

Antimicrobial activity of chlorhexidine in patients with fixed orthodontic appliances

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Abstract

Aim: Oral environment of orthodontic patients undergoes changes, such as pH reduction, larger number of sites available for *Streptococcus mutans* collection, and increased accumulation of food particles, which may lead to an increased number of *S. mutans* colony-forming units (CFU) in saliva. Chlorhexidine gluconate (CHX) is the most potent documented antimicrobial agent against Mutans streptococci and dental caries. The aim of this work was to assess efficiency of CHX-based mouthwashes in patient with fixed orthodontic appliances. **Methods:** Twenty patients with fixed appliances were selected for this study. They were undergoing full-bonded non extraction treatment with metal brackets (Roth 0.22, Discovery Dentaaurum) on their teeth and bands on their molars. Each patient was provided with a toothbrush and toothpaste. The mouthwashes were used by patients according to the manufacturers' directions 15 min after toothbrushing: 5 mL of 0.2% CHX (Corsodyl, GlaxoSmithKline) was applied for 60 s in the morning and before bedtime for 2 weeks. **Results:** The data were analyzed according to the nonparametric Wilcoxon signed rank test (SPSS software). Statistical significance level was set at $p < 0.05$. **Conclusions:** The use of CHX-based mouthwashes in patients with fixed orthodontic appliances led to reduction in the level of *S. mutans*.

Keywords: chlorhexidine, *Streptococcus mutans*, orthodontic treatment.

Introduction

Bonded orthodontic appliances increase the number of plaque retention sites, reduce the possibility self-cleaning on vestibular areas and impede oral hygiene. As of result of this, the oral cavity of orthodontic patients undergoes changes, such as pH reduction, larger number of sites available for *Streptococcus mutans* collection, and increased accumulation of food particles, which may lead to an increased number of *S. mutans* colony-forming units (CFU) in saliva¹.

Dental plaque is a multi-species biofilm consisting of more than 700 species of oral bacteria on tooth surfaces, and mutans streptococci (MS) are the major group of early primary colonizers². MS are microorganisms that primarily colonize dental surfaces. At concentrations of 10^4 - 10^5 CFU/mL in saliva, *S. mutans* is able to colonize clean, smooth surfaces of teeth. The presence of MS on tooth surfaces increases the possibility of caries development³. Due to some of their vital characteristics, MS are regarded potentially highly cariogenic⁴. Therefore, preventive efforts in these risk groups have concentrated on direct suppression of the cariogenic microflora by chemotherapeutics as an adjunct to improved oral hygiene.

Chlorhexidine gluconate (CHX) is the most potent documented antimicrobial agent against MS and dental caries⁵. Mouth rinsing with a chemical agent could

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be a useful clinical adjunct for reducing the bacterial plaque accumulation during the active phase of orthodontic treatment. Chemical agents also help orthodontic patients who have difficulties in maintaining plaque control by mechanical means alone. The aim of this work was to assess efficiency of CHX-based mouthwashes in patients with fixed orthodontic appliances.

Material and methods

Twenty patients with fixed appliances were selected for this study. The following criteria were used for selecting patients who were undergoing full-banded non extraction treatment with metal brackets (Roth 0.22, Dentaaurum GmbH & Co., Ispringen, Germany) on their teeth and bands on their molars who: were at least 13 and no more than 18 years old with complete permanent dentition including second molars; had no evidence of decalcification on their teeth; had no active caries lesion; had no known medical problem or current antibiotic therapy; had anterior composite fillings; had no known hypersensitivity to CHX.

Each patient was provided with a toothbrush, a toothpaste and a leaflet with brushing instructions; All patients were instructed to brush for a minimum of 3 min.

The same protocol was followed for each patient. First, the gingiva of individual teeth was examined and scoring was performed, according to the following scoring system: 0: Normal gingiva; 1: Slight inflammation - a minor change in color, consistency (no bleeding on probing); 2: Average inflammation - redness, swelling (bleeding on probing); 3: Severe inflammation - strong redness and swelling (spontaneous bleeding). Final score was obtained when the total score was divided by the number of examined teeth.

After collection of stimulated saliva sample for the purpose of establishing the quantities of *S. mutans* and *Lactobacillus spp.*. Saliva samples were collected at two timelines for each patient: 1. Before use of CHX (at least 1 month after bonding); 2. After 2 weeks of use of CHX. For such purpose, colony counting test kit (CRT Bacteria, Ivoclar Vivadent, Liechtenstein) was used, according to manufacturer's instruction. Patients were given a piece of (factory-made) wax, which they chewed for 5 min in order to collect enough stimulated saliva. While chewing, they collected saliva into disposable sterile plastic cups.

After 5 min, disposable pipettes were used to take saliva and seed it on slides for *Streptococci mutans* and *Lactobacilli spp.* The protective coat from sterile slides was removed, 5 drops were neatly dripped on the slide (until its entire surface was covered in saliva), which was held under a slight angle, taking special care not to damage the surface of the slide with the sharp edge of pipette. Once the procedure was over, a tablet of NaHCO_3 was put in slide boxes, and then the boxes were closed and placed into an incubator at 37°C . Forty-eight hours later, the results were read as indicated in the manufacturer's scheme, according to the following scale: Class 1 = $<10^4$ CFU/mL saliva; Class 2 = 10^4 - 10^5 CFU/mL saliva; Class 3 = 10^5 - 10^6 CFU/mL saliva; Class 4 = $>10^6$ CFU/mL saliva (Figure 1.)

The mouthwashes were used by patients according to the manufacturer's directions 15 min after toothbrushing: 5 mL of 0.2% CHX (Corsodyl, GlaxoSmithKline) was applied for 60 s in the morning and at bedtime for 2 weeks. The patients were instructed not to consume any liquid or food or at least 30 min after using the prescribed mouthwash. All patients are asked to bring the mouthwash bottle, so we could determine patient compliance based on how much liquid was left.

The data were analyzed using the nonparametric Wilcoxon signed rank test (SPSS software, SPSS Inc., Chicago, IL, USA). Statistical significance level was set at $p < 0.05$

Results

The results of the statistical analysis of MS levels, *Lactobacillus spp.* levels and gingival tissue status before and after use of CHX mouthwash are presented in Tables 1, 2 and 3. The distribution of *S. mutans* before and after use of CHX mouthwash is given in Table 4.

The findings of the present study indicate that the use of CHX mouthwashes reduced *S. mutans* levels ($p = 0.002$) in patients with fixed orthodontic appliances. Thirteen patients presented lower *S. mutans* while in 6 patients *S. mutans* counts remained the same regardless of use of the antimicrobial agent.

CHX-based mouthwash had no significant impact on *Lactobacillus spp.* levels, as 5 patients presented higher counts, 5 presented lower counts while in 10 patients *Lactobacillus spp.* counts remained the same regardless of use of the antimicrobial agent.

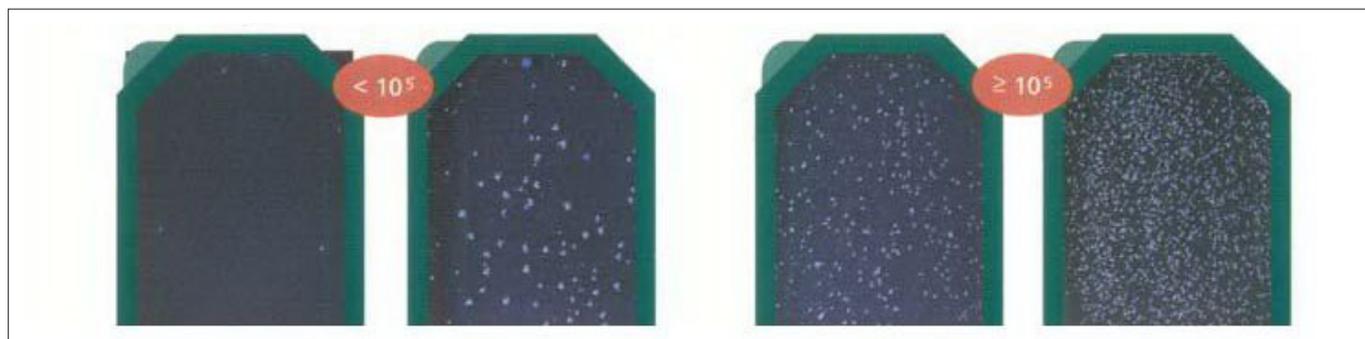


Fig. 1 - *Mutans Streptococci* (CFU/ml saliva)

Table 1. Statistical analysis of MS levels before and after use of CHX mouthwash.

		N	Mean rank	Sum of ranks
STREPT2 - STREPT1	Negative ranks	13	7.58	98.50
	Positive ranks	1	6.50	6.50
	Tied ranks	6		
	SUM	20		
Z	-3.116			
Asymp. Sig. (2-tailed)	.002			

Table 2. Statistical analysis of Lactobacillus spp. levels before and after use of CHX mouthwash.

		N	Mean Rank	Sum of ranks
LAKT2 - LAKT1	Negative ranks	5	5.50	27.50
	Positive ranks	5	5.50	27.50
	Tied ranks	10		
	SUM	20		
Z	.000			
Asymp. Sig. (2-tailed)	1.00			

Table 3. Statistical analysis of gingival tissue status before and after use of CHX mouthwash.

		N	Mean Rank	Sum of ranks
GING2 - GING1	Negative ranks	5	3.00	15.00
	Positive ranks	0	.00	.00
	Tied ranks	15		
	SUM	20		
Z	-2.032			
Asymp. Sig. (2-tailed)	.042			

Table 4. Distribution of *S. mutans* before and after use of CHX mouthwash

<i>Streptococcus mutans</i> Class	Baseline (%)	After Chlorhexidine (%)
No detected	0	10
Class 1= <10 ⁴ CFU/mL saliva	0	15
Class 2=10 ⁴ -10 ⁵ CFU/mL saliva	20	10
Class 3=10 ⁵ -10 ⁶ CFU/mL saliva	15	40
Class 4=>10 ⁶ CFU/mL saliva	65	25

Discussion

The findings of the present study regarding the effect of the CHX mouthwash on the microbial counts are in accordance with those of other authors. Oltramari-Navarro et al. (2009)⁶ suggested that the use of dentifrices with lower CHX concentration can reduce the risk of tooth staining without compromising its effectiveness in controlling gingivitis and bleeding in orthodontic patients. Masek et al. (2008)⁷ found that Cervitec[®] caused a reduction of *S. mutans* and Lactobacillus spp. saliva counts in patients with previously identified high level of these bacteria. Sari (2007)⁸ reported that 0.2% CHX mouthwash decreased *S. mutans* levels, but had no effect on lactobacilli

levels. Olympio et al. (2006)⁹ observed that the use of dentifrices containing CHX seems to be effective for the treatment of gingivitis in orthodontic patients. Beyth (2003)¹⁰ found a significant reduction of *S. mutans* CFU in 10 patients after use of CHX oral rinse¹⁰. According to Eldridge (1998)¹¹, the use of CHX mouthwash reduces the levels of *S. mutans*, gingival index and gingival bleeding. Anderson (1997)¹² found that the use of CHX oral rinse contributes to improving oral hygiene in patients with fixed orthodontic appliances¹².

In the present study, 6 patients reported discoloration of teeth as a result of the treatment, which is a possible side effect of CHX. Eldridge (1998)¹¹ described the appearance of brown color tongue that spontaneously resolved after cessation of the use of CHX, which, however, was not observed in the present study. Anderson (1997)¹² observed discoloration of teeth and increase in dental calculus formation, but they did not determine the significance of these phenomena.

Our results corroborate previous findings about the influence of CHX on *S. Mutans* levels, oral hygiene and gingival condition¹³⁻¹⁴. In the present study, the use of CHX-based mouthwashes reduced *S. mutans* counts and improved the gingival index, but had no significant impact on Lactobacillus counts.

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