effectiveness, safety considerations, dosage of use and individual treatment plan. Many studies have investigated different types of fluoride applications, such as varnishes, gels, foams and toothpaste. Each format has specific characteristics that affect its suitability for different ages and compatibility levels.² It is important to understand the mechanism by which fluoride exerts its caries-protective effects.⁸ Recent clinical studies have consistently proven the effectiveness of fluoride in preventing tooth decay in children and reaffirm its importance in the prevention of dental caries.⁹

Modifying fluoride dosage based on patient risk assessment is a growing trend in Pediatric Dentistry. Recent studies highlight the need for self-administered targeted therapy to improve immunity, but studies showed professional application has better efficacy.¹⁰ Clarkson et al in 2000 found that duraphat varnish is one of the most concentrated commercial fluoride products available in the market, containing almost twice as much fluoride as APF gels.¹¹ In this study also the sodium fluoride varnish released more amount of fluoride ions compared to APF gel at the end of 14 days. Sorazabal et al in 2023 did a study and found that utilizing a toothbrush for the application of APF gel as an alternative technique demonstrated sustained dental health benefits over 24 months. This method has the potential to be cost-effective and may present advantages compared to the conventional application of fluoride varnish.¹³ According to Piesiak et al in 2023 stated that despite extensive in vitro and in vivo studies, our understanding of the mechanisms influencing fluoride's impact on dental hard tissues remains incomplete, and not all relevant variables affecting this effect are identified. Furthermore, considering emerging concerns about local adverse effects of fluoride varnishes on soft tissues, ongoing experiments are crucial to enhance both efficacy and safety.¹⁴

CONCLUSION

Based on the research performed and results obtained in the initial 7 days, APF gel led by releasing more amount of fluoride ions compared to NAF varnish, but it reversed after 14 days.

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