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ORIGINAL ARTICLE

Effectiveness of Xylitol Chewing Gum in patients with Orthodontic Pain

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ABSTRACT

Background: Pain during active orthodontic treatment is a common experience. Orthodontic treatment involves active and passive stretching and compression of periodontal ligaments as well as of adjacent soft tissues which is the basic cause of pain. Pain is one of the important factors which have impact on oral health-related quality of life (OHRQOL) because it hinders the proper plaque control by the patient.

Aim: To ascertain the efficacy of xylitol chewing gums on the reduction in pain levels during the first week of orthodontic treatment.

Methods: This is a case control study in which 60 orthodontic patients were selected and randomly allocated into two groups. 30 patients were in control group and 30 were treated with Xylitol gum. Patients were advised to take xylitol chewing gum 3-5 times per day and not to take any analgesics. 2 weeks follow up is advised with filled Visual Analog Scale form.

Results: The average age of patients was 19.93±3.04 years. There were 39(65%) male and 21(35%) female. At 24 hours and at 7 days, the mean pain score was significantly low in Xylitol gum groups as compare to control groups.

Conclusion: In present study, Xylitol gum had higher analgesic efficacy than control group. So Xylitol gums can be good replacement for orthodontic pain relief that has an advantage of minimum side effects in contrast to ibuprofen.

Keywords: Analgesics, Orthodontic treatment, Pain, Xylitol gum

INTRODUCTION

Pain during active orthodontic treatment is a common experience. On an average, 70% to 95% patients report pain[1.] Orthodontic treatment involves active and passive stretching and compression of periodontal ligaments as well as of the adjacent soft tissues which is the basic cause of pain. Initial ischemia, inflammation and edema caused by the stretching of periodontal ligaments release tissue mediators such as histamine, prostaglandins etc., which are responsible for the irritation of nerve endings for pain receptors[2.]

Pain is one of those important factors which have an impact on oral health-related quality of life (OHRQOL) because it hinders the proper plaque control by the patient[3.] There are various methods of controlling pain and discomfort in orthodontic patients which include NSAIDS, low level laser therapy, transcutaneous electrical nerve stimulation (TENS) and vibratory stimulation of periodontal ligaments[1]. NSAIDS, being one of the over the counter drugs, were considered to be the most successful treatment modality for orthodontic pain. The function of these drugs is to inhibit enzyme cyclooxygenase (COX). For the scientific knowledge it is important to mention that COX is constituted of two types, i.e. COX-1 and COX-2 which have a similar structure but act as two complete different entities. They are generally interpreted as monotropic integral membrane proteins detected fundamentally in the endoplasmic reticulum (COX-1) and peri- nuclear envelope (COX-2). Both of these types of COX produce prostaglandins. Reduction in prostaglandin decreases pain but at the expense of reduced bone resorption, thus causing restricted tooth movement. Few side effects such as thrombocytopenia, skin rashes, headache etc. are also related with NSAIDS1. Therefore, the effective orthodontic treatment goal cannot be achieved with this pain relieving method.

Chewing gums or bite wafers are one of the recommended non pharmacological methods of pain control[2]. Chewing gums lack the systemic side effects of NSAIDS as well as the negative effects in tooth movement[3]. The process behind chewing action is to relax the firmly woven periodontal ligament fibers encircling blood vessels which in turn lead to the restoration of normal vascular circulation and enhance the pulpal sensory thresholds to electrical stimulation, thus resolving the inflammation and edema and alleviating discomfort and pain[1]. So any intervention which can temporarily displace tooth in the socket and restore the normal blood supply of periodontal ligament will alleviate pain.

Xylitol chewing gum has been recommended for orthodontic pain control. The distinctiveness of xylitol is that it is basically non fermentable by oral bacteria. Therefore, along with the benefits of chewing action, xylitol gum also helps in the reduction of plaque and caries incidence by decreasing the levels of *streptococcus mutans* (MS) found in the plaque and saliva, thus resulting in reduction of their potential of acid production and enhancement of salivary flow, which causes an increase in bicarbonate concentration and buffering capacity of saliva[4.]

There is around one gram of xylitol in the “all xylitol” mints and gums. Studies showed that a total of 4 to 12 grams of xylitol should be consumed 3 to 5 times per day. Apart from this, xylitol should be taken immediately after eating and clearing the mouth by swishing the water. The recommended maximum intake of xylitol should not exceed more than 15 grams per day as higher intakes yield no additional dental benefits.

A previous study showed significant difference in pain by mean population of 7.47±2.73 and test value of 3.47± 3.83[5.] There is very little research available to check the effect of xylitol on orthodontic pain. The main goal of this study is to find out the efficacy of xylitol chewing gums in pain reduction during the initial week of orthodontic treatment.

MATERIAL AND METHODS

A sample of 60 patients, coming to the orthodontic department of KRL Hospital Islamabad, who fulfilled the inclusion criteria of being new orthodontic patients and within age group of 15-25 years, were selected for the study. Patients with temporomandibular joint problems, medically compromised patients, pregnant and lactating patients, patients receiving analgesic therapy and patients with poor dental and periodontal health were excluded from this study. Out of these 60 patients, 30 patients were in the control group and 30 in the study group. Xylitol was prescribed to every patient of study group immediately after bonding. All patients of study group and control group were given and requested to fill a visual analog scale questionnaire about the intensity of pain and discomfort at 24 hours and 7 days. Patients were advised to take xylitol chewing gum 3-5 times per day and not to take any analgesics. 2 weeks follow up was advised with the

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filled Visual Analog Scale form. Data was collected in six months duration.

Data was entered on computer software SPSS version 17. Quantitative variables like age of the patient and VAS at 24 hours and 7th day was measured as mean ± SD while qualitative data like gender was measured by frequency and percentages. Independent sample t-test was applied to compare the mean pain at 24 hours and 7th day between the 2 groups. P value 0.05 was found to be significant.

Effect modifiers like gender, age were managed by the stratification. Post stratification independent sample t test was applied.

RESULTS

In this study, 60 orthodontic patients were selected and randomly allocated into two groups. 30 patients were in control group and 30 were given Xylitol gum. The patient's average age was 19.93±3.04 years and 20.60±2.95 years in the study and control groups respectively. There were 39(65%) male and 21(35%) female. Gender distribution with respect to groups is shown in the figure 2.

At 24 hours, the mean pain score was significantly low in Xylitol gum groups as compare to the control groups [4.10±0.80 vs. 6.00±1.44; p=0.0005] as shown in the figure 3. At 7th day the mean pain score was also recorded to be significantly low in Xylitol gum groups as compared to the control groups [2.27±0.78 vs. 3.10±0.99; p=0.0014] as shown in figure 4.

Stratification analysis was performed and observed that at the 24th hour and 7th day, mean pain score was significantly low in Xylitol gum groups as compared to control groups for all stratified age groups as shown in the tables I and II. According to gender stratification, it was also observed that the mean pain score was remarkably low in Xylitol gum groups as compare to control groups at 24 hours and 7 days for male whereas at 24 hours it was significant between groups for female and at 7th day was found not to be significant between the fore mentioned group for females as shown in the tables II and III respectively.

Fig. 1: Distribution of age with respect to groups (n=60)

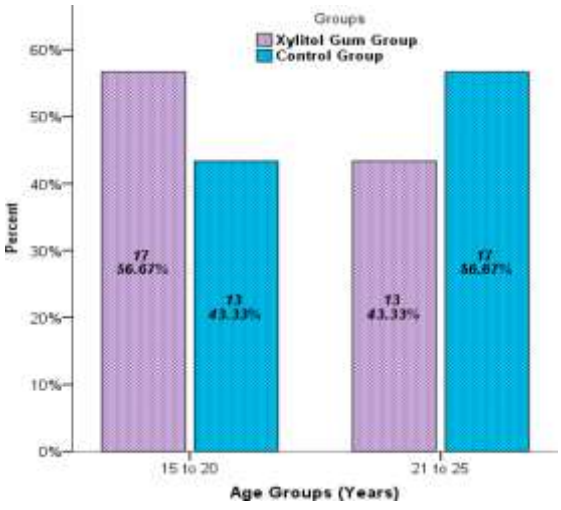

Fig. 2: Gender distribution with respect to groups(n=60)

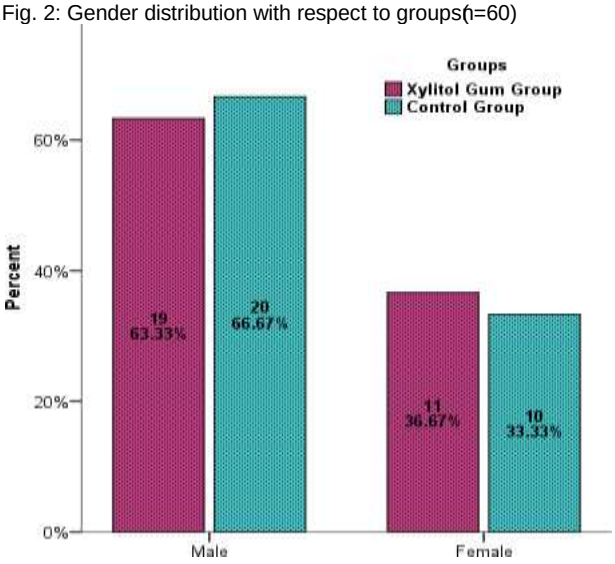

Fig. 3: Comparison of mean pain between groupsat 24 hours

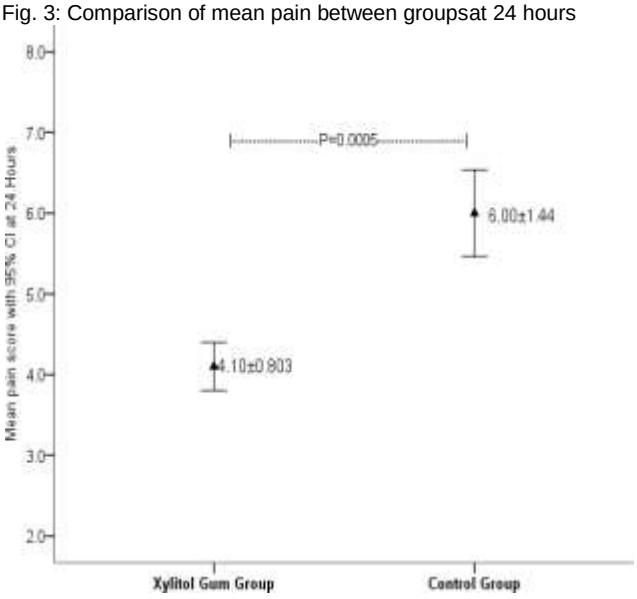

Fig. 4: Comparison of mean pain between groupsat 7th day

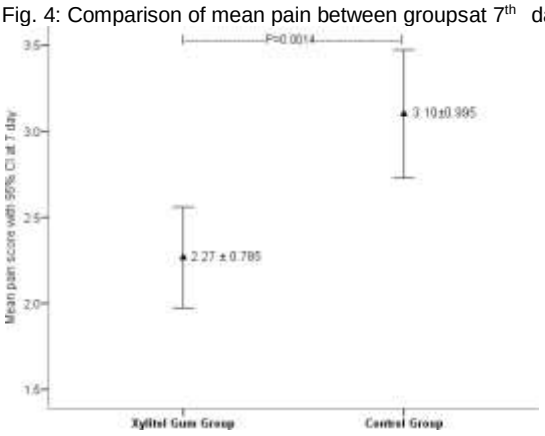

Table 1: Comparison of mean pain between groups with respect to timefor 15 to 20 years of age patients

Pain score	Xylitol GumGroup (n=17)	ControlGroup (n=13)	P-Value
At 24 Hours	4.12±0.78	6.38±1.26	0.0005
At 7th day	2.24±0.90	3.08±1.12	0.030

Table II: Comparison of mean pain between groups with respect to timefor 21 to 25 years of age patients

Pain Score	Xylitol GumGroup (n=13)	ControlGroup (n=17)	P-Value
At 24 Hours	4.08±0.86	5.71±1.53	0.002
At 7th day	2.31±0.63	3.12±0.93	0.012

Table III: Comparison of mean pain between groups with respect to timefor male

Pain Score	Xylitol GumGroup	ControlGroup	P-Value
At 24 Hours	4.00±0.816	6.10±1.41	0.0005
At 7th day	2.11±0.87	3.15±1.04	0.002

DISCUSSION

Fixed orthodontic appliances have been shown to be the leading cause of decline of OHRQoL in young adolescent [6, 7] and adults[8], especially in the initial month after placement. Wearing of fixed appliances can cause discomfort in the oral functions and social settings[9,] along with the physical discomfort and pain [10, 11] which can greatly impact OHRQoL. This impact on OHRQoL may lead to reduced compliance and premature termination of the orthodontic treatment by the patients.

Systemic analgesics are one of the most common methods used in the control of oral pain[12, 13.] Local pharmacological agents have also been put under investigations as the means of controlling pain after placement of fixed appliances[14.] For decades, to ease the orthodontic pain, non-steroidal anti-inflammatory drugs (NSAIDs) are being used. The mechanism of action of NSAIDS is to curb the functions of cyclooxygenase (COX) enzymes, which are involved in the production of prostaglandins[23.] Prostaglandins as a mediator promote inflammation, pain and fever by attaching to the sensory endings of the nerves and encourage tooth movement by activating bone remodeling. In this way, orthodontic pain could be diminished by using NSAIDs, which block prostaglandin release. Generally prostaglandins elevate localized inflammation and metabolism of bone, but when the level of prostaglandins decreases after NSAID ingestion, it results in the hindrance of osteoclasts and reduction in the rate of tooth movement. Along with this, a second procedure which causes NSAIDs to block tooth movement during orthodontic treatment has been presented where NSAIDs obstruct the activity of collagenase enzyme and the production of procollagen, and result in the hindered periodontal remodelling[24.]

Other non-pharmacological methods which include transcutaneous electrical nerve stimulation (TENS) [15,] vibrations, chewing gums, biting wafer and lasers[16] are also of great interest. The suggested method for vibration, chewing gum and biting wafers is presented in the fact that mechanoreceptors are activated by mechanical stimuli which transmit tactile signals and on the other hand subdue the dispatch of painful signals[25.] The fact that pain can be relieved by rubbing the painful area's skin could be explained by this action. As mentioned above, in addition, the forces generated by orthodontic treatment constrict periodontal blood vessels and create localized ischemia and later on, localized inflammation. Normal blood flow is regenerated through vibrations and hence reduces the fore mentioned pain. However, the disagreement regarding the efficacy of vibration in relieving orthodontic discomfort still persists. The success of chewing gum and biting wafers still requires further verification.

When teeth are activated with orthodontic forces, noticeable reactions can be seen at paradental tissues along with those of periodontal and the dental pulp[26, 27.] A surge in the self-limiting inflammatorymarkers which produce cellular, vascular, neural and immunological reactions, act in an organized manner which will in the end lead to the orthodontic pain and eventually movement in the teeth. In consequence, orthodontic pain and tooth movement are interrelated to each other with relative biological episodes along with the local inflammation being their common mechanism. Prostaglandin and bradykinin which are released as a consequence of local inflammation takes action on the sensory endings and thus stirs up the painful sensations[28.] Thus, periodontal inflammatory responses which are influenced by the orthodontic forces are the reason for the channels underlying orthodontic pain. These periodontal inflammatory responses consist of threeunits: vascular, cellular and chemical events. These three elements interconnect with each other and create a matrix. Chewing has been shown to increase the pulpal sensory thresholds to electrical stimulation [17.] Other mechanism by which chewing reduces edema and inflammation is increased blood and lymphatic flow all around the periodontal membrane which can wash away these inflammatory markers. The stimulation of salivary flow leads to increased release of bicarbonates and increased buffering capacity of saliva, whereas reduction of acidic plaque also leads to the decreased incidence of demineralization and caries[18].

In present study, the patient's average age of was 19.93±3.04 years and 20.60±2.95 years in studyand control groups respectively. There were 39(65%) male and 21(35%) female. In the study of Waheed-ul-Hamid[3] mean age was 14.03±1.17 years and number of male patients was 133 (53%) while female patients were 117 in number (47%).

The point of initiation and time duration of orthodontic pain was found out to be alike in the majority of the studies i.e. after four hours of application of an orthodontic force, patientscommonly started to undergo pain and discomfort. In a study, the Visual analogue scale (VAS) was used to assess the intensity of pain that initiated after the placement of separators. The maximum level was perceived on the following day, while there was no pain by the fifth day[29.] The diet routine was urged to be changed and the use of analgesics was obliged to almost half of the patients who were assessed in this study.

There are hardly any studies which assess the outcome of chewing in decreasing the effect of fixed orthodontic appliances. Otasevic et al.[19] compared the effectiveness of chewing a bite wafer and that of avoiding hard food to decrease pain related to initial orthodontic force application in a randomized clinical trial study. Results showed that for the first 4 days, there were significantly higher median pain scores in the bite wafer group.
In the present study at 24 hours and at 7 day , the mean pain score was significantly low in Xylitol gum groups as compare to control groups [p=0.0005]. A previous study showed significant difference in pain by population mean of 7.47+/- 2.73 and test value of 3.47 +/- 3.83[1.] A local study also showed similar results with this study[3] presenting that chewing gums can cause similar level of pain reduction in comparison to ibuprofen.

Ngan et al [18] inferred that the favorable analgesic to reduce orthodontic treatment related pain was ibuprofen. Davidovitch and Shanfield observed the nature of pain during orthodontic treatment. They concluded that as the pain during treatment is inflammatory in nature, NSAID must be the standard treatment to control this orthodontic pain. Furstman and Bernik also observed that pain is a result of pressure which leads to ischemia, inflammation, and edema in the periodontium after the initial orthodontic appliance placement. Any method which can temporarily move the teeth in socket when orthodontic forces are applied, can cause decrease in orthodontic pressure and that in the ischemic spots or eliminate pain. Based on this analysis, Proffit[20] suggested chewing gum to relieve pain in the orthodontic patients after orthodontic bond up.

Otasevic et al[19] found the avoidance of hard diet in the initial week after bond up and initial arch wire placement to be more efficient in reducing pain as compared to chewing on bite wafers. However, suggesting patients to avoid a hard diet does not appear logical. Recently, Murdock et al[21] studied pain reaction during first week after bond up in patients designated to the 2

groups at random. They found the effectiveness of bite wafers and NSAIDs to be almost same in controlling the pain following orthodontic activations. Alshammari AK and Huggare J did a randomized control trail to evaluate the effect of paracetamol and chewing gums on oral pain after initial bond up. They found out that chewing gums are as effective as paracetamol in reducing pain and there was no increased incidence of bracket breakages[21].

The results of this study are similar to the study conducted by Fahimeh and Zebarjad[22]. They compared effectiveness of chewing gum and viscoelastic bite wafers against ibuprofen. They concluded that both the methods lead to decrease in pain after orthodontic treatment andcan be a viable alternative to ibuprofen. Yet, in the study of Fahimeh and Zebarjad[22], the sample size included only girls while in this study placement of girls and boys in the two groups was balanced by gender based stratification.

CONCLUSION

Hence in the aforementioned study, Xylitol gum had higher analgesic efficacy than the control group without chewing gum in the initial period after the placement of orthodontic arch wires. Xylitol gums showed greater relief from orthodontic pain after appliance placement in comparison to the control group. So Xylitol gum can be a good replacement for the control of orthodontic pain and can be used easily instead of ibuprofen which has negative effects related to it. Chewing xylitol gum has also been shown to greatly reduce the impact of discomfort and pain related to fixed orthodontic appliances. No evidence depicting that chewing gum4-5 times a day may result in an increased incidence of fixed orthodontic appliance breakages was found.

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