CARIES RISK IN PATIENTS UNDERGOING ORTHODONTIC TREATMENT

RIZIK KARIJESA KOD PACIJENATA PODVRGNUTIH ORTODONTSKOM TRETMANU

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ABSTRACT

The risk of tooth decalcification around brackets in orthodontic patients can be reduced by adequate oral hygiene and use of fluoride.

The aim of the study was to evaluate the effect of the applied preventive treatment in patients undergoing orthodontic treatment as well as to detect whether healthy teeth remain intact at the end of the research period.

Clinical examinations encompassed 40 patients with diagnosed malocclusion - started before orthodontic treatment. The examinees were divided in two subgroups (20 examinees in each group). The first subgroup was preventively treated with dental cream (GC Tooth Mousse), and the second subgroup with fluor (Fluorogal - solution with a low concentration of fluoride - 0.05% F). Control group comprised 20 patients. DMFT-index was registered in all examinees (60) before and at the end of orthodontic treatment.

In this study, minimum statistically significant increase in DMFT-index was registered at the end of treatment in both examinees' groups. Statistically significant increase in the DMFT-index was registered in control group, where DMFT-index was 7.40 before initiation of treatment and at the end of orthodontic therapy its value amounted to 8.50.

Caries and decalcification continue to be a serious problem, which has also been presented by high caries rate in our study. Meticulous caries-prophylactic measures such as professional tooth cleaning and fluoridation continue to be decisive factors in prevention caries risk in patients undergoing orthodontic treatment.

Kay words: caries, orthodontic treatment, prevention

SAŽETAK

Rizik od demineralizacije zuba oko bravica kod ortodontskih pacijenata može se smanjiti adekvatnom oralnom higijenom i pomoću primjene fluorida.

Cilj: Cilj ove studije bio je da se klinički procijeni utjecaj preventivnog tretmana kod pacijenata kod kojih je primijenjen ortodontski tretman, kao i to da li zubi koji su bili zdravi ostaju netaknuti na kraju ispitivanog perioda.

Klinička ispitivanja su obuhvatila 40 pacijenata sa dijagnosticiranom ortodontskom anomalijom prije početka ortodontskog tretmana. Pacijenti su bili podijeljeni u dvije podgrupe (po 20 u svakoj grupi). Prva podgrupa je bila preventivno tretirana sa dentalnom kremom (GC Tooth Mousse), a druga podgrupa sa fluorom (Fluorogal – rastvor sa niskom koncentracijom fluora – 0,05% F). Kontrolnu grupu je sačinjavalo 20 pacijenata. DMFT-indeks bio je registriran kod svim ispitanika (60) prije i na kraju ortodontskog tretmana.

U ovoj studiji, kod ispitanika obje grupe (preventivno tretirane u toku ortodontskog tretmana) bio je registriran minimalni, statistički značajani porast DMFT-indeksa na kraju ortodontskog tretmana. Statistički značajan porast DMFT-indeksa dobili smo u kontrolnoj grupi u kojoj je prije početka tretmana DMFT-indeks bio 7,40, dok je na kraju ortodontske terapije DMFT-indeks porastao na 8,50.

Karijes i demineralizacija i dalje prestavljaju ozbiljan problem kao što smo prikazali pomoću visoke stope karijesa u našoj studiji. Karijes-profilaktičke mjere kao što su profesionalno čišćenje zuba i upotreba fluorida nastavljaju da budu odlučujući faktor u prevenciji karijes rizika kod pacijenata koji su podvrgnuti ortodontskom tretmanu.

Ključne riječi: karijes, ortodontski tretman, prevencija

Introduction

Caries is a reversible multi-factorial process of tooth demineralization and re-mineralization [1]. It's also known as tooth decay or disease where bacterial processes damage hard tooth structure [2]. In orthodontics caries usually occurs on smooth surfaces, affecting 2 to 96% of all orthodontic patients [3]. Increase in caries risk during such treatment is due to several factors, lesions are difficult to locate, lowering of resting pH, increased volume of dental plaque and rapid shift in bacterial flora. Maxillary lateral incisors, maxillary canines and mandibular premolars are the most commonly affected teeth [4]. However, any tooth may be involved and often a number of anterior teeth show demineralization.

The risk of tooth decalcification around brackets in orthodontic patients can be reduced by adequate oral hygiene and use of fluoride. Artun et al. [5] in their research showed that oral hygiene during orthodontic treatment was more effective in reducing enamel decalcification. On the other hand, fluoride therapy allows reduction of enamel demineralization and prevents plaque activity by blocking the bacterial enzyme system. Geiger et al. [6] monitored the effect of fluoride on the formation of white spots in patients with fixed orthodontic appliances. After fixing the brackets to the teeth, patients were recommended a daily use of 0.05% NaF solution for rinsing mouth before sleep. Out of 101 patients, one third had formed a white stain on one or more teeth (of 1567 examined teeth, 117 or 7.5% had an early form of a white spot). The authors concluded that individual local application of fluoride immediately after fixation of the device, showed no positive effect. Patients need to use daily mouth-rinses with fluoride at all times while wearing a fixed orthodontic appliance.

Poor oral hygiene is one of the main problems routinely faced in the orthodontic treatment [7]. Orthodontic appliance creates an environment that provides potential space for bacterial flora. This condition is clinically seen as white spot lesions and cavitations in the most severe cases. It was concluded that fluoride dentifrices could indeed be considered as an efficient preventive method to enhance enamel resistance against the cariogenic challenges during orthodontic therapy [8].

Lot of research has been focused on reducing the occurrence of decalcification during orthodontic treatment. Researchers have turned their attention toward appliance design, bonding materials, use of fluorides, sealants and improving oral hygiene [9]. Many products have been developed to prevent demineralization of enamel surface, such as phosphor-peptide-amorphous calcium phosphate (CPP-ACP). CPP-ACP can be found in multiple products. Recaldent™ is a unique complex containing amorphous calcium phosphate (ACP) and casein phosphor-peptide (CPP), obtained from milk casein. The preparation is recommended in need for hard tissue re-mineralization. The manufacturer compares the material to "liquid enamel". CPP-ACP complex make a strong binding with a bio-film on teeth and form calcium and phosphate reservoir. They are then incorporated into the surface of enamel and dentine [10]. The effect of GC Tooth Mousse, with CPP-ACP complex is part of the new and modern approach to caries prevention. The CPP-ACP complex contained in Recaldent™ is hence an ideal system for transporting free calcium and phosphate ions, and GC Tooth Mousse, containing this novel active ingredient, is the world's first product for professional use in the dental practice [11]. The proposed anti-cariogenic mechanism of CPP-ACP involves the incorporation of the nano-complexes into dental plaque and onto the tooth surface, thereby acting as a calcium and phosphate reservoir. Studies have shown that CPP-ACP incorporated into dental plaque can significantly increase the levels of plaque calcium and phosphate ions. This mechanism is ideal for the prevention of enamel demineralization as there appears to be an inverse association between plaque calcium and phosphate levels and measured caries experience [12].

The aim of the study was to evaluate the effect of the applied preventive treatment in patients undergoing orthodontic treatment as well as to detect whether healthy teeth remain intact at the end of the research period.

Materials and methods

Clinical examinations encompassed 40 patients with diagnosed malocclusion - started before orthodontic treatment. The examinees were divided in two subgroups (20 examinees in each group). The first subgroup was preventively treated with dental cream (GC Tooth Mousse), and the second subgroup

with fluor (Fluorogal - solution with a low concentration of fluoride - 0.05% F). GC Tooth Mousse was applied for 5 minutes each day in patients undergoing orthodontic treatment. Control group comprised 20 patients. Selection criteria included ages 12-18 years, healthy and a treatment period with fixed appliance.

DMFT-index was registered in all examinees (60) before and at the end of orthodontic treatment.

Clinical oral health status was measured with a mouth mirror and a blunt probe under clinical lighting, prior to and after drying the tooth surface with compressed air according to the World Health Organization caries diagnostic criteria for epidemiological studies [13]. A tooth was marked as 'decayed' when any of the following was observed: unmistakable cavitations on the occlusal, buccal, or lingual walls of the tooth; a detectable softened floor or wall, or remaining, carious roots; and a filled tooth with signs of caries. Caries occurrence was expressed as the decayed, missing (due to caries), and filled permanent teeth (DMFT) count.

In this study GC Fuji LC was the adhesive used for bonding brackets.

During the laboratory investigation pH in saliva of the subjects was determined before orthodontic treatment (baseline assessment), in all subsequent scheduled controlled examinations (after one, three, six and twelve months) and after orthodontic treatment.

Results

The results of our clinical examinations are presented in tables (1-10) and figures (1-2). There were no statistically significant differences according to sex between the groups (Kruskal Wallis ANOVA: H=0.131, p=0.365). Male and female examinees were equally represented and hence, influence of the sex on the obtained results was eliminated (**Table 1**).

Student's t - test for dependent samples in examinees treated with preventive dental cream (GC Tooth Mousse) showed a statistically significant difference between mean values of DMFT-index before and after orthodontic treatment (t= - 4.702; df =19; p=0.000155) (**Table 2**).

Student's t - test for dependent samples in examinees treated with preventive fluor solution (Fluorogal) showed a statistically significant difference between mean values of DMFT-index before and after orthodontic treatment (t= -5.338; df=19, p= 0.000038) (**Table 3**).

Student's t-test for dependent samples in control subjects (**Table 4**) showed a statistically significant difference between mean values of DMFT-index before and after orthodontic treatment (t= -5.772; df = 19; p =0.000015).

Examined groups	Male	Female	n
Treatment with GC Tooth Mousse (I)	9 (45%)	11 (55%)	20 (100%)
Treatment with Fluorogal (II)	10 (50%)	10 (50%)	20 (100%)
Control group	10 (50%)	10 (50%)	20 (100%)
n	29	31	60

Table 1.
Distribution of participants according to sex

DMFT-index	mean	sd	p
Before treatment	6,45	4,23	0.000155*
After treatment	7,50	4,41	

*statistically significant diferences

Table 2.
Values of DMFT-index in subjects treated with GC Tooth Mousse

DMFT-index	mean	sd	p
Before treatment	7,10	4,14	0.00038*
After treatment	8,30	3,88	

*statistically significant diferences

Table 3.
Values of DMFT-index in subjects treated with Fluorogal

DMFT-index	mean	sd	p
Before treatment	7,40	4,06	0.00015*
After treatment	8,50	4,08	

*statistically significant diferences

Table 4.
Values of DMFT-index in control subjects

The analysis of variance (**Table 5 and Figure 1**) showed no statistically significant difference between the groups in relation to DMFT-index before treatment (F=0.274; p=0.7609). Tukey's HSD (honestly significant difference test) showed differences (not statistically significant), among mean values of DMFT-index in the examined groups before treatment (**Table 6**).

The analysis of variance (**Table 7** and **Figure 2**) showed no statistically significant difference between the groups in relation to DMFT-index after treatment (F=0.328; p=0.7214). Tukey's HSD (honestly significant difference test) showed differences among mean values of DMFT-index in the examined groups after treatment (**Table 8**).

Analysis of variance showed statistically significant higher values of pH at different time in examinees preventively treated with GC Tooth Mousse (Friedman ANOVA: ^{2}=89.123; p=0.0000001) (**Table 9**).

Analysis of variance showed statistically significant higher values of pH at different time in examinees preventively treated with Fluorogal (Friedman ANOVA: ^{2}=82,086; p=0,000001) (**Table 10**).

Groups	mean	sd	n
I	6,45	4,23	20
II	7,10	4,14	20
III	7,40	4,06	20

I - brackets bonded with Fuji Ortho™ LC and treatment with GC Tooth Mousse
II - brackets bonded with Fuji Ortho™ LC and treatment with Fluorogal
III -brackets bonded with Fuji Ortho™ LC (control group)

Table 5.
Values of DMFT-index in subjects of I, II and III group before treatment

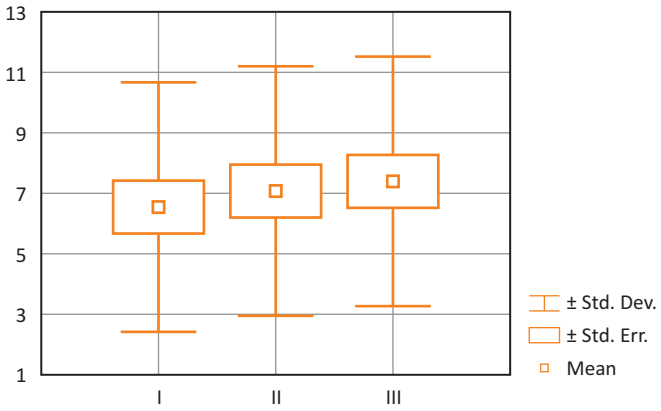

Figure 1.
Values of DMFT-index in subjects of I, II and III group before treatment

Discussion

The etiology of cariogenic process is a motive for conducting scientific researches in this field. In time, determination of caries-risk is of great importance in preventive dentistry, in which direction, different methods and procedures are applied DMFT-index, oral hygiene index, quality and quantity of saliva and its buffering capacity. A greater emphasis has been given to the dynamic characteristics of the process of demineralization and re-mineralization taking place on the enamel surface, with the apostrophe on the biological performance of the enamel, and the presence of dental plaque with its metabolites, and electrolyte composition of saliva.

The increase in carious lesions during treatment with fixed orthodontic appliances has been confirmed by other researchers as well. Pancherz and Mulich [14] examined 108 patients for carious lesions before and after orthodontic treatment. They detected new or increased number of carious lesions in 29.4% of the teeth examined. Fluoride is one of the most effective means of preventing tooth decay. The presence of fluoride leads to inhibition of demineral-

Groups	Turkey (HSD) test
I and II	0,8736
I and III	0,7500
II and III	0,9716

*statistically significant diferences

Table 6.
Difference between values of DMFT-index before treatment in I, II and III group

Groups	mean	sd	n
I	7,50	4,41	20
II	8,30	3,88	20
III	8,50	4,08	20

Table 7.
Values of DMFT-index in subjects of I, II and III group after treatment

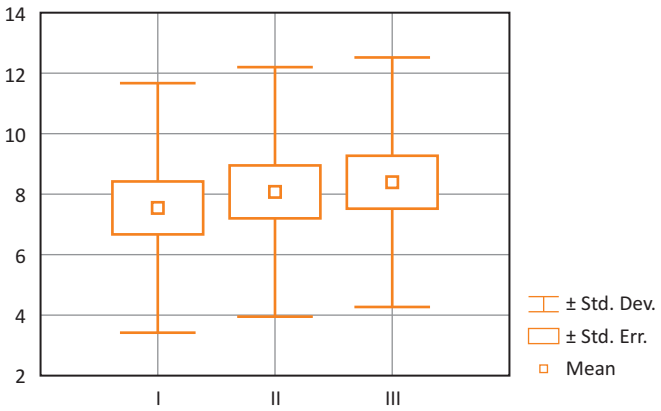

Figure 2.
Values of DMFT-index in subjects of I, II and III group after treatment

Groups	Turkey (HSD) test
I and II	0,8139
I and III	0,7254
II and III	0,9872

*statistically significant diferences

Table 8.
Difference between values of DMFT-index before treatment in I, II and III group

GC Tooth Mousse

pH	mean	sd	n
Before treatment	6.49	0.050	20
After 1 month	6.51	0.052	20
After 3 months	6.69	0.066	20
After 6 months	6.79	0.095	20
After 12 months	6.81	0.112	20
After treatment	6.80	0.115	20

Table 9.
Values of pH at different time intervals

Fluorogal

pH	mean	sd	n
Before treatment	6.48	0.051	20
After 1 month	6.50	0.064	20
After 3 months	6.63	0.220	20
After 6 months	6.77	0.090	20
After 12 months	6.78	0.103	20
After treatment	6.79	0.097	20

Table 10.
Values of pH at different time intervals

zation process of dental hard tissues, stimulating the re-mineralization processes and giving an inhibitory effect on bacteria in dental plaque [15].

However, a more recent study by Boersma [16] found that 40% of the buccal surfaces in males had demineralization compared to 22% in females. One possible explanation for these results is that females are generally more compliant orthodontic patients [17,18]. Wisth and Nord [19] evaluated changes in the caries experience of 26 girls and 26 boys who had received orthodontic treatment and compared the results to a control group consisting of 58 girls and 53 boys who had not received orthodontic treatment in Norway. Surprisingly, the percentage distribution of DMFT counts indicated somewhat fewer caries in the treated group. They explained that regular hygiene control during orthodontic treatment was the reason for this situation. As a control group (who had not received orthodontic treatment) was not used in this study owing to ethical reasons, we could not compare our results with data of patients who had not received orthodontic treatment. The change in DMFT counts during orthodontic treatment was highest for 12-year-old children and the lowest for 18-year-old children. Respective values for 12-, 15-, and 18-year-old children were 0.46, 0.34, and 0.24. This might have been due to the increased consciousness of oral care within an older age group.

In this study, statistically significant increase in DMFT-index was registered at the end of treatment in the examinees of both groups. Statistically significant increase in the DMFT-index was registered in control group, where DMFT-index was 7.40 before initiation of treatment, and at the end of orthodontic therapy its value reached 8.50. This shows that the low level of the pH in the oral cavity persisted for longer period of time; hence, it can be accepted as an indicator of increased activity of caries in examined subjects.

It is important to reaffirm that patient compliance with regard to tooth brushing and prophylactic fluoridation are the most important factors in preventing the development of carious lesions during treatment with a fixed orthodontic appliance. The incidence of carious lesions during treatment fell in conjunction with more frequent teeth cleaning and greater intensity of fluoridation. Our results emphasize the need for good instructions, motivation, and control of patient's oral hygiene measures during treatment with fixed appliances.

Since F enhances enamel re-mineralization, its clinical use to repair early caries lesions was advocated ("fluoride therapy"). However, the effect of F in the dynamics of the caries process and its success in controlling caries should not be confused with its arrestment or reversal effect on caries lesions [20]. Furthermore, it should be emphasized that shallow de-mineralized enamel areas re-mineralized faster than deep ones. The effect of F on enamel re-mineralization is easily shown *in vitro* [21]. These study showed the effect of F on enamel with a "caries lesion" simulating a clinical situation under low caries challenge (Re >De). The enamel surface was rehardened, the lesion depth was reduced and there was an increase in F concentration in the re-mineralized enamel. However, the lesion was not totally repaired.

Most orthodontists agree that patients seeking orthodontic treatment run a high risk of developing caries [22,23]. Many publications have addressed this risk in orthodontic patients [24,25]. Multiple factors have been discussed related to the orthodontic treatment, caries development, plaque accumulation, effect of fluoride, and demineralization [26,27].

Salivary pH concentration is a significant factor for oral and dental health. The longer period of treatment with dental cream (GC Tooth Mousse) was needed for increasing the value of salivary pH. Six months were necessary to reach the desired result that is higher salivary pH (pH 6.49 at the beginning of the treatment versus 6.79 at the end of the treatment). The decrease in the production of the acid affords quicker retorted neutral salivary pH value; this, in turn, has an effect on decreasing the demineralization effect, namely to starting the process of re-mineralization. Thus, small differences in increasing the pH value (after 6 and 12 months) may also give differences in the genesis of carious lesions.

Increase of salivary pH has been noted in examinees treated with Fluorogal, in two separate time intervals. Prior to the orthodontic treatment, the pH value in this examined group was 6.48, and at 1, 3, 6 and 12 months an increase of pH was noticed, with highest values after 6 months of orthodontic treatment (6.77).

There were no changes of the concentration of hydrogen ions (salivary pH) in the control group regarding its increase at certain time intervals (before the beginning of the orthodontic treatments it was 6.47 and after treatments it was 6.50). The positive effect of preventive treatment, especially with Fluorogal and its influence on acid and alkaline balance could be noticed. Maintenance of acid and alkaline balance have effect on oral homeostasis, regular functions of tissues and biochemical reactions which take place in the oral cavity.

Conclusions

Caries and decalcification continue to be a serious problem as shown by high caries rate in our study. Clinicians must observe closely the new lesions and the increase of carious lesions in all the teeth evaluated. Meticulous caries-prophylactic measures such as professional tooth cleaning and fluoridation continue to be decisive factors in prevention caries risk in patients undergoing orthodontic treatment.

Salivary pH in both groups showed a gradual increase with the highest statistically significant values six months after beginning of treatment (in examinad groups). There were no changes in the concentration of hydrogen ions (salivary pH) in the control group in terms of its increasing at all time intervals. The lowest increase in DMFT was noticed in the examined group treated with solution containing fluoride, and the highest increase in the control group.

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