

## Effectiveness of an Essential Oil Mouthrinse in Improving Oral Health in Orthodontic Patients

Eser Tufekci<sup>a</sup>; Zachary A. Casagrande<sup>b</sup>; Steven J. Lindauer<sup>c</sup>; Chad E. Fowler<sup>d</sup>; Kelly T. Williams<sup>e</sup>

### ABSTRACT

**Objective:** To test the null hypothesis that adding Listerine mouthrinse to the standard oral hygiene regimen has no added benefit for orthodontic patients in maintaining proper oral health.

**Materials and Methods:** Patients within their first 6 months of orthodontic treatment were assigned either to the brushing + flossing (N = 25) or brushing + flossing + Listerine (N = 25) group. Initially, all of the participants received a prophylaxis and instructions on how to brush and floss. Measurements were recorded for the bleeding, gingival, and plaque indices (BI, MGI, and PI, respectively) that provided baseline values (T1). Subsequent measurements were taken at 3 months (T2) and 6 months (T3). Mean BI, MGI, and PI at T1, T2, and T3 were compared statistically between the groups using repeated measures analysis of variance. The significance level was set at  $P \leq .05$ .

**Results:** The response profiles for the BI, MGI, and PI over time were significantly different between the two groups. Patients who had Listerine in their daily oral hygiene regimen exhibited significantly lower scores for all three indices at T2 and T3 than the patients who only brushed and flossed.

**Conclusions:** The hypothesis is rejected. This study shows that use of Listerine mouthrinse can reduce the amount of plaque and gingivitis in patients undergoing orthodontic treatment. Adding Listerine to the standard oral hygiene regimen may be beneficial for orthodontic patients in maintaining proper oral health, thus reducing the likelihood that white spot lesions and gingivitis will develop.

**KEY WORDS:** Malocclusion; Mouthrinse; Plaque; Gingivitis

### INTRODUCTION

During orthodontic treatment, the development of white spot lesions is almost inevitable when oral hygiene is poor.<sup>1,2</sup> Demineralization is more commonly seen on the buccal surfaces of orthodontically treated

teeth than on untreated teeth.<sup>1</sup> This is due to the prolonged plaque retention around the brackets, which causes a decrease in pH when certain bacteria interact with sugars.<sup>2-6</sup> These incipient lesions can appear in as little as 2 to 3 weeks after plaque accumulation in buccogingival areas of the teeth.<sup>2</sup> The presence of white spot lesions may lead to patient dissatisfaction at the end of orthodontic treatment and may necessitate cosmetic intervention by a dentist. If these lesions progress to decay, more extensive dental procedures may be needed.

The development of gingivitis and hyperplastic gingiva is also a well-recognized problem during orthodontic treatment with fixed appliances.<sup>1,2</sup> The primary causative factor in the development of gingivitis is the insufficient removal of supragingival plaque. The presence of orthodontic fixed appliances makes toothbrushing more difficult and predisposes the patient to plaque buildup on the buccal surfaces of teeth around the brackets. Additionally, many orthodontic patients,

<sup>a</sup> Assistant Professor, Department of Orthodontics, School of Dentistry, Virginia Commonwealth University, Richmond, Va.

<sup>b</sup> Private Practice, Reston, Va.

<sup>c</sup> Professor and Department Chair, Department of Orthodontics, School of Dentistry, Virginia Commonwealth University, Richmond, Va.

<sup>d</sup> Resident, Department of Orthodontics, School of Dentistry, Virginia Commonwealth University, Richmond, Va.

<sup>e</sup> Private Practice, Richmond, Va.

Corresponding author: Dr Eser Tufekci, Department of Orthodontics, School of Dentistry, 520 N 12th St, PO Box 980566, Richmond, VA 23298-0566 (e-mail: etufekci@vcu.edu)

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especially children and adolescents, fail to floss because they find this procedure time-consuming and tedious in the presence of orthodontic archwires.<sup>7</sup> Several clinical studies have shown an increase in the levels of *Streptococcus mutans* and lactobacilli, the main pathogens associated with the initiation and development of caries, in the dental plaque after placement of orthodontic attachments.<sup>2,8,9</sup> In addition, poor oral hygiene may increase the progression of gingival hyperplasia, eventually requiring intervention or even surgical reduction in some cases.

A common strategy to improve mechanical plaque removal is to incorporate a chemotherapeutic agent, such as an antibacterial mouthrinse, into the oral hygiene regimen.<sup>10</sup> Numerous periodontal studies have confirmed the ability of the essential-oil mouthrinses to kill a broad spectrum of microorganisms in vitro and in vivo.<sup>11–13</sup> Considerable clinical trial evidence is available showing that oral hygiene status is significantly improved when antibacterial mouthrinses are added to daily oral hygiene measures (toothbrushing and flossing) compared with toothbrushing and flossing alone.<sup>14</sup>

The bactericidal efficacy of Listerine (Pfizer Consumer Healthcare, Morris Plains, NJ), the essential oil-containing mouthrinse, has long been recognized.<sup>11–13,15</sup> The clinical benefits associated with the bactericidal activity of Listerine include prevention and reduction of supragingival plaque and gingivitis, decreased intrinsic oral malodor and a significant decrease in viable bacteria contained in the aerosols that are generated during dental procedures.<sup>11–13</sup>

The purpose of this study was to determine whether the use of Listerine in addition to the standard oral hygiene regimen (toothbrushing and flossing) has an added benefit for orthodontic patients in maintaining proper oral health.

Following were the null hypotheses of this study:

- There is no difference in gingival health when Listerine use is added to the daily oral hygiene regimen in orthodontic patients.
- There is no difference in plaque accumulation when Listerine use is added to the daily oral hygiene regimen in orthodontic patients.

## MATERIALS AND METHODS

### Subjects

This prospective study included 50 patients who were undergoing treatment in the Orthodontic Clinic of the School of Dentistry, Virginia Commonwealth University. Sample size was determined by a power analysis based on mean and standard deviation values for periodontal indices presented in a previous study by Charles et al.<sup>16</sup> Subjects within the first 6 months of

treatment and without a clinically significant medical or dental history were eligible for this study. Patients who agreed to participate signed a consent form before the study and were informed that they would be given \$25 upon completion of the study. Approval from the Institutional Review Board at Virginia Commonwealth University was obtained before the study began.

The study population had a mean age of 16.6 years (range = 10 to 64 years). The population was divided into a control group (brushing + flossing, N = 25) and an experimental group (brushing + flossing + Listerine, N = 25). Patients in the control and experimental groups were matched first for age and then for gender as compliance could significantly affect the results of the study. To minimize potential bias, group assignments were made by a person otherwise not involved in the study. The examiner who performed the measurements was blinded to the group assignments.

### Procedure

At the beginning of the study, all of the volunteers were given instructions on how to brush and floss. Each participant received an initial prophylaxis by the same dental hygienist. At this time (T1), baseline readings were recorded for the bleeding index (BI), modified gingival index (MGI), and plaque index (PI).

The BI was scored as described by Saxton and van der Ouderaa<sup>17</sup> upon probing the buccal sulcus of the Ramfjord teeth (upper right first molar, upper left central incisor, upper left first premolar, lower left first molar, lower right central incisor, lower right first premolar) as described: 0 = absence of bleeding after 30 seconds, 1 = bleeding observed after 30 seconds, and 2 = immediate bleeding.

The MGI was scored according to the MGI on the buccal marginal gingiva of the Ramfjord teeth as follows: 0 = absence of inflammation, 1 = mild inflammation (either marginal or papillary gingival unit), 2 = mild inflammation (entire marginal and papillary gingival unit), 3 = moderate inflammation, and 4 = severe inflammation.

The PI was scored according to the Turesky modification on the Quigley-Hein PI<sup>18</sup> on the buccal surface of Ramfjord teeth as described: 0 = no plaque; 1 = discontinuous band of plaque at the gingival margin; 2 = up to 1 mm continuous band of plaque at the gingival margin; 3 = band of plaque wider than 1 mm but less than one-third of the surface; 4 = plaque covering one-third or more of the surface, but less than two-thirds of the surface; and 5 = plaque covering two-thirds or more of the surface. One measurement for each tooth was scored for all categories.

Subjects in the control group were instructed to brush and floss only twice daily. Subjects in the rinse

group were asked to rinse vigorously for 30 seconds twice daily with 20 mL of Cool Mint Listerine in addition to their basic oral hygiene regimen (toothbrushing and flossing). All of the subjects in the mouthrinse group were monitored monthly for compliance by having them bring empty mouthrinse bottles from the previous month. All of the patients were provided with an Oral-B 35 soft-textured toothbrush (Gillette, Boston, Mass). All clinical measurements were performed by the same blinded examiner at 3 and 6 months (T2 and T3, respectively).

### Statistical Analyses

Before the study the examiner was calibrated in the use of periodontal indices by a clinical researcher experienced in their determination. Mean BI, MGI, and PI scores were compared statistically between the groups using repeated measures analysis of variance. The significance level was set at  $P \leq .05$ .

### RESULTS

Of the 50 volunteers who participated, 47 completed the 6-month study. One subject from the brushing + flossing + Listerine was excluded because she initiated a systemic drug therapy that could have affected the results. Two subjects from the brushing + flossing group were excluded because they did not regularly attend scheduled orthodontic appointments. The remainder of the participants complied as requested. The final brushing + flossing + Listerine group included 24 subjects (12 males, 12 females; mean age = 16.2 years; age range = 10 to 43 years; 4 adults and 20 children). The brushing + flossing group included 23 subjects (8 males, 15 females; mean age = 17.0 years; age range = 9 to 64; 4 adults and 19 children).

All index values for the brushing + flossing group increased significantly from the baseline period to the 3-month point ( $P < .05$ ). Although the measures for all indices continued to increase for the brushing + flossing group, at the 6-month point the increases were not statistically significant. The brushing + flossing + Listerine group demonstrated small changes in index values at the 3-month and 6-month intervals, but these values were not statistically significantly different from those at baseline.

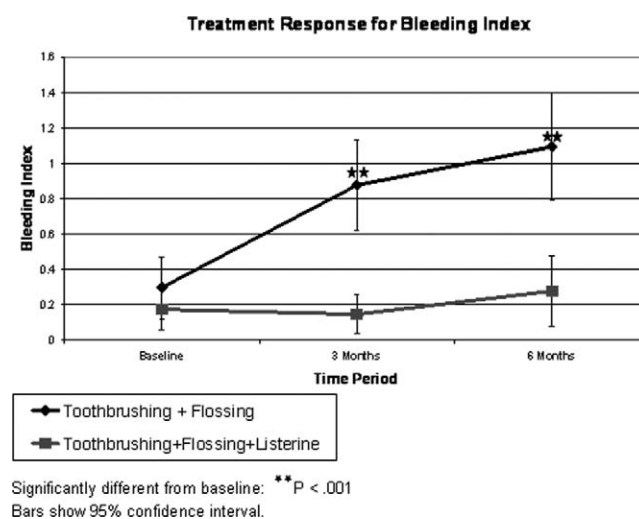
Table 1 shows BI, MGI, and PI scores for each oral hygiene regimen protocol for each of the three time points. The baseline measurements (T1) were not significantly different between the two groups ( $P > .05$ ). At T2, subjects in the mouthrinse group had statistically significantly lower mean BI ( $P < .001$ ), MGI ( $P < .01$ ), and PI ( $P < .01$ ) scores than the subjects in the brushing + flossing group. Mean BI, MGI, and PI

**Table 1.** Mean (SD) BI, MGI and PI scores for each regimen at baseline (T1), 3 months (T2), and 6 months (T3)

	Brushing + Flossing + Listerine® (N = 24)	Brushing + Flossing (N = 23)	Significance Between Groups
<b>Bleeding Index</b>			
Baseline	0.174 (0.271)	0.297 (0.405)	
3 Months	0.146 (0.266)	0.877 (0.589)†	***
6 Months	0.278 (0.471)	1.094 (0.703)†	***
<b>Marginal Gingival Index</b>			
Baseline	0.799 (0.453)	0.891 (0.587)	
3 Months	0.847 (0.602)	1.572 (0.977)†	**
6 Months	0.951 (0.595)	1.957 (1.079)†	***
<b>Plaque Index</b>			
Baseline	0.799 (0.586)	0.826 (0.589)	
3 Months	0.924 (0.639)	1.775 (0.934)†	***
6 months	1.014 (0.698)	2.167 (1.168)†	***

Significant within groups, †  $P < 0.05$ .

Significant between groups, \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .



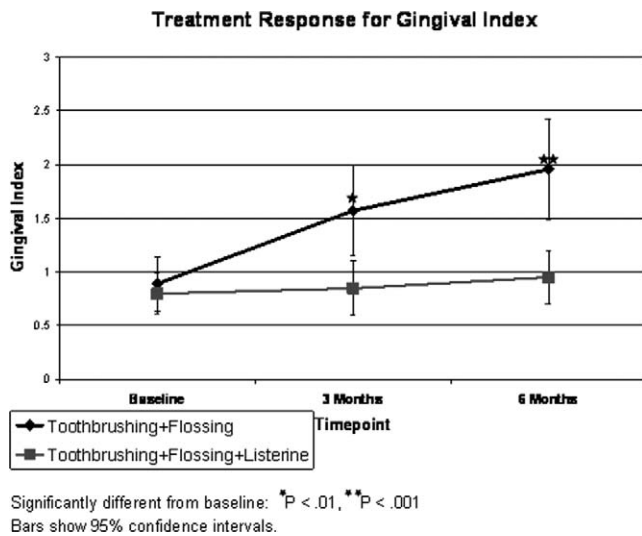
**Figure 1.** Treatment response for bleeding index.

scores remained significantly different between the groups ( $P < .001$ ) at 6 months (T3).

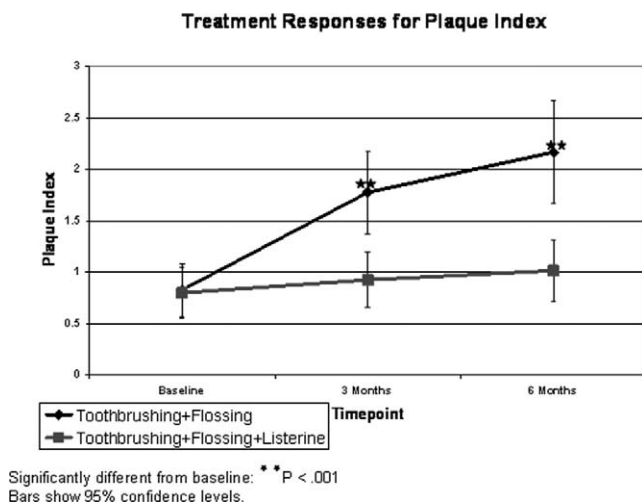
The changes in BI, MGI, and PI scores between groups over time are compared graphically in Figures 1, 2, and 3, respectively. The response profile for the brushing + flossing + Listerine group was significantly different ( $P < .001$ ) from that of the brushing + flossing group, the brushing + flossing group showing higher scores in all three indices at both the 3-month and 6-month intervals.

### DISCUSSION

Plaque accumulation and subsequent gingivitis are common in orthodontic patients because of the challenge of controlling oral hygiene with the combination



**Figure 2.** Treatment response for modified gingival index.



**Figure 3.** Treatment response for plaque index.

of brackets, bands, wires, and elastomeric ligatures present. 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.<sup>1,2,4,5</sup> Considerable clinical trial evidence shows that oral hygiene status is significantly improved when antibacterial mouthrinses are added to the daily oral hygiene regimen (toothbrushing and flossing) compared with tooth brushing and flossing alone.<sup>14</sup> Although rinsing with Listerine should not replace flossing, it could be an efficient adjunct to brushing in orthodontic patients who struggle to floss regularly in the presence of fixed appliances.<sup>14–16,19</sup>

This study evaluated the effect of Listerine mouthrinse in orthodontic patients when added to their routine oral hygiene regimen (brushing + flossing) over a 6-month period. The brushing + flossing + Listerine

group demonstrated significantly better BI, MGI, and PI scores than the brushing + flossing only group at all treatment intervals after baseline measurements. The results were in agreement with previous studies demonstrating the effectiveness of the oil-containing mouthrinse, Listerine, in controlling plaque and gingivitis in numerous clinical trials on persons who did not have orthodontic fixed appliances.<sup>14–16,19</sup>

Although the evidence suggests that use of Listerine reduces plaque and gingivitis, it is possible that the reduced plaque and gingivitis in the brushing + flossing + Listerine group was attributable to “enhanced hygiene awareness” because of the added step of rinsing with Listerine. Patients who rinsed twice a day with Listerine might have been motivated to care for their teeth more meticulously than the patients who just brushed and flossed. The lower mean scores in BI, MGI, and PI measurements may also have been attributable to the mechanical effect of rinsing alone. However, results from previous studies that used a placebo mouthrinse for control-group patients support bactericidal efficacy rather than any mechanical effect as the source of reduction in scores in experimental subjects.<sup>15,16,19</sup> Additional studies should be conducted using a negative-control mouthrinse in orthodontic patients to confirm that the decrease in BI, MGI, and PI scores was due to the bactericidal effect of the mouthrinse.

Studies on predicting patient compliance reported that cooperation levels varied considerably depending on the patient’s age and sex, perception of malocclusion, influence of parents on the child, personality type, and socioeconomic factors.<sup>20</sup> Although some studies suggested that young patients were more compliant than older ones, others found no correlation with age.<sup>21–23</sup> In the current study, patients in the two groups were matched by age. The brushing + flossing group had a higher proportion of females, which may have biased the outcome in favor of better oral hygiene in that group. However, despite the greater proportion of males in the brushing + flossing + Listerine group, this group still demonstrated significantly lower BI, MGI, and PI scores over time than the brushing + flossing group. Compliance with rinsing in the brushing + flossing + Listerine group was monitored by having participants return empty bottles on a monthly basis and suggested that the patients were compliant with the given instructions.

In previous studies evaluating the use of Listerine in nonorthodontic subjects, BI, MGI, and PI scores were significantly improved at T2 compared with baseline values at T1.<sup>15,16,19</sup> In the current study, there was a continuous increase in the BI, MGI, and PI scores for both groups, except in the BI score from baseline to 3 months in the brushing + flossing + Listerine group.



This is to be expected as toothbrushing and flossing becomes more challenging in the presence of the orthodontic appliances.<sup>7,24</sup> The results of the present investigation demonstrated that the use of Listerine mouthrinse provided significant reductions in the amount of plaque and gingivitis present compared with the control group. Use of Listerine in addition to the standard oral hygiene regimen was found to be beneficial for orthodontic patients in maintaining proper oral health.

## CONCLUSIONS

- Adding Listerine to the daily oral hygiene regimen reduces plaque and gingivitis development in orthodontic patients over a 6-month period.
- As fixed orthodontic appliances may cause enamel decalcification because of plaque accumulation around the bracket base, it is recommended that orthodontists instruct their patients to rinse twice a day with 20 mL of Listerine in addition to brushing and flossing.

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