Effects of casein phosphopeptide-amorphous calcium phosphate application after interproximal stripping on enamel surface: An in-vivo study

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Introduction: The aim of this study was to investigate the effects of casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) application after interproximal stripping on enamel surface structures in vivo. **Methods:** Fifteen patients with a mean age of 15.8 years participated in this study. For each patient, the extraction of 4 first premolars was part of the orthodontic treatment plan. The patients were randomly divided into 5 groups of 3 patients. With the exception of group 1, the mesial and distal surfaces of all first premolars were stripped with a stripping disc (Komet; Gebr Brasseler, Lemgo, Germany) under air cooling and then polished with Sof-Lex polishing discs (3M Dental Products, St Paul, Minn). In group 1, no stripping was performed, and the teeth were removed immediately. In group 2, the teeth were removed immediately after the stripping. In group 3, the stripped teeth were extracted after exposure to oral conditions for 3 months. In groups 4 and 5, CPP-ACP (Recaldent Tooth Mousse; GC Europe, Leuven, Belgium) or fluoride varnish (Bifluoride 12; Voco, Cuxhaven, Germany) was applied to the stripped surfaces for 3 months, respectively, before the teeth were extracted. Surface roughness and microhardness values were evaluated with 1-way analysis of variance and Tukey HSD tests. **Results:** The CPP-ACP and the fluoride varnish applications increased the surface roughness and microhardness values that had been decreased by stripping. No statistically significant differences were found between groups 3, 4, and 5 for microhardness or between groups 4 and 5 for surface roughness ($P > 0.5$). **Conclusions:** The saliva and saliva plus remineralizing agents (fluoride varnish and CPP-ACP) increased the microhardness and surface roughness values of stripped enamel surfaces that had been decreased by stripping. (Am J Orthod Dentofacial Orthop 2017;151:167-73)

Interproximal enamel stripping is defined as clinically removing part of the dental enamel from an interproximal contact area by grinding. This approach has been applied in orthodontics for many years to obtain more space to align crowded teeth or to correct a Bolton tooth-size discrepancy.[1-3] By means of enamel reduction, approximal contacts can also be reshaped to correct morphologic anomalies and to camouflage interdental gingival papilla retraction.[4] In clinical orthodontics, grinding of dental enamel can be achieved with handheld or motor-driven abrasive strips but also with discs or burs mounted on a hand piece.[5-7]

Several studies have investigated the detrimental effects of enamel stripping due to loss of the protective superficial enamel layer by interdental stripping.[5,8,9] Some studies have claimed that iatrogenic injuries to the integrity of the proximal enamel surface by stripping can be predisposing factors for caries and periodontal disease.[8,10,11] Qualitative scanning electron microscope (SEM) evaluations have shown that all stripping methods affect enamel surface morphology, leaving furrows and scratches.[5,9] These surface irregularities might facilitate bacteria adherence and plaque accumulation.[8]

On the other hand, contradictory results also have been reported in previous studies evaluating the

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relationship between the stripping and caries and periodontal problems.[2,12,13] Long-term results of interdental stripping showed no iatrogenic damage: eg, dental caries, gingival problems, or increased alveolar bone loss.[2,3] It is still controversial whether a significant clinical relationship exists between stripping procedures and increased susceptibility to caries or periodontal disease. However, the use of polishing discs and some agents (fluoride products and sealants) has been recommended to prevent the undesirable side effects of interdental stripping by producing smoother enamel surfaces and enhancing remineralization.[1,6,9,10,14]

During the last decade, bioactive agents based on milk products have been developed that enhance the remineralization of enamel and dentin by means of releasing active ions under cariogenic conditions.[15] This agent is based on a nano-complex of the milk protein casein-phosphopeptide (CPP) with amorphous calcium phosphate (ACP). CPP-ACP serves as a reservoir source for calcium and phosphate ions on the tooth surface, thus helping to depress demineralization, enhance remineralization, and increase the microhardness of softened enamel.[15,16]

Although many studies are focusing on the use of CPP-ACP for white spot lesion prevention and caries prophylaxis before bracket bonding procedures, only 2 studies were identified that evaluated the effects of CPP-ACP paste on stripped enamel in orthodontic practice.[17,18] Giulio et al[17] evaluated in vitro the effect of CPP-ACP on enamel surfaces after interdental stripping and reported that CPP-ACP is effective in promoting enamel remineralization. However, it is a well-recognized fact that in-vitro studies cannot exactly simulate clinical situations for reasons such as differences in the mineral content of enamel, plaque formation, oral hygiene, and diet of patients. Also, saliva is an important factor for the remineralization of enamel. In a recent in-vivo study, the changes of morphology and composition of stripped enamel surfaces after exposure to saliva and CPP-ACP with sodium fluoride were investigated by Paganelli et al.[18] They concluded that the effects of saliva and CPP-ACP with sodium fluoride on stripped enamel in vivo showed no difference after 30 days.

The aims of our in-vivo study were to investigate and to compare the effects of a commercial paste based on CPP-ACP complex and a fluoride varnish application after interproximal stripping of enamel surfaces. The research hypotheses were that the remineralizing agent application (1) will not alter the roughness and (2) will not increase the microhardness of the stripped enamel surfaces.

MATERIAL AND METHODS

A power analysis was performed by G*Power software (version 3.0.10; Franz Faul Universitat, Kiel, Germany). Based on a 1:1 ratio between groups, a sample size of 24 surfaces in each group would give more than 80% power to detect significant differences with a 0.40 effect size at a significance level of $\alpha = 0.05$.

Fifteen patients (6 boys, 9 girls) with skeletal Class I malocclusion participated in the study. The average age was 15.8 years, with a range of 13.5 to 18.7 years. These patients were to receive routine orthodontic treatment with fixed appliances. For each patient, the extraction of 4 first premolars and the need for moderate anchorage mechanics were parts of the treatment plan. Before the study, information about the study design was given to the subjects, and informed consent was obtained from all adult patients and the parents of those under 18 years of age. This study protocol was approved at the Karadeniz Technical University by the ethical committee of Trabzon Clinical Researches.

Before this study, all patients received full-mouth clinical and radiographic caries assessments by an examiner (C.Y.). For this purpose, posterior bitewing radiographs were taken by using the long-cone technique. Selection criteria called for no cracks, hypoplasia, caries, fillings, or exposure to chemical agents (ie, bleaches) at the first premolars.

All patients were given oral hygiene instructions and monitored for 2 weeks. They were instructed by the orthodontist to brush their teeth for 3 minutes using the toothpaste (containing 1450 ppm of fluoride) supplied for daily use throughout the study. They were told not to use any other oral agents, including oral irrigators or antimicrobial mouth rinses.

The patients were randomly divided into 5 groups of 3 patients (12 premolars, 24 surfaces) according to the following procedures.

Group 1: No stripping was performed, and the first premolars were removed immediately.

Group 2: Approximal surfaces of the first premolars were stripped with a stripping disc (Komet; Gebr Brasseler, Lemgo, Germany) and then polished with extra-thin Sof-Lex discs (3M Dental Products, St Paul, Minn). The teeth were removed immediately after the stripping.

Group 3: Approximal surfaces of the first premolars were stripped with a stripping disc (Komet) and then polished with extra-thin Sof-Lex discs (3M Dental Products). The teeth were removed after exposure to oral conditions for 3 months.

Group 4: Approximal surfaces of the first premolars were stripped with a stripping disc (Komet) and then polished with extra-thin Sof-Lex discs (3M Dental