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Comparative Evaluation Of Antimicrobial Effect Of Turmeric (Curcuma Longa) And Chlorhexidine Mouth Wash In Patients Undergoing Fixed Orthodontic Treatment

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Abstract
Aim: *This research aims to examine the anti-microbial property of turmeric (Curcuma longa) mouthwash and chlorhexidine mouthwash in patients undergoing orthodontic treatment who are more susceptible to biofilm formation in their oral cavities because of the appliances, which in turn can cause gingivitis and periodontitis.*
Material and method*: The research was a parallel arm, randomized controlled clinical trial with a single blind center and a 1:1 allocation ratio. There were 40 contestants in all, regardless of gender. Throughout the trial, the oral hygiene status of each participant was evaluated three times. Before beginning orthodontic treatment (T1), the initial evaluation of the gingival index (GI) and plaque index (PI) was completed. Following whole mouth scaling, a typical preadjusted edgewise approach was applied in both dental arches in every instance. The second scoring was completed three weeks following the appliance's implantation (T2). Following the second scoring, the patients were split up into two groups, with 20 patients in each group. Turmeric mouthwash comprises group I, while chlorhexidine mouthwash comprises group II. The third scoring (T3) was completed three weeks following the use of both Turmeric and chlorhexidine mouthwash.*
Results*: Forty patients were assessed, revealing an increase in plaque index (2.02 ± 0.35 to 2.18 ± 0.33) and a reduction in gingival index (1.52 ± 0.30 to 1.38 ± 0.28) between T1 and T2. Paired t-test indicated a notable decrease in GI (p = 0.001) and an increase in PI (p = 0.002) after orthodontic bonding. At T3, no notable statistical differences were found between the groups using turmeric and chlorhexidine, suggesting similar efficacy in preserving periodontal health.*
The ***limitation*** *of this study is that its antimicrobial effect was evaluated using PI and GI indices; no microbiological assessments were done, staining property of turmeric was also not evaluated.*
Conclusion: *The current investigation has demonstrated that the effectiveness of oral hygiene is unaffected by the type of Mouthwash—Turmeric and chlorhexidine. Adequate maintenance of oral hygiene was offered by both varieties of mouthwash.*
Keywords*: curcumin, chlorhexidine, plaque, plaque index, gingival index, mouthwash*

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I. Introduction:

From birth, the oral cavity undergoes colonisation by various microbiota, some of which contribute to plaque formation, ultimately leading to gingivitis and periodontal disease.

Plaque formation is facilitated in the presence of dental appliances, whether fixed or removable, such as a fixed maxillary arch expansion appliance, which promotes biofilm accumulation, exacerbating dental plaque formation.[1]

Various methods, including mechanical (such as tooth brushing) and chemical (such as mouthwash use), can help control plaque. While individual methods may not yield optimal results, the combined use proves to be more effective. Apart from that, commercially available mouthwashes often have drawbacks, necessitating the exploration of natural alternatives.

Ayurveda, the ancient Indian medical system, has a history of successfully treating systemic ailments using herbs. Trusted since the times of Charaka and Sushruta, herbs like tulsi, triphala, neem, honey, ajwain, and turmeric are commonly employed, either individually or in combination, as safe and effective antibacterial agents. Turmeric, known scientifically as Curcuma longa or commonly as "haldi," boasts a plethora of properties including anti- inflammatory, antioxidant, antimicrobial, hepatoprotective, immune-

stimulating, antiseptic, and antimutagenic effects[2]. Bhakti et al (2019) told that turmeric also reduces corrosion[3]. Along with that, curcumin also induced bone formation[4].

The main importance of the study in terms of the orthodontic context is that plaque retention is increased by fixed orthodontic appliances, which raises bacterial counts and elevates the risk of gingivitis.

Chlorhexidine as the gold standard: Although chlorhexidine gluconate has significant adverse effects like tooth discoloration, changed taste perception, and mucosal irritation, it is frequently used due to its potent antiplaque and antibacterial qualities. An alternate option is turmeric, which includes curcumin, an antibacterial, anti-inflammatory, and antioxidant. The study assesses whether turmeric mouthwash may accomplish comparable microbial control without the negative effects of chlorhexidine.

II. Material And Methodology:

In this study, 40 patients undergoing fixed orthodontic treatment in November 2024, aged from 13 to 30 years old, were enrolled. The mouthwash that is used is CUR-Q-FRESH-CURCUMIN mouthwash and a chlorhexidine mouthwash.

The inclusion criteria are as follows:

- Patient undergoing fixed orthodontic treatment.
- Age between 13 to 30 years

The exclusion criteria:

- Allergy or sensitivity to turmeric mouthwash
- Systemic disease and conditions affecting gingival health
- Use of corticosteroids in the last 3 months
- Pus discharge
- Root fracture or deep pockets
- Habits such as alcoholism and smoking.
- Patient not willing and uncooperative.

Study Design:

This research is a parallel-arms, single-center, blind, randomized controlled clinical trial with a 1:1 allocation ratio of an in-vivo study, approved by the institutional review board.

Sample Size Calculation:

The formula for comparing means was used to determine the sample size. The study's power, or type II error, β, was set at 80%, while the type I error (α) was set at 95%. By combining the variance and calculating the average of the gingival index (GI) values from earlier research, a variance σ of 0.24 was obtained. 0.2 was chosen as the predicted smallest difference. For the study, an anticipated 20 participants were needed for each group, for a total sample size of 40.

III. Methodology:

Throughout the trial, the oral hygiene status of each participant was evaluated three times. Before beginning orthodontic treatment, the initial evaluation of PI and GI was completed (T1). On the day of the assessment, the patients were told not to use mouthwash, and the amount of dental plaque was scored using Silness and Loe's (1964) plaque index system (PI) **Table (1)**. The GI of Loe and Silness (1963) **Table (2)** was used to score gingival inflammation to determine the gingival condition.

Following whole mouth scaling, a typical preadjusted edgewise approach was applied in both dental arches in every instance. The second scoring was completed three weeks following the appliance's implantation (T2). Following the second scoring, the patients were split up into two groups, with 20 patients in each group:

Group I: Turmeric mouthwash

Group II: Chlorhexidine mouthwash

Table (1): Plaque index score according to (Loe & Silness, 1963).

Score	Description
0	No plaque
1	Thin film of plaque which is invisible to the naked eye and may be noticed only by running a probe along the tooth surface
2	Moderate accumulation of plaque which is visible
3	Abundance of plaque

Table (2): Gingival index score according to (Loe & Silness, 1963).

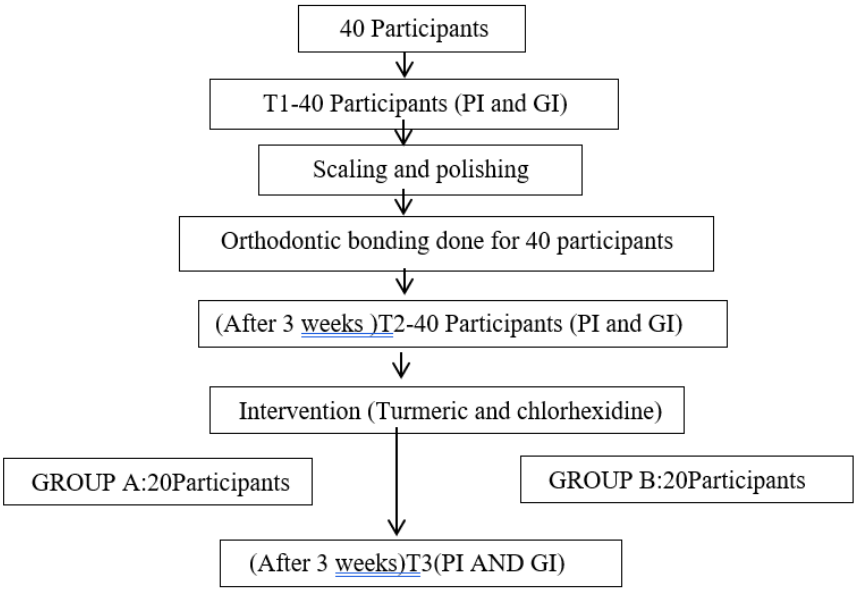
score	Description
0	Normal gingiva
1	Mild inflammation, slight changes in colour, slight oedema; no bleeding on palpation
2	Moderate inflammation, redness, oedema, glazing and bleeding on probing
3	Severe inflammation, marked redness, oedema, liberation and tendency to spontaneous bleeding.

Statistical Method:

All of the data was analyzed using SPSS version 20.0. A paired t-test was used to compare the baseline (T1) and second follow-up (T2). The independent sample t-test was used for intergroup comparisons (at T3).

A total of 40 people participated in the study. After T2, they were randomly assigned to two groups, I and II, each with 20 participants. Participants in Group I were given mouthwash containing turmeric, whereas those in Group II were given mouthwash containing chlorhexidine**(Figure 1)**. The subjects were randomly assigned to groups, and the principal investigator was blinded.

Figure (1): Flowchart of methodology



IV. Results:

The findings of this comparison study between chlorhexidine and turmeric mouthwash showed clear changes in gingival and plaque indices over time. Participants had significant gingival inflammation (GI mean 1.52 ± 0.30) and plaque accumulation (PI mean 2.02 ± 0.35) at baseline (T1). After orthodontic bonding (T2), the plaque index significantly increased to 2.18 ± 0.33 (p = 0.002), indicating greater plaque retention around bonded appliances, while the gingival index significantly decreased to 1.38 ± 0.28 (p = 0.001), indicating decreased gingival inflammation. Following intervention with chlorhexidine (Group II) and turmeric mouthwash (Group I), both groups shown additional improvement at T3: PI dropped to 1.70 ± 0.40 and 1.68 ± 0.42, respectively, while GI decreased to 1.20 ± 0.25 in the turmeric group and 1.18 ± 0.27 in the chlorhexidine group.With mean differences of only 0.02 for both indices, statistical analysis showed no significant difference between the two groups at T3 (GI p = 0.81; PI p = 0.87). These results demonstrate that both turmeric and chlorhexidine mouthwashes are efficient in lowering plaque and gingival inflammation, with turmeric performing similarly to chlorhexidine, even though orthodontic bonding initially exacerbates plaque buildup. This implies that during orthodontic treatment, turmeric mouthwash may be a viable natural substitute for chlorhexidine in terms of preserving oral cleanliness.

Table:3 Participants' descriptive statistics in the study

Parameter	Time/Group	n	Mean	SD
GI	T1	40	1.52	0.30
	T2	40	1.38	0.28
	T3 Group I	20	1.20	0.25
	T3 Group II	20	1.18	0.27

Parameter	Time/Group	n	Mean	SD
PI	T1	40	2.02	0.35
	T2	40	2.18	0.33
	T3 Group I	20	1.70	0.40
	T3 Group II	20	1.68	0.42

Table 4: Following orthodontic bonding, there was a statistically significant rise in the plaque index and a fall in the gingival index.

Parameter	Mean Difference	SD	t-value	df	p-value
GI (T1–T2)	0.14	0.25	3.54	39	0.001*
PI (T1–T2)	-0.16	0.30	-3.37	39	0.002*

Table (5) Following grouping, there was no discernible difference between the gingival and plaque indices (Table 1&2). There was no discernible change in PI or GI at T3 (p = 0.051)

Parameter	t-value	df	p-value	Mean Difference
GI (T3)	0.24	38	0.81	0.02
PI (T3)	0.16	38	0.87	0.02

V. Discussion:

Most common problem of the oral cavity is the accumulation of food debris which eventually leads to dental plaque and stains. As the cycle continues it leads to dental caries, gingival and periodontal problems and halitosis. From the ancient time the technique used is mechanical plaque control and chemical plaque control. Mechanical aid that is commonly used is tooth brush and floss. Along with mechanical aid , chemical methods are also used such as mouth rinse. Latter one alone is not effect against plaque control, it need to be used with the former. Technical plaque removal is the method that is preferred worldwide. Oral health maintenance can be problematic in orthodontic patients due to the increased plaque retention around the orthodontic appliances [5]-[6].

The oral hygiene gets complicated when there is a complex appliance in the oral cavity such as orthodontic braces. The accessibility to such areas are difficult. These devices put a person's oral hygiene at risk, particularly for those receiving fixed orthodontic treatment. Therefore, additional techniques are required to maintain oral hygiene in patients receiving orthodontic therapy.

The chemical methods with the composition such as chlorhexidine show some adverse side effect. This lead to using natural ingredient. There are studies that suggest that turmeric has anti-inflammatory, antioxidant , antimicrobial, immunostimulant, antiseptic and anti-mutagenic effects. Hence the aim of the study is to use curcumin mouthwash and to evaluate their antimicrobial property in patient undergoing orthodontic treatment. Turmeric's anti-inflammatory, antibacterial, and anticancer qualities, as well as its many therapeutic applications, may be used to treat a wide range of conditions, not only in dentistry but also in oral health in general [7].

However, it significantly reduced the resorption of bone or roots [8]. Plaque is retained by these orthodontic brackets and wires, making it challenging to maintain proper dental hygiene. [9]-[14]. According to Bhojraj et al., there is no difference in the efficiency of oral hygiene between herbal and non-herbal dentifrice types.

Adequate maintenance of oral hygiene was offered by both varieties of dentifrice. Therefore, the brushing technique needs to be prioritized above the type of mouthwash or dentifrice.[15].

VI. Limitation:

The limitation of our study is the staining property of turmeric was not evaluated.The study was done based on plaque and gingival index alone, microbiological assessments like colony count test and isolation of individual oral microbiome is not done.In future studies staining property of turmeric can be assessed and microbiological assessments can be done.

VII. Conclusion:

The current study has demonstrated that utilizing turmeric mouthwash has an effect on oral hygiene. Based on the results, it can be said that in terms of oral cleanliness in patients receiving fixed orthodontic treatment, turmeric mouthwash has proven to be just as beneficial in clinical settings as chlorhexidine mouthwash.

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