Different methods of fluoride delivery in prevention of white spot lesions in orthodontics

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Abstract
Orthodontic patients on fixed appliances are at an increased risk of developing white spot lesions which can progress to frank cavitations. Fluoride application in different forms has been shown to be effective in the reduction of formation of white spot lesions. The aim of this short communication is to discuss different methods that have been used in prevention of white spot lesions in orthodontic patients. Daily mouth rinse using 0.05% sodium fluoride is the most efficacious method in prevention of white spot lesions. It is thereby recommended for use in conjunction with proper maintenance of oral hygiene.

Keywords: Demineralisation; Fluoride; Glass Ionomer; Compomer; Orthodontics.

Introduction

Patients using fixed orthodontic appliances are at an increased risk of developing white spot lesions (WSLs**)** (1,2)**.** This is due to an increase in plaque retentive sites that are not easily cleaned. If white spot lesions are left untreated, they can progress to frank cavitations (3). One of the measures for reducing WSLs is through fluoride application in conjunction with proper maintenance of oral hygiene. When fluoride is availed over the tooth surface it forms a reservoir of fluoride ions. Fluoride ions in the mouth inhibit WSL formation through enhancing remineralisation by formation of fluoroapatite crystals, inhibiting demineralization and reducing plaque formation by inhibition of bacterial metabolism (3)

Fluoride delivery onto the tooth surface during orthodontic treatment can be achieved through topical fluoride application (e.g. mouth rinse, gel, varnish, toothpaste) and use of fluoride-releasing materials (e.g. bonding materials, elastics). The aim of this short communication is to present various forms of fluoride applications used to reduce the prevalence of white spot lesions in patients undergoing orthodontic treatment

Various forms of fluoride that are applied to prevent white spot lesions

(i) Mouth rinse

Systematic review articles indicate that daily fluoride mouth rinses using NaF 0.05% is the most efficacious method of topical fluoride application for management of white spot lesions in patients with orthodontic appliances (1,4). There are three common preparations of fluoride mouth rinses:

1. Acid-phosphate-fluoride (APF) mouth rinse:
   This is prepared by mixing 20 gm of sodium fluoride in 1 litre of 0.1M phosphoric acid. The mechanism of action of APF mouthwash is that when APF is applied on teeth, it produces CaF^2 spheres on the surface of enamel and fluoride-containing apatite crystals in dental enamel (5). CaF^2 spheres release free fluoride ions to the oral environment while fluorohydroxyapaptites have been shown to be more resistant to acid attack. The concentration of fluoride in APF mouthwash is 1.23%. The acid is in form of orthofluoride acid with a pH of 3.2 and is available in the form of gel, solution and foam. The gel form is more preferable than the solution as it increases the time of retention of the material on the tooth surface (1).

2. Sodium fluoride mouth rinse
   Sodium fluoride acts by reacting with calcium which is present in the teeth to form calcium fluoride. Calcium fluoride acts as a reservoir which releases fluoride whenever the pH falls below critical levels. 0.2% sodium fluoride mouthwash is a strong solution and consumption on a long time basis causes fluoride toxicity which is sometimes fatal. Hence the concentration of sodium fluoride in mouth rinses is only 0.05 %. One study reported no significant change in mineral loss

with the use of mouth rinses but the occurrence of white spot lesions reduced significantly (2).

3. Stannous fluoride mouth rinse
   The concentration of stannous fluoride in mouth rinses is 8% (0.8gm in 10 ml). The mechanism of action of stannous fluoride is that it reacts with hydroxyapatite to form stannous trifluorophosphate, which is more resistant to caries than normal enamel. Stannous fluoride is more effective for controlling plaque accumulation and gingivitis in the presence of orthodontic appliances than conventional tooth brushing alone (6). Commercially available products are in a glycerine base and have an indefinite shelf life (7). However the drawback of stannous fluoride mouth rinse is that it has to be freshly prepared each time before use.

(ii) Fluoride varnish

The composition of varnish is 5% difluorosilane. When the varnish is applied over the tooth surface it forms a reservoir of fluoride ions which constantly releases fluoride (3). Application of fluoride varnish has been reported to result into 40- 50% reduction in demineralization (8,9). Fluoride varnishes should be considered for use as a preventive adjunct to reduce enamel demineralization adjacent to orthodontic bracket. Six monthly applications are considered adequate (10).

(iii) Bonding agents

1. Fluoridated and non-fluoridated composite for bonding
   There is evidence to suggest that fluoride-releasing composites may have caries preventive effect around orthodontic brackets (11–13) compared to non fluoridated composites.
2. Glass ionomer cement for bonding
   Glass ionomer cement provides a sustained release of fluoride and also decreases the acid production (14,15). It increases fluoride levels in plaque adjacent to brackets bonded with glass ionomer cement (16,17). Further it also acts by decreasing the caries susceptibility by reducing the oral microflora.
3. Compomer for bonding
   A union of composite resin and fluoride silicate glass results in a compomers. They are superior to GIC in their ability to release and uptake fluoride (18–20) thereby minimizing decalcification around the brackets.

(iv) Fluoridated and non-fluoridated elastics

Elastics are one of the most versatile materials and invaluable tools of the orthodontist.

A study by Banks et al (21) showed that the use of fluoride releasing elastomeric modules and chains reduced the post-fixed appliance treatment enamel decalcification scores per tooth by 49 percent. This is likely to be due to their ability to release fluoride ions into the oral environment adjacent to the brackets.

Conclusion

There are various methods for fluoride application in an orthodontic patient namely, mouth rinses, varnishes, bonding agents and elastics with varying efficacy and ease of application. Of these, daily 0.05% sodium fluoride mouth rinse has been shown to be the most efficacious method in prevention of white spot lesions. It is thereby recommended for use in conjunction with proper maintenance of oral hygiene

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