Slow Releasing Fluoride Devices: A Novel Preventive Treatment Option

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Abstract

Dental caries (tooth decay) is a common infectious disease affecting children and adolescents. Application of fluoride remains the mainstay among all the preventive agents used worldwide. Slow release fluoride devices were developed based on the inverse relationship existing between intra-oral fluoride levels and dental caries experience. These devices are effective in raising intra-oral fluoride concentrations at levels able to reduce enamel solubility, resulting in a caries-preventive effect. The concept of continuously providing low levels of intra-oral fluoride has great potential for caries prevention in high caries-risk groups.

Key Words: Dental caries, Slow-release fluoride devices.

Introduction

Dental Caries (tooth decay) continues to be the most common infectious disease in the world. It has affected the teeth of all nations irrespective of geographic and bio-cultural differences. The cause of this high prevalence is likely to be as multi factorial as the disease itself. While the profession has made great strides in reducing the amount of disease in the population through the wide application of fluoride, there remains a significant amount of work to be done in the area of fluoride applications.

The caries-preventive effect of fluoride is mainly attributed to the effects on demineralization/ remineralization at the tooth oral fluids interface. Sub ppm levels of fluoride in saliva are effective in shifting the balance from demineralization to remineralization. This is attributed to the fluoride- enhanced precipitation of calcium phosphates, and the formation of fluorhydroxyapatite in the dental tissues. Low fluoride levels found in saliva are ineffective in interfering with processes of growth and metabolism of bacteria, and also do not result in a significantly reduced dissolution of tooth mineral as a result of firmly bound fluoride incorporation.

Slow release fluoride device is a newly developed sustained-release, passive drug delivery system based on the inverse relationship existing between intra-oral fluoride levels and dental caries experience. They serve to increase the fluoride levels in saliva and plaque to levels at which caries can be prevented. There are mainly three types: the copolymer membrane type, glass bead and mixture of sodium fluoride and hydroxyapatite. These devices release low levels of fluoride for at least 2 years and have great potential for caries prevention in high caries-risk groups and irregular dental attenders in addition to a number of other applications. They have been demonstrated to be safe to use and without the risk of fluoride toxicity.

Such a device would overcome compliance problems as it does not require patient involvement except for periodic replacement, thus reducing the effect of patient compliance on its effectiveness in dental caries prevention and could be targeted with success to high caries risk individuals.It may not eliminate all caries, but certainly reduces it and in combination with anti bacterial treatment could indeed eliminate caries in these individuals.

However retention rates of these devices are the main problem and still requires further improvements. Further randomized clinical trials are needed in order to validate the use of these devices in clinical practice.

In India the incidence of caries has increased during the past four decades presumably due to increased sugar intake. Rather than expending resources on an entire population, many of whom are not at risk for a disease, targeting preventive and interceptive strategies to at - risk populations is a sound public health and private practice strategy.

Types Of Devices

There are three main types of slow-release fluoride devices:

1. Copolymer Membrane Device: It was developed in United States by Cowsar et al. and consists of a small pellet which could be attached on or near the tooth surface. This system was developed as a membrane-controlled reservoir-type and has an inner core of hydroxyethyl methacrylate (HEMA) / methyl methacrylate (MMA) copolymer (50:50 mixture), containing a precise amount of sodium fluoride. This core is surrounded by a 30:70 HEMA/MMA copolymer membrane, which controls the rate of fluoride release from the device. The device is approximately 8mm in length, 3mm in width and 2mm in thickness and is usually attached to the buccal surface of the first permanent molar by means of stainless steel retainers that are spot welded to orthodontic bands or are bonded to the tooth surfaces using adhesive resins. Depending on the amount of F in the inner core, the rate of F release can be between 0.02 and 1.0 mg F/day for upto 180 days.

2. Glass Device: It was developed in Leeds, United Kingdom. The F glass device dissolves slowly when moist in saliva, releasing F without significantly affecting the device's integrity. The original device was dome shaped, being usually attached to the buccal surface of the first permanent molar using adhesive resins. Due to the low retention rates of the original device, it was further substantially changed to a kidney shaped device. A new modification was introduced more recently, in order to facilitate device handling, attachment and replacement. This new device has been shaped in form of a disk that is placed within a plastic bracket. In contrast to the copolymer membrane device, the glass type has shown a longer lifetime, releasing F continuously for upto 2 years.

3. Hydroxyapatite-eudragit Rs100 Diffusion Controlled F-system: It consists of a hydroxyapatite, sodium fluoride and Eudragit RS100. It contains 18 mg of NaF and is intended to release 0.15 mg F/day. This device is able to significantly increase salivary and urinary F concentrations for at least 1 month.

Indications

(1) Child patients belonging to high-caries-risk group. (2) Non-compliant child patients. (3) Child patients undergoing orthodontic treatment. (4) Xerostomia or irradiation patients. (5) For prevention of enamel and root caries in medically compromised child patients. (6) Children with dentine sensitivity. (7) Children from low socio-economic groups.

Conclusion

Slow-releasing fluoride devices have been shown to be effective in elevating salivary fluoride levels and to enhance the remineralisation of dental enamel. These devices have a number of potential uses in dentistry and in particular have great potential for caries prevention of non-compliant high caries-risk groups. They have been demonstrated to be safe to use and without the risk of fluoride toxicity.

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