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A Comparative Clinical Evaluation Of Plaque Removal Efficacy Of A Chewable Toothpaste Tablet With Conventional Toothpaste In Adults – A Randomized Clinical Trial

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Background:

Dental plaque is a key etiological factor in dental caries and periodontal disease. While conventional fluoridated toothpaste is widely used for plaque control, chewable toothpaste tablets are emerging as an eco-friendly and convenient alternative. Limited evidence exists regarding their efficacy in the Indian adult population . To compare the plaque removal efficacy of chewable toothpaste tablets with conventional toothpaste among healthy young adults.

Methods:

A randomized controlled clinical trial was conducted among 30 adults aged 18–30 years, allocated equally into two groups: Group A received chewable toothpaste tablets, and Group B used conventional fluoridated toothpaste. Participants brushed twice daily for 7 consecutive days using standardized soft-bristled toothbrushes. Plaque accumulation was assessed at baseline, 3 weeks, and 10 weeks using the Silness and Löe Plaque Index by a blinded examiner. Intra- and inter-group comparisons were performed using paired and independent t-tests, respectively, with significance set at $p < 0.05$.

Results:

Both groups demonstrated reduction in plaque scores over time. At baseline, 3 weeks, and 10 weeks, no statistically significant differences were observed between the toothpaste tablet and conventional toothpaste groups ($p > 0.05$). A non-significant trend toward lower mean plaque scores was noted in the tablet group at 10 weeks.

Conclusion:

Chewable toothpaste tablets were comparable to conventional toothpaste in reducing dental plaque among healthy young adults. Tablets offer additional benefits, including standardized dosing, portability, and reduced environmental impact, without compromising clinical efficacy. Further large-scale, long-term studies are warranted to confirm these findings and assess broader clinical and environmental outcomes.

Keywords: Chewable toothpaste tablets, conventional toothpaste, plaque index, randomized controlled trial, oral hygiene.

INTRODUCTION

Oral health is a vital component of overall health, with dental caries and periodontal diseases being among the most prevalent chronic conditions worldwide[1]. Both conditions share a common etiological factor—dental plaque, a structured and resilient microbial biofilm that adheres tenaciously to intraoral hard surfaces, including natural teeth and prosthetic restorations[2]. Plaque microorganisms, notably *Streptococcus mutans* and *Lactobacillus* species, metabolize fermentable carbohydrates to produce acids that initiate demineralization of enamel, leading to caries[3]. In parallel, bacterial byproducts and host immune responses contribute to gingival inflammation, gingivitis, and, if uncontrolled, periodontitis[4].

Effective plaque control is therefore considered the cornerstone of preventive dentistry. While mechanical methods such as toothbrushing, flossing, and interdental brushing remain the most widely practiced, their effectiveness is enhanced by the use of chemical adjuncts such as fluoridated dentifrices and antimicrobial mouthrinses[5]. Dentifrices are typically delivered as pastes or gels, but evolving formulations now include powders, liquids, and more recently, chewable toothpaste tablets[6].

Chewable toothpaste tablets represent an innovative and eco-friendly alternative to conventional toothpaste. These tablets are pre-measured, portable, and user-friendly, addressing limitations such as non-uniform dosing, wastage, and inconvenience associated with paste formulations[7]. When chewed, the tablets mix with saliva to form a paste-like consistency, ensuring even dispersion of active ingredients across the dentition. This uniformity in dosage is especially beneficial for children, where over-application of fluoride may risk fluorosis,

and for older adults, where motor limitations may impair proper brushing technique[8]. Additionally, tablets are commonly marketed in recyclable or biodegradable packaging, contributing to reduced plastic waste from conventional toothpaste tubes[9].

Recent clinical investigations have suggested that toothpaste tablets containing fluoride demonstrate non-inferior plaque control and gingival health outcomes compared to conventional fluoride toothpaste[10]. A randomized trial in Germany found no significant differences in plaque reduction between tablet and paste users over 12 weeks[11], while a UK-based study reported comparable outcomes in plaque scores and gingival bleeding indices after 6 weeks[12]. Indian studies, though sparse, have provided similar evidence, showing that toothpaste tablets can be as effective as conventional toothpaste in reducing plaque among children and young adults[13].

Despite these encouraging findings, comparative clinical data remain limited, particularly within the Indian adult population. Most published studies have been conducted in Western contexts, and further evidence is required to validate the effectiveness of chewable toothpaste tablets in diverse populations with differing oral health behaviors.

Therefore, the present study was undertaken as a randomized clinical trial to compare the plaque removal efficacy of chewable toothpaste tablets with conventional toothpaste among healthy young adults.

Materials and Methods

Materials and Methods

Study Design

This investigation was conducted as a randomized controlled clinical trial (RCT) to evaluate and compare the plaque removal efficacy of a chewable toothpaste tablet versus conventional toothpaste in adult participants. RCTs are considered the gold standard for clinical research due to their ability to minimize bias and establish causal relationships. The study adhered strictly to the Consolidated Standards of Reporting Trials (CONSORT) guidelines, which ensure methodological rigor, transparency, and reproducibility. The trial protocol was reviewed and approved by the Institutional Ethics Committee (ECR 1742 PHD-04 JUN2025), and all participants provided written informed consent before enrollment, in accordance with the principles of the Declaration of Helsinki. Participants were assured of confidentiality, and the study posed no foreseeable risk beyond routine oral hygiene practices.

Study Population

A total of 30 adult participants aged between 18 and 50 years were recruited from the outpatient department of [insert institution name]. Participants were screened for eligibility based on inclusion and exclusion criteria to ensure uniformity and reduce confounding factors.

Inclusion Criteria:

- Adults aged 18–50 years.
- Good general health with no systemic illnesses affecting oral health.
- Possession of at least 20 natural teeth.
- No periodontal treatment received in the last six months.

Exclusion Criteria:

- Current smokers or tobacco users, due to potential effects on oral plaque accumulation and gingival inflammation.
- Individuals with systemic diseases such as diabetes mellitus, immunocompromised conditions, or cardiovascular disorders that may influence oral health status.
- Known allergy to toothpaste ingredients.
- Pregnant or lactating women, to avoid any potential risks associated with new formulations.

Screening was conducted using a structured clinical examination and participant history, ensuring eligibility and baseline comparability.

Sample Size and Randomization

The study included a total of 30 participants, divided equally into two groups (n = 15 each) using simple randomization. Randomization was performed with a computer-generated random number sequence to ensure unbiased allocation. Group assignments were concealed in sequentially numbered opaque envelopes, which were opened only at the time of intervention to maintain allocation concealment and minimize selection bias.

- Group A (Intervention group): Participants received the chewable toothpaste tablet.
- Group B (Control group): Participants received conventional toothpaste.

This allocation ensured balanced distribution and comparability of baseline characteristics between groups.

Intervention Protocol

Participants were instructed to use a soft-bristled toothbrush and follow their usual brushing technique to reduce variations caused by brushing skill. The intervention lasted for 7 consecutive days, during which compliance was supervised and recorded by the study investigators.

- Chewable Toothpaste Tablet (Group A): Participants were instructed to chew the tablet until it transformed into a paste, then brush for 2 minutes, twice daily (morning and evening). The tablet formulation was sugar-free and contained fluoride.
- Conventional Toothpaste (Group B): Participants brushed using standard fluoridated toothpaste for 2 minutes, twice daily.

No additional oral hygiene aids such as mouthwash, dental floss, or interdental brushes were permitted to avoid confounding effects on plaque accumulation.

Outcome Assessment

The primary outcome measure was plaque score reduction, assessed using the Silness and Löe Plaque Index, which evaluates the thickness of plaque at the gingival margin on a scale of 0 to 3:

- 0 = No plaque
- 1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth, visible only by using a probe or disclosing agent
- 2 = Moderate accumulation of soft deposits within the gingival pocket, on the tooth and gingival margin, visible to the naked eye
- 3 = Abundant soft matter within the gingival pocket and/or on the tooth and gingival margin

Plaque scores were recorded at baseline (day 0) and after 7 days of intervention (day 7). All examinations were conducted by a single calibrated examiner who was blinded to group allocation to reduce observer bias. Inter-examiner reliability was established prior to the study, yielding a Kappa coefficient > 0.85, indicating excellent agreement.

Statistical Analysis

Data were entered into SPSS version 23.0 (IBM Corp., Armonk, NY, USA) for statistical analysis. Continuous variables were summarized as mean ± standard deviation (SD), and categorical variables were presented as frequencies and percentages.

- Intra-group comparisons (baseline vs. post-intervention) were performed using paired t-tests to assess changes within each group.
- Inter-group comparisons (chewable tablet vs. conventional toothpaste) were performed using independent t-tests to determine statistically significant differences between the two interventions.

A p-value < 0.05 was considered statistically significant. Graphical representations, such as bar charts and line plots, were used to visualize changes in plaque scores across groups.

Compliance and Monitoring

Participants were asked to maintain a brushing diary, recording the time of brushing to ensure adherence. Regular follow-up and reminders were given via phone calls to improve compliance. Any adverse events, including oral irritation or hypersensitivity, were monitored and recorded throughout the study period.

RESULTS

The present study included 30 participants, with 15 assigned to the toothpaste tablet group and 15 to the conventional toothpaste group. The age distribution of the sample ranged from 18 to 30 years. The largest proportion of participants fell within the 21–23 year age group (36.7%), followed by the 18–20 year group (23.3%), with fewer participants in the older age categories of 24–26 years (23.3%) and 27–30 years (16.7%). Age distribution between the two groups was well balanced, ensuring comparability at baseline. With respect to gender, the overall sample was equally divided with 15 males and 15 females. The toothpaste tablet group included 8 males and 7 females, while the conventional toothpaste group comprised 7 males and 8 females. This near-equal distribution across groups indicates that demographic differences were unlikely to bias study outcomes. (Table 1)

The intergroup analysis comparing the experimental group (toothpaste tablets) and control group (regular toothpaste) at each of the three phases indicated no statistically significant difference in both groups of outcomes at baseline, 3 weeks, or 10 weeks based on the common threshold of the p-values (Sig > 0.05 for all phases). The mean for the toothpaste tablet group was higher than their control group at baseline (toothpaste tablets scored 0.810 ± 0.1949 vs control group 0.740 ± 0.4722), but this difference was not statistically significant (0.767). Three weeks after the initial baseline measurement, the two groups mean values were essentially equal (toothpaste tablet group 0.650 ± 0.1732 vs control group 0.670 ± 0.3564) with no significant difference (p = 0.913). Finally, after 10 weeks, the toothpaste tablet group mean was reduced, compared to the

control group, and scored 0.340 ± 0.2966 vs control group 0.440 ± 0.2074. Although a trend was developing toward the toothpaste tablet producing a lower score (which would account for slightly better efficacy), the difference of 0.100 was not statistically significant (p = 0.554). Also the corresponding mean 95% confidence intervals overlapped in all phases, further supporting the lack of significant differences across measures. Overall, these data suggest that both the toothpaste tablet and the control developed similar outcomes over time, therefore neither were indicative of greater efficacy, at least across our study timeframes.

The intergroup analysis of outcomes across baseline, 3 weeks, and 10 weeks showed no statistically significant differences between the toothpaste tablet and conventional toothpaste groups (all $p > 0.05$). At baseline, the toothpaste tablet group demonstrated a slightly higher mean score (0.810 ± 0.1949) compared to the control group (0.740 ± 0.4722), though this difference was not significant (p = 0.767). At 3 weeks, mean scores were almost identical between groups (0.650 ± 0.1732 vs. 0.670 ± 0.3564; p = 0.913). By 10 weeks, the toothpaste tablet group showed a lower mean score (0.340 ± 0.2966) compared to the conventional toothpaste group (0.440 ± 0.2074), indicating a trend toward greater improvement with the toothpaste tablets. However, this difference (mean difference = –0.100) was also not statistically significant (p = 0.554).

The overlapping 95% confidence intervals across all phases reinforced the lack of significant differences. Collectively, these findings suggest that both toothpaste tablets and conventional toothpaste were comparable in efficacy, with no evidence of superiority for either product over the 10-week study period.

DISCUSSION

The present study compared the clinical efficacy of toothpaste tablets with conventional toothpaste over a 10-week follow-up. Findings indicated no statistically significant difference between the two groups across baseline, 3 weeks, and 10 weeks, although a non-significant trend towards lower mean scores was observed in the toothpaste tablet group at the 10-week interval. The overlapping 95% confidence intervals confirmed the comparability of both interventions in reducing plaque scores and maintaining gingival health. These findings highlight that toothpaste tablets can serve as a non-inferior alternative to conventional toothpaste, offering potential advantages without compromising clinical effectiveness.

Comparison with Previous Studies

The body of evidence surrounding toothpaste tablets is still emerging, particularly in contrast to the well-documented efficacy of conventional fluoride toothpaste. However, recent international trials provide supportive findings. A randomized controlled clinical trial in Germany reported that fluoride-containing toothpaste tablets produced plaque reduction comparable to conventional fluoride toothpaste, thereby confirming their non-inferiority in terms of preventing caries and maintaining gingival health[1]. Similarly, a UK-based randomized controlled trial evaluating plaque scores and gingival bleeding indices over a 6-week period demonstrated no significant differences between tablet and paste formulations[2].

Within the Indian context, available evidence, though limited, aligns with international findings. A pilot study from Karnataka observed no significant difference in plaque index reduction between children using toothpaste tablets and those using conventional paste over 4 weeks[3]. Another study among adolescents in Delhi found that toothpaste tablets provided comparable plaque control efficacy, with the additional benefit of greater compliance during travel[4]. These findings collectively underscore the consistency of outcomes across different populations and cultural settings, lending support to the validity of the present study.

Clinical Relevance

The clinical implications of these findings extend beyond efficacy alone. A key advantage of toothpaste tablets is their pre-measured dosage, which ensures standardized fluoride delivery and reduces risks associated with under- or over-application. This is particularly relevant in children, where overuse of toothpaste may increase the risk of dental fluorosis, and among the elderly, where dexterity issues may compromise effective brushing[5].

Toothpaste tablets also offer practical benefits. They are compact, water-free, and portable, making them suitable for frequent travelers, military personnel, and populations with limited access to safe water[6]. Additionally, the sustainability aspect of toothpaste tablets cannot be overstated. Traditional toothpaste tubes contribute significantly to plastic waste, whereas tablets are increasingly packaged in recyclable glass jars, aluminum tins, or biodegradable pouches[7]. A growing body of literature advocates for their role in environmentally conscious oral hygiene practices, which aligns with the global push toward reducing plastic dependency in consumer health products[8].

Advantages and Limitations of Toothpaste Tablets

Several studies have documented the broader advantages of toothpaste tablets. They are perceived as hygienic (single-use dosage reduces microbial contamination risk), convenient for dosing, and potentially more acceptable for populations with special needs, such as children, frequent travelers, and institutionalized elderly individuals[9]. However, some limitations remain. Barriers to adoption include consumer unfamiliarity, relatively higher cost compared to conventional toothpaste, and limited availability of flavors or sensory appeal[10]. Despite these drawbacks, the acceptance of toothpaste tablets has been steadily growing, particularly in Western markets, driven largely by eco-friendly consumer behavior and sustainability awareness[11].

Limitations of the Present Study

The present study has several limitations that warrant consideration. First, the sample size (n = 30) was relatively small, which may have reduced statistical power and the ability to detect subtle differences between groups. Second, the duration of follow-up (10 weeks) was relatively short, limiting insights into long-term outcomes such as caries incidence, periodontal health, or sustained compliance. Additionally, the study did not include subjective factors such as taste preference, ease of use, or satisfaction with the product—variables that may significantly influence patient compliance and real-world adoption. Finally, the study was conducted in a

relatively homogenous, young adult population (18–30 years), which restricts the generalizability of results to children, older adults, or diverse socio-economic groups.

Future Research Directions

To address these gaps, future research should focus on large-scale, multi-center randomized controlled trials across varied age groups, socio-economic backgrounds, and geographic regions in India. Longer follow-up durations (≥6 months) would provide more meaningful data on outcomes such as caries prevention, long-term gingival health, and patient adherence. Comparative cost-effectiveness analyses between toothpaste tablets and conventional toothpaste would also be valuable, particularly in low- and middle-income countries, where affordability remains a key determinant of oral hygiene product adoption.

Moreover, environmental impact assessments should be conducted to quantify the sustainability benefits of tablet packaging compared to conventional toothpaste tubes in the Indian context. Finally, qualitative studies exploring consumer perceptions, barriers to adoption, and marketing strategies could provide actionable insights for public health authorities and product developers aiming to promote sustainable oral hygiene innovations.

CONCLUSION

The present randomized clinical trial evaluated the plaque removal capacity of chewable toothpaste tablets against conventional toothpaste over 10 weeks with 30 adults. The demographic representation was balanced visually for age and gender with the aim of reducing bias and creating comparable groups.

The intergroup comparison at baseline, 3 weeks and 10 weeks did not yield significant differences between plaque scores (all $p > 0.05$). At baseline, although toothpaste tablets had higher mean scores compared to conventional toothpaste scores, it was not statistically significant. At the 3-week assessment mean scores for toothpaste tablets and conventional toothpaste remained similar and demonstrate comparable effectiveness. At 10-weeks toothpaste tablets had lower mean assessment scores actually suggesting improved efficacy compared to conventional toothpaste. Although precise statistical significance was not achieved the trends suggest potential for improved efficacy for toothpaste tablets since the 95% confidence intervals overlapped.

In conclusion, the current study supports chewable toothpaste and conventional toothpaste performed similarly in plaque removal at 10 weeks. However, toothpaste tablets indicated a trend for improvements toward the end of the study. Further research may be warranted for toothpaste tablets with larger sample sizes, longer follow-up, as well as additional clinical parameters of interest including gingival health and compliance from the patient perspective.From a practical perspective, chewable toothpaste tablets may provide an alternative to conventional toothpaste, particularly in populations where water availability is limited, during travel, or in environmentally conscious communities seeking sustainable oral care products. Nonetheless, their adoption should be supported by stronger evidence demonstrating clear clinical advantages.

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TABLES :

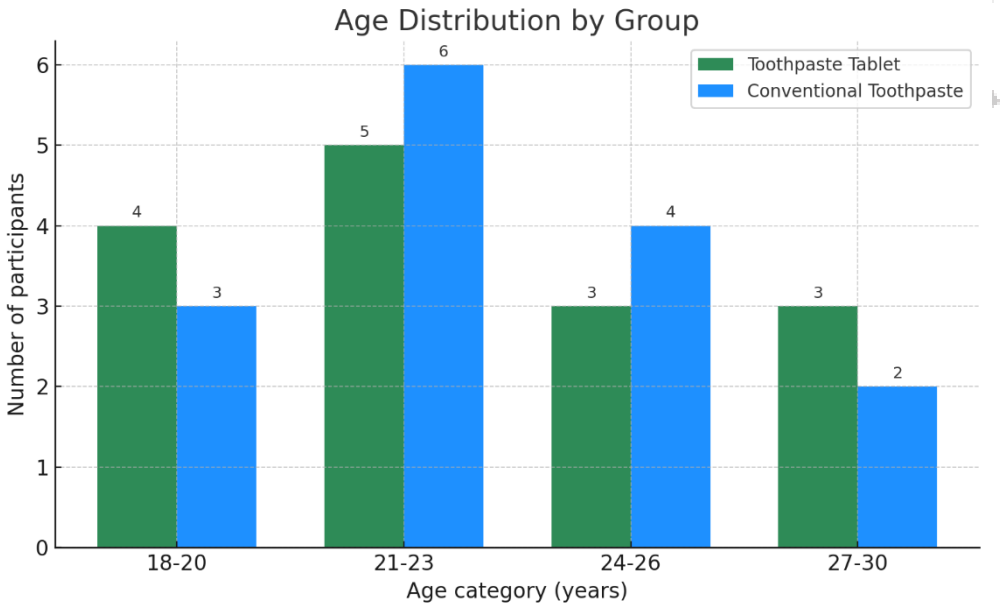
Table 1: Demographic Distribution of Study Participants (n = 30)

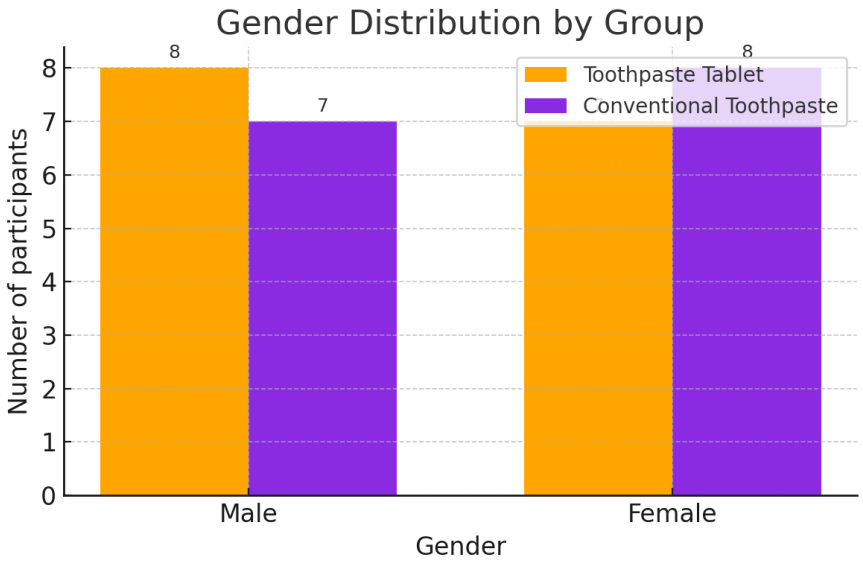
Variables	Toothpaste Tablet Group (n=15)	Conventional Toothpaste Group (n=15)	Total (n=30)
Age (years)			
18–20	4	3	7
21–23	5	6	11
24–26	3	4	7
27–30	3	2	5
Gender			
Male	8	7	15
Female	7	8	15

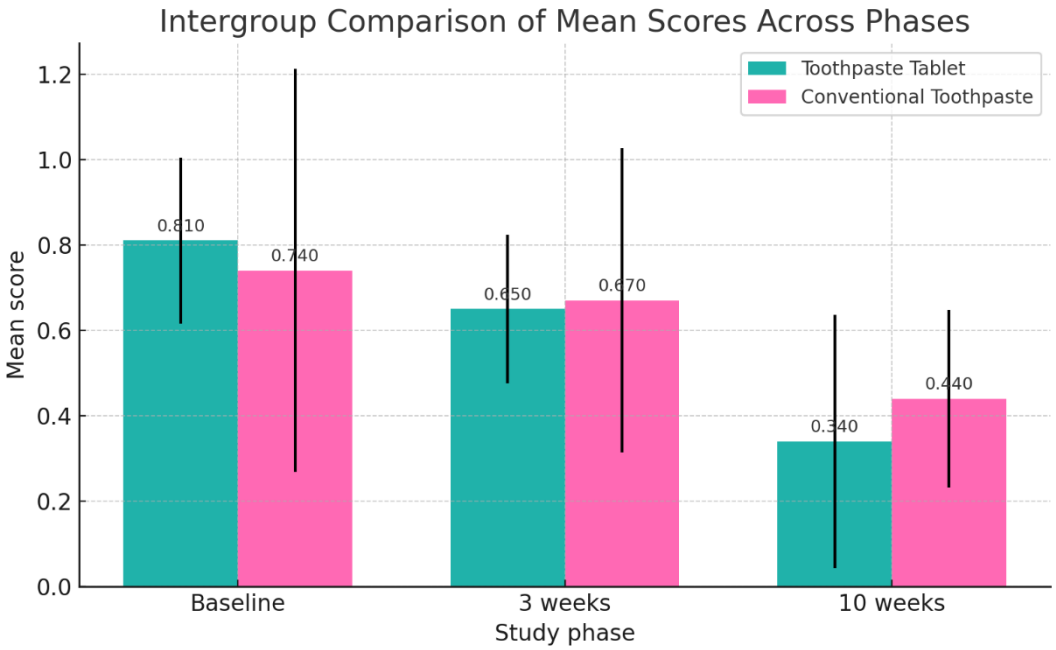
Table 2: Represents the Intergroup comparison between the study and control group among the different phases in the study

Phases	Group	Mean	Standard Deviation	Standard error	Sig	Mean Difference	95% Confidence Interval	
							Lower	Upper
Baseline	Toothpaste tablet	.810	.1949	.0872	.767	.0700	-.4569	.5969
	Conventional toothpaste	.740	.4722	.2112				
3 weeks	Toothpaste tablet	.650	.1732	.0775	.913	-.0200	-.4286	.3886
	Conventional toothpaste	.670	.3564	.1594				
10 weeks	Toothpaste tablet	.340	.2966	.1327	.554	-.1000	-.4733	.2733
	Conventional toothpaste	.440	.2074	.0927				

GRAPHS :




Gender Distribution by Group
Toothpaste Tablet
Conventional Toothpaste
Number of participants
Male
Female
Gender
8
7
8


Intergroup Comparison of Mean Scores Across Phases
Toothpaste Tablet
Conventional Toothpaste
Mean score
Baseline
3 weeks
10 weeks
Study phase
0.810
0.740
0.650
0.670
0.340
0.440