RESEARCH PAPER

Comparative Effectiveness of Probiotic Toothpaste vs. Regular Toothpaste on Gingival Health in Adult Orthodontic Patients

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ABSTRACT

Background: Maintenance of gingival health is a major challenge in adult orthodontic patients due to the presence of fixed appliances, which increase plaque accumulation and gingival inflammation. Conventional toothpastes primarily focus on mechanical plaque removal and fluoride delivery but may not sufficiently control gingival inflammation in orthodontic patients. Probiotic toothpaste has emerged as a novel preventive approach that may improve gingival health by modulating the oral microbiota and suppressing pathogenic bacteria.

Objectives: To compare the effectiveness of probiotic toothpaste versus regular toothpaste on gingival health among adult orthodontic patients.

Study Design & Setting: This randomized controlled comparative study was conducted over a period of six months in the Departments of Dentistry Orthodontics Department Sharif Medical and Dental College Lahore from May 2025 to October 2025.

Methodology: A total of 120 adult patients aged 18–40 years undergoing fixed orthodontic treatment were enrolled and randomly allocated into two equal groups. Group A was instructed to use probiotic toothpaste, while Group B used regular fluoridated toothpaste. All participants were advised to brush twice daily using the modified Bass technique and were given standardized oral hygiene instructions. Gingival health was assessed at baseline and after four weeks using Plaque Index, Gingival Index, and Bleeding on Probing scores. Data were analyzed using SPSS version 25.0, and intergroup and intragroup comparisons were performed using appropriate statistical tests, with a p-value of <0.05 considered statistically significant.

Results: Baseline plaque index, gingival index, and bleeding on probing scores were comparable between the two groups. After four weeks, Group A showed greater reductions in plaque index, gingival index, and bleeding on probing compared to Group B. The differences between the probiotic toothpaste group and the regular toothpaste group at follow-up were statistically significant for all assessed parameters. Intragroup analysis also demonstrated significant improvement in gingival health indicators in both groups over time.

Conclusion: Probiotic toothpaste was more effective than regular toothpaste in improving gingival health among adult orthodontic patients. Its use may be recommended as an adjunctive oral hygiene measure during fixed orthodontic treatment to reduce gingival inflammation and plaque accumulation

Keywords: Adult Orthodontic Patients, Gingival health, Plaque Index, Probiotic Toothpaste, Regular Toothpaste

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INTRODUCTION

Maintenance of optimal gingival health is a critical component of successful orthodontic treatment.[1] Fixed orthodontic appliances create additional plaque-retentive areas that compromise oral hygiene and predispose patients to gingival inflammation, bleeding, and periodontal deterioration.[2] Adult orthodontic patients are particularly vulnerable, as they often present with pre-existing periodontal challenges and reduced tissue adaptability compared to adolescents. Therefore, effective plaque control strategies are essential to prevent gingival complications during orthodontic therapy.[3,4]

Toothbrushing with fluoridated toothpaste remains the cornerstone of daily oral hygiene and plaque control. Conventional toothpastes primarily rely on mechanical plaque removal and chemical agents such as fluoride, detergents, and abrasives to maintain oral health.[5] While these formulations are effective in caries prevention, their impact on gingival health during orthodontic treatment is often limited by patient compliance, appliance-related

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plaque retention, and alterations in the oral microbial ecosystem. As a result, adjunctive approaches aimed at modifying the oral biofilm have gained increasing attention.[6]

Probiotics have emerged as a promising preventive modality in dentistry due to their ability to modulate the oral microbiota by inhibiting pathogenic microorganisms and promoting microbial balance.[7] Probiotic toothpaste formulations contain beneficial bacterial strains that may competitively inhibit periodontal pathogens, reduce inflammatory responses, and enhance gingival health. Unlike antimicrobial agents that non-selectively eliminate oral bacteria, probiotics aim to restore ecological balance within the oral cavity, making them particularly suitable for long-term use.[8]

Several studies have demonstrated the beneficial effects of probiotics on periodontal parameters, including reductions in plaque index, gingival index, and bleeding on probing. However, evidence regarding their effectiveness specifically in orthodontic patients remains limited and inconsistent.[9,10] The presence of fixed appliances alters plaque composition and increases gingival susceptibility, potentially influencing the therapeutic effects of probiotic agents. Furthermore, adult orthodontic patients represent a distinct population with different oral hygiene behaviors, microbiological profiles, and periodontal responses compared to younger patients.[11]

Comparative evaluations of probiotic toothpaste versus regular toothpaste in orthodontic settings are scarce, particularly in adult populations. Understanding whether probiotic toothpaste provides additional gingival health benefits beyond conventional formulations is essential for evidence-based clinical recommendations. From a community and preventive dentistry perspective, identifying simple, cost-effective, and patient-friendly interventions can significantly improve oral health outcomes and reduce the burden of periodontal complications during orthodontic treatment. Therefore, the present study aims to compare the effectiveness of probiotic toothpaste with regular toothpaste on gingival health parameters in adult orthodontic patients. The findings of this study may contribute valuable evidence for preventive strategies in orthodontic care and guide clinicians in optimizing oral hygiene recommendations for adult patients undergoing fixed orthodontic treatment

MATERIALS AND METHODS

This randomized controlled study was conducted in the Department of Departments of Dentistry Orthodontics Department Sharif Medical and Dental College Lahore from May 2025 to October 2025. Adult patients undergoing fixed orthodontic treatment were recruited after obtaining informed written consent. Ethical approval was obtained from the Institutional Review Board prior to the commencement of the study.

A total of 120 adult orthodontic patients aged 18 to 40 years were included in the study. The sample size was calculated using an anticipated mean difference in gingival index scores between probiotic and regular toothpaste groups, with a confidence level of 95% and a study power of 80%. Based on these assumptions and accounting for a possible dropout rate of 10%, a final sample size of 120 patients was determined.

Patients who had been on fixed orthodontic appliances for at least three months and demonstrated mild to moderate gingival inflammation were included. Patients with systemic diseases affecting periodontal health, recent antibiotic or probiotic use within the previous four weeks, active periodontal disease, smokers, pregnant or lactating females, and those using any adjunctive chemical plaque control agents were excluded from the study.

The participants were randomly allocated into two equal groups of 60 patients each using a computer-generated randomization sequence. Group A was instructed to use probiotic toothpaste, while Group B was instructed to use regular fluoridated toothpaste. Both groups were advised to brush twice daily using the modified Bass technique and were provided standardized oral hygiene instructions to minimize behavioral bias.

Baseline clinical assessments were performed by a single calibrated examiner. Gingival health was evaluated using the Gingival Index and Plaque Index at baseline and after four weeks of toothpaste use. Bleeding on probing was also recorded as a secondary outcome measure. All clinical measurements were performed under standardized conditions using a mouth mirror and periodontal probe.

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Quantitative variables were expressed as mean and standard deviation, while qualitative variables were expressed as frequencies and percentages. Intragroup comparisons were performed using paired t-tests, and intergroup comparisons were performed using independent t-tests. A p-value of less than 0.05 was considered statistically significant.

RESULTS

As given in Table 1, the mean age of the study participants was 26.8 ± 5.4 years. Among the 120 participants, 52 (43.3%) were males and 68 (56.7%) were females. Regarding the duration of orthodontic treatment, 47 (39.2%) patients had been undergoing treatment for 3–6 months, while 73 (60.8%) had been under treatment for more than six months

Table 1. Descriptive Statistics of Characteristics of Patients

Variable	Category	n (%)
Age (years)	Mean ± SD	26.8 ± 5.4
Gender	Male	52 (43.3)
	Female	68 (56.7)
Duration of orthodontic treatment	3–6 months	47 (39.2)
	>6 months	73 (60.8)

As presented in Table 2, the baseline plaque index scores were comparable between Group A (1.89 ± 0.31) and Group B (1.86 ± 0.29). After four weeks, the plaque index score was reduced to 1.21 ± 0.27 in Group A and to 1.48 ± 0.30 in Group B, with a statistically significant difference observed between the two groups.

Table 2: Comparison of Plaque Index Scores Between Groups at Baseline and 4 Weeks

Time Point	Group A (Probiotic toothpaste)	Group B (Regular toothpaste)	p-value
Baseline	1.89 ± 0.31	1.86 ± 0.29	0.58
4 weeks	1.21 ± 0.27	1.48 ± 0.30	<0.001

As illustrated in Table 3, the gingival index scores at baseline were similar in Group A (1.74 ± 0.34) and Group B (1.71 ± 0.32). At the four-week follow-up, the gingival index score was reduced to 1.05 ± 0.25 in Group A and to 1.32 ± 0.28 in Group B, showing a statistically significant intergroup difference.

Table 3: Comparison of Gingival Index Scores Between Groups at Baseline and 4 Weeks

Time Point	Group A (Probiotic toothpaste)	Group B (Regular toothpaste)	p-value
Baseline	1.74 ± 0.34	1.71 ± 0.32	0.64
4 weeks	1.05 ± 0.25	1.32 ± 0.28	<0.001

As depicted in Table 4, the baseline bleeding on probing scores were comparable between Group A (24.6 ± 6.8) and Group B (23.9 ± 7.1). After four weeks of intervention, bleeding on probing was reduced to 12.8 ± 4.9 in Group A and to 17.6 ± 5.3 in Group B, with a statistically significant difference between the groups.

Table 4: Comparison of Bleeding on Probing Scores Between Groups at Baseline and 4 Weeks

Time Point	Group A (Probiotic toothpaste)	Group B (Regular toothpaste)	p-value
Baseline	24.6 ± 6.8	23.9 ± 7.1	0.59
4 weeks	12.8 ± 4.9	17.6 ± 5.3	<0.001

As reported in Table 5, intragroup comparison revealed that the gingival index score in Group A decreased from 1.74 ± 0.34 at baseline to 1.05 ± 0.25 at four weeks, while in Group B it decreased from 1.71 ± 0.32 to 1.32 ± 0.28 over the same period. Both groups demonstrated statistically significant reductions from baseline to follow-up.

Table 5: Intragroup Comparison of Gingival Index Scores at Baseline and 4 Weeks

Group	Baseline	4 Weeks	p-value
	(Probiotic toothpaste)	(Regular toothpaste)	
Group A	1.74 ± 0.34	1.05 ± 0.25	<0.001
Group B	1.71 ± 0.32	1.32 ± 0.28	<0.001

DISCUSSION

Gingival health maintenance is essential during orthodontic treatment, particularly in adult patients wearing fixed appliances. Orthodontic brackets and wires increase plaque retention and make routine oral hygiene challenging.[12] Conventional toothpastes mainly assist in mechanical plaque removal but may not adequately control gingival inflammation in orthodontic patients. Probiotics have gained attention due to their ability to modulate oral microbiota and suppress pathogenic bacteria. Probiotic toothpastes offer a biological approach to improving gingival health without disturbing microbial balance.[13] However, evidence comparing probiotic and regular toothpaste in adult orthodontic patients remains limited.

The present study demonstrated that probiotic toothpaste produced significantly greater improvements in gingival health parameters compared to regular toothpaste in adult orthodontic patients. Statistically significant reductions were observed in plaque index, gingival index, and bleeding on probing after four weeks in the probiotic group, while the regular toothpaste group showed comparatively smaller improvements. These findings support the concept that probiotic-containing oral hygiene products can positively influence gingival health during fixed orthodontic treatment. Our findings were partially consistent with those reported by Tahir et al. (2025), who observed a significantly lower median gingival score in the probiotic group compared to the control group (0.12 vs. 0.15; $p = 0.041$).[14] Similarly, our study showed a significant reduction in gingival index scores in the probiotic group compared to the regular toothpaste group ($p < 0.001$). However, Tahir et al. reported no significant difference in plaque scores between groups ($p = 0.15$), whereas our study demonstrated a statistically significant reduction in plaque index in the probiotic group compared to controls. This difference may be attributed to variations in study population, orthodontic appliance duration, and follow-up periods.[14]

Microbiological evidence from previous studies supports the clinical improvements observed in our study. Prabakar et al. (2018) reported significant reductions in Streptococcus mutans and Lactobacillus counts across all treatment groups at 30 days, with the greatest reduction observed in the chlorhexidine dentifrice group ($p < 0.05$). Although chlorhexidine showed superior antimicrobial efficacy, probiotic toothpaste still demonstrated meaningful biological activity, aligning with our observed reductions in plaque and gingival inflammation. These findings suggest that probiotic formulations may offer a safer long-term alternative without the adverse effects associated with chlorhexidine.[15]

Similarly, Naz et al. (2021) reported that conventional toothpastes exhibited moderate antimicrobial activity against oral pathogens, with antibiotics showing the highest

zones of inhibition. This supports our finding that regular toothpaste improved gingival parameters but to a lesser extent than probiotic toothpaste, highlighting the added benefit of microbiome modulation rather than simple antimicrobial action.[16] The results of our study closely aligned with Patel et al. (2025), who demonstrated a significant reduction in Streptococcus mutans levels around orthodontic brackets following the use of probiotic toothpaste. The microbial reduction observed by Patel et al. provides a plausible explanation for the significant reductions in plaque index and gingival inflammation seen in our probiotic group.[17]

Strong agreement was also found with Albardawel et al. (2024), who reported significantly lower plaque index, gingival index, papillary bleeding index, and probing depth values in the probiotic group compared to the control group at follow-up ($p < 0.05$). In contrast to their control group, which showed worsening periodontal parameters over time, both groups in our study demonstrated improvement, likely due to standardized oral hygiene reinforcement.[18] In contrast, Kusnoto et al. (2025) reported no significant changes in plaque index despite reductions in periodontal pathogens. This discrepancy may be explained by differences in plaque assessment methods and patient compliance, whereas our study used standardized brushing instructions and plaque scoring.[19]

Comparable findings were also reported by Mahmood et al. (2023), where both groups showed significant reductions in plaque and gingival bleeding indices ($p < 0.001$), but greater reductions were observed in the herbal toothpaste group at Weeks 4 and 8. This supports our results, suggesting that biologically active toothpaste formulations provide superior clinical benefits over conventional products.[20] Finally, Johar et al. (2025) reported a significantly greater reduction in plaque index in the probiotic group (from 2.15 ± 0.28 to 1.14 ± 0.21) compared to the control group ($p = 0.001$), which closely mirrors the magnitude and direction of plaque reduction observed in our study.[21]

Overall, the present findings reinforce existing evidence that probiotic toothpaste offers superior benefits in improving gingival health among orthodontic patients by reducing plaque accumulation and gingival inflammation more effectively than regular toothpaste. This study employed a randomized comparative design, which minimized selection bias. A standardized oral hygiene protocol was followed for all participants to ensure consistency. The use of validated clinical indices strengthened the reliability of outcome assessment. Inclusion of adult orthodontic patients enhanced the clinical relevance of the findings.

STUDY LIMITATIONS

However, the study was conducted at a single center, which may limit generalizability. The relatively short follow-up period restricted assessment of long-term effects of probiotic toothpaste.

CONCLUSION

Probiotic toothpaste demonstrated improved gingival health outcomes compared to regular toothpaste in adult orthodontic patients. Its use may serve as a beneficial adjunct in maintaining gingival health during fixed orthodontic treatment. Further long-term, multicenter studies are recommended to confirm these findings..

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