

Clinical Study on the Effect of Chlorhexidine Mouth Rinse in Improving Oral Health in Orthodontic Patients with Fixed Appliances

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Abstract

During orthodontic treatment, there is an increased risk of periodontal disease and caries. Treatment with fixed orthodontic appliances leads to prolonged accumulation of dental plaque. Patients are at risk because they may develop gingival inflammation and enamel demineralization during treatment. **The purpose** of this study was to evaluate the effect of chlorhexidine rinsing solution on plaque and gingival bleeding and also the efficiency in preventing demineralization in orthodontic patients with fixed appliances. This study included 40 patients who were divided into a control group (brushing) and an examined group (brushing + chlorhexidine mouth rinse). The parameters used were dental plaque index (DPI), index of gingival inflammation (IGI) and white spot lesions (WSLs) index.

Plaque index and gingival inflammation scores showed statistically significant differences ($p \leq 0.05$) between the two groups for each of the three time points. A statistically significantly decreased WSLs one month and three months after treatment were registered in the examined group. Therefore, adding chlorhexidine mouth rinse to the daily oral hygiene regimen reduces plaque and gingivitis development and is effective in improving the appearance of white spot lesions in orthodontic patients. Orthodontists have to instruct their patients to rinse with chlorhexidine mouth wash once daily in addition to daily brushing.

Keywords: dental plaque, gingival inflammation, white spot lesions, Chlorhexidine.



Introduction

Orthodontic treatments may induce oral ecologic changes, leading to increase of *Streptococcus mutans* in saliva and plaque. (23) Orthodontic brackets play a significant role in gathering microbial plaque. (1) Caries-preventive measures, good oral hygiene, noncariogenic diet, and regular fluoride supplementation are often insufficient in preventing the occurrence of new carious lesions in orthodontic patients with high caries activity. Also, it has been shown that orthodontic treatment with fixed appliances results in enamel demineralization and increased numbers of carious lesions, predominantly in sites adjacent to brackets. (2)

Brackets, arch wires and other appliance components are both a focus for plaque accumulation and obstruction to plaque removal, thereby promoting gingivitis. Plaque also harbours cariogenic bacteria potentially capable of hard tissue damage, especially at the bracket margins. (19,4) While mouth rinses may aid to reduce plaque formation and mechanical cleaning of tooth surface can be accomplished in many forms, regular tooth brushing is advised routinely as the means of preventing gingival and dental diseases during orthodontic appliance therapy. (36) The primary causative factor in the development of gingivitis is the insufficient removal of supragingival plaque. The presence of orthodontic fixed appliance makes tooth brushing more difficult and predisposes the patient to plaque build-up on the buccal surfaces of teeth around the brackets. Additionally many orthodontic patients, especially children and adolescents, fail to floss because they find this procedure time-consuming and tedious in the presence of orthodontic archwires. (3) Good plaque control is an important factor in the maintenance of dental health during fixed appliance therapy. But plaque control is very difficult in patients with fixed orthodontic appliances and the use of chemical agents such as chlorhexidine has been shown to be useful adjuncts in plaque control for these patients. (33, 8) A common strategy to improve mechanical plaque removal is to incorporate a chemotherapeutic agent, such as an antibacterial mouth rinse into the oral hygiene regimen. Considerable clinical trial evidence shows that when antibacterial mouth rinses are added to daily oral hygiene measures (tooth brushing and flossing) is better than tooth brushing and flossing alone. (34)

Standard caries prevention measures based on mechanical plaque removal, non-cariogenic dietary habits and regular fluoride supplementation are often insufficient to prevent



new lesions in orthodontic patients. (14) Following the formation of a highly colonized cariogenic micro-flora, neither tooth brushing nor increased fluoride delivery is capable of effectively preventing the demineralization process. (21) Thus, the use of an antimicrobial agent to suppress cariogenic bacteria, and thereby to inhibit the development of new caries lesions, seems to be a rational approach during orthodontic treatment. (16, 6)

Chlorhexidine (CHX) is the most potent documented antimicrobial against *Mutans streptococci* (MS); it is one of the most pronounced bacteria causing early enamel caries. (7) CHX is commonly delivered in forms of varnishes, gels and rinsing solutions, which also determine the mode of its effect. The persistence of bacterial suppression is related to contact time of CHX with intraoral tissues, its rate of release and concentration. Depending on these particular factors, CHX varnishes establish the most persistent reduction in MS followed by gels and mouthwashes. (13) Numerous studies have investigated the possible effects of different CHX applications on the adhesion of brackets. CHX was tested in all three forms under following conditions: before acid etching without subsequent surface cleaning; after enamel etching mixed with bonding agent; after enamel etching alone, without additional bonding agent; after enamel etching prior to photo-polymerization of the bonding agent; after enamel etching following the photopolymerization of the bonding agent and mixed with bonding agent on hydrophilic primer applied etched enamel. (12, 22, 31, 15, 10)

The safety of chlorhexidine has been reportedly confirmed; although a drawback of chlorhexidine is associated staining of the pellicle. The effect of subgingival irrigation with chlorhexidine on gingivitis in adolescent with fixed orthodontic has been reported by Morrow *et al.* (26)

The purpose of this study was to evaluate the effect of chlorhexidine rinsing solution on plaque and gingival bleeding and also the efficiency in preventing demineralization in orthodontic patients with fixed appliances.

Materials and methods

This study included 40 patients (20 females and 20 males), who are undergoing treatment at the University Dental Clinical Centre “St. Pantelejmon” in Skopje, Macedonia. The subjects were qualified on the basis of the following criteria:



- 16 to 19 years of age with orthodontic fixed appliances,
- existing gingivitis,
- no clinical evidence of periodontal diseases,
- without medical problems or evidence of current antibiotics therapy.

The study population had a mean age of 18 years (range = 16-19 years). The patients were divided into a control group (only brushing, N=20) and an examined group (brushing + chlorhexidine mouth rinse N=20).

Clinical procedures

Before the beginning of the examination, all of the selected volunteers were diagnosed with existing gingivitis. They were instructed for tooth brushing technique (Bass-technique) and the examined group was advised to include chlorhexidine mouth rinse once daily in addition to daily tooth brushing. The following parameters (DPI) dental plaque index of Silness- Løe and IGI, index of gingival inflammation of Løe and Silness, were recorded at baseline (day 0), after one month and three months, at each of four surfaces (buccal or labial, mesial, distal and palatal or lingual). (24) The selected teeth were: upper right first molar, upper right lateral incisors, upper left first premolar, lower left first molar, lower left lateral incisor and lower right first premolar. The WSL index was used for visual evaluation of the buccal surfaces of the anterior teeth, premolars, and first molars in the maxilla and mandible. The scoring was as follows: 0: no visible white spot or surface disruption (no demineralization); 1: visible WSL that covered less than one-third of the surface, without surface disruption (mild demineralization); 2: visible WSL that covered more than one-third of the surface, with a roughened surface but not requiring restoration (moderate demineralization); and 3: visible cavitation, requiring restoration (severe demineralization). (17)

Preparations

Curasept 0.05% Chlorhexidine Mouthrinse (Curaprox Laboratories) and its composition (0.05% chlorhexidine and 0.05% fluoride, alcohol free).



Results

A total of 40 orthodontic patients aged 16–19 years were included in this study and assigned into an examined group (14 males and 6 females) and a control group (9 males and 11 females). Mean and standard deviations of the total sample (examined and control groups) are presented in Tables 1-2. Plaque index scores showed statistically significant differences ($p \leq 0.05$) between the two groups for each of the three time points and they are illustrated in Table 1 and Figure 1.

Table 1. Descriptive statistics for Dental Plaque Index (DPI) in control and examined groups at the beginning, after one month and after three months of treatment

Group	Index	N	Mean	SD	t-test	df	p-value
Control	DPI (0)	20	1.80	0.33	3.6	38	0.0008*
	DPI (1m)		1.42	0.33	3.64		0.000791*
	DPI (3m)		1.07	0.28	7.47		0.000000*
Examined	DPI (0)	20	1.80	0.33	7.47	38	0.000000*
	DPI (1m)		1.07	0.28	10.16		0.000000*
	DPI (3m)		0.32	0.16	17.66		0.000000*



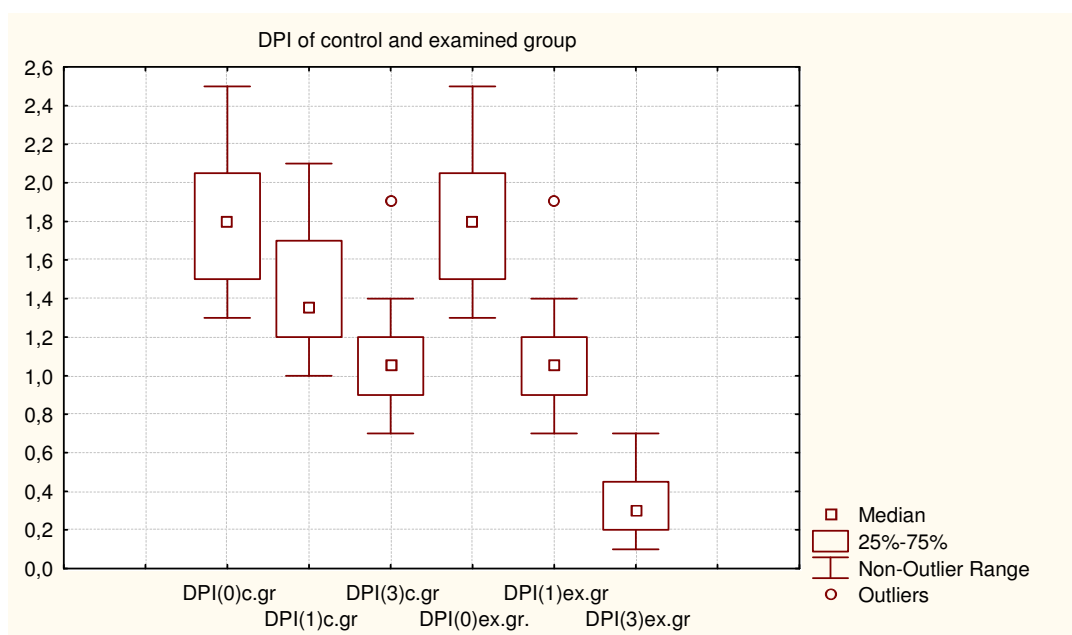


Figure 1. Mean DPI values of control and examined groups at the beginning, after one month and after three months of treatment

Table 2 and Figure 2 display significant differences between the examined and the control groups for the gingival index scores in the three time points (baseline, after 1 month and after 3 months).

Table 2. Descriptive statistics for Index of Gingival Inflammation (IGI) in control and examined groups at the beginning, after one month and after three months of treatment

Group	Index	N	Mean	SD	t-test	df	p-value
Control	IGI (0)	20	1.75	0.34	3.46	38	0.001329*
	IGI (1m)		1.38	0.31	3.26		0.00231*
	IGI (3m)		1.07	0.28	6.76		0.000000*
Examined	IGI (0)	20	1.77	0.29	7.85	38	0.000000*
	IGI (1m)		1.06	0.27	9.00		0.000000*
	IGI (3m)		0.35	0.20	17.56		0.000000*



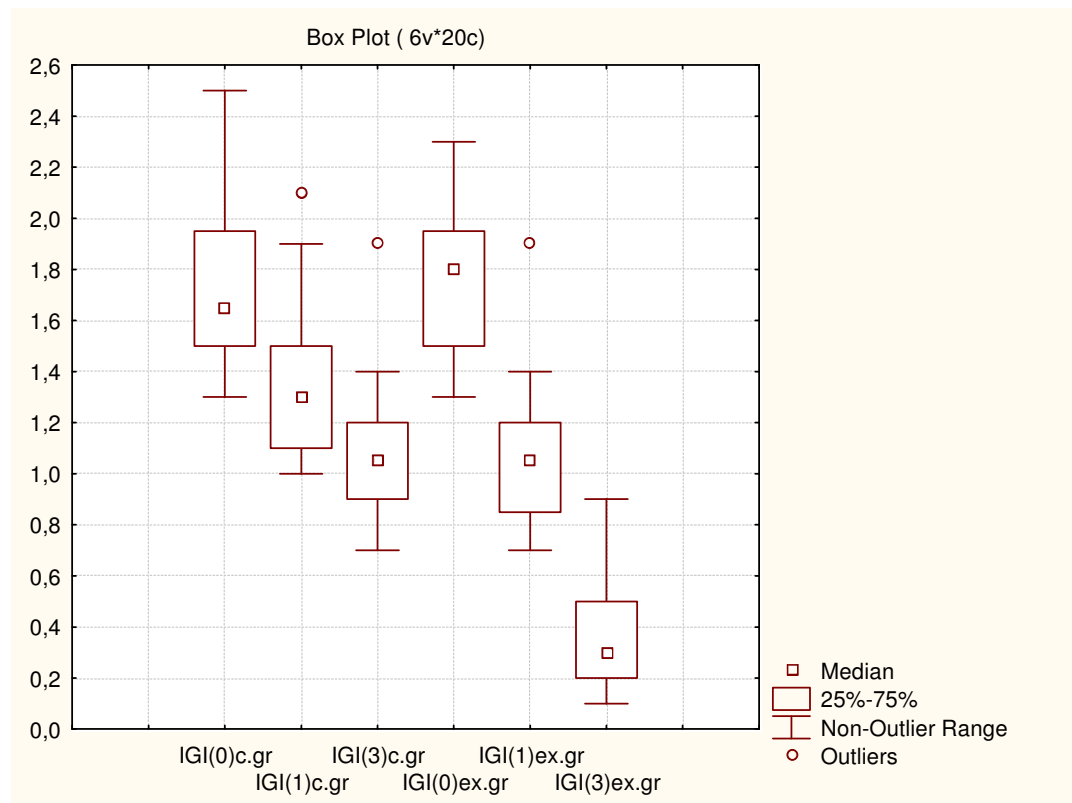


Figure 2. Mean IGI values in control and examined groups at the beginning, after one month and after three months of treatment

The frequency of patients with white spot lesions (WSLs) at the beginning, after one month and after three months of treatment is presented in Table 3. After one month of brushing + 0.12% chlorhexidine mouth rinse (examined group), statistically significant differences in demineralization were found (score of 1, score of 2) in comparison to baseline values. No significant differences were observed between the groups for demineralization (score of 3).



Table 3. Frequency of patients with white spot lesions (WSLs) at the beginning, after one month, and after three months of treatment

Group	WSL values	0	1	2	3
Control	WSL _{c.gr.(b)}	0 (0%)	8 (40%)	10 (50%)	2 (10%)
	WSL _{c.gr.(1m)}	0 (0%)	11(55%)	9 (45%)	0 (0%)
	WSL _{c.gr.(3m)}	0 (0%)	12(60%)	8 (40%)	0 (0%)
Examined	WSL _{ex.gr.(b)}	0 (0%)	7 (35%)	12(60%)	1 (5%)
	WSL _{ex.gr.(1m)}	0 (0%)	16(80%)	4 (20%)	0 (0%)
	WSL _{ex.gr.(3m)}	16(80%)	4(20%)	0 (0%)	0 (0%)

Table 4 and Figure 3 display significant differences between the examined and the control groups for the WSL scores in the three time points (baseline, after 1 month and after 3 months).

Table 4. Mean values for WSLs scores in orthodontic patients (control and examined group) at the beginning, after one month and after three months of treatment

Group	WSLs	N	Mean	SD	t-test	df	p-value
Control	WSL _{c.gr.(b)}	20	1.70	0.65	1.34	38	0.18
	WSL _{c.gr.(1m)}		1.45	0.51	0.31		0.75
	WSL _{c.gr.(3m)}		1.40	0.65	1.62		0.11
Examine	WSL _{ex.gr.(b)}	20	1.70	0.57	3.17	38	0.0029
	WSL _{ex.gr.(1m)}		1.20	0.41	7.7		0.000000*
	WSL _{ex.gr.(3m)}		0.20	0.57	9.53		0.000000*



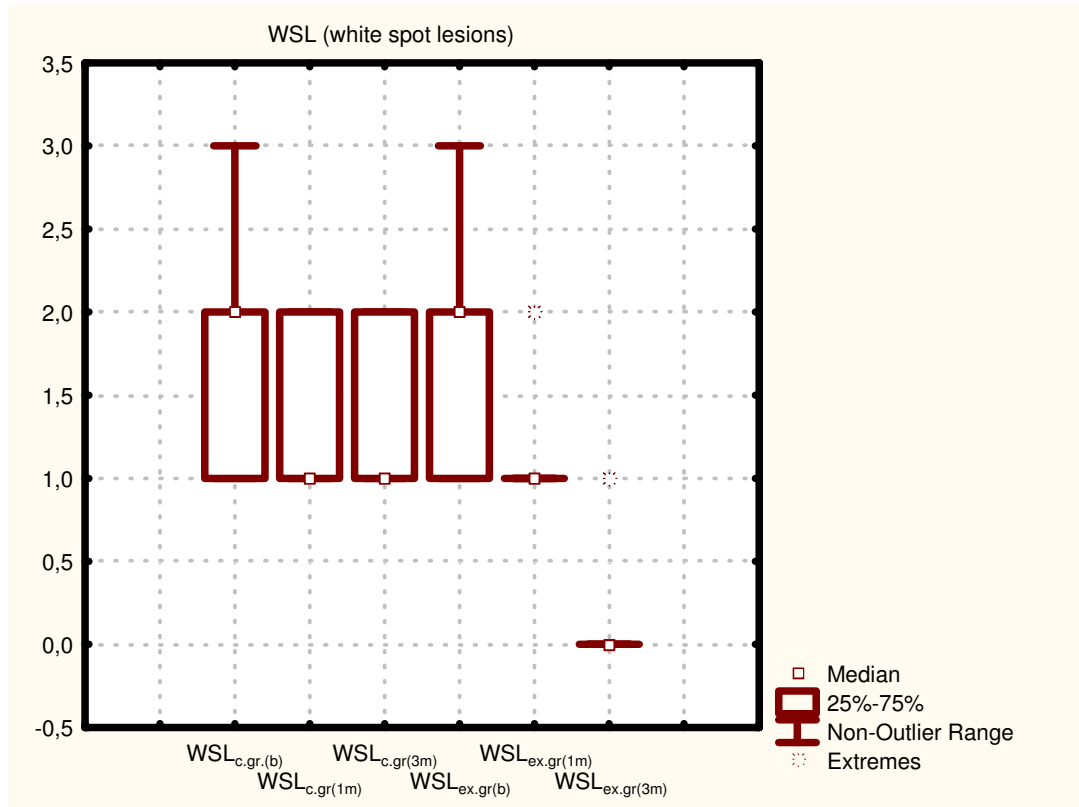


Figure 3. WSLs scores in orthodontic patients (control and examined group) at the beginning, one month and three months after treatment

Discussion

Orthodontic treatment has preventive effect against periodontal disease and caries because it facilitates establishing the functional occlusion and makes all tooth areas accessible to oral hygiene. That problem is specific for the patients who have crowded and rotated teeth, open bite, overbite or cross bite. Numerous studies have shown that orthodontic patients are at high risk of developing periodontal disease and caries because orthodontic treatment lasts for a considerable time. Presence and position of fixed orthodontic appliance gives poor conditions for maintaining oral hygiene. Therefore these patients have to be involved in preventive programs to be adequately trained and motivated to maintain proper oral hygiene, which would, along with



control check-ups, help to preserve their oral health when orthodontic treatment is finished. (18, 27)

Plaque accumulation and subsequent gingivitis are common in orthodontic patients because of the challenge of controlling oral hygiene with the combination of brackets, bands, wires and elastomeric ligatures. Poor oral hygiene can eventually lead to the formation of white spot lesions, decay and hyperplastic gingival tissue that may require intervention by a general dentist upon the completion of orthodontic treatment. (35) The results obtained during our study showed statistically significant decrease for two indices (DPI and IGI), in both groups, the examined (brushing + 0.12% chlorhexidine mouth rinse) and the control group (only brushing), after one and after three months of follow-up. The patients were instructed to maintain regular oral hygiene, which include daily tooth brushing in addition to interdental cleaning aids (dental floss, dental sticks, or interdental tooth brushes) for an efficient plaque removing from the front, back and biting surfaces of the teeth. (11) Although rinsing with chlorhexidine should not replace daily tooth brushing, it could be an efficient adjunct to brushing in orthodontic patients. Many clinical findings proved the antiplaque and antigingivitis effect of chlorhexidine mouth rinse (containing 0.12% chlorhexidine 0.05% chlorhexidine (Curasept). It may be employed as an adjunct to other preventive measures such as professional care and patient-oriented instruction on an intermittent basis in order to reduce the plaque-induced iatrogenic side effects and to enhance the efficacy of oral hygiene measures in connection with orthodontic therapy with fixed appliances. (17) The use of dentifrices with 1100 ppm NaF and lower concentration of chlorhexidine can reduce the risk of tooth staining without compromising its effectiveness in controlling gingivitis and bleeding in orthodontic patients, although the intense motivating contact that the volunteers had with the researchers may have also played a role. (29, 30) Published data in the literature are in agreement with the results of our study which evaluated the effect of chlorhexidine mouth rinse in orthodontic patients when it was added to routine oral hygiene treatment (brushing + flossing) over one month period. The brushing + chlorhexidine group demonstrated significantly better plaque index and gingival index scores at all treatment intervals after baseline measurements. (32)



The results of the study are in agreement with the findings of Jayaprakash and Hiremath, who assessed the effects of a mouth rinse containing chlorhexidine and sodium fluoride on plaque accumulation and gingivitis in comparison with a chlorhexidine mouth rinse alone in a group of school children aged 13-16 years in Bangalore city. They suggested that the chlorhexidine-sodium fluoride mouth rinse potentially possesses a significant effect on inhibition of plaque accumulation and gingivitis. This combination along with the well-established effect of fluoride in the prevention of caries, presents an important contribution to dental public health. (20)

Early detection of white spot lesions during orthodontic treatment is also very important, as it would allow clinicians to implement preventive measures to control the demineralization process before progression of the lesions. The results of our study have indicated that WSLs remain a considerable problem during orthodontic treatment. Detecting WSLs during active treatment can be challenging for the clinician. The clinical crown must be free from plaque and debris, and the presence of excess gingival tissue can make visualization of WSLs difficult. Furthermore, to detect incipient WSLs, the tooth must be air-dried. If these steps are not followed, WSLs could easily be overlooked. Therefore, a thorough examination of each patient should be done at each appointment, and each patient should receive a customized oral hygiene treatment regimen to halt the progression of any demineralization.

In this study, statistically significantly decreased WSLs one month and three months after treatment were registered in subjects of the examined group (score of 1, score of 2). No significant differences were observed between the groups for demineralization (score of 3).

To date, clinical detection of WSLs has been carried out primarily by means of traditional methods such as visual inspection after air drying and tactile examination by dental probing. We chose to use this approach in our study. However, the subjectivity and lack of reproducibility of these approaches, together with the prerequisite of the presence of a significantly advanced lesion, have led to the introduction of several optical techniques during recent decades: the optical caries monitor, use of quantitative laser and light-induced fluorescence, digital imaging with fiber-optic trans illumination, laser fluorescence, and computer analysis of digital photographs. (28)



Conclusions

In conclusion, adding chlorhexidine mouth rinse to daily oral hygiene reduces bacterial plaque accumulation and improve the gingival index.

Chlorhexidine mouth rinse appears to be more effective than the normal home care for improving the appearance of white spot lesions over a 3 months period.

It is recommended Orthodontists to instruct their patients to rinse with chlorhexidine mouth wash once daily in addition to daily brushing.

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