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Caries associated with orthodontic care part 2: management

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Caries associated with orthodontic care: prevalence, prevention and management

Abstract

It is recognised that wearing an orthodontic appliance increases the caries risk of the individual. The prevalence of demineralisation has been reported to be as high as 73%. When demineralisation occurs a number of treatments exist: fluoride application, acid microabrasion, casein phosphopeptide-amorphous calcium phosphate (ACP-CCP), resin infiltration, and self-assembling peptides. Of these topical fluoride has the most evidence to support its use.

Clinical relevance

Demineralisation is the most common complication of orthodontic care. The clinician should understand how to manage this when it occurs.

Objective

The reader should be able to describe the available treatments for the management of demineralisation associated with orthodontic care when it occurs.

Introduction

As discussed in the first of these papers one of the most commonly recognised complications of orthodontic care is demineralisation due to poor oral hygiene.[1] Studies have shown the incidence of developing white spot lesions during fixed appliance (Figure 1) treatment to be as high as 73%, with 2.3% of patients developing cavities.[2] Figure 2 shows demineralisation associated with poor oral hygiene and sub-optimal fluoride exposure whilst wearing a fixed appliance.

The first of these papers described the aetiology, prevalence and prevention of demineralisation associated with orthodontic care. This second paper describes the treatments available to manage caries focusing on demineralisation post orthodontic treatment. The following are the more commonly used treatment methods to treat these lesions.

Management

Oral hygiene

Natural remineralisation of white spot lesions can occur as dental mineral is in equilibrium with its environment. A non-orthodontic study by Backer-Dirks found that 37 out of 72 white spot lesions disappeared over a 6 year period.[3] For this to occur, however, it is important to note that the caries challenge must either be reduced or eliminated and sufficient mineral must be introduced into the voids present in the white spot lesions, to return the refractive index of the enamel to normal. This must be firstly the use of fluoridated toothpaste twice daily as recommended.[4] In addition, as with the prevention of demineralisation, the use of high strength fluoride toothpastes and fluoride mouthrinses should be advised.

Early enamel can remineralise and return to a natural normal appearance.[5,6] However, a degree of the regression is due to abrasion of the lesion over time.[7]

Fluoride

The use of fluoride to remineralise early enamel demineralised lesions is still currently the most reliable approach to prevent further caries progression.[8] For the vast majority of patients oral hygiene and the application of fluoride toothpaste are one and the same.

It has been suggested that fluoride should not be used in high concentration as it tends to prevent remineralisation and can lead to further staining.[8] Excessive levels of fluoride can lead to rapid mineral precipitation on the enamel surface and block the surface enamel pores that communicate with the underlying demineralised lesion. Thus limiting or preventing remineralisation of the sub-surface demineralised enamel.[9]

As remineralisation is greatly increased by the addition of fluoride, routine fluoride mouth rinses can serve a necessary adjunct in the treatment of these lesions after debonding of orthodontic brackets.

A clinical trial examining the effects of fluoride on caries development and the effects on established lesions after orthodontic treatment found that using a daily fluoride mouth rinse with a 0.2% sodium fluoride solution arrested the development of the demineralised lesion significantly. It also found using the fluoride solution with a low pH (1.9), inhibited the formation completely.[10]

CPP-ACP

Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) (Tooth Mousse, Leuven, Belgium) is derived from the milk protein casein and has been shown to reduce demineralisation of tooth tissue and encourage remineralisation. It does this by localizing the

ACP in dental plaque which buffers the free calcium and phosphate ions and therefore helps to maintain a state of super saturation promoting remineralization.[11] Figure 3 shows a patient applying CPP-ACP directly to the demineralised teeth. However, it is probably of more value to use the patient's Essix retainer as a reservoir tray as this will provide longer exposure to the CPP-ACP, as in Figure 4.

Fluoride remineralises the surface of lesions and prevents penetration of ions into the depths of the lesion. Therefore a white spot lesion may well remain visible though the surface is remineralised. CPP-ACP however will penetrate to the full depth of the lesion and will deposit both calcium and phosphate ions throughout the lesion.

CPP-ACP comes either with or without fluoride (900 ppm F^-). From a short study looking at the remineralisation of white spot lesions not related to orthodontic appliances, there is evidence that using CPP-ACP with fluoride is superior as the two agents work synergistically,.[12] This study also suggested that on smooth surface fluoride containing CCP-ACP is superior to fluoride varnish at remineralising white spot lesions.

From the orthodontic literature a study of 60 adolescent patients with post-orthodontic demineralisation were randomised to 10% CPP-ACP or fluoride toothpaste.[13] The CPP-ACP treatment of the white spot lesions after debonding of orthodontic appliances resulted in significantly reduced fluorescence (indicating remineralisation) and surface area of the white spot lesions after a 4-week period. The improvement however was not found to be greater than the natural regression following daily use of the fluoride toothpaste. As yet the clinical trials do not provide as convincing data on the effectiveness of CPP-ACP as the in-vitro studies.

Microabrasion

This technique uses a chemical compound to erode and roughen the enamel surface of a tooth to remove brown and white spot enamel lesions on permanent teeth. The depth of enamel removed in 10 applications is approximately 100μm (0.1 mm) and therefore is a micro-invasive treatment that can significantly aid improving aesthetics. Two techniques are suggested: 37% phosphoric acid and 18% hydrochloric.[14] Figures 5 and 6 show demineralisation treated with three courses of 37% phosphoric acid microabrasion.

One study used image processing software to measure the area of the regions of demineralisation present in 8 orthodontic patients before and after microabrasion using 18% hydrochloric acid and pumice.[15] The results showed that microabrasion significantly reduced the visible demineralisation with the mean reduction in size of 83%.

Resin Infiltration

Resin infiltration (ICON DMG, Hamburg, Germany) involves the use of a 15% hydrochloride acid to remove the surface zone of the lesion to expose inner porosities. Following this, the initial lesion is infiltrated with an unfilled low viscosity light cured resin. This micro-invasive treatment fills the pores in the lesion returning the refractive index of the enamel to normal and thus improving the aesthetics.

Infiltration has been reported to be more efficient in treating the chalky appearance of white spot lesions compared to a 0.05% fluoride solution.[16] The surfaces are also reported to be more resistant to further caries and the colour is more stable.

Self-assembling peptides

One of the more recent advances in the remineralisation of early enamel white spot lesions has been the use of self-assembling peptides (P11-4).[17] P11-4 monomers are applied to early non-cavitated lesions, diffusing into the subsurface of the lesion to create a 3D matrix. This

in turn attracts calcium phosphate from saliva and forms hydroxyapatite crystals around the 3D matrix, which enables the regeneration of enamel and dentine.[18]

The use of P11-4 (Curodont, Credentis AG, Busswil, Switzerland) for the regeneration of demineralised lesions has been looked at in-vitro.[19] A total of 40 buccal surfaces of extracted teeth were artificially demineralised and Curodont was applied to 30 of them. Following this visual and scanning electron microscopic examination showed this to be effective at reducing remineralisation.

Obviously for cavitated lesions such as that shown in Figure 7 restoration is the only treatment option.

Conclusion

Despite recent advances in dental materials and methods to reduce the incidence of enamel demineralisation, studies indicate the development of white spot lesions continues to be a significant problem amongst orthodontic patients. The incidence of developing at least one white spot lesion during multi-bracket orthodontic treatment has been reported to be as high as 73%.[2]

Though a number of treatment methods have been discussed in this paper regarding the management of post-orthodontic demineralisation, it is important to make sure that good oral hygiene and dietary advice is continually reinforced prior to appliance therapy and throughout, to prevent this occurring.

Fluoride remains the most widely used treatment to prevent and control demineralisation related to orthodontics, although more novel techniques may offer an alternative once the literature supports their use.

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Legends to figures

Figure 1
Wearing a fixed appliance increases the risk of caries

Figure 2
Demineralisation associated with poor oral hygiene and sub-optimal fluoride exposure while wearing a fixed appliance

Figure 3
A patient wearing an Essix retainer which also contains CPP-ACP

Figure 4
A patient applying CPP-ACP to the demineralised teeth

Figure 5
Post-orthodontic demineralisation prior to 37% phosphoric acid microabrasion

Figure 6
Teeth in Figure 5 after three courses of 37% phosphoric acid microabrasion

Figure 7
Buccal caries associated with the Adams Clasp of a removable appliance, which requires restoration.

Figure 1

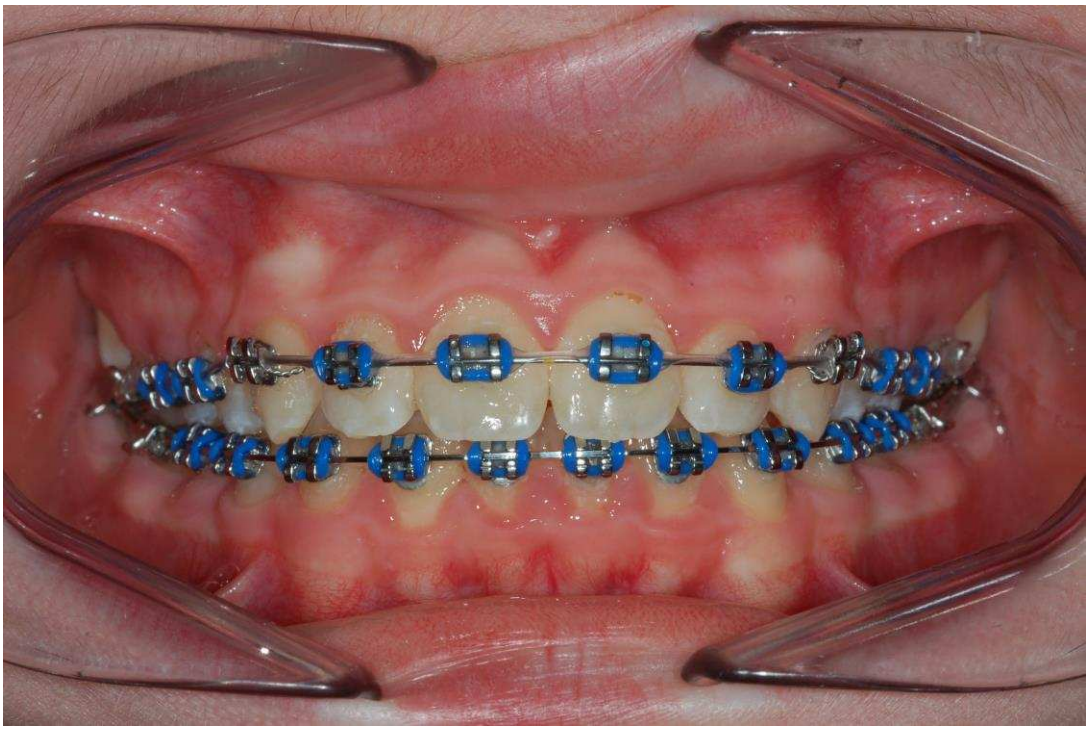

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7