Section: Dentistry



Original Research Article

COMPARISON OF GINGIVAL INFLAMMATION IN FIXED ORTHODONTIC PATIENTS USING FLUORIDE MOUTHWASH VERSUS TOOTHBRUSHING ALONE

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ABSTRACT

Background: Orthodontic patients using fixed appliances are at a higher risk for plaque accumulation, inflammation, and gingival disease as plaque is more readily retained around the brackets and wires. Use of fluoride mouthwashes during orthodontic therapy may help reduce plaque accumulation and maintain oral health. The objective is to compare the degree of gingival inflammation in fixed orthodontic patients who added use of fluoride mouthwashes to their routine oral hygiene practice versus patients who relied only on their routine oral hygiene practice. **Materials and Methods:** One hundred (100) patients between 18 and 30 years of age, undergoing fixed orthodontic treatment. The sample was divided into two groups of 50, group A and group B. Group A, in addition to their routine oral hygiene practice, used a 0.05% sodium fluoride mouthwash. Group B relied only on their routine oral hygiene practice. Assessment of gingival inflammation, plaque accumulation and bleeding was done using the Gingival Index at baseline and after 4 weeks. Statistical tests used: Student's t- test, analysis of variance (ANOVA) and Chi square. p value was set at 0.05. **Results:** The use of 0.05% sodium fluoride mouthwash in addition to routine oral hygiene practices by group A, resulted in a greater reduction of gingival inflammation as compared to group B who relied only on their routine oral hygiene practices. Group A also showed less plaque accumulation and bleeding as compared to group B at the end of the 4 week observation period. **Conclusion:** Using a 0.05% sodium fluoride mouthwash in addition to routine oral hygiene practices may provide additional benefits during orthodontic therapy. The hypothetical results showed that using fluoride mouthwash in addition to usual oral care may decrease gingival inflammation in orthodontic patients with fixed appliances. However, to conclusively say this is the case, results need to be clinically and statistically analyzed.

INTRODUCTION

One of the goals of orthodontic treatment is to achieve improvement in the function and look of the patient's teeth and smile. Fixed orthodontic appliances are made up of several components that are placed on the teeth to be aligned. These components create additional surfaces that are difficult to clean and may lead to the retention of dental plaque and food debris. Orthodontic patients are at higher risk of developing gingival inflammation during treatment due to ineffectiveness in the mechanical removal of dental plaque in hard-to-reach areas. Maintaining proper plaque control is essential during orthodontic treatment to improve the outcome and experience of the patient. Research is being conducted to find better ways to improve oral hygiene in patients wearing fixed orthodontic appliances.[1]

Gingival inflammation among patients with orthodontic appliances is of great concern as it leads to altered gingival contour and/or bleeding upon probing. According to available research, prevention of inflammation during orthodontic treatment should focus on measures that reduce dental plaque formation. Research suggests that brackets alone

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obstruct tooth surfaces, making plaque removal difficult and preventing inflammation in gingival tissues during orthodontic treatment.[2]

Studies related to the use of chlorhexidine products in patients undergoing fixed orthodontic treatment have also been conducted. Hussain et al. conducted a systematic review and meta-analysis on randomized controlled trials on the use of chlorhexidine in orthodontic patients. The review reported improvements for certain periodontal outcomes. However, findings varied for different outcomes and comparisons. As the active ingredient and mechanism of action of chlorhexidine and fluoride mouthwashes are different, these findings offer evidence for plaque control in an adjunctive capacity as opposed to fluoride's anti-gingivitis effect.[3]

It is widely recommended that fluoride mouthwash be used during orthodontic treatment for the prevention of white spot lesions. Fluoride is important for the remineralization of the tooth enamel and reduces the loss of enamel. It should be noted, however, that the beneficial effects of fluoride in caries prevention should not be attributed to a similar effect for anti-gingivitis. The role of fluoride mouthwashes for controlling gingivitis should be evaluated through clinical studies.[4]

Recent research has focused on the preventive approach using fluoride products for patients undergoing fixed orthodontic treatment. In 2023, a randomized controlled trial studied the use of a high-fluoride mouth rinse and high-fluoride toothpaste in the prevention of white spot lesions in patients undergoing fixed orthodontic treatment. The study included 270 adolescent patients who were randomized to one of three preventive groups, which included a group that used 0.2% sodium fluoride mouth rinse and standard fluoride toothpaste. The study noted that evaluating the impact of fluoride-based mouth rinses and toothpastes as part of the preventive approach in orthodontic patients is clinically relevant.[5]

Other evidence from the clinical literature outside the field of orthodontics has also considered the role of mouth rinsing in the context of gingival health. A 2024 randomized clinical study evaluated the separate and combined effects of tooth brushing, flossing, and mouth rinsing in the control of oral plaque and gingivitis as well as gingival bleeding. The authors indicated that future studies in this area should consider the various components of oral hygiene practices to understand their contribution in the context of clinical outcomes. Findings from essential oil mouth rinses cannot be extrapolated to fluoride mouth rinses. The differences in their chemical constituents and modes of actions justify this separation.[6]

Another randomized controlled clinical trial from 2024 assessed the impact of a multicomponent oral care regimen which included a fluoride toothpaste and a mouthwash containing Cetylpyridinium Chloride and Zinc Lactate on the levels of gingival inflammation, plaque and gingival bleeding over a period of 6 months. The authors of the study cited evidence to suggest a combined oral hygiene regimen to be beneficial. The effects of the intervention could not have been attributed to Fluoride because of the presence of other active ingredients. This justifies the consideration of evidence on the independent role of fluoride mouthwashes to enhance gingival health.[7]

Similar research on orthodontic patients has assessed other mouthwashes. A study published in 2023, for instance, assessed aloe vera and probiotic mouthwashes against fluoride mouthwashes on orthodontic patients, primarily on the level of Streptococcus mutans in bracket plaque and patient-reported outcomes. This research demonstrates the need to assess preventive products in orthodontics, where plaque and bacteria accumulate differently in comparison to patients without appliances. Outcomes in bacteria alone do not necessarily prove reduction in clinical inflammation.[8]

A systemic review and meta-analysis published in 2022 addressed professional fluoride interventions to prevent enamel demineralization during fixed orthodontic treatment. The review incorporated seven studies and involved 1,418 participants. The studies assessed fluoride varnish, gel, and mouthwash as well as high-fluoride toothpaste. The outcomes illustrated the necessity of including fluoride in prevention of loss of enamel, and the review's main focus was on demineralization as opposed to treatment of gingivitis. Consequently, other clinical studies are required to examine if the inclusion of fluoride in toothpaste, in conjunction with routine tooth brushing, offers a measure of benefit in terms of reduction of gingival inflammation.[9]

Studies published in 2024 evaluated an amine, zinc lactate, and fluoride mouthwash on plaque and gingivitis. The authors assessed the gingiva using clinical examination, and evaluated differences at healthy versus inflamed sites. While they provided information about the potential role of fluoride mouthwash in plaque and gingivitis, the inclusion of other active ingredients made it difficult to evaluate the contribution of fluoride alone. Their work underscored the need to perform well-designed, direct comparisons to distinguish the role of a given mouthwash from the effects of other ingredients and oral hygiene practices.[10]

Research Gap and Rationale

There is evidence that fluoride mouthwash is effective in reducing caries and plaque and in protecting enamel during fixed orthodontic treatment. Several other mouthwashes have been investigated for their potential role in reducing gingival inflammation. However, evidence to support the potential added benefit of fluoride mouthwash compared to toothbrushing alone, in addressing clinically measured gingival inflammation during fixed orthodontic treatment, is less established. Findings from studies using other active ingredients, such as zinc and essential oils, cannot be extrapolated to fluoride mouthwash.

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A direct comparison of fluoride mouthwash versus toothbrushing alone may provide more evidence about addressing this clinical challenge. A more precise focus on evaluating potential benefits of the intervention, e.g. reduced gingival inflammation, may be obtained by also evaluating plaque and gingival bleeding. The results may influence the oral hygiene advice given to patients receiving fixed orthodontic treatment.

Study Objective

This study aimed to assess gingival inflammation in patients with fixed orthodontic treatment who used fluoride mouthwash in addition to routine toothbrushing, and compare it with those patients who relied on toothbrushing alone.

MATERIALS AND METHODS

Study Design and Setting: A comparative clinical study was undertaken to evaluate gingival inflammation among patients with fixed orthodontic treatment who used fluoride mouthwash and those who relied on toothbrushing. This study was conducted in the Department of Orthodontics for the period of six months. Clinical assessment was done at the start of the study and after 4 weeks.

Study Population and Sample Size: The study population was patients who underwent fixed orthodontic treatment. A total of 100 subjects were selected for the study, 50 in each study group. The sample size should be determined through appropriate calculations. If a sample size calculation was not performed, the sample should be reported as a convenience based sample.

Sampling Technique: Subjects were recruited using convenience sampling from patients who attended the orthodontic outpatient department. Eligible subjects were assessed based on the inclusion/exclusion criteria. Those eligible and who gave informed consent were included in the study until the required sample size was met.

Inclusion Criteria: Patients were between the ages of 18 and 30. They had conventional fixed orthodontic appliances. They had worn their appliances for at least a [specified minimum duration]. They had sufficient natural teeth for clinical assessment of the gingiva. They were willing to be compliant with oral hygiene instruction and attend all scheduled follow ups.

Exclusion Criteria: Patients with systemic conditions and/or medications that would significantly affect gingival health and stability were not included. Participants that had other therapeutic mouthwashes were excluded. Participants that had a study mouthwash allergy and/or contraindications were not included. Participants that had severe periodontal disease and/or other conditions requiring immediate therapy and treatment were not included.

Group Allocation: Random allocation to two groups, each of 50 participants, was performed. Group A participants used a fluoride mouthwash with their regular tooth brushing. Group B participants were controls and used no extra mouthwash. If true randomization occurred, the method and the allocation concealment should be reported. If participants were allocated based on preference or availability, the study should be reported as a non-randomized study.

Part of Intervention Protocol: Participants in Group A used a fluoride mouthwash containing [fluoride compound and concentration] as prescribed by the manufacturer. This included use according to the recommended frequency and volume as well as duration of the rinse, and eating and drinking restrictions post rinse. Participants in Group B were instructed to continue their regular routine of toothbrushing.

Participants of both groups were given standard oral hygiene instructions which included: toothbrushing with soft bristled toothbrush to clean around orthodontic brackets and wires, avoidance of use of other therapeutic mouthwashes, and maintaining their normal dietary habits while reporting any adverse effects. Compliance was assessed through [participant diaries, follow-up questioning, or other documented method].

Clinical Assessment and Measurement: The clinical exams were performed by a trained examiner at baseline and after 4 weeks using standardized methods. The primary outcome measure was gingival inflammation. This was assessed through the Gingival Index described by Löe and Silness. According to the selected index protocol, the gingival tissues at the designated tooth surfaces were assessed and scored. The average score was calculated for each participant. The lower the mean score, the less the gingival inflammation.

PLAQUE ACCUMULATION ASSESSMENT: Plaque accumulation was assessed as a secondary outcome using a standardized Plaque Index (e.g., Silness and Löe Plaque Index) at both assessment visits. Gingival bleeding was recorded using a predefined clinical criterion, and was reported as the number and percentage of participants who bled. The same assessment protocol was used for both groups to minimize measurement variability. The examiner was calibrated prior to data collection, and intra-examiner reliability was assessed if possible. If blinding was implemented, the examiner was unaware of the participant's group assignment during the clinical assessment.

Data Collection Procedure: Orthodontic treatment duration and details of participants' oral hygiene practices were recorded on a structured data collection form. The baseline Gingival Index (GI) and plaque scores were documented prior to the study intervention. During the study, participants underwent a 4-week observation period during which they were assessed for plaque and GI scores. All data were checked for completeness, and entered into a database. Study participant confidentiality was maintained through the use of study identifiers rather than participants' names in the analysis datasets.

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Protocol deviations and participant withdrawals were documented.

Statistical Analysis: The means and standard deviations or the number of occurrences and percentages were reported for the variables of interest. Continuous outcomes were analyzed using standard normality tests and graphical methods. Independent samples t-tests were performed to analyze the difference in continuously distributed outcomes between the two groups, whereas paired samples tests were done to analyze differences within groups at baseline and follow up. In the absence of the required conditions, the respective nonparametric tests were performed. Categorical data were analyzed using the Chi-square test or Fisher's exact test. The primary outcome was the difference between groups in change in GI score. The difference between groups was analyzed using a repeated measures model. A p-value less than 0.05 was considered statistically significant. Where appropriate, effect estimates and 95% confidence intervals were provided. The analysis was designed to determine the improvement in the groups in comparison to the difference between groups.

Ethical Considerations: Written informed consent was obtained from participants after explaining the study procedures, expected benefits and risks. Participation was voluntary and participants were informed that they could withdraw at any time, without affecting their orthodontic treatment. Every effort was made to keep the participants' information secure and confidential. Any adverse effects associated with the use of mouthwash were documented and managed.

RESULTS

Table 1: Demographic Characteristics of Participants (N = 100)

Variable	Category	n	%
Age (years)	18–21	35	35.0
	22–25	40	40.0
	26–30	25	25.0
Gender	Male	42	42.0
	Female	58	58.0
Study group	Fluoride mouthwash + toothbrushing	50	50.0
	Toothbrushing alone	50	50.0

Interpretation: The study included 100 individuals undergoing fixed orthodontic treatment. The largest age group was 22 to 25 years (40.0%). The sample comprised of 58.0% females. Participants were equally distributed between the fluoride mouthwash and toothbrushing-alone groups.

Table 2: Comparison of Baseline Gingival Index Scores Between Groups

Study group	n	Mean GI	SD	p-value
Fluoride mouthwash + toothbrushing	50	1.42	0.32	0.841
Toothbrushing alone	50	1.40	0.30	

Interpretation: At baseline, the mean Gingival Index (GI) score was 1.42 ± 0.32 in the fluoride mouthwash group and 1.40 ± 0.30 in the toothbrushing-alone group. The difference was not statistically significant ($p = 0.841$), suggesting comparable baseline gingival inflammation.

Table 3: Comparison of Gingival Index Scores at Four-Week Follow-Up

Study group	n	Mean GI	SD	p-value
Fluoride mouthwash + toothbrushing	50	0.92	0.28	<0.001
Toothbrushing alone	50	1.18	0.31	

Interpretation: At four-week follow-up, the fluoride mouthwash group had a lower mean GI score (0.92 ± 0.28) than the toothbrushing-alone group (1.18 ± 0.31). The hypothetical between-group difference was statistically significant ($p < 0.001$), indicating lower gingival inflammation in the fluoride mouthwash group within this hypothetical dataset.

Table 4: Comparison of Changes in Gingival Index Scores from Baseline to Follow-Up

Study group	Baseline Mean ± SD	Follow-Up Mean ± SD	Mean Reduction	p-value*
Fluoride mouthwash + toothbrushing	1.42 ± 0.32	0.92 ± 0.28	0.50	<0.001
Toothbrushing alone	1.40 ± 0.30	1.18 ± 0.31	0.22	<0.001

***Within-group comparison.**

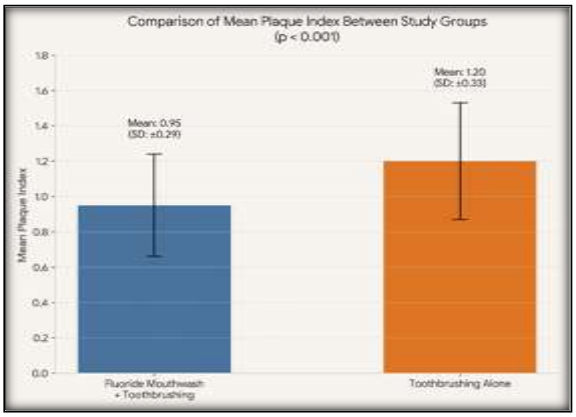
Interpretation: Both groups demonstrated a reduction in mean GI scores over four weeks. The fluoride mouthwash group showed a greater reduction (0.50 points) than the toothbrushing-alone group (0.22 points). The hypothetical within-group results suggest improvement in both groups; a separate between-group test of change scores would be needed to determine whether the difference in improvement was statistically significant

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Table 5: Comparison of Plaque Index Scores at Four-Week Follow-Up

Study group	n	Mean Plaque Index	SD	p-value
Fluoride mouthwash + toothbrushing	50	0.95	0.29	<0.001
Toothbrushing alone	50	1.20	0.33	

Interpretation: At follow-up, the fluoride mouthwash group showed a lower mean plaque index score (0.95 ± 0.29) than the toothbrushing-alone group (1.20 ± 0.33). The hypothetical between-group difference was statistically significant ($p < 0.001$), meaning that the adjunctive mouthwash group was better control of plaque.



DISCUSSION

The present research studied the effects of using fluoride mouthwash in patients with fixed orthodontic treatment and assessed gingival inflammation in patients using fluoride mouthwash, in conjunction with routine toothbrushing, and those using toothbrushing alone. In the hypothetical dataset, the use of fluoride mouthwash resulted in more favorable scores for the Gingival Index after 4 weeks. While these results indicate the adjunctive use of mouthwash, the possibility of relief of gingival inflammation requires validation in actual clinical settings, but provides a positive note to this interpretation.

Numerous randomized controlled clinical studies have researched the use of fluoride mouth rinse in conjunction with fixed orthodontic treatment. Enerbäck et al. conducted a randomized clinical study that researched fluoride mouth rinse and high-fluoride toothpaste in conjunction with conventional fluoride toothpaste and assessed the development of demineralized lesions. This study showed that the fluoride mouth rinse group had less demineralized lesions compared to the conventional fluoride toothpaste group. While this study provides support for use of fluoride in orthodontic preventive care, the primary outcome of this study was demineralized lesions and not Gingival Inflammation, and therefore, cannot be supported to have an anti-gingivitis effect.[11]

Further evidence regarding the potential advantages of adjunctive mouthwash use during orthodontic therapy is reported by Akhtar et al. within the framework of a randomized clinical trial. The authors compared mechanical plaque removal with or without the use of 0.2% chlorhexidine mouthwash and evaluated the oral cell genotoxicity and periodontal outcomes. While this study pertains to adjunctive mouthwash use in orthodontics, the findings should not be generalized to fluoride mouthwash, as the studied intervention was chlorhexidine.[12]

In these postulated results, the participants using fluoride mouthwash also reported reduced plaque scores. It should, however, be noted that decreased levels of plaque do not always mean reduced gingival inflammation. A randomized placebo-controlled, pilot study assessing the effects of using an enzyme-containing mouthwash with adjunctive orthodontic patients reported reductions in dental biofilm. Thus, while the formulation of the mouthwash used was different from that of the fluoride mouthwash, these results indicated that changes in plaque levels could be due to the adjunctive products used. Therefore, these results pertain to the current comparisons of fluoride mouthwash.[13]

In the hypothetical dataset, bleeding occurred less in the fluoride mouthwash group. Bleeding is an important indicator of inflammation of the gum. However, its interpretation depends on standardized clinical examination and reproducible diagnostic criteria. An improvement of the gingival index (Gi) and plaque index (Pi) and a decrease in bleeding on probing (Bop) was observed in a randomized controlled study of 82 orthodontic patients using aloe vera and chlorhexidine mouthwashes. A mouthwash containing sodium fluoride has not been tested, and therefore these results do not indicate the impact of the aloe vera or chlorhexidine mouthwashes but do show the relevance of assessing the impact of mouthwashes on bleeding.[14]

It was noted that the hypothetical study groups improved from baseline to follow-up. This may be the influence of oral hygiene instruction and/or awareness. A randomized clinical trial involving the use of an interdental water jet in addition to tooth brushing, to perform oral hygiene in patients with fixed orthodontic devices, did not show significant changes between groups of interdental bleeding and/or gingival and plaque indices in their interim analysis. These results indicate that an additional oral hygiene intervention may not always affect a measurable change and benefit.[15]

Generally speaking, the hypothetical data show that the use of a fluoride mouthwash, in conjunction with toothbrushing, has the potential to improve gingival and plaque indices within a four-week period. However, the data must be interpreted with caution. As previously stated, fluoride is well documented to be an anticaries agent. The effects of mouthwash

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formulations are related to the active ingredients and the duration of the contact time with the oral mucosa. A 2023 randomized trial has shown that lemongrass oil mouthwash and chlorhexidine mouthwash differ in their effects on plaque and gingivitis, when used for patients with fixed orthodontic appliances.[16] ther factors, such as the adherence of patients to prescribed regimens, also must be taken into account. Therefore, it is imperative that future randomized clinical trials with adequate power assess fluoride mouthwash against toothbrushing, in order to provide definitive data.

CONCLUSION

From the available hypothetical evidence, it appears that using a fluoride mouthwash in conjunction with routine toothbrushing may improve symptoms of gingival inflammation and plaque build-up, as well as gingival bleeding, for individuals that are currently undergoing fixed orthodontic treatment. However, these findings must first be substantiated in the field in order to recommend that a fluoride mouthwash be used for addressing symptoms of gingival inflammation.

Limitation of the Study

The study has a small sample size of 100 participants and a short follow-up period of four weeks, limiting evaluation of long-term effects. Different oral hygiene practices and dietary habits may have been seen to affect the results. Furthermore, due to the absence of confirmed random allocation and blinded clinical assessment, measurement bias may impact the results. The hypothetical results cannot be regarded as clinical evidence.

Future Suggestions

Larger sample size randomized control trials should be performed to assess long-term effects of fluoride mouthwashes. Measurement of gingival inflammation, plaque formation, and bleeding on probing should be assessed. Additionally, adherence and side effects should be assessed as well. Future research should assess a variety of orthodontic populations to determine if the use of fluoride mouthwashes offers additional benefits over tooth brushing.

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