



A Comparative Evaluation Of Efficacy Of Benzocaine, Meloxicam, and Diclofenac As A Mucoadhesive Patch To Relieve Pain Caused By Elastomeric Separators

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Abstract

Aims and objectives: The Purpose of this study was to evaluate and compare the efficacy of benzocaine, meloxicam and diclofenac in reducing pain caused by elastomeric separators.

Materials and methods: A sample size of 60 patients coming to Department of Orthodontics and Dentofacial Orthopaedics for orthodontic treatment were included in the study.

Elastomeric separators were placed mesial and distal to first maxillary molars in both quadrants. And half an hour later the drug mucoadhesive patch and the placebo mucoadhesive patch were randomly placed on buccal mucosa above the 1st maxillary molar, among 20 patients each in three groups. For both the quadrants, the patients were given Visual Analogue Scales (VAS) and Numerical Rating Scales (NRS). The Mann-Whitney U test and Krausal test analyses were done after data collection. The patients marked readings every six hours beginning 30 minutes after the patch insertion. The mucoadhesive drug and placebo patch was replaced after 48 hours and every six hours, the reading was remarked, and the final marking was conducted at 72nd hour and mucoadhesive patch was replaced.

Results: There was statistically significant reduction in pain, when the mucoadhesive drug patch was compared with that of the placebo patch. It was seen that benzocaine was most effective at 6th, 48th, 72nd hour, followed by meloxicam which was also effective at 6th, 48th, 72nd hour and diclofenac effective at 6th, 12th, 18th, 48th, 72nd hour. When all the three drug patches were compared, it was observed that benzocaine was significantly more effective in relieving pain caused due to separators.

Conclusion: It can be concluded from the study that the mucoadhesive drug patches are significantly effective in reducing pain caused by elastomeric separators as compared to the placebo patch. The use of benzocaine patches was most effective followed by a meloxicam mucoadhesive patch and diclofenac.

Introduction: The pain and discomfort is the most cited negative effect that arises from orthodontic force application which is a concern for many prospective orthodontic patients^{1,2} and also it is the most common reason for discontinuing the orthodontic treatment by the patients.³

The orthodontic treatment begins by placing separators, which aid in separation by loosening the tight interproximal contacts between teeth to create space for the orthodontic bands by forcing or wedging the teeth apart. It approximately takes a week for the separation to take place but usually depends on the types of separators placed. Different separators express the different magnitudes of the force in different periods. Orthodontic separators though used routinely in an orthodontic practice, are the least researched auxiliary till date. There are different types of separators like Kesling separators, Kansal separators, brass wire, Elastomeric separators, Dumb-bell separators which are commonly used.⁴

The discomfort experienced by patients due to separator placement is often described by them as a feeling of pressure, tension, soreness, or severe. This discomfort can be assessed with the help of rating scaling which evaluates the amount of pain experienced by the patient. So, for assessing pain several scales can be used, the Visual Analogue Scales (VAS) and Numerical rating scales (NRS)⁵ are a few among those. Analgesics are largely prescribed to the patients undergoing orthodontic tooth movement for relieving pain. The drugs which are available for pain belong to two major groups: non-narcotic analgesics (e.g. NSAIDs) and opioids (or narcotics). The most commonly used NSAIDs in dentistry are aspirin, ibuprofen, and paracetamol, all of which are available as 'over-the-counter' medications.

The mucoadhesive patches are significantly more effective and are better tolerated than the oral route, as they are said to have direct access to the systemic circulation through the jugular vein bypassing the first pass hepatic metabolism leading to high bioavailability. This study was performed which is based on patients pain perception, to evaluate the efficacy of benzocaine, meloxicam and diclofenac mucoadhesive patches in relieving caused by the elastomeric separator.

MATERIAL AND METHODOLOGY:

A sample size of 60 patients from the Department Of Orthodontics & Dentofacial Orthopaedics, for the orthodontic treatment was considered for the study.

Patients were divided randomly into three groups of 20 each patients, in which placebo patches and the drug patch were placed randomly in both quadrant of maxillary arch.

- GROUP-A : comprised of 20 patient each where Benzocaine mucoadhesive patches were placed
- GROUP-B : comprised of 20 patient each where Meloxicam mucoadhesive patches were placed
- GROUP-C : comprised of 20 patient each where Diclofenac mucoadhesive patches were placed

All the patches were of 1x1cm² dimension (figure 1 &2). After inserting the separators, patches were applied on the buccal attached gingivae and embrasure of both the first maxillary molars (figure 3) and the patient were given both the scales Visual Analogue Scales, (VAS) as well as Numerical Rating Scale (NRS). The patient recorded readings every six hours beginning 30 minutes after the patch insertion. The mucoadhesive drug and placebo patch was replaced after 48 hours and every six hours, the reading was remarked, and the final marking was conducted along with replacement of mucoadhesive patch at 72nd hour.



Figure: 1 Mixture Preparation Magnetic Stirrer



Figure: 2 Mucoadhesive Patch



Figure: 3 Benzocaine Mucoadhesive Patch at Buccal Mucosa

RESULT

In our present study, the mean VAS and NRS scores for benzocaine and placebo mucoadhesive patches were compared. The benzocaine mucoadhesive patch showed statistically significant reduced pain at the 6th hour with the VAS mean value (2.45 + 1.33) and p-value (0.0001)*, 48th hour (2.23 + 0.64) and p-value (0.0001)*, and 72nd hour (1.81 + 0.55) and p-value (0.0001)*. And the NRS at 6th hour with the mean value (2.45 + 1.35) and p-value (0.0001)*, 48th hour (2.10 + 0.79) and p-value (0.0001)*, and 72nd hour (1.78 + 0.53) and p-value (0.0001)* thus the(table 1 and 2) depicted that the 72nd hour was the lowest VAS and NRS score was noted.

Table : 1 The (VAS) Score Comparison of Benzocaine with Placebo at Different Time Intervals

Time interval	Benzocaine			Placebo			p-value
	Mean	S.D.	Mean rank	Mean	S.D.	Mean rank	
0	3.04	2.12	18.75	3.40	2.14	22.25	0.355
6	2.45	1.33	12.15	4.89	1.32	28.85	0.0001*
12	5.21	1.11	19.95	5.13	1.67	21.05	0.779
18	5.38	1.12	21.93	5.06	1.45	19.08	0.445
24	5.32	1.39	22.45	4.96	1.71	18.55	0.301
48	2.23	0.64	11.03	5.14	1.81	29.98	0.0001*
72	1.81	0.55	10.50	5.15	1.88	30.50	0.0001*

Mann Whitney U test applied, *p-value significant at p<0.05

Table : 2 The (NRS) Score Comparison of Benzocaine with Placebo at Different Time Intervals

Time interval	Benzocaine			Placebo			p-value
	Mean	S.D.	Mean rank	Mean	S.D.	Mean rank	
0	3.10	2.174	19.65	3.40	2.14	21.35	0.659
6	2.45	1.35	13.40	4.65	1.56	27.60	0.0001*
12	5.27	1.17	21.35	4.95	1.54	19.65	0.659
18	5.40	1.14	23.05	4.92	1.52	17.95	0.174
24	5.35	1.38	21.90	5.10	1.67	19.10	0.461
48	2.10	0.79	11.03	5.15	1.81	29.98	0.0001*
72	1.78	0.53	10.50	5.10	1.86	30.50	0.0001*

Mann Whitney U test applied, *p-value significant at $p < 0.05$

The mean VAS and NRS scores for meloxicam and placebo mucoadhesive patches were compared. The meloxicam mucoadhesive patch showed statistically significant reduced pain at the 6th hour with the VAS mean value (2.56 + 0.89) and p-value (0.0001)*, 48th hour (3.44 + 1.36) and p-value (0.0001)*, and 72nd hour (5.52 + 1.90) and p-value (0.0001)*. And NRS at the 6th hour was with the mean value (2.53 + 0.97) and p-value (0.0001)*, 48th hour (3.13 + 1.51) and p-value (0.0001)*, and 72nd hour (3.10 + 1.21) and p-value (0.0001)*, thus the 6th hour having the lowest VAS and NAS score were noted.(Table 3 & 4)

Table : 3 The (VAS) Score Comparison of Meloxicam with Placebo at Different Time Intervals

Time interval	Meloxicam			Placebo			p-value
	Mean	S.D.	Mean rank	Mean	S.D.	Mean rank	
0	2.73	2.16	20.25	2.75	2.04	20.75	0.904
6	2.56	0.89	11.43	4.92	1.02	29.58	0.0001*
12	5.72	1.43	20.90	5.45	0.97	20.10	0.841
18	5.78	1.49	20.38	5.69	1.21	20.63	0.947
24	5.42	1.66	19.20	5.62	1.33	21.80	0.495
48	3.44	1.36	13.60	5.68	1.76	27.40	0.0001*
72	5.52	1.90	13.60	5.52	1.90	27.40	0.0001*

Mann Whitney U test applied, *p-value significant at $p < 0.05$

Table : 4 The (NRS) Score Comparison of Meloxicam with Placebo at Different Time Intervals

Time interval	Meloxicam			Placebo			p-value
	Mean	S.D.	Mean rank	Mean	S.D.	Mean rank	
0	2.95	2.14	20.88	2.65	2.11	20.13	0.841
6	2.53	0.97	12.15	4.75	1.16	28.85	0.0001*
12	5.60	1.43	20.90	5.39	0.83	20.10	0.841
18	5.67	1.47	19.90	5.70	1.13	21.10	0.758
24	5.25	1.29	18.10	5.77	1.22	22.90	0.201
48	3.13	1.51	12.90	5.73	1.65	28.10	0.0001*
72	3.10	1.21	13.48	5.50	1.93	27.53	0.0001*

Mann Whitney U test applied. *p-value significant at $p < 0.05$

When the placebo mucoadhesive patch was compared with the Diclofenac mucoadhesive patch showed statistically significant reduced pain(VAS and NRS score) respectively at the 6th hour with the mean value (1.76 + 1.23) and p-value (0.0001)*, 12th hour (4.76 + 1.13) and p-value (0.0001)*, 18th hour (4.91+ 0.96) and p-value (0.0001)*, 48th hour (3.23 + 0.69) and p-value (0.0001)*, and 72nd hour (3.13 + 0.55) and p-value (0.0001)*. And NRS mean value (1.70 + 1.26) and p-value (0.0001)*, 12th (4.72 + 1.11) and p-value (0.0001)*, 18th (4.95+ 1.05) and p-value (0.0001)*, 48th (3.10 + 0.79) and p-value (0.0001)*, and 72nd (3.15 + 0.58) and p-value (0.0001)* with the 6th hour having the lowest VAS and NRS score. (Table 5 & 6)

Table : 5 The (VAS) Score Comparison of Diclofenac with Placebo at Different Time Intervals

Time interval	Diclofenac			Placebo			p-value
	Mean	S.D.	Mean rank	Mean	S.D.	Mean rank	
0	3.01	1.91	21.50	2.52	1.60	19.50	0.602
6	1.76	1.23	10.60	4.88	1.19	30.40	0.0001*
12	4.76	1.13	15.55	5.77	1.09	25.45	0.007*
18	4.91	0.96	14.55	6.21	1.34	26.45	0.001*
24	5.21	0.97	18.33	6.05	1.56	22.68	0.242
48	3.23	0.69	11.03	6.24	1.47	29.98	0.0001*
72	3.13	0.55	10.65	6.24	1.51	30.35	0.0001*

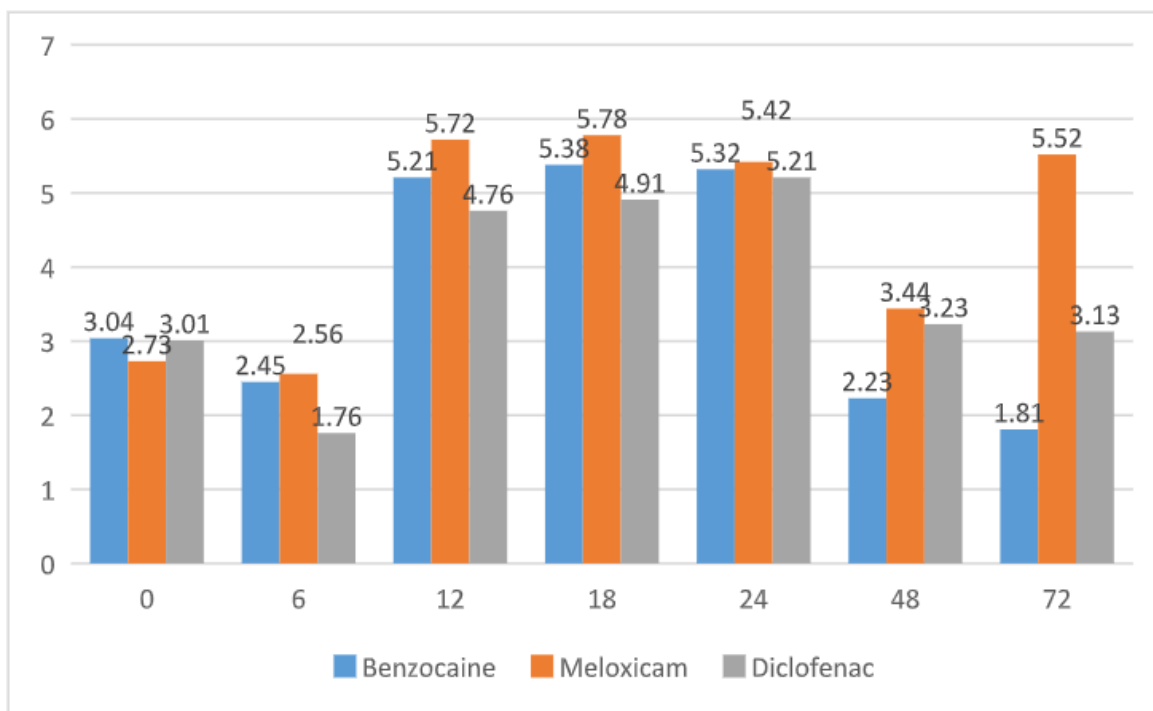
Mann Whitney U test applied, *p-value significant at $p < 0.05$

Table : 6 The (NRS) Score Comparison of Diclofenac with Placebo at Different Time Intervals

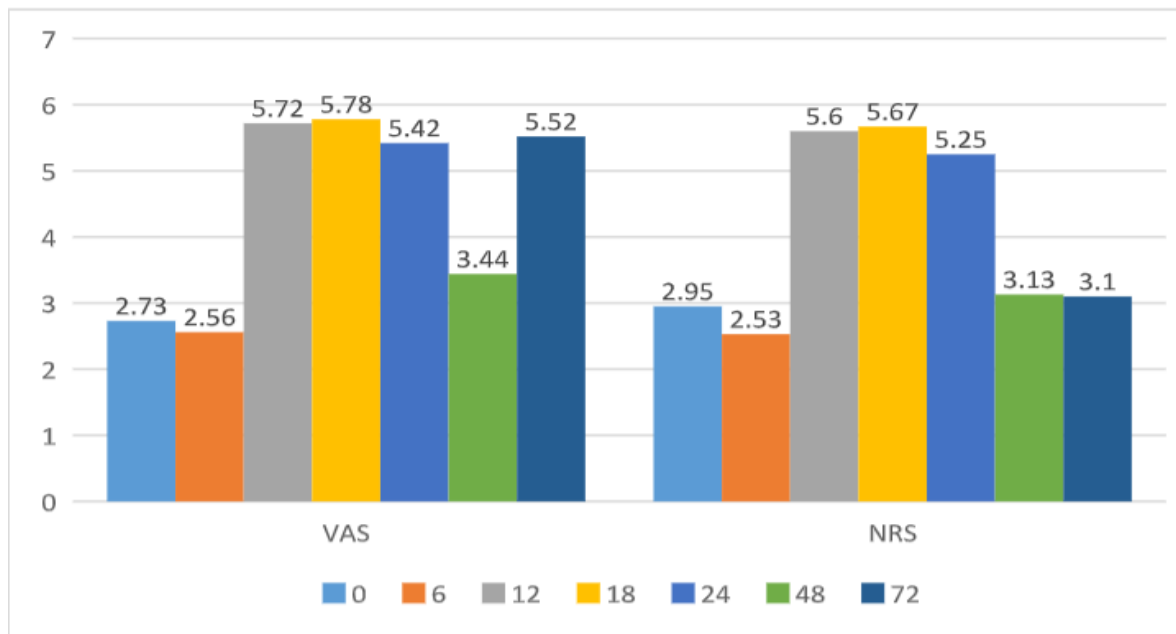
Time interval	Diclofenac			Placebo			p-value
	Mean	S.D.	Mean rank	Mean	S.D.	Mean rank	
0	3.00	1.97	22.28	2.35	1.53	18.73	0.341
6	1.70	1.26	10.90	4.90	1.16	30.10	0.0001*
12	4.72	1.11	15.68	5.70	1.17	25.33	0.008*
18	4.95	1.05	16.25	6.10	1.55	24.75	0.021*
24	5.20	1.01	17.35	6.10	1.55	23.65	0.091
48	3.10	0.79	11.03	6.15	1.46	29.98	0.0001*
72	3.15	0.58	10.88	6.24	1.47	30.13	0.0001*

Mann Whitney U test applied, *p-value significant at $p < 0.05$

When the three mucoadhesive patches of Benzocaine, Meloxicam, and Diclofenac, VAS and NRS were compared (Graph 1&2) it was observed that , pain score significantly lowest for benzocaine at the 48th hour and 72nd hour respectively. So, it was concluded as Benzocaine was the most effective at reducing pain from elastomeric separators, followed by Diclofenac and Meloxicam.



Graph 1: Comparison of VAS Scale Among The Three Mucoadhesive



Graph 2: Comparison of NRS Scale Among The Three Mucoadhesive

DISCUSSION

The present study was conducted to evaluate the patient's pain perception with mucoadhesive patches due to elastomeric separators.

A similar study was done by Ngan et al.⁶ which was also associated with separator placement and concluded that pain increased over 24 hours and decreased within 7 days of insertion. The results obtained indicated that when VAS and NRS score of all the three mucoadhesive patches of benzocaine, meloxicam, and diclofenac were compared with placebo mucoadhesive patch there was significant effective in decreasing the pain caused by elastomeric separators. In 2020, Chandrashekar et al.⁷ conducted a study, which gave resembling results when the mucoadhesive patches of meloxicam and diclofenac were compared to meloxicam and diclofenac tablets for reducing pain caused by an odontogenic tumor. Diclofenac mucoadhesive patches reduced pain more effectively than meloxicam patches ($p > 0.05$). When compared to meloxicam, diclofenac tablets showed a statistically significant reduction ($p < 0.05$)

In the present study the patches were most effective in reducing pain at some particular time. For benzocaine mucoadhesive patch it was effective at 6th, 48th and 72nd hour for meloxicam was effective at 6th, 48th and 72nd hour and for Diclofenac was effective at 6th, 12th, 18th, 48th and 72nd hour. There are few studies which gave similar result to this study like Eslamian L et al. (2013)⁸ 30 patients were studied. At 2, 18, 24, 48, and 72 hours, there were significant differences in pain perception between groups. Pain perception did not differ between genders or jaws ($p > 0.05$). Only in the placebo group were significant negative correlations (r) found between pain perception scores and patient ages at 18 (-0.438), 24 (-0.526), 48 (-0.565), and 72 h. (-0.458). The benzocaine 20% patches were found to significantly reduce post-separation orthodontic pain.

Annigeri et al. in (2015)⁹ a similar study was done to assess the efficacy of Meloxicam mucoadhesive patches in the treatment of dental pain. The study included 55 patients of either gender who were suffering from dental pain. Meloxicam patches were applied to the site of the

primary complaint for about 30 minutes, and pain levels were recorded. The pain started decreasing significantly from baseline to the score recorded after 30 minutes. The pain reduction was greatest in the first 20 minutes. There was a significant reduction in dental pain when using mucoadhesive patches with no side effects, and it was suggested that meloxicam administered in this mucoadhesive patch presented a potential therapeutic use as a strong analgesic. There is little research available that combines all three drugs, namely benzocaine, meloxicam, and diclofenac mucoadhesive patch. As a result, there is a need to investigate these drugs together.

CONCLUSION

1. It was found that the benzocaine, meloxicam, and diclofenac mucoadhesive patches were significantly effective in reducing pain caused by elastomeric separators as compared to placebo.
2. When all the three mucoadhesive drug patches were compared it was found that benzocaine was most effective in reducing pain caused by elastomeric separators.

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