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Full Length Research Paper

Does chewing gum manage orthodontic pain better than sucking sweets?

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Abstract

Introduction: The chewing of gum has been indicated for the control of orthodontic pain due to its proposed mechanical effect on the periodontal tissue. The literature on this is however scant. The aim of this study was to compare the effect on pain of conventional sugar-free chewing gum with sucking sugar-free sweets in patients with fixed appliances. Method: A double-blind, randomised clinical trial, with 60 participants randomly assigned to two intervention groups, the sugar-free chewing gum group and the sugar-free sweets group was conducted. Informed consent was obtained and participants with fixed orthodontic appliances were asked to chew gum or to suck sweets at specific time intervals and record their pain scores using a visual analogue scale. Repeated measures ANOVA was used in the analysis. Results: Sixty questionnaires were returned. The mean pain score decreased with time in both groups. Results showed significantly lower mean pain scores in the chewing-gum group at 48 hours ($p<0.001$). Conclusion: Both groups indicated a reduction in pain over time. However, at 48 hours, chewing gum was associated with significantly reduced pain compared with the sweet sucking. A more extensive study on the effects of chewing and orthodontic pain could augment the literature in this field.

Keywords: Orthodontic pain, placebo, medicaments, chewing gum, sucking sweets.

INTRODUCTION

Conventional sugar free chewing gum has been proposed as an inexpensive and convenient option to consider for orthodontic pain management, but the mechanisms remain unclear. (Kamiya et al., 2010).

The added benefits of gum emanate from its ability to improve oral hygiene through saliva production and mechanical cleaning (Imfeld, 1999) and to decrease anxiety through various psychosomatic pathways (Kamiya et al., 2010; Weijenberg and Lobbezoo, 2015). According to some studies, gum could possibly reduce or replace NSAIDs as a treatment option for patients undergoing fixed orthodontic appliance therapy (Ireland et al., 2017).

All previous theories surrounding the ability of chewing gum to reduce orthodontic pain have focused on its mechanical effects on the periodontal ligament, which is a physiological process. There have been no studies investigating possible 'placebo effects' as a mechanism of reducing orthodontic pain.

The use of sucrose and non-nutritive sucking for pain reduction has been vaguely discussed in the literature, but the focus is largely on neonatal studies and is somewhat

controversial due to the toxic effect that high doses of sucrose may have (Li et al., 2022). Moreover, there are no known studies showing any physiological pain reducing effects of sucking sugar free sweets. It can, therefore, be postulated that any pain reducing effects associated with these medicaments are most likely 'placebo effects'.

Pain modulation is complex and explains how pain is perceived and modified. The Gate Control Theory, introduced by Melzack and Wall in 1965, proposed that incoming pain sensory information could be downregulated through various pathways using neurotransmitters. This controversial theory was the turning point in the understanding of pain perception and explained how networks that play a role in the receiving and processing of pain information are complex (Mendell, 2014).

The 'placebo effect' is a psychobiological phenomenon that can be attributed to different mechanisms, including an expectation of clinical improvement (Benedetti et al., 2005). It has been shown that patients can improve their pain experience through simple distractions (Finniss et al., 2010).

The current study considered two philosophies, the physiological effects of conventional chewing gum and the 'placebo effect'. Both intervention groups of the study (chewing gum and sucking sweets) were susceptible to this 'placebo effect' because of blinding.

The objective was to measure the perceived intensity of pain experienced by participants following the placement of fixed orthodontic appliances and to remark on any differences when using the assigned medicament.

It has been documented in the literature that pain begins 4–12 hours after applying orthodontic force, peaks at 24 hours, and gradually diminishes over 3−7 days (Marković et al., 2015). Hence, pain in the 'initial phase' following placement of a fixed bracket appliance was examined in this study.

MATERIALS AND METHODS

A randomised clinical trial was conducted across three sites in Cape Town, South Africa. Three private dental practices, providing fixed orthodontic treatment were included in the study. The method employed in randomly assigning participants to the intervention groups conformed to recommended Consolidated Standards of Reporting Trials (CONSORT) guidelines.

The inclusion criteria for the study population were patients aged between 12 years and 30 years receiving fixed orthodontic appliance treatment for the first time. Exclusion criteria were patients who were hypersensitive to ingredients in conventional sugar-free chewing gum or sugar-free sweets, patients who were medically compromised, patients who had undergone any type of surgery in the previous three weeks (including dental extractions), patients who had reported the use of pain medication at the time of the initial bracket placement, and orthodontic retreatment cases.

The sample comprised 60 (n = 60) orthodontic patients and was divided into two intervention groups; one group received conventional sugar-free chewing gum (n = 30) and the other group received sugar-free sweets (n = 30). In total, 60 questionnaires and medicament envelopes were distributed across three practices, with each practice receiving an equal quantity of both medicaments.

Two unmarked medicaments were used in this study: conventional sugar-free chewing gum and sugar-free sweets. Even amounts of each medicament were distributed among the three practices. The unmarked medicaments were removed from the original packaging and resealed in sterile pouches. Each sterile pouch contained either 10 conventional sugar-free chewing gums or 10 sugar-free sweets to last the duration of the experiment. Thereafter, the sterile pouches were sealed in a brown envelope with the instructions for the patient either to chew gently (chewing gum) in different areas of the mouth for 10 minutes or to suck (sweets) until completely dissolved without any chewing. Each envelope had an identification number, and this was recorded with the relevant medicament that it contained by the independent record keeper prior to distribution to the practices, thus ensuring double blinding.

Data collection was achieved through self-administered questionnaires incorporating the visual analogue scale (VAS). The questionnaire was designed using a diary template with clear instructions regarding usage of the medicaments and recording of pain scores. These were completed by the participant over a 48-hour period following the placement of a fixed orthodontic appliance.

The initial time interval, time interval 0 (T0), was four hours following the initial placement of the fixed appliance; this formed the baseline score for pain without an intervention. Time interval 1 (T1) was eight hours following the initial placement of the fixed appliance and recorded the first pain score after the use of an intervention medicament. Time interval 2 (T2) was recorded at 24 hours following the initial placement of the fixed appliance to draw comparisons with similar studies in which maximum orthodontic pain (with no intervention) was experienced (Ertan Erdinç and Dinçer, 2004). Time interval 3 (T3), the last interval in this experiment, was 48 hours after the initial placement of the fixed appliance to coincide with the beginning of pain resolution, as mentioned in the literature (Ertan Erdinç and Dinçer, 2004; Marković et al., 2015).

The chosen VAS incorporated a linear numerical measure that was scaled from 0 cm to 10 cm (1 cm intervals) with facial diagrammatic representation to engage with the participants' visual interpretation of pain. In addition, typical Likert word descriptions were employed that categorised pain in segmented scoring:

No pain (score 0 cm), Mild pain (score 1–2 cm), Moderate pain (scores 3–4 cm and 5–6 cm) and Severe pain (scores 7–8 cm and 9−10 cm), where 10 cm was recorded as 'Worst possible pain'. Concurring with the scientific literature, linear numerical readings were used to measure the pain scores in this study (Hjermstad et al., 2011).

Interactions between variables were tested through a repeated measures ANOVA test and cross-checked using (post-hoc) pairwise comparisons, thus further ensuring the validity of the acquired data. Any discrepancies between ANOVA and the pairwise comparisons were accurately documented and discussed further.

Data were recorded on an Excel spreadsheet, and transferred to StataCorp (2017), Stata Statistical Software: Release 15. Histograms, bar graphs, and box-and-whisker plots of the data were examined, and comparisons were made.

A repeated measures ANOVA was used to determine if there was an interaction between the interventions and the level of pain that was perceived over time. Post-hoc testing and pairwise comparisons were used to support the ANOVA testing. Any differences in the test results were discussed accordingly. Descriptive statistics were presented as mean and standard deviation unless otherwise specified.

The treatment of all the participants in this study followed the principles that govern the actions of all healthcare practitioners treating any patient in South Africa.

Ethical approval was obtained from the Biomedical Research Ethics Committee (BMREC) of the University of the Western Cape (BMREC Approval Number BM17/7/11). Anonymity and confidentiality of all information recorded during the study was assured, and study subjects were advised that they could withdraw from the study at any point without penalty or prejudice. All conducted research activities followed strict ethical principles in honour of the Declaration of Helsinki (Skierka and Michels, 2018).

RESULTS

Demographics

Sixty participants with a mean age of 14.82 years (SD 4.02) were recruited for the study. Most participants in this investigation were aged between 12 years and 15 years (62%) with a mean age of 14.82 years (SD 4.02). Only 10% of the sample was over 20 years of age.

An identical number of sugar-free chewing gum pieces and sugar-free sweets were used in the sample (n = 30 for each).

Pain reporting

A boxplot representation of the survey data (Figure 2*)* showed generally higher levels of pain with sweets than gum over time, except at time interval T1 (8 hours) where gum scored a maximum pain level of 9 compared with sweets for which the maximum recorded pain was 8. The interquartile range (IQR) and the median between the groups were the same at this time interval. 'No pain' or 0 scores were recorded at each interval and presented as outliers at 4 hours, 8 hours, and 24 hours and as a lower fence (minimum score) at 48 hours. The maximum pain recording for gum at 48 hours was just slightly more than the median and first quartile recording of sweets. This is further reflected in the statistical difference detected when comparing the means of both groups ($p<0.001$) (Table 1).

A repeated measures ANOVA showed that there was a statistically significant interaction between the medicament and time on pain scores ($F [3, 174] = 8.19$, $p<0.001$).

A further post-hoc analysis using a pairwise comparison (Table 2) allowed for the inter comparison of pain scores between the two groups. At the beginning of the experiment (4 hours) and at 8 hours and 24 hours, there was no statistically significant difference between sweets and gum ($p>0.05$). However, at 48 hours, pain was significantly lower in the gum group (1.45; 0.98) than in the sweet group (3.6; 1.39), with a difference of 2.15, 95% CI (1.54 to 2.76)($p<0.001$).

The positive contrast recording at each comparison (sweet vs gum) was indicative of the mean pain scores always being higher in the sweets group than in the gum group at each time interval.

DISCUSSION

The primary outcome measure of the study was to compare the effect of conventional sugar-free chewing gum with the effect of sugar-free sweets on orthodontic pain scores following the placement of a fixed appliance.

Orthodontic pain is known to start shortly after the fixed appliance has been fitted (Ertan Erdinç and Dinçer, 2004). This holds true for the current study in which pain was high at the start of the experiment (T0). According to Bergius et al. (2000), pain peaks at 24 hours following the placement of fixed appliances with no intervention. In contrast, the current study showed a decline in mean pain scores for both intervention groups over time. The mean pain scores of participants with gum were always lower than the mean scores of participants with sweets, except at T1 when the scores were equal. There was also no 'Peak pain' noted in this study (see Figure 1). At 24 hours, both intervention groups showed a marked decrease in mean pain scores compared with other studies recording on VAS (Krishnan, 2007).

Table 1 and Figure 1 (the profile plot) demonstrate that the mean overall orthodontic pain decreased over time in both intervention groups. Mean pain scores in the gum group were always lower than the sweet group, except at 8 hours (T1) when the mean pain scores were equal in both groups. The boxplot (Figure 2) demonstrates a greater spread of pain data at T1 for the chewing-gum group, with greater upper and lower limits.

Table 1: Summary of mean pain scores and standard deviation for gum and sweets over time.

		T0	T1	T2	T3
Medicament	**Pain scores over time intervals**				
Gum	n	30	30	30	30
	Mean	**4.6**	**5**	**4.1**	**1.4**
	SD	1.73	1.44	1.27	0.98
Sweets	n	30	30	30	30
	Mean	**5.2**	**5**	**4.6**	**3.6**
	SD	2.01	1.49	1.44	1.39
Total Pain	n	60	60	60	60
	Mean	4.9	5	4.4	2.5
	SD	1.88	1.46	1.37	1.61

SD: Standard deviation
T0 = 4 hours post the placement of the fixed appliance; no intervention (start of the experiment)
T1 = 8 hours post the placement of the fixed appliance
T2 = 24 hours post the placement of the fixed appliance
T3 = 48 hours post the placement of the fixed appliance (end of the experiment).

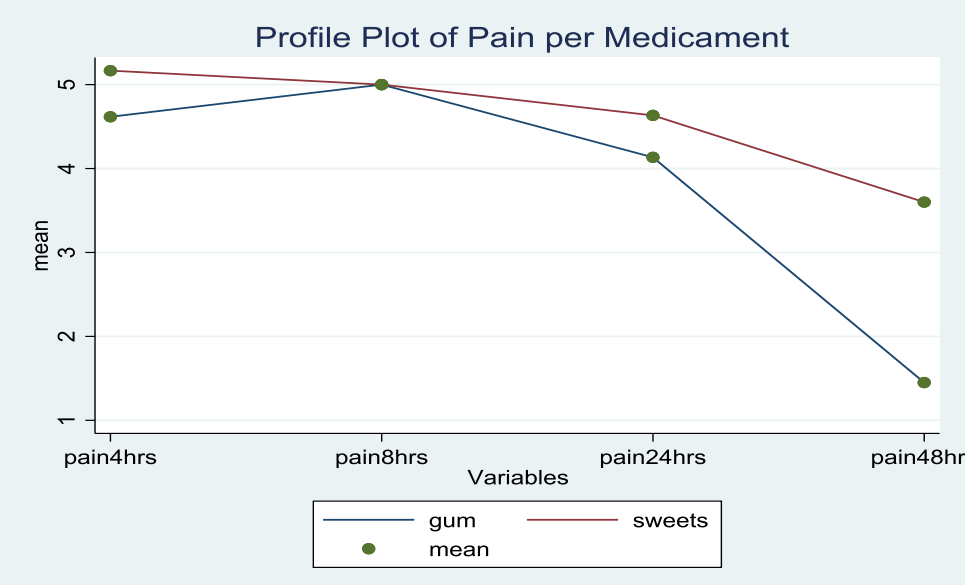

Figure 1: Mean pain trend of gum versus sweets over time.

The IQR and median pain scores were, however, equal for both intervention groups at T1, which further emphasised that the slight upward trend in the profile for gum was not statistically or clinically significant. At the end of the experiment (T3 = 48 hours), participants in the chewing-gum group had a greater reduction in mean pain scores than the participants in the sweet group, with a difference of 2.15, 95% CI (1.54 to 2.76), which was statistically significant ($p<0.001$).

Most participants in the chewing-gum group reported pain scores of less than 2 on the VAS at the end of the experiment, while most participants in the sweet group still reported scores between 2.5 and 3.5 for the same time interval, with the highest recording being 6.5. This suggests moderate pain in the sweet group even at the end of the experiment (Figure 2).

This study, therefore, suggests that following the placement of an orthodontic appliance, both conventional sugar-free chewing gum and sugar-free sweets are associated with a reduction of orthodontic pain over time. However, chewing gum is associated with lower pain scores than sugar-free sweets and with significantly reduced pain between 24 hours and 48 hours.

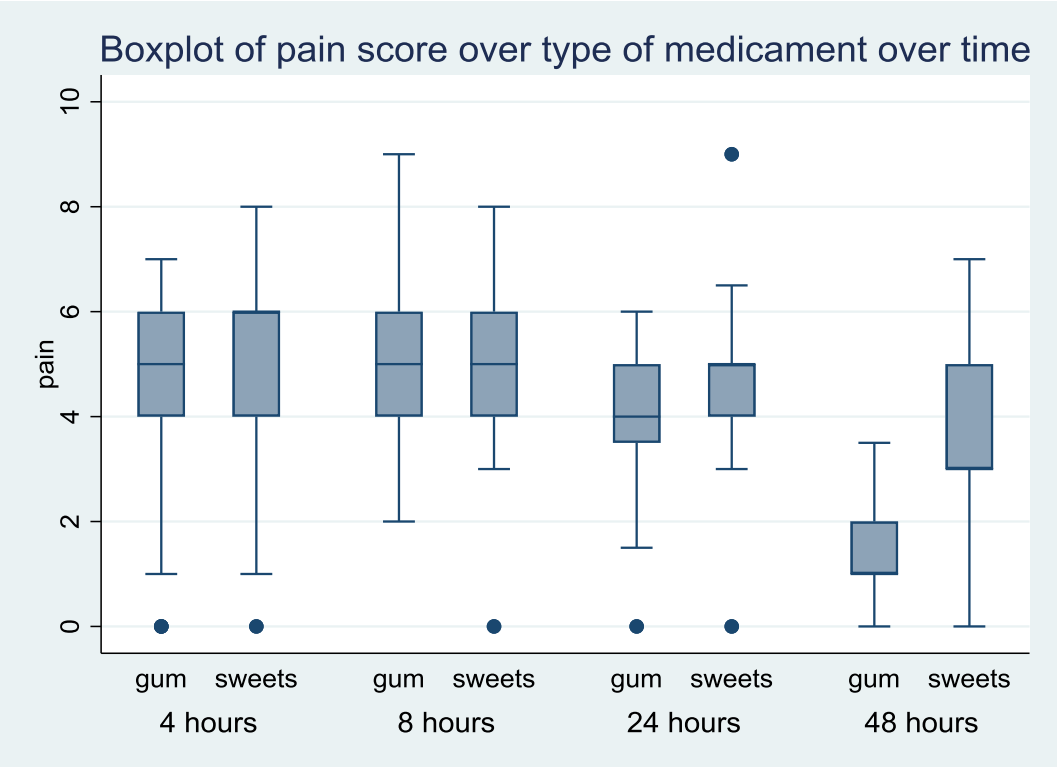

Figure 2: Pain variation and median pain scores over time for gum and sweets.

Table 2: Pairwise comparison (posthoc) showing mean difference between sweets and gum over time.

Pairwise comparison: Medicament and pain	Contrast (Mean difference)	Standard error	95% Confidence Interval for Mean Difference		p-value
			Lower Bound	Upper Bound	
Sweet vs Gum at T0 (4 hrs)	0.55	0.484	-0.398	1.498	0.255
Sweet vs Gum at T1 (8 hrs)	4.44e-15	0.379	-0.743	0.743	1.000
Sweet vs Gum at T2 (24 hrs)	0.5	0.351	-0.189	1.189	0.155
Sweet vs Gum at T3 (48 hrs)	2.15	0.310	1.541	2.759	<0.001

Both intervention groups were susceptible to 'placebo effects' due to blinding. The rapid reduction in the mean pain scores of the chewing gum group at the time interval T2–T3 suggests that chewing gum may have both a positive psychological effect and a positive biological or physiological effect on pain relief and that these effects

are superior to those of a 'placebo effect' alone. These effects are supported in the literature. Long et al. (2016) describe the complex physiological process that is involved when an orthodontic force is applied to a tooth. This process includes a vascular, cellular, and chemical response, which can be modulated along various points of the central nervous system (Long et al., 2016). Kamiya et al. (2010) postulate that chewing gum physically reduces pain by stretching the periodontal ligament and suppressing nociceptive responses. Ireland et al.(2016), Shedam et al. (2015), and Waheed-Ul-Hamid et al. (2016) all show the pain-reducing effects of chewing gum in orthodontic treatment. Furthermore, the literature demonstrates that although the onset of pain relief with chewing gum is slightly delayed, it is more effective in reducing pain once it takes effect (Ireland et al., 2016).

Orthodontic studies have not reported the usefulness of 'placebo effects' in pain reduction. However, in general pain studies, chewing gum has been shown to be beneficial as a distractor, demonstrating positive 'placebo effects' in lowering perceived pain (Kamiya et al., 2010). This effect was seen in the current study. The mean baseline scores (T0) and the subsequent mean pain scores (in both intervention groups) were lower than the mean pain scores at similar time intervals in other studies that inspected the effects of sugar-free chewing gum and controls on orthodontic pain (Ireland et al., 2016; Shedam et al., 2015; Waheed-Ul-Hamid et al., 2016).

Waheed-Ul-Hamid et al. (2016) reported mean baseline scores for chewing-gum intervention at a level of 7.72 (1.49) and a control (ibuprofen) mean baseline score of 7.78 (1.28) using a similar VAS to the current study. In comparison, the current study showed mean baseline scores of 4.6 (1.73) for chewing gum and 5.2 (2.01) for sweets. The lower pain scores in this study than in the study by Waheed-Ul-Hamid et al. (2016) are most likely due to a positive 'placebo effect' that participants may have experienced, especially since the other comparative variables such as age, gender distribution, and time intervals were similar in both studies. Similar remarks can be made when comparing the current study with the study of Shedam et al. (2015).

A study by Eslamian et al. (2016) compared a medicated (ketoprofen) gum with conventional gum and an anaesthetic gel. The study showed that participants in the ketoprofen gum group reported mean pain scores that were slightly lower than participants in the conventional gum and anaesthetic gel groups, but the scores were not statistically or clinically significant (Eslamian et al., 2016). There is a lack of evidence in the full efficacy of medicated gum, and the side effects are still unknown.

LIMITATIONS

There were two limitations in this study. The first limitation was the small sample size. A convenience sample was accepted because of time constraints. Despite this, a statistically significant difference between the two interventions were found at the end of the experiment. Another limitation was the lack of a control group that received no intervention. The pain scores found in this study appear lower than previous studies using the same VAS. It would, however, have been beneficial in this study to see if participants receiving no intervention had different pain scores from those receiving sugar-free sweets.

CONCLUSION

Conventional chewing gum and sugar-free sweets were associated with a reduction in orthodontic pain. This mechanism could possibly be due to positive 'placebo effects'. The lower pain scores associated with chewing gum compared with sucking sweets suggest that after 24 hours following the placement of a fixed orthodontic appliance, there could be a combined physiological and psychosomatic effect associated with chewing gum that is significantly greater than sucking sweets.

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