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Evaluation of the Effect of Different Ligature System On Microbial Attack

SUMMARY

The objective of this study was to investigate the effect of elastomeric and stainless steel ligatures on the microbiology of local dental plaque. Clinical reports have shown that patients who receive orthodontic treatment are more susceptible to enamel white spot formation. Metallic orthodontic brackets have also been found to inflict ecologic changes in the oral environment, such as decreased pH and increased plaque accumulation. Changes manifested in the oral flora included elevated Streptococcus mutans *and* Lactobacilli *colonization and imposing a potential risk for enamel decalcification. The subjects were 40 patients at the beginning of their treatment with fixed orthodontic appliances. Orthodontic brackets were bonded to the buccal surface of the test teeth with a non-fluoridated adhesive and than arch wires were fixed by elastomers and stainless steel ligatures at the different time in same patients.*

There were no significant differences in account of S. mutans *and* Lactobacilli *after the use of metallic ligature ($p>0.05$); elastomeric ligatures increased these level significantly ($p<0.05$). There was a significant difference between these groups ($p<0.05$)*

Keywords: Elastomeric Ligature; Microorganisms; S. Mutans; Lactobacilli

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Introduction

In orthodontics, white spots and decalcification are attributed to prolonged accumulation and retention of bacterial plaque on the enamel surface adjacent to the attachments[9,12]. Demineralization of enamel has been reported to occur around orthodontic brackets after only 1 month[9]. Ligature ties represent new retentive areas around the brackets, so their role in caries formation is very important. Formation, origin and shape of the ligatures affect the oral microflora balance differently[4].

Metallic orthodontic bracket ligatures have been found to cause ecological changes in the oral environment, such as decreased pH, elevated *Streptococcus mutans* colonization, and increased plaque accumulation, which adversely affect orthodontic patients who are susceptible to enamel white spot formation[2,8]. Recently, the biophysical properties and chemical constituents of orthodontic bracket pellicles were reported by Eliades et al[5]. However, no information is available on the molecular identification of adsorbed salivary pellicles on orthodontic materials, including brackets, and this limits our understanding of the mechanism of initial microbial adherence to the surfaces of orthodontic materials[6].

The advantages of elastomeric ligatures are that they can be applied quickly, are comfortable to the patient, and are available in a variety of colours. Disadvantages are that the dentition and soft tissues may be adversely affected by microbial accumulation on the tooth surfaces adjacent to brackets ligated with elastomeric ligatures, arch wires may not completely seat during torque or rotational corrections, and binding may occur with sliding mechanics.

Plaque is a major etiological factor in the development of dental caries. The control of plaque is fundamental in the control of caries and periodontitis. It has been shown that placing a fixed orthodontic appliance leads to both an increase in the levels[1] and a change in the composition of dental plaque[7]. Sakamaki and Bahn[10] showed an increase in the lactobacillus index and the salivary lactobacillus counts after the placement of orthodontic bands. Corbett et al[3] and Scheie et al[11] demonstrated an increase in the level

of *S. mutans* in the plaque surrounding an orthodontic appliance, and suggested that placing an orthodontic appliance leads to the creation of new retentive areas favouring the local growth of this organism.

Fixed orthodontic appliance treatment significantly increases the risk of white spot lesions and enamel decalcification[2,12]. Enamel decalcification is caused by an imbalance between demineralising and demineralising of enamel, and the resultant white spot lesion is considered to be a precursor of enamel caries[12].

Materials and Methods

The subjects of this study were 40 children undergoing orthodontic treatment at the Department of Orthodontics, Faculty of Dentistry, Dicle University, with fixed orthodontic appliances in both jaws. Exclusion criteria included the use of oral antimicrobials or antibiotics within the past 3 months, the presence of prosthodontic appliances, or significant systemic disease. We advised them to brush their teeth and the appliances 4 times every day during this study period.

The CRT Bacteria Test (Vivadent Ets, Lichtenstein) was used to determine the *S. mutans* and *Lactobacilli* counts in saliva by means of selective culture media (Fig. 1).

Figure 1: The production kit of S. Mutans and Lactobacilli

At visit 1, the fixed appliance brackets and bands were placed. Stainless steel ligature ties were used to fix the arch wires. The patients were given standard fluoridated toothpaste (Colgate - Palmolive company, UK). Conventional non-fluoridated elastomers were placed on the remaining teeth.

Visit 2 was 4 weeks later. At this first adjustment appointment, metallic ligatures on the teeth were aseptically removed, placed in separate containers with a pre-reduced transport medium and coded. These were taken to the laboratory within 10 minutes. The appliance was adjusted, it was advised patients to brush their tooth and non-fluoridated elastomers were placed on all teeth to allow for a washout any mouth rinse period of at least 4 weeks.

At visit 3, the appliance was adjusted and the conventional elastomers were removed from teeth surface. These were taken to the laboratory.

In the laboratory, the agar carrier was removed from the test vial, and a $NaHCO_3$- tablet was placed at the bottom of the vial. The protective foils were removed carefully from the agar surface. Using transporters, agar surfaces were wetted with ligatures and excess was allowed to drip off. The agar carrier was placed back into the vial, which was closed tightly. The vials were incubated at 37°C for 48 hours. After that all of the samples were evaluated as product company directions by its scale. Findings of 10^5 CFU or more of lactobacilli and mutans streptococci per ml saliva indicated a high caries risk.

For statistical evaluation of the differences in the levels of the *S. mutans* and *Lactobacilli*, Wilcoxon Singned Ranks test was used.

Results

In the *S. mutans* evaluation group, there wasn't any significant difference between 1 and 2 visit samples (p = 0.655); differences were found in comparison of 1-3 visit and 2-3 visit (Tab. 1). In the *Lactobacilli* group, there wasn't any significant difference between 1 and 2 visit samples (p = 0.265). However, comparing 1-3 visit, and 2-3 visit we found significant differences (Tab. 2).

Table 1. Comparison of different ligatures' effect to S. Mutans level

GROUP	p	Significance
A-B	0.002	**
B-C	0.655	n.s.
A-C	0.007	**

A: Elastic Ligature
B: Stainless Steel Ligature
C: Initial Treatment
n.s.: not significant (p>0.05)
** p< 0.01

Table 2. Comparison of different ligatures' effect to Lactobacilli level

GROUP	p	Significance
A-B	0.025	*
B-C	0.206	n.s.
A-C	0.007	*

A: Elastic Lıgature
B: Stanless Steel Ligature
C: Initial Treatment
n.s.: Not significant (p>0.05)
* p< 0.05

There was no significant difference in account of *S. mutans* and *Lactobacilli* after the use of metallic ligatures ($p > 0.05$); elastomeric ligatures increased this account significantly ($p < 0.05$). Moreover, there was a significant difference between *S. mutans* and *Lactobacilli* groups ($p < 0.05$).

Discussion

This study has shown that, after a clinically relevant time in the mouth, there were significant differences in percentage of *S. mutans* and *Lactobacilli* counts in plaque obtained from elastomeric ligatures compared with stainless steel ligature. This study also provides valuable information for understanding bacterial colonization on the surfaces of orthodontic brackets ligatures and for investigating means to interfere with the adherence of pathogenic bacteria to the pellicle of orthodontic ligatures.

Forsberg et al[6] found that most patients had a higher bacterial count on teeth ligated with conventional elastomers than on teeth ligated with steel ligatures. In the present study, it was noticed that, clinically, there was a marked deterioration in the physical properties of elastomers in the mouth; they were considerably swollen compared with the conventional elastomers after 4 weeks, and several were missing when the patient returned. Besides, there wasn't any deterioration and deformation in the stainless steel ligature group.

Eliades et al[5] suggested that the presence of different materials intraorally, such as elastomers and metals (arch wires and bands), and exposure of adhesive resin margins, will presumably increase plaque accumulation on the appliances.

Wearing orthodontic appliances has been found to induce specific changes, such as a lower pH, increased plaque accumulation, and elevated *S. mutans* and *Lactobacilli* colonization, all of which increase orthodontic patients' susceptibility to enamel demineralization. Knowledge about the relationship between the bracket ligatures and oral bacteria will provide the basis for preventing the adhesion of pathogenic microorganisms around the bracket surface. This study showed that various microorganism adhered selectively to the orthodontic materials. The selective adherence was due to differences in the bracket ligatures.

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