



THE EFFECTIVENESS OF PREOPERATIVE AND POSTOPERATIVE PARACETAMOL ADMINISTRATION FOR ORTHODONTIC PAIN CONTROL ON PLACEMENT OF ELASTOMERIC SEPARATOR USING VISUAL ANALOG SCALE. A RANDOMIZED CLINICAL TRIAL

Tauseef Mohsin^{1*}, Farheen Akhtar², Sania Mohsin³

^{1*}PG Resident, Department of Orthodontics, University of the East, Manila, Philippines

²PG Resident, Department of Conservative dentistry and Endodontics, Hitkarini Dental College, Jabalpur, M.P, India.

³PG Resident, Department of Prosthodontics, Crown and Bridge, Mithila Minority Dental College, Darbhanga, India.

***Corresponding Author:** Dr Tauseef Mohsin

*PG Resident, Department of Orthodontics, University of the East, Manila, Philippines,
tauseef.mohsin11@gmail.com

Abstract

Background-During orthodontic treatment, the most prevalent issue that patients experience is discomfort. NSAIDs is frequently taken as a pain reliever. Many NSAIDs are available in the market which includes aceclofenac, paracetamol, ibuprofen, and celecoxib etc. Paracetamol has been recommended that the best analgesic for orthodontic therapy. It is the safest medication.

Aim- The purpose of this study is to compare the effectiveness of paracetamol when administered before the placement of the separator in one group and after the placement of the separator in another group.

Methodology- Patients seeking orthodontic treatment were included in this study. The participants were randomly divided into 3 groups. Group 1- control group, Group 2- preemptive group, Group 3- postemptive group. Each tablet was placed in a resealable plastic bag, with a corresponding dose. Each plastic bag was labeled at what time the patient should take the tablet. The tablet was not identifiable as to what it contained, paracetamol or placebo(vitamin B complex).Placebo was used in control group. Posterior separators were placed by the researcher depending on the sample group. The participants recorded their degree of discomfort in four instances of time while at rest, before placement of the separator, and while chewing on anterior biting, and posterior biting. The participants were instructed to take the medicine 1hr before placement and 4hrs after placement of the separator. The participants recorded their degree of pain over a visual analog scale having a marking of 100 mm called VAS SCALE. Kolmogorov- Smirnov test and Shapiro-Wilks test were employed to test the normality of data. Kruskal Wallis Test and post hoc analysis were performed for quantitative variables. The level of significance was fixed at 5% and $p \leq 0.05$ was considered statistically significant.

Results-There is no significant difference b/w among all 3 groups at 1 hr before placement. There is a significant difference between preemptive and postemptive groups at rest, before separator placement as well as during anterior and posterior biting at 2hr, at bedtime,4 hr, upon awakening, and 24hrs.

Conclusion-This study concluded that the pain increased after orthodontic separator placement and then gradually lessened after 24 hours.

Keywords-Orthodontic Pain, Paracetamol, Separator

INTRODUCTION

Pain is defined as a complex constellation of unpleasant sensory, emotional, and cognitive experiences provoked by real or perceived tissue damage and manifested by certain autonomic, psychological, and behavioral reactions.¹ In orthodontics, nonsteroidal anti-inflammatory drugs (NSAIDs) are the most often prescribed medicine. These drugs act as an inhibition of the cyclooxygenase (COX) enzyme, which controls the conversion of prostaglandins (PGs) from arachidonic acid in the cellular plasma membrane. PGs like PGE1 and PGE2 are crucial bone resorption mediators.²Paracetamol has been suggested as the choice of analgesic during orthodontic treatment.³Paracetamol is a para aminophenol-family NSAID that neither completely nor slightly inhibits PGs and has no impact on the movement of orthodontically aligned teeth.²Some of the studies showed that the orthodontic pain starts in between 4-12 hrs after orthodontic force application and peaks after 1 day then progressively decreases over the following 3 to 4 days and returning to baseline level after 1 month.⁴Almost 95% of patients receiving orthodontic therapy reported pain and discomfort at certain treatment phases such as when placing the separator or the arch wire.⁵The purpose of this study is to compare the effectiveness of preoperative and postoperative paracetamol administration for orthodontic pain control on placement of an elastomeric separator.

MATERIALS AND METHOD

A total of 60 patients seeking orthodontic treatment were included in this study. Age of 18-35 years, a healthy individual without any debilitating systemic disease pain in any of the teeth at rest, requires the placement of two separators in each of the four quadrants, currently not using antibiotics or analgesics were included. Patients with contraindications or adverse reactions to acetaminophen, history of urticaria, or allergic-type reactions after taking aspirin or other NSAIDs (nonsteroidal anti-inflammatory drugs), pregnant patients, lactating mothers, or patients with liver disease were excluded. A clinical examination was done for all the patients to determine inclusion to the required criteria. The medical history of the patients was taken and a medical questionnaire was given to exclude patients failing into the required criteria. Informed consent was obtained from every participant as a part of the requirements of research ethics. The participants in this study were randomly selected and the body weight was taken to determine doses, and divided into three groups of twenty each. Group 1- Control group, Group 2- Preemptive group, Group 3-Postemptive group. The individuals were weighed on a weighing machine and based on their weight paracetamol doses were calculated using the formula.

INDIVIDUAL DOSE=BW/70XAVERAGE ADULT DOSE.

(OBESE AND LEAN INDIVIDUALS INCLUDED UNDER THIS CATEGORY)

Each tablet was placed in a resealable plastic bag, with a corresponding dose. Each plastic bag was labeled at what time the patient should take the tablet. The tablet was not identifiable as to what it contained, paracetamol or placebo (vitamin B complex).Placebo was used in control group.Posterior separators were placed by the researcher depending on the sample group. The participants recorded their degree of discomfort in four instances of time while at rest, before placement of the separator, and while chewing on anterior biting, and posterior biting. The participants were instructed to take the medicine 1hr before placement and 4hrs after placement of the separator. To ensure compliance

the researcher texted them to remind them to take the medication as prescribed. Grower(original) peanuts were used as a chewing substance. The participants recorded their degree of pain over a visual analog scale having a marking of 100 mm called VAS SCALE.

T0- 1HOUR before separator placement

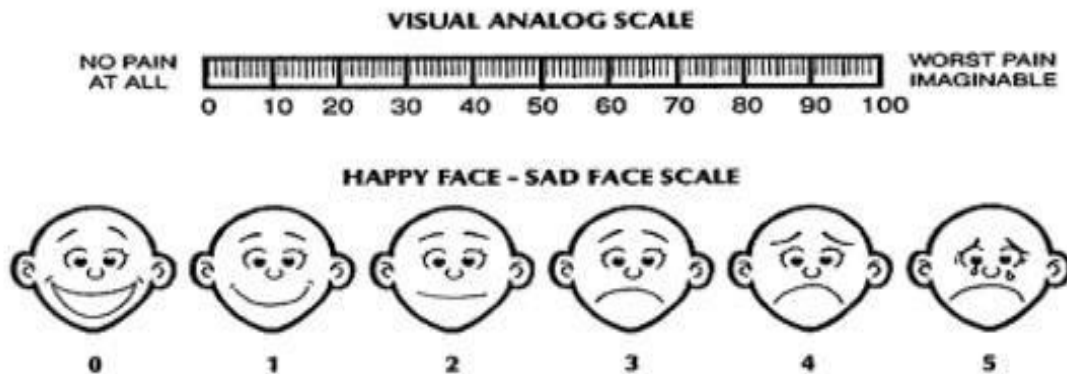
T1- 2HOURS after placement of separator placement.

T2- 4 HOURS after separator placement.

T3- AT bedtime.

T4- upon awakening.

T5-24 Hours of separator placement.



STATISTICAL ANALYSIS

The collected data was entered in Microsoft Excel and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS, IBM version 20.0). At 5% and $p \leq 0.05$, the significance level was established. Shapiro-Wilks and Kolmogorov-Smirnov tests were used to determine whether the data were normal. Kruskal Wallis Test and post hoc analysis were performed for quantitative variables.

RESULT

Table 1 shows the evaluation and comparison of the effectiveness of paracetamol among different groups, 1 hour before separator placement. An evaluation revealed no significant difference between the three groups at rest, before separator placement as well as during anterior and posterior biting.

Table 2 shows the evaluation and comparison of the effectiveness of paracetamol among different groups 2 hours after the separator placement. A comparative evaluation revealed significant differences between the three groups at rest, before separator placement as well as during on anterior and posterior biting with lower means values during preemptive administration when compared with postemptive administration. Post hoc analysis also revealed significant differences between the preemptive and postemptive group at rest, after separator placement as well as during anterior and posterior biting.

Table 3 shows the evaluation and comparison of effectiveness of paracetamol among different groups at bedtime. A comparative evaluation revealed significant differences between the three groups at rest, before separator placement as well as during anterior and posterior biting with lower means values during preemptive administration when compared with postemptive administration. Post hoc analysis also revealed a significant difference between preemptive and postemptive group at rest, before separator placement as well as during anterior biting; however, no significant difference was obtained between preemptive and postemptive scores during posterior biting.

Table 4 shows the evaluation and comparison of the effectiveness of paracetamol among different groups 4 hours after the separator placement. A comparative evaluation revealed significant differences between the three groups at rest, before separator placement as well as during anterior and posterior biting with lower means values during preemptive administration when compared with postemptive administration. Post hoc analysis also revealed a significant difference between the

preemptive and postemptive group at rest, before separator placement as well as during anterior biting; however, no significant difference was obtained between preemptive and postemptive scores during posterior biting.

Table 5 shows the evaluation and comparison of the effectiveness of paracetamol among different groups upon awakening. A comparative evaluation revealed significant differences between the three groups at rest, before separator placement as well as during anterior and posterior biting with lower means values during preemptive administration when compared with postemptive administration. Post hoc analysis also revealed significant differences between preemptive and postemptive groups at rest, before separator placement as well as during anterior and posterior biting.

Table 6 shows the evaluation and comparison of the effectiveness of paracetamol among different groups within 24 hours of separator placement. A comparative evaluation revealed significant differences between the three groups at rest, before separator placement as well as during anterior and posterior biting with lower means values during preemptive administration when compared with postemptive administration. Post hoc analysis also revealed a significant difference between preemptive and postemptive groups at rest, before separator placement as well as during anterior and posterior biting.

Table 1: Evaluation and comparison of effectiveness of paracetamol among different groups 1 hour before separator placement

	Control	Preemptive	Post-emptive	p value
At Rest	.30±.733	.15±.366	.55±.826	.226
Before placement of separator	.60± 1.188	.25±.444	.30±.571	.642
Chewing on anterior biting	.35±.745	.30±.470	.20±.410	.773
Chewing on posterior biting	.40±.754	.20±.523	.50±.827	.429

Graph 1: Comparison of effectiveness of paracetamol among different groups 1 hour before separator placement

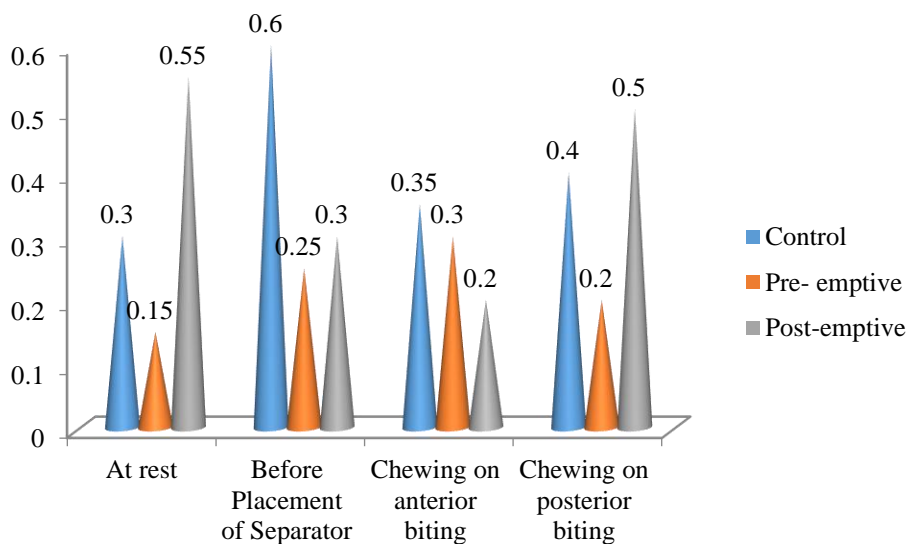


Table 2: Evaluation and comparison of effectiveness of paracetamol among different groups 2 hours after the separator placement

	Control	Pre-emptive	Postemptive	p value
At Rest	2.30±1.174	.95±.686	1.75±.550	.001*(s)
Before placement of separator	2.10±.788	.95±.510	1.55±.686	.001*(s)
Chewing on anterior biting	1.95±.848	.95±.686	1.85±.745	.001*(s)
Chewing on posterior biting	2.25±.910	.80±.696	1.65±.745	.001*(s)

Graph 2: Comparison of effectiveness of paracetamol among different groups 2 hours after the separator placement

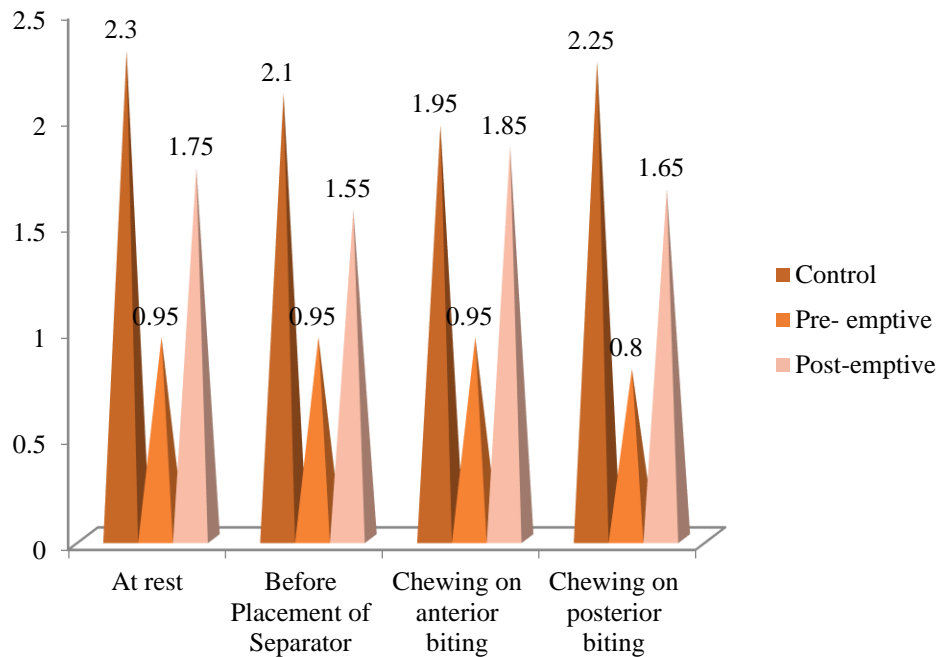


Table 3: Evaluation and comparison of effectiveness of paracetamol among different groups at bed time

	Control	Preemptive	Postemptive	p value
At Rest	2.00 \pm .91	1.05 \pm .51	1.80 \pm .95	.001* (s)
Before placement of separator	1.90 \pm .64	.95 \pm .88	1.70 \pm .86	.001* (s)
Chewing on anterior biting	1.70 \pm .80	.60 \pm .82	1.50 \pm .94	.001* (s)
Chewing on posterior biting	1.70 \pm .86	.70 \pm .86	1.30 \pm .57	.001* (s)

Graph 3: Comparison of effectiveness of paracetamol among different groups at bed time

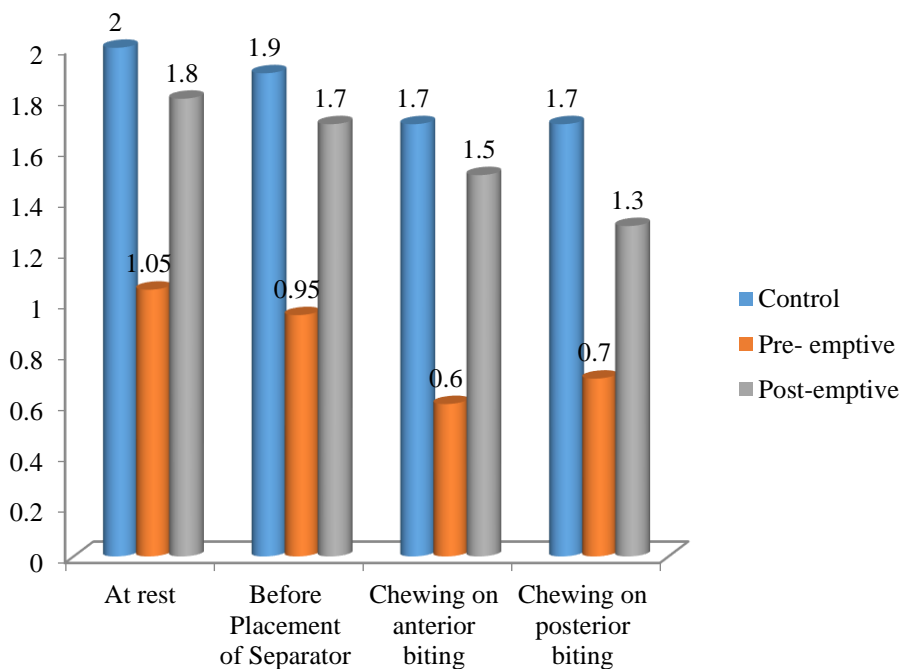


Table 4: Evaluation and comparison of effectiveness of paracetamol among different groups 4 hours after the separator placement

	Control	Preemptive	Postemptive	p value
At Rest	1.85±1.13	.95±.686	1.80±.410	.001* (s)
Before placement of separator	1.75±1.06	.65±.67	1.60±.75	.001* (s)
Chewing on anterior biting	1.55±1.23	.55±.759	1.80±.767	.001*(s)
Chewing on posterior biting	1.80±1.151	.45±.686	1.50±.60	.001* (s)

Graph 4: Comparison of effectiveness of paracetamol among different groups 4 hours after the separator placement

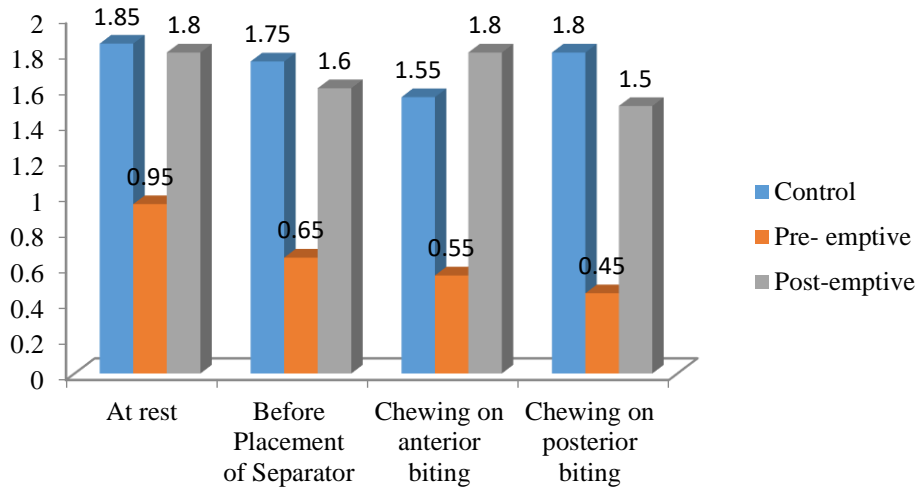


Table 5: Evaluation and comparison of effectiveness of paracetamol among different groups upon awakening

	Control	Pre-emptive	Postemptive	p value
At Rest	1.70±.801	.95±.686	2.00±.562	.001* (s)
Before placement of separator	1.10±.788	.55±.686	1.65±.813	.001* (s)
Chewing on anterior biting	1.35±1.1089	.55±.686	1.75±.851	.001* (s)
Chewing on posterior biting	1.35±1.137	.60±.754	1.70±.571	.001* (s)

Graph 5: Comparison of effectiveness of paracetamol among different groups upon awakening

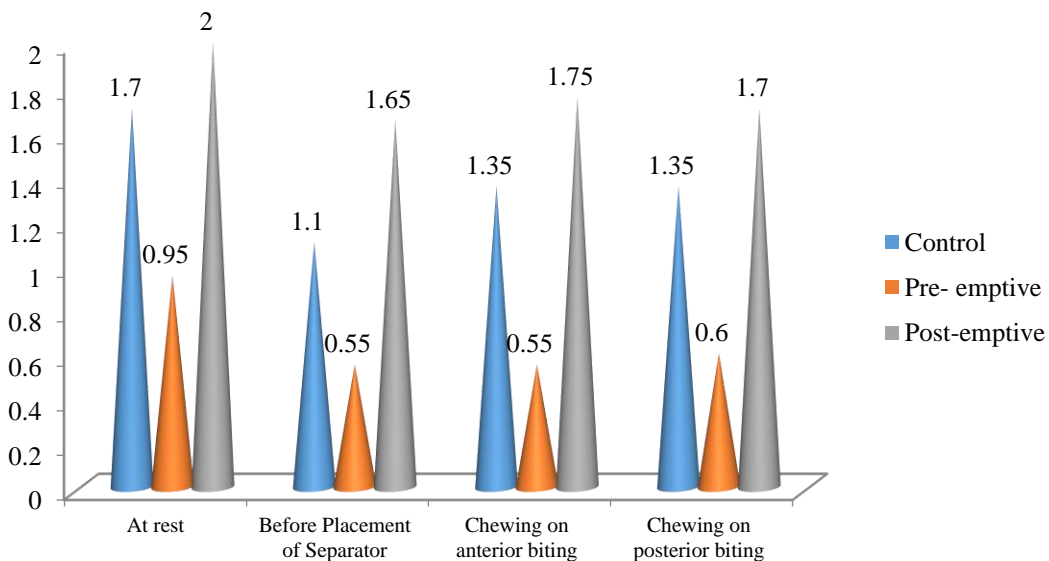
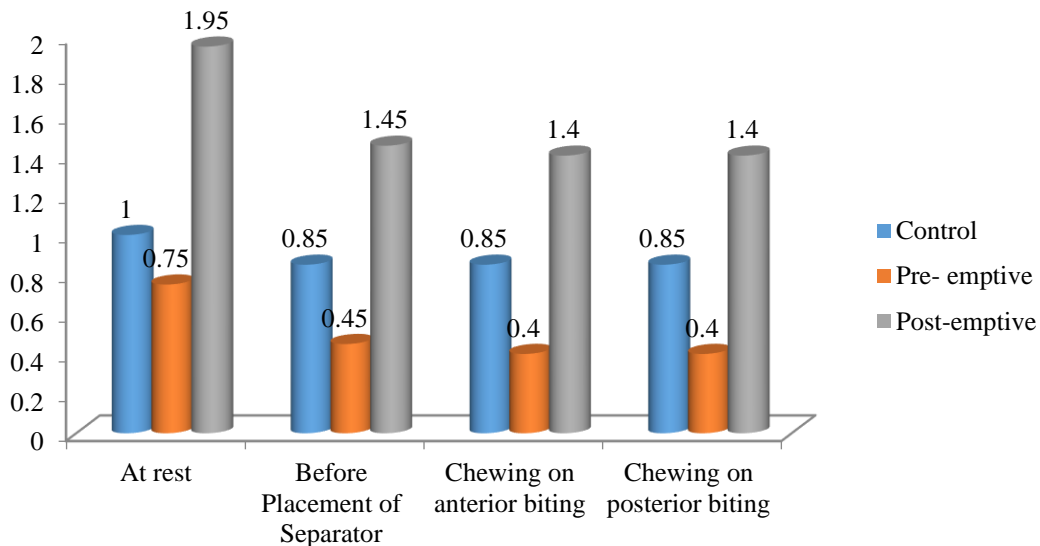


Table 6 Evaluation and comparison of effectiveness of paracetamol among different groups 24 hours of separator placement

	Control	Pre-emptive	Postemptive	p value
At Rest	1.00±.918	.75±.639	1.95±.510	.001*(s)
Before placement of separator	.85±.875	.45±.686	1.45±.759	.001*(s)
Chewing on anterior biting	.85±.671	.40±.595	1.40±.821	.001*(s)
Chewing on posterior biting	.85±.813	.40±.681	1.40±.754	.001*(s)

Graph 6: Comparison of effectiveness of paracetamol among different groups 24 hours of separator placement



DISCUSSION

Orthodontic discomfort causes inflammation.⁶ Once orthodontic forces are applied to teeth, inflammatory responses trigger the release of various biochemical mediators in the periodontium and dental pulp which cause the sensation of pain along with coordinated responses from the vascular, cellular, neural, and immune systems eventually lead to pain and tooth movement. Orthodontic discomfort and tooth movement are two biological events that are linked and reliant on local inflammation as their mode of action. Products like prostaglandin and bradykinin work on sensory terminals during localized inflammation to exacerbate unpleasant sensations. The fundamental mechanisms of orthodontic pain are found in periodontal inflammatory reactions induced by orthodontic stresses and consist of a network of the interacting elements listed below: chemical, cellular, and vascular events. Each person's perception of pain is unique and varies tremendously.⁷ Various factors affect orthodontic pain such as age, sex, clinical activations, psychosocial factors, and genetic polymorphisms of candidate genes.⁸

The pain usually starts within four hours then increases over the next 24 hours and gradually decreases within seven days after initial bonding and placement of separators.⁹ In the present study, the scores were taken 1 hour before separator placement, 2 hours after the placement of separator placement, 4 hours after separator placement, at bedtime, upon awakening, and 24 Hours after separator placement. Patient interviews/questionnaires and ratings with VAS, McGill pain questionnaire (MPQ), Verbal Rating Scales (VRS), and algometers can be effectively used to evaluate pain.¹⁰ The numerical rating scale (NRS) and the visual analog scale (VAS) are the two most common ways to measure the severity of pain.⁹ In the present study, the VAS scale has been used to record the scores.

There are several ways to manage orthodontic pain i.e. pharmacological approaches, laser irradiation therapy, mechanical and behavioral approaches, etc. For decades, non-steroidal anti-inflammatory medications (NSAIDs) have been used to treat orthodontic pain. A variety of NSAIDs are available

like paracetamol, Ibuprofen, Celecoxib, Misoprostol, and Naproxen sodium.⁷ The OTC drug paracetamol has antipyretic and analgesic effects by centrally inhibiting the third isoform of the cyclooxygenase enzyme (COX3), which is mostly located in the cerebral cortex and heart.⁵ Paracetamol has been suggested as the choice of analgesic during orthodontic treatment.³ In the present study, paracetamol has been used to manage the orthodontic treatment.

Zarif Najafi et al.(2015) compared the effect of preemptive acetaminophen, ibuprofen, and meloxicam after separator placement at different intervals i.e. immediately after separator placement (T0), 2 h posttreatment (T1), 6 h post-treatment (T2), 24 h posttreatment (T3), and 48 h after separator placement (T4), etc. According to his findings, they suggested that preoperative administration of meloxicam (7.5 mg) was as effective as acetaminophen (650 mg) and ibuprofen (400 mg) to control postseparator pain. But they also considered paracetamol as a choice of drug to control orthodontic pain because it does not cause gastrointestinal (GI) ulcers and does not affect the rate of tooth movement. Based on her findings of acetaminophen the pain increased immediately after the placement of the separator and reached a peak at 24 h and then gradually subsided until 48 h. The degree of pain felt while at rest did not significantly vary over time.¹¹ The result of the above study was similar to our study which showed that the paracetamol increases the pain after 2 hr placement of the separator and reached a peak at 24 hrs at rest, before separator placement as well as during anterior and posterior biting.

According to T. Hosseinzadeh Nik, et al.(2016) was examined the effectiveness of acetaminophen 650 mg or liquefied ibuprofen 400 mg in treating orthodontic patients' pain during elastic separator separation. They recorded the discomfort by using visual analog scales immediately after separator placement, 2 hrs, 6 hrs, at bedtime, and 24 hrs after separator placement. According to his findings, acetaminophen and liquefied ibuprofen have similar effects in pain reduction during separation with an elastic separator. Based on the result of acetaminophen the pain gradually increased up to 24hrs.¹² In the present study, there is a significant difference between the groups at 2hr, bedtime,4hr, upon awakening, and 24hrs as well as during anterior biting and posterior but there is no significant difference in between the groups at 1hr. The result of the above study was similar to our study which means the pain gradually increases up to 24 hours after the placement of the separator.

Another study conducted by Suzzane E. Bird et al in 2007 revealed that the orthodontic pain has been increased immediately after the placement of the separator,2 to 3 hours later, at bedtime, and on awakening on next morning.¹³ Based on her acetaminophen findings, the result of the present study was similar which means pain gradually increases after placement of separator at 2 hours,4 hours, at bedtime, upon awakening,24 hours.

Samiksha Chopra et al. (2022) concluded that orthodontic pain was felt the day after the separator placement and was not relieved by the two ibuprofen doses used the day before. Based on her findings of acetaminophen the pain was increased after the separator.¹⁴ In Another study conducted by N. Alqahtani et al in 2017, the result of this study the pain was high for all groups in the first 3 days and then gradually lessened until the 7th day.¹⁵ The result of the present study was similar to both studies. One study was conducted by V. Sudhakar et al in 2014 and concluded that pre-emptive and post-emptive administration was more effective in controlling orthodontic pain, after separator placement at all-time intervals.¹⁶ The result of the above study was similar to our study.

Cheng et al.(2020) conducted a meta-analysis on the efficacy of analgesics in controlling orthodontic pain and they analyzed the six investigators who reported the efficacy between acetaminophen and placebo including 316 patients at different time points. The results of Patel et al. and Salmassian et al. indicated no statistical difference for pain relief at all three-time points.¹⁷ In our study there are significant differences in b/w among all three groups at rest, before separator placement as well as during anterior and posterior biting with lower means values during preemptive administration when compared with postemptive administration.

In the end, it should be noted that pain is a subjective sensation that can be influenced by several factors i.e cultural background, previous traumatic experience, sex, age, psychological factors, pain sensitivity, orthodontic procedures, etc.^{7,11} In the present study, we compared the effect of a preemptive and postemptive administration of acetaminophen on controlling of orthodontic pain.

However, the prolonged use of analgesics may affect the rate of orthodontic tooth movement .¹¹So it can be suggested that furthermore studies are required in this field.

CONCLUSION

Within the limitations of this study, it was concluded that there is a significant difference between the preemptive group and postemptive group at rest, before separator placement as well as anterior biting and posterior biting. The level of pain increases after separator placement and then gradually decreases after 24 hours.

REFERENCES

1. Dubin AE, Patapoutian A. Nociceptors: the sensors of the pain pathway. *The Journal of clinical investigation*. 2010 Nov 1;120(11):3760-72.
2. Karthi M, Anbuslevan GJ, Senthilkumar KP, Tamizharsi S, Raja S, Prabhakar K. NSAIDs in orthodontic tooth movement. *Journal of pharmacy & bioallied sciences*. 2012 Aug;4(Suppl 2):S304.
3. Shetty N, Patil AK, Ganeshkar SV, Hegde S. Comparison of the effects of ibuprofen and acetaminophen on PGE2 levels in the GCF during orthodontic tooth movement: a human study. *Progress in orthodontics*. 2013 Dec;14(1):1-5.
4. Abdaljawwad AA, Al-Groosh DH. Effects of various analgesics on pain perception and rate of tooth movement: a randomized controlled clinical study. *Journal of Baghdad College of Dentistry*. 2022 Jun 15;34(2):37-51.
5. Zarif Najafi H, Oshagh M, Salehi P, Babanouri N, Torkan S. Comparison of the effects of preemptive acetaminophen, ibuprofen, and meloxicam on pain after separator placement: a randomized clinical trial. *Progress in Orthodontics*. 2015 Dec;16(1):1-9.
6. Long H, Wang Y, Jian F, Liao LN, Yang X, Lai WL. Current advances in orthodontic pain. *International journal of oral science*. 2016 Jun;8(2):67-75.
7. Rafeeq RA, Saleem AI, Hassan AF, Nahidh M. Orthodontic pain (causes and current management) a review article. *International Medical Journal*. 2020;25(3):1071-80.
8. Lin W, Farella M, Antoun JS, Topless RK, Merriman TR, Michelotti A. Factors associated with orthodontic pain. *Journal of Oral Rehabilitation*. 2021 Oct;48(10):1135-43.
9. Hussain AS, Al Toubity MJ, Elias WY. Methodologies in orthodontic pain management: a review. *The open dentistry journal*. 2017;11:492.
10. Krishnan V. Orthodontic pain: from causes to management—a review. *The European Journal of Orthodontics*. 2007 Apr 1;29(2):170-9.
11. Zarif Najafi H, Oshagh M, Salehi P, Babanouri N, Torkan S. Comparison of the effects of preemptive acetaminophen, ibuprofen, and meloxicam on pain after separator placement: a randomized clinical trial. *Progress in Orthodontics*. 2015 Dec;16(1):1-9.
12. Nik TH, Shahsavari N, Ghadirian H, Ostad SN. Acetaminophen versus liquefied ibuprofen for control of pain during separation in orthodontic patients: a randomized triple blinded clinical trial. *Acta Medica Iranica*. 2016 Jul 9:418-21.
13. Bird SE, Williams K, Kula K. Preoperative acetaminophen vs ibuprofen for control of pain after orthodontic separator placement. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2007 Oct 1;132(4):504-10.
14. Chopra S, Rampal V, Chopra A, Jhumat D. An Investigation of the Comparative Effectiveness of Ibuprofen and Paracetamol in the Management of Orthodontic Discomfort. *Journal of Coastal Life Medicine*. 2023 Feb 22;11:635-41.
15. Alqahtani N, Alwakeel A, Alzamil A, Alturki S, Aldawsari G, Aljabaa A, Albarakati S. Comparison of two analgesics used for pain relief after placement of orthodontic separators. *Saudi pharmaceutical journal*. 2017 Dec 1;25(8):1169-74.
16. Sudhakar V, Vinodhini TS, Mohan AM, Srinivasan B, Rajkumar BK. The efficacy of different preand post-operative analgesics in the management of pain after orthodontic separator

placement: a randomized clinical trial. Journal of pharmacy & bioallied sciences. 2014 Jul;6(Suppl 1):S80.

17. Cheng C, Xie T, Wang J. The efficacy of analgesics in controlling orthodontic pain: a systematic review and meta-analysis. BMC Oral Health. 2020 Dec;20:1-9.