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CURCUMIN GEL VERSUS CHLORHEXIDINE GEL FOR TREATMENT OF DENTAL PLAQUE-INDUCED GINGIVITIS ASSOCIATED WITH FIXED ORTHODONTIC APPLIANCE

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ABSTRACT:

Background and aims: Gingivitis in orthodontic treatment remains a challenging and undesirable consequence of orthodontic treatment. Hence, a variety of chemical or herbal agents, methods, and techniques have been investigated to prevent or reduce gingivitis that occurs in orthodontic treatment. In this study, we will evaluate and compare the effect of curcumin (CMN) gel with chlorhexidine (CHX) gel on clinical parameters (plaque and gingival index) and oral bacterial number (total bacterial count test) in fixed orthodontic patients that have gingivitis. We are the first to use curcumin gel for patients that have gingivitis with fixed orthodontic appliances. Samples and Methods: Forty-five patients with fixed orthodontic appliances with metallic brackets that have generalized chronic dental plaque-induced gingivitis were selected randomly and divided into three groups - Group I (control), Group II (CMN), and Group III (CHX), respectively. Clinical parameters which are plaque index (PI) and gingival index (GI) were recorded at the baseline, 14 days, and 21 days of treatment, and a total bacterial count test (TBCT) was done for all the participants before and after treatment. Results: Both Curcumin and Chlorhexidine gel groups showed a significant reduction ($P<0.05$) in PI, GI, and TBCT compared to the control group at the end of treatment (after 21 days). However, there was no significant difference between Curcumin and Chlorhexidine gel groups ($P>0.05$). Conclusion: The results of this study show that curcumin and chlorhexidine gel have comparable anti-plaque, anti-gingivitis, and antibacterial activities and that both can be used to effectively treat plaque-induced gingivitis.

KEYWORDS: Curcumin gel, chlorhexidine gel, dental plaque-induced gingivitis, orthodontic treatment, anti-plaque, anti-inflammatory, and anti-microbial effect.

1. INTRODUCTION

A bacterial infection is the most prevalent cause of gingivitis, an inflammatory condition of the gingival tissue. There is no attachment loss, and hence no junctional epithelium migration, unlike periodontitis. The condition only affects the soft tissues and connective tissue of the gingival epithelium (Marchesan et al., 2020).

Gingivitis is thought to be the most prevalent of all periodontal disorders. Based on the clinical symptoms, length of the infection, severity, and cause, there are two types of gingivitis. However, it's thought that the plaque-induced chronic form of gingivitis is the one that occurs the most frequently. When gently probed, the gingival tissues exhibit swelling, redness, discomfort, a glossy surface, and bleeding. Many people fail to recognize the condition and seek treatment because gingivitis frequently doesn't cause any discomfort and rarely results in spontaneous bleeding (Trombelli et al., 2018).

The bands, brackets, orthodontic adhesives, auxiliary equipment, and arch wires make up the fixed orthodontic appliance. To prevent periodontal disease from spreading, patients undergoing orthodontic treatment must maintain good dental hygiene. Plaque accumulation on orthodontic device components is enabling periodontal tissues to deteriorate to a larger tooth surface covered in the absence of oral hygiene maintenance, and the complexity of orthodontic equipment makes it challenging to maintain a correct oral hygiene routine (Kitada et al., 2009).

Patients who do not maintain good oral hygiene practices may get gingivitis. During orthodontic therapy, patients frequently display swelling of the gingiva, bleeding, a greater build-up of plaque, and calculus development (Türkkahraman et al., 2005). Plaque build-up surrounding orthodontic devices may result in periodontal disease and dental cavities (Lo et al., 2008).

Chlorhexidine is the gold standard for treating and preventing gingivitis, according to the current standards. The negative effects of chlorhexidine, such as oral mucosal erosion, tooth colour changes, and bitter taste, nevertheless make other treatments conceivable. The common herb turmeric has anti-inflammatory, antioxidant, antibacterial, antiviral, and anti-fungal properties. Due to these properties, various controlled research has been carried out to determine how well turmeric treats gingivitis (Stoyell et al., 2016).

Curcumin, the active component, is found in the Zingiberaceae plant species Curcuma longa. It is Chemically known as diferuloylmethane (1, 7-bis (4-hydroxy-3-methoxyphenyl)-1, 6-heptadine-3, 5-diene) and is produced from the rhizome of a perennial plant having the molecular formula C21H20O6. Curcumin has been widely used as an herbal remedy for a variety of diseases, and research has demonstrated that it has important anti-inflammatory properties (Wal et al., 2019).

There are several therapeutic alternatives for the management of gingival disease; however, the majorities have unfavourable side effects. Curcumin can be used to treat a number of inflammatory disorders because of its anti-inflammatory properties (Shirban et al., 2021).

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The most plausible mechanism by which curcumin exerts its anti-inflammatory benefits is through its capacity to inhibit cyclooxygenase-2 (COX-2), lipoxygenase (LOX), and inducible nitric oxide synthase (iNOS). COX-2, LOX, and iNOS are significant inflammatory response-regulating enzymes. The pathophysiology of inappropriate COX-2 and/or iNOS overexpression has been connected to both inflammatory diseases and specific types of human cancer. More research has therefore been conducted during the past few decades on the antioxidant and anti-inflammatory properties of curcumin (Menon & Sudheer, 2007).

Because it lessens the intensity of the tissue response over time, curcumin is regarded as a biocompatible material (Sha & Garib, 2019).

Curcumin has substantial antibacterial activity when used at large doses, according to the animal experiments (Gunes et al., 2016). A strong medication for preventing periodontal disorders, curcumin has anti-bacterial activity contrary to periodontopathic bacteria. These bacteria Porphyromonas gingivalis, Prevotella intermedia, Fusobacterium nucleatum, and Treponema denticola have been shown dose-dependent growth inhibition by curcumin. At extremely low quantities of curcumin, bacterial growth was virtually totally inhibited (Izui et al., 2016).

Curcumin, a bioactive polyphenol extracted from the Curcuma longa plant, has been shown to have anti-inflammatory, anti-microbial, anti-oxidant, and analgesic properties. Numerous studies have assessed the efficiency of curcumin in preventing periodontal diseases (Forouzanfar et al., 2020).

2. SAMPLES AND METHODS

The study's 45 fixed orthodontic patients with metallic brackets, who ranged in age from 15 to 35 years old and included 13 men and 32 women, were the subjects. Participants came from attendees (patients) seeking care at the orthodontics department, dental college, Duhok University, and a private orthodontic dental clinic in Zakho city (convenient sample). Written approval from the Duhok Medical Committee and consent of patients or their parents were taken at the beginning of the research. Regardless of the malocclusion type, the participants were split into three groups and tested to make sure no one had a history of any systemic disorders. Group I (Control group) n=15 members were told to practice their usual dental hygiene, group II (Curcuma Oral Gel (curenext) group) n=15 members were told to do their regular oral hygiene while using Curcuma Oral Gel, which contains 1% curcumin (Abbott company Indian product). Since curcumin, an active component of turmeric extract, is present in this gel, it was employed. Group III (Perio Kin Gel group) n=15 members were told to perform their routine oral hygiene procedures while using Perio Kin Gel, which contains 0.20% chlorhexidine digluconate (Kin company Spanish product). This gel was utilized because it has 0.2% chlorhexidine digluconate, a substance that is thought to be one of the gel's active ingredients. PLI and GI calculations were performed according to (Loe & Silness, 1963) using scoring as demonstrated in the table (1 and 2), at the beginning of the treatment (baseline), after (14 days), and after (21 days) of treatment. Additionally, TBCT was performed for the entire participant before and after (21 days) of treatment.

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

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 clearly visible.
3	Abundance of plaque.

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

0	Normal gingiva.
1	Mild inflammation, slight change in color, slight edema; no bleeding on palpation.
2	Moderate inflammation, redness, edema, glazing and bleeding on probing.
3	Severe inflammation, marked redness, edema, liberation and tendency to spontaneous bleeding.

3. ETHICS

The study procedure and informed consent forms were approved by the College of Dentistry ethical committee, University of Duhok, Kurdistan region, Iraq. Ethical considerations including the privacy of personal data were considered during all steps of the study. Written informed consent was acquired from each subject before sampling.

4. STATISTICAL ANALYSIS

The data were processed and analyzed using the statistical package for social science (software PRISM version 19.1). The comparison between groups (Control, Curcumin, and Chlorhexidine) for both plaque and gingival index at three different time intervals (baseline, 14 days, and 21 days) was analyzed using Tukey's multiple comparisons test after Two-way ANOVA. The intra-group comparison was performed for analysing TBCT before and after treatment by using Dunn's multiple comparisons test after One-way ANOVA.

5. RESULTS

5.1 Plaque Index (PI)

The PI values of the three groups did not significantly differ from one another at the baseline ($P>0.05$). After 14 days, the mean PI scores of the Curcumin gel and Chlorhexidine gel groups showed a significant difference from the Control group, whereas the Curcumin gel and Chlorhexidine gel groups did not differ significantly from one another ($P<0.01$, $P>0.05$, respectively). Additionally, after 21 days the Curcumin and chlorhexidine gel groups' mean PI scores demonstrated a significant change from the Control group ($P<0.01$). However, there was no discernible difference between the Curcumin and Chlorhexidine gel groups ($P>0.05$). In the existing study, the mean +SD of PI of the curcumin gel at baseline was 2.17+0.48 and it reduced to 1.23±0.38 after 14 days and reduced after 21 days to 0.82±0.08. For the chlorhexidine gel, the mean +SD of PI at baseline was 1.98+0.37 and it reduced to 1.43+0.30 after 14 days and reduced after 21 days to 0.92±0.17, as demonstrated in the table (3).

Table (3): Comparisons between the mean values and standard deviations of the Plaque index scores for each group (the Curcumin gel, the Chlorhexidine gel, and the Control group) at various time point

Parameter	Groups	Baseline		14D		21D	
		mean ±SD	P-value	mean ±SD	P-value	mean ±SD	P-value
PLI	Curcumin gel	2.17±0.48	0.06 NS	1.23±0.38	0.06 NS	0.82±0.08	0.40 NS
	Chlorhexidine gel	1.98±0.37		1.43±0.30		0.92±0.17	
	Curcumin gel	2.17±0.48	0.57 NS	1.23±0.38	0.0001 HS	0.82±0.08	0.0001 HS
	Control group	2.09±0.51		2.03±0.55		2.02±0.53	
	Chlorhexidine gel	1.98±0.37	0.39 NS	1.43±0.30	0.0001 HS	0.92±0.17	0.0001 HS
	Control group	2.09±0.51		2.03±0.55		2.02±0.53	

5.2 Gingival Index (GI)

The mean GI of the Curcumin and Chlorhexidine gel groups did not differ significantly from the Control group at baseline (P>0.05). Although there was no significant difference between the Curcumin and Chlorhexidine gel groups (P>0.05) after 14 days of the treatment, the Curcumin and Chlorhexidine gel groups differed remarkably from the Control group (P<0.01). After 21 days, there was no statistically significant difference between the Curcumin and Chlorhexidine gel groups (P>0.05), but there was a highly notable difference in the mean GI scores of the two groups compared to the Control group (P<0.01). Consuming curcumin gel was found to significantly reduce gingival irritation. The gingival scores in the curcumin gel group declined from a baseline of 1.83±0.39 to 1.06±0.22 on day 14 and then again on day 21 of the experiment to 0.80±0.12, as demonstrated in the table (4). For the chlorhexidine gel, the mean ±SD of GI at baseline was 1.79±0.35 and it reduced to 1.16±0.16 after 14 days and to 0.83±0.13 after 21 days.

Table (4): Mean +SD of the Gingival index scores for the different groups (Control group, Curcumin gel, and Chlorhexidine gel) at different time intervals (baseline, 14 days, and 21 days).

Parameter	Groups	Base line		14D		21D	
		mean ±SD	P-value	mean ±SD	P-value	mean ±SD	P-value
GI	Curcumin gel	1.83±0.39	0.83 NS	1.06±0.22	0.13 NS	0.80±0.12	0.88 NS
	Chlorhexidine gel	1.79±0.35		1.16±0.16		0.83±0.13	
	Curcumin gel	1.83±0.39	0.50 NS	1.06±0.22	0.0001 HS	0.80±0.12	0.0001 HS
	Control group	1.76±0.33		1.73±0.34		1.72±0.34	
	Chlorhexidine gel	1.79±0.35	0.85 NS	1.16±0.16	0.0001 HS	0.83±0.13	0.0001 HS
	Control group	1.76±0.33		1.73±0.34		1.72±0.34	

5.3 Total Bacterial Count Test (TBCT)

The mean of the Curcumin and Chlorhexidine gel groups did not significantly differ from the Control group for the TBCT at the baseline (P>0.05). After 21 days, the Curcumin gel demonstrated a highly significant change from the control group, and the Chlorhexidine gel group demonstrated the same (P<0.01). However, there was no discernible difference between the groups using the chlorhexidine gel and curcumin (P>0.05). The mean +SD of TBCT of the curcumin gel before treatment was $2.28*10^6 \pm 3.19*10^6$ and it reduced to $2.87*10^4 \pm 2.71*10^4$ after treatment. For the chlorhexidine gel, the mean +SD of TBCT before treatment was $3.63*10^6 \pm 9.38*10^6$ and it reduced to $1.48*10^5 \pm 3.19*10^5$ after treatment, as demonstrated in the table (5).

Table (5): Comparisons between all the groups (Control group, Curcumin gel, and Chlorhexidine gel) for the Mean + SD of the Total Bacterial Count test at the beginning and after 21 days of treatment.

Parameter	Groups	Base line		21 days	
		mean ±SD	P-value	mean ±SD	P-value
TBCT	Curcumin gel	$2.28*10^6 \pm 3.19*10^6$	0.999 NS	$2.87*10^4 \pm 2.71*10^4$	0.999 NS
	Chlorhexidine gel	$3.63*10^6 \pm 9.38*10^6$		$1.48*10^5 \pm 3.19*10^5$	
	Curcumin gel	$2.28*10^6 \pm 3.19*10^6$	0.999 NS	$2.87*10^4 \pm 2.71*10^4$	0.001 HS
	Control group	$2.83*10^6 \pm 7.84*10^6$		$3.11*10^6 \pm 9.40*10^6$	
	Chlorhexidine gel	$3.63*10^6 \pm 9.38*10^6$	0.999 NS	$1.48*10^5 \pm 3.19*10^5$	0.01 HS
	Control group	$2.83*10^6 \pm 7.84*10^6$		$3.11*10^6 \pm 9.40*10^6$	

6. DISCUSSION

We are the first to use curcumin gel for patients that have gingivitis with fixed orthodontic appliances.

Since bacterial plaque is the most important reason for gingivitis and periodontitis, plaque management is crucial in the prevention of these conditions. The most logical method of preventing and controlling periodontal diseases is the regular, efficient elimination of plaque through good oral hygiene practices. Along with mechanical techniques, many chemical plaque inhibitors have been attempted. However, the majorities of them have negative side effects and are also pricey (Nagpal & Sood, 2013).

Chlorhexidine has long been known to be beneficial like a supplement to periodontal therapy. It modifies the microbiota of the periodontal pocket and prevents powerful periodontal infections from producing microbial proteases (Daneshmand *et al.,* 2002; Mizrak *et al.,* 2006). Its mode of action involves a decrease in pellicle development, a change in bacterial adhesion to teeth, and a change in bacterial cell walls (Fiorellini & Paquette, 1992).

However, the drawbacks of chlorhexidine, including tooth discoloration, altered taste, and a rise in calculus buildup, prevent its long-standing usage. When it comes to treating periodontal disorders over the long term, various substances have similar abilities to improve clinical and microbiologic parameters while having fewer adverse effects than chlorhexidine (Anitha *et al.*, 2015).

By lowering the production of inflammatory mediators through the arachidonic acid pathway, curcumin exhibits anti-inflammatory effects. This results in less inflammatory edema and less blood vessel engorgement in connective tissue. Additionally, it promotes fibroblast migration at the wound site and results in connective tissue fibrosis, both of which speed up wound healing (Anuradha *et al.,* 2015).

These findings for both PI and GI are consistent with those of earlier research conducted by (Anitha *et al.,* 2015; Kandwal *et al.,* 2015; Teow *et al.,* 2016; Stoyell *et al.,* 2016; Nagunuri & Babitha, 2016; Arunachalam *et al., 2017*; Shirban *et al.,* 2021) however, for the PI they did not accord with the outcomes of other earlier research projects carried out by Morrow *et al.* that shown neither the plaque index nor the pocket depth significantly decreased (Morrow *et al.,*1992). Also, Cosyn and Verelst concluded that both PI and GI were not reduced when CHX chewing gum utilized as a complement to usual oral cleanliness routines, CHX chewing gum seems to have little effect on teenage orthodontic patients (Cosyn & Verelst, 2006). In addition, Poosti *et al.* showed that there is a necessity for more effective oral hygiene management techniques while receiving orthodontic treatment. Mouth rinses could be used as an adjuvant since the plaque and gingival index did not significantly reduce in chlorhexidine mouth rinse users compared to the control group, suggesting that correct tooth brushing and flossing are the key contributors to plaque elimination and gingival health (Poosti *et al.,* 2006).

Because of its anti-inflammatory properties, curcumin gel's mean GI decreased in our study. Other literatures also came to the same conclusion (Arora *et al.,* 1971; Ghatak & Basu, 1972; Charles *et al.,* 2004).

In our investigation, the clinical PI and GI indicators used to evaluate Curcumin's anti-inflammatory effect revealed a considerable decline. So it is better to use Curcumin gel than Chlorhexidine gel because curcumin gel does not cause dryness, ulceration, or tooth staining also it is a biocompatible material and free of any negative side effects. Thus, to determine the least dose and time of application of Curcumin gel for the best management of chronic gingivitis more research is needed.

In our investigation, curcumin significantly reduced the microbiological and clinical indicators assessed at 21 days compared to chlorhexidine. This demonstrates that curcumin may be a good complement to chlorhexidine in the treatment of gingivitis. The study outcomes were in agreement with earlier studies conducted by (Chaudhari *et al.*, 2011; Mali *et al.*, 2012; Zorofchian Moghadamtousi *et al.*, 2014; Anitha *et al.*, 2015; Teow *et al.*, 2016).

Neither the CHX nor the CMN groups had any negative side effects, and both groups had strong patient compliance. The clinical trial's shorter duration and smaller sample size, however, were drawbacks of the study. Further investigation is required to see whether the effect is clinically and statistically significant over a longer time frame.

7. LIMITATION OF THE STUDY

A small number of patients, a limited amount of time, and need more specific tests to determine the anti-microbial effect of curcumin against specific species of bacteria that cause gingivitis.

8. ACKNOWLEDGEMENTS

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9. ETHICAL APPROVAL

The study was approved by the Scientific and Ethics Committee, College of Dentistry, University of Duhok, Kurdistan Region, Iraq (01/11/ 2021, 784).

10. FUNDING/SUPPORT

No funding or support.

11. COMPETING INTERESTS

The authors have declared that no competing interest exists.

12. AUTHORS CONTRIBUTION

We confirm that the manuscript has been contributed, reviewed and approved by all authors. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

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