

# Assessment of the Plaque-Induced Gingivitis Patient With and Without Hyaluronic acid and Xylitol Toothpaste

Haider J. Talib, Hussein A. Mousa, Athraa A. Mahmood

Department of Periodontal Dentistry, College of Dentistry, Mustansiriyah University, Baghdad, Iraq

ABSTRACT

**Context:** The traditional manner of treatment of periodontal tissue inflammation includes giving information about the problem to the patient, oral motivation, and mechanical scaling and root planning (SRP). **Aims:** We aimed at estimating the effect of using toothpaste with hyaluronic acid (Hyaluronan, HA) and xylitol (HAX) as a therapeutic agent in the treatment of plaque-induced gingivitis. **Materials and Methods:** Sixty male patients who were in the age group of 20 to 35 years participated in this study. All of them endured 4 appointments, who suffered plaque-induced gingivitis, they distributed into 2 groups depending on the toothpaste variety: group 1 (G1): made up of 30 patients who consume toothpaste that contains HAX, while group 2 (G2): made up of 30 patients who consume toothpaste without HAX (placebo type). Clinical periodontal parameters (CPPs) for all of them were recorded, once at the beginning of the treatment besides four times throughout the treatment at weekly interims during all visits. **Results:** The means of plaque indices (PLI) and gingival indices (GI) decreased along with the sessions for both groups, where the initial means of PLI and GI (baseline) were  $2.55 \pm 0.14$ ,  $2.33 \pm 0.15$  for the G1, and  $2.57 \pm 0.13$ ,  $2.34 \pm 0.16$  for G2, respectively; whereas the least means shown at the fourth visit were  $0.39 \pm 0.05$ ,  $0.30 \pm 0.06$  for G1, and  $0.71 \pm 0.07$ ,  $0.61 \pm 0.05$  for G2, respectively. There was a reduction in the mean percent of bleeding on probing (BOP) score 1 for all visits in both groups. Finally, an intragroup comparison among dissimilar visits and intergroup comparisons for each visit showed highly significant differences at a *P*-value of  $\leq 0.001$  for PLI, GI, and BOP. **Conclusions:** Using toothpaste with or without HAX can decrease gingival inflammation; it can result in a higher improvement in the periodontal status of patients than toothpaste without HAX.

**KEYWORDS:** Clinical periodontal parameters, gingivitis, hyaluronic acid, xylitol

Received : 11-09-20  
 Revised : 04-10-20  
 Accepted : 20-10-20  
 Published : 15-04-21

## INTRODUCTION

Periodontal disease (PD) is an infectious disease of the gingiva, the bone beside periodontal ligaments that support the teeth and embrace them in the jaw.<sup>[1]</sup> Gingivitis and periodontitis are the most mutual types of PDs.<sup>[2]</sup> Gingivitis shows through a range of diseases that its commencement is usually because of the bacterial existence within dental plaque (DP); however, there are additional types of

gingivitis that are principally not caused by DP,<sup>[3]</sup> whereas gingivitis shows the reversible PD.<sup>[2,4]</sup> In different nations, there are diverse cleaning maneuvers that have used toothbrushes, chewing sticks, chewing sponges, etc. Nowadays, toothbrushing is the most

**Address for correspondence:** Dr. Haider Jaafer Talib, Department of Periodontal Dentistry, College of Dentistry, Mustansiriyah University, Baghdad, Iraq.  
 E-mail: haider.j.talib@uomustansiriyah.edu.iq

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**How to cite this article:** Talib HJ, Mousa HA, Mahmood AA. Assessment of the plaque-induced gingivitis patient with and without hyaluronic acid and xylitol toothpaste. J Int Soc Prevent Communit Dent 2021;11:138-43.

Access this article online	
<b>Quick Response Code:</b> 	<b>Website:</b> www.jispcd.org
	<b>DOI:</b> 10.4103/jispcd.JISPCD_371_20

popular oral hygiene measure that is frequently used.<sup>[5]</sup>

No solitary oral hygiene technique fits all patients. It depends on the dentition shape (crowding, spacing, the phenotype of the gingiva, etc.). The oral hygiene aids along with the cleaning methods can determine depending on the form and severity of the destructed periodontal tissues, besides individual manual skill. Depending on the position of the brush and the brush motion, the cleaning technique categorized: horizontal brushing, vertical brushing, circular brushing, vibratory, roll and modified bass/Stillman, charters, bass, Fones, Leonard, and scrub.<sup>[2]</sup>

In 1975, Anaise<sup>[6]</sup> found that the horizontal scrubbing technique has a more significant ability for the elimination of plaque outcomes compared with the roll, charters, and modified Stillman methods. Kremers *et al.* in 1978, Zhang *et al.* in 2005, McClure in 1966, and Sangnes *et al.* in 1972<sup>[7-10]</sup> proved that the modified bass technique was efficient in plaque elimination interdentally; this technique was highly significant in plaque removal than the horizontal scrub technique, whereas Fones technique showed the least efficacy.<sup>[11]</sup> The results of the Fones technique group the least once due to the inactivity in interdental plaque removal.<sup>[11,12]</sup> Also, the modified bass technique appeared to be superior to the normal toothbrushing technique in decreasing DP.<sup>[13]</sup>

HA is a mucopolysaccharide that is usually found in all living organisms. It can comprise multiple thousands of sugars (carbohydrates). When the HA does not connect to other particles, it binds to water, giving it a solid viscous structure similar to a jelly-like appearance. The HA is originally present in the extracellular and pericellular matrices but it also appears intracellularly.<sup>[14]</sup> We have studied it as a metabolite or indicator of inflammation in the gingival crevicular fluid (GCF), besides it being an important element in growth, development, and tissue reparation.<sup>[15-17]</sup> In vitro, during mesenchymal cell migration and differentiation, HA was elevated along with multiple functions of blood cells, with exceptional attention to the inflammatory reaction, for example, phagocytosis and chemotaxis.<sup>[18]</sup> The anti-inflammatory influence may be because of the action of exogenous HA as a scavenger through draining prostaglandins, metalloproteinase, and additional bioactive molecules.<sup>[19]</sup>

Xylitol, a naturally occurring five-carbon sugar polyol, is a white crystalline carbohydrate that has been famous since the previous century. It is naturally present in fruits, vegetables, and berries, and it is artificially made

from xylan-rich plant resources such as birch and beech wood.<sup>[20]</sup> Meanwhile, a study performed in 1970 in Turku and Finland assessed the xylitol efficiency in reducing DP. Xylitol has been broadly investigated and universally recognized as a natural sweetener accepted by the US Foods and Drug Administration (FDA) and the American Academy of Pediatrics Dentistry.<sup>[21]</sup> The xylitol consumed as chewing gum or the big xylitol pastille, similar to any other sweetener, encourages stimulation of the salivary flow.<sup>[22]</sup> So, in this study, we aimed at showing the efficacy of toothpaste with HA and xylitol in the treatment of plaque-induced gingivitis.

## MATERIALS AND METHODS

The assortment of 60 male subjects aged 20 to 35 years old was carried out from December 2017 to December 2018. They were recruited from the Periodontics Department at the Teaching Hospital of College of Dentistry, University of Mustansiriyah, Iraq, Baghdad.

We confirm that the current study included human subjects and this was in agreement with the Helsinki declaration of 1975, as reviewed in 2000, and the Ethics Committee of Al-Mustansiriyah University approved the study (protocol 63; December 1<sup>st</sup>, 2017). They utilized a written consent formula for all patients for their participation in the study, using toothpaste with a toothbrush and dental floss, and the publication results of the study were displayed later.

The inclusion criteria were: people who had plaque-induced gingivitis were allocated into two groups depending on the kind of toothpaste that they were given:

- **Group 1 (G1):** comprises 30 subjects who consumed toothpaste that contains HAX (Hyalogic<sup>®</sup>, Dr. John's toothpaste, USA).
- **Group 2 (G2):** comprises 30 subjects who consumed toothpaste that does not contain HAX (Placebo type).

The other inclusion principles were systemically healthy patients with a minimum of 20 teeth in their mouth. The exclusion criteria were: females, smokers, alcohol drinkers, patients who had undergone periodontal treatment and/or taken anti-inflammatory, antimicrobial drugs in the past 3 months before the study, medically compromised patients (those with diabetes mellitus, cardiovascular disease, rheumatoid arthritis, etc.), and those with no prosthetic appliance.

In this study, the CPPs included indices such as PLI,<sup>[23]</sup> GI,<sup>[24]</sup> and BOP.<sup>[2]</sup> We recorded these indices by using

William’s periodontal probe (Hu-Friedy, UK) before using toothpaste (baseline reading) and we recorded another four readings at the first, second, third, and fourth weeks after using toothpaste.

As a part of systematic plaque-control procedures, the instructions that the patients received were: brushing two times per day with a manual Pro-Expert Oral-B toothbrush (Procter and Gamble, Ireland) and toothpaste by using a modified bass technique; also, Oral B Essential Waxed Mint Floss (Procter and Gamble, Ireland) had to be used once at night after brushing. We repeated these instructions for each patient at each visit.

The Statistical Package for Social Science (SPSS-21) was used for statistical analysis preparation, and the statistical test was one-way repeated-measures ANOVA; however, for multiple comparisons and partial eta squared for effect sizes such as 0.01 (small), 0.06 (medium), and 0.14 (large) the Bonferroni post hoc test was used.

**RESULTS**

The results of our study showed a reduction in the means of PLI in both groups during the advancement of visits. In G1, the mean was  $2.55 \pm 0.14$  initially (baseline reading) and it became  $1.85 \pm 0.07$ ,  $1.46 \pm 0.08$ ,  $0.88 \pm 0.11$ , and  $0.39 \pm 0.05$  at the first, second, third, and fourth visits subsequently; in G2, the mean was  $2.57 \pm 0.13$  initially and it became  $2.16 \pm 0.17$ ,  $1.61 \pm 0.05$ ,  $1.32 \pm 0.09$ , and  $0.71 \pm 0.07$  at the first, second, third, and fourth visits subsequently. Also, there was a reduction in the means of GI in both groups during the advancement of visits. In G1, the mean was  $2.33 \pm 0.15$  initially and it became  $1.74 \pm 0.13$ ,  $1.25 \pm 0.07$ ,  $0.73 \pm 0.08$ , and  $0.30 \pm 0.06$  at the first, second, third, and fourth visits subsequently; in G2, the mean was  $2.34 \pm 0.16$  initially and it became  $1.94 \pm 0.16$ ,  $1.59 \pm 0.04$ ,  $1.02 \pm 0.10$ , and  $0.61 \pm 0.05$  at the first, second, third, and fourth visits subsequently. Similarly, as depicted in the results presented, there was a reduction in the percentage of BOP score 1 for both groups for all time intervals. In G1, the mean was  $84.57 \pm 5.18$  initially and

**Table 1: Statistical analysis of CPPs for groups at all visits**

CPPs	G1			G2		
	Visits	Mean	±SD	Visits	Mean	±SD
PLI	Baseline	2.546	0.142	Baseline	2.570	0.132
	First	1.847	0.071	First	2.157	0.168
	Second	1.458	0.079	Second	1.607	0.050
	Third	0.881	0.111	Third	1.318	0.090
	Fourth	0.388	0.044	Fourth	0.710	0.065
	Repeated ANOVA <i>F</i> = 10267.083 <i>P</i> = 0.000			Repeated ANOVA <i>F</i> = 6987.893 <i>P</i> = 0.000		
	Sig (HS)			Sig (HS)		
GI	Baseline	2.334	0.149	Baseline	2.338	0.155
	First	1.735	0.123	First	1.937	0.161
	Second	1.253	0.073	Second	1.587	0.037
	Third	0.730	0.082	Third	1.021	0.101
	Fourth	0.300	0.056	Fourth	0.612	0.044
	Repeated ANOVA <i>F</i> = 6640.180 <i>P</i> = 0.000			Repeated ANOVA <i>F</i> = 5975.467 <i>P</i> = 0.000		
	Sig (HS)			Sig (HS)		
BOP Score 1	Baseline	84.57	5.18	Baseline	84.03	3.65
	First	67.20	5.09	First	76.10	3.61
	Second	55.97	3.75	Second	68.50	3.05
	Third	22.40	2.44	Third	35.43	1.55
	Fourth	1.53	0.63	Fourth	12.43	1.14
	Repeated ANOVA <i>F</i> = 5072.713 <i>P</i> = 0.000			Repeated ANOVA <i>F</i> = 4597.736 <i>P</i> = 0.000		
	Sig (HS)			Sig (HS)		

it became  $67.20 \pm 5.09$ ,  $55.97 \pm 3.75$ ,  $22.40 \pm 2.44$ , and  $1.53 \pm 0.63$  at the first, second, third, and fourth visits subsequently; in G2, the mean was  $84.03 \pm 3.65$  initially and it became  $76.10 \pm 3.61$ ,  $68.50 \pm 3.05$ ,  $35.43 \pm 1.55$ , and  $12.43 \pm 1.14$  at the first, second, third, and fourth visits subsequently. The results showed HS differences (with  $P \leq 0.001$ ) at all visits for each group in all CPPs (PLI, GI, and BOP score 1), as shown in Table 1.

As presented in Tables 2 and 3, the intragroup comparison for all CPPs on dissimilar interims for both

G1 and G2 revealed (HS) differences with  $P$ -value of  $\leq 0.001$ .

From Table 4, it can be observed that intergroup differences for each visit for CPPs exhibited HS differences with  $P \leq 0.001$ .

**DISCUSSION**

If the patient stops taking care of their oral hygiene, gingivitis can appear within a few days.<sup>[11]</sup> In our study, we used a modified bass technique because

**Table 2: Intragroup differences at visits for CPPs in the G1**

Visits	PLI			GI			BOP		
	MD	P-value	Sig.	MD	P-value	Sig.	MD	P-value	Sig.
Baseline × first	0.699	0.000	HS	0.599	0.000	HS	17.367	0.000	HS
Baseline × second	1.088	0.000		1.081	0.000		28.600	0.000	
Baseline × third	1.665	0.000		1.604	0.000		62.167	0.000	
Baseline × fourth	2.158	0.000		2.034	0.000		83.033	0.000	
First × second	0.389	0.000		0.482	0.000		11.233	0.000	
First × third	0.966	0.000		1.005	0.000		44.800	0.000	
First × fourth	1.459	0.000		1.435	0.000		65.667	0.000	
Second × third	0.577	0.000		0.523	0.000		33.567	0.000	
Second × fourth	1.070	0.000		0.953	0.000		54.433	0.000	
Third × fourth	0.493	0.000		0.431	0.000		20.867	0.000	

**Table 3: Intragroup differences at visits for CPPs in the G2**

Visits	PLI			GI			BOP		
	MD	P-value	Sig.	MD	P-value	Sig.	MD	P-value	Sig.
Baseline × first	0.413	0.000	HS	0.401	0.000	HS	7.933	0.000	HS
Baseline × second	0.963	0.000		0.751	0.000		15.533	0.000	
Baseline × third	1.252	0.000		1.317	0.000		48.600	0.000	
Baseline × fourth	1.860	0.000		1.726	0.000		71.600	0.000	
First × second	0.550	0.000		0.350	0.000		7.600	0.000	
First × third	0.839	0.000		0.916	0.000		40.667	0.000	
First × fourth	1.447	0.000		1.325	0.000		63.667	0.000	
Second × third	0.289	0.000		0.566	0.000		33.067	0.000	
Second × fourth	0.897	0.000		0.975	0.000		56.067	0.000	
Third × fourth	0.608	0.000		0.409	0.000		23.000	0.000	

**Table 4: Intergroup differences at each visit for CPPs**

CPPs	Visits	F-test	P-value	Sig.
PLI	First × first	83.141	0.000	HS
	Second × second	73.101	0.000	
	Third × third	267.915	0.000	
	Fourth × fourth	482.282	0.000	
GI	First × first	28.442	0.000	HS
	Second × second	478.310	0.000	
	Third × third	143.120	0.000	
	Fourth × fourth	546.997	0.000	
BOP score 1	First × first	60.904	0.000	HS
	Second × second	202.025	0.000	
	Third × third	609.255	0.000	
	Fourth × fourth	2116.683	0.000	

previous studies showed that this technique can give a substantial reduction in the amount of DP, besides protection against the mechanical trauma that can occur by manual toothbrushing.<sup>[12,25]</sup>

According to the results of our study, we showed an improvement in the CPPs in both groups. These may be related to the instructions and motivations given to the patients at each visit, and the use of toothpaste (HAX or Placebo) as well as the use of mechanical plaque control (toothbrush, dental floss).

The G1 showed more reduction in the means of all CCPs than G2. We can relate this patient in G1 used to that the HAX toothpaste that contains two main compounds (hyaluronic acid and xylitol). So, the effect of this toothpaste was double, as it contains the effects of hyaluronic acid and xylitol.

This finding was in agreement with earlier studies<sup>[26,27]</sup> which found improvement in gingival health after supragingival HA application in patients with gingivitis. Besides, both Shah *et al.*<sup>[28]</sup> and Mahmood *et al.*<sup>[29]</sup> used HA gel subgingivally and agreed with our study; they revealed a greater, significant improvement of CPPs in the HA group when compared with scaling and root planing alone. This could be because the HA has an anti-inflammatory influence created by the scavenger effect of HA through the draining of prostaglandins, metalloproteinase, and other bioactive molecules.<sup>[19]</sup> Also, HA has an anti-edematous influence that may be associated with osmotic action. Because of its tissue-healing stimulating properties, it might act as an adjunct to manual treatment.<sup>[26]</sup> In 2004, Xu *et al.*<sup>[30]</sup> did not display a difference in BOP between HA and control groups after using HA. This result perhaps supposed that the consumption of 8% HA is important, particularly during the first earliest time after treatment.

Whereas the xylitol has a beneficial effect in reducing the level of *mutans streptococci* (MS) in plaque and saliva by deranging their energy production procedures; as a result, a useless energy cycle and cell death ensue. Xylitol decreases the attachment between these microorganisms and the tooth surface, and it diminishes their probable acid production.<sup>[31,32]</sup> In 2019, Saheer *et al.*<sup>[33]</sup> agreed with our study, where they found that the use of sugar-free gum that contains xylitol can reduce the plaque, gingival, and bleeding scores in patients with gingivitis. In 2014, Keukenmeester *et al.*<sup>[34]</sup> used chewing gum with xylitol and they found that there was a decrease in CPPs scores in the non-brushing group, whereas there was no effect of xylitol on CPPs scores in the regular brushing group.

## CONCLUSION

The result showed that patients with daily use of toothpaste (HAX or Placebo) with a toothbrush and dental floss can keep their periodontal condition healthy for life. There was an HS difference between patients with G1 and G2, where the rate of decrease of CPPs in G1 is higher than G2.

## ACKNOWLEDGMENT

Special thanks to the Al-Mustansiriyah University ([www.uomustansiriyah.edu.iq](http://www.uomustansiriyah.edu.iq)), Baghdad, Iraq for its assistance in this research.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICT OF INTEREST

There are no conflicts of interest.

## AUTHORS CONTRIBUTIONS

Haider J. Talib: substantially contributed to Concepts and Designing the study, done the Definition of intellectual content and the Literature search, contributed in the clinical studies, Experimental studies and acquisition and analysis of the data, prepared and reviewed the Manuscript and is the guarantor.

Hussein A. Mousa: contributed for the Designing the study, the intellectual content and searched the Literature, contributed to data analysis and statistical analysis, and also worked for Manuscript editing and reviewed and is the guarantor.

Athraa A. Mahmood: contributed in the Literature search, clinical studies, Experimental studies and data acquisition, and also contributed to statistical analysis, Manuscript preparation and review and is the guarantor.

## ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

Not applicable.

## DECLARATION OF PATIENT CONSENT

Not applicable.

## DATA AVAILABILITY STATEMENT

Not applicable.

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