Remineralisation of Enamel Subsurface Lesions with Casein Phosphopeptide - Amorphous Calcium Phosphate in Patients with Fixed Orthodontic Appliances

SUMMARY

One of the most common problems in everyday dental practice is the occurrence of dental caries. The easiest way to deal with this problem is its prevention. A lot of research has been done to find a material that would help to prevent the occurrence of dental caries, which means to stop tooth demineralization (loss of minerals from the tooth structure) and replace it with the process of remineralisation (reincorporating minerals in dental tissue).

In this review article we will present the remineralisation potential of casein phosphopeptide - amorphous calcium phosphate (CPP-ACP) in clinical studies. We considered all articles that were available through the browser of Pubmed Central. After analyzing the results obtained from these studies, we concluded that casein phosphopeptide - amorphous calcium phosphate has significant remineralisation effect when used in patients with fixed orthodontic appliances.

Keywords: Dental Remineralisation; Casein Phosphopeptide; Amorphous Calcium Phosphate

LITERATURE REVIEW (LR)

Balk J Stom, 2013; 17:81-91

Introduction

Dental caries is defined as localized destruction of tooth hard tissue with acids, produced during fermentation of carbohydrates, by bacteria in dental plaque\(^1\,2\). Scientific advances in restorative dentistry, new materials and techniques used, as well as understanding of its pathogenesis, have led us to more efficient preservation of oral health\(^3\,5\). Main efforts are focused on reducing the risk of caries in patients by preventing its occurrence\(^6\,7\). Particular role in this has the correct approach of the dentist with the patient, patient’s motivation to maintain oral hygiene and regular dental checkups.

The emergence of the subsurface tooth enamel lesions in patients with fixed orthodontic appliances is a common problem in dental practice\(^8\). The use of orthophosphoric acid as a dental etching material, in order to get better connection between the tooth surface and orthodontic rings and brackets, makes the structure of the enamel porous and sensitive to internal and external factors\(^9\). Apart of this, maintaining oral hygiene is difficult in patients with fixed orthodontic appliances; this is the reason for accumulating food debris on the tooth surface\(^10\). Moreover, with this condition, a lot of bacteria are accumulated also. Acids produced by bacteria demineralise the tooth hard tissue\(^11\). These initial demineralised parts of the tooth are called white spots. They have white chalky colour and indicate an area of demineralization of the enamel. This is the earliest sign of new carious lesion. According to Gorelick et al\(^12\), their incidence in such patients reaches 49.6%. White spots have the potential to develop for a period of 4 weeks after the placement of these appliances\(^13\). Without acting, these spots furthermore will possibly turn into a cavitation\(^14\,15\). Before the cavity forms the process is reversible, but once a cavity forms the lost tooth structure cannot be regenerated. Therefore, efforts are made to prevent this process and replace it with
Calcium and phosphate are essential components of enamel and dentin. They form insoluble complexes but, in the presence of CPP, they become soluble and biologically available. These CPP-ACP complexes applied on tooth surface by chewing gums, mouth rinses, tooth pastes or applied by using a spray, are able to adhere to dental biofilm and enamel hydroxyapatite crystals. Thus, bioactive calcium and phosphate ions are formed in the biofilm. Also, CPP-ACP complex serves as a reservoir of bioactive calcium and phosphate ions. The oral environment becomes supersaturated, which enables an uninterrupted supply of these ions in places that are previously demineralised. This is proved by the fact that significantly higher levels of calcium and phosphate are found in biofilms, as well as lower levels of demineralisation of dental tubules and enamel surfaces, in patients previously treated with CPP-ACP based products.

Numerous clinical studies prove the anti-cariogenic effect of CPP-ACP, as well as in laboratory conditions, animal and human in situ experiments. This examination usually is made by using scanning electron microscope (SEM) with energy dispersive X-ray analysis (Fig. 1). SEM provides detailed high resolution images of the sample by rastering a focussed electron beam across the surface. An Energy Dispersive X-Ray Analyser (EDX or EDA) is also used to provide elemental identification and quantitative compositional information. This allows us to estimate quantitatively the amount of minerals present at the tooth sample. Based on the results taken from the analysis we can calculate the amount of minerals loss during the process of demineralisation, or amount of minerals incorporated by the process of remineralisation. From the microscopic images, noted below, we can easily see zones of remineralisation, as thickened hyper-calcified lines around the porous spots of the enamel structure (Fig. 2).

**Method of Search**

Searching the literature through Pubmed Central browser, we found approximately 15 papers where clinical trials related to this issue were performed. The purpose of these studies was to prove the remineralisation effect of CPP-ACP ions on the initials subsurface enamel lesions. These studies were done in vitro. Electron microscope was used as a method of inspection of the treated teeth.

The conclusions of all the papers we found highlight the positive effect of CPP-ACP in the process of remineralisation.
The positive effect of CPP-ACP makes it applicable to various ranges of patients:

- Patients with mineral disbalance in oral cavity;
- Patients with high risk of caries;
- Patients with xerostomia;
- High dental sensitivity;
- After professional teeth cleaning and curettage;
- Before, during and after teeth whitening;
- During the entire orthodontic treatment;
- In patients with dental erosion or recession of the gingiva;
- At sufficiently formed early lesions;
- Lesions of the white spots;
- Stimulating the process of remineralisation;
- For patients with diabetes or HIV;
- Patients who are treated by radiotherapy or chemotherapy.

There are many methods of application and they are quite simple. For example, special individual template can be made for this purpose in which we put paste that contains CPP-ACP. Then, we can apply it by using dental micro-brush, interproximal brush, dental sponge stick, or simply put the required amount of paste on a finger and abundantly coat the tooth surface.

One of the studies that we process in this review article indicates the dependence of dose and duration of use of CPP-ACP products in remineralisation process. So, it is noted that the process of remineralisation reaches its maximum effect after 35 days of its use, if it is applied twice a day for a period of 3 minutes (Figs. 3 and 4).
Beside the use of CPP-ACP as a material for remineralisation of the tooth surface in dental practice, also other fluoride based materials are used for this occasion, such as fluoride rinses and fluoride pastes. However, it is proven that the use of fluoride rinsing solutions has significantly lesser effect than the use of CPP-ACP ions - GC Tooth Mousse 31.

Based on the results obtained, we can conclude that CPP-ACP complexes have a positive effect in dental practice. Therefore they should be included in treatment of patients with fixed orthodontic appliances, such as risk group that has a predisposition for the occurrence of enamel defects.

**References**