

A Comparative Evaluation of Separation Effect and Perception of Pain using Two Different Orthodontic Separators

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ABSTRACT

Objective: To compare the time taken to achieve adequate separation of tooth contact and perception of pain associated with it using elastomeric and spring separators.

Materials and methods: A total of 60 subjects (30 males, 30 females) in the age range of 18 to 25 years were divided into three groups with 20 subjects each (10 males and 10 females). Group 1, 2 and 3 were evaluated after 1, 2 and 3 days of separator placement respectively for the degree of separation and pain perception. Two types of separators namely elastomeric and spring separators were placed, at the mesial and distal contacts of the first permanent molars in the maxillary and mandibular arches. The amount of separation at each contact point was measured with the help of the feeler gauge and discomfort level was recorded on verbal rating scale.

Results: Both types of separators achieved adequate separation after 2 days of separator placement. There was no genderwise difference in the amount of separation and time taken for separation as well as pain perception with either of the separators. The intensity of pain remained mild-to-moderate on VRS scale scoring 2 to 3 with either of separators. The pain was worst after 2 days of separator placement and declined after 3 days irrespective of the type of separators.

Conclusion: Both types of the separators are comparable for separation effect and pain perception associated with them. Molar band fitting should be done at least 3 days after inserting either of the separators.

Keywords: Separators, Pain perception, Spring separator.

How to cite this article: Juneja A, Bagga DK, Sharma R, Sharma P. A Comparative Evaluation of Separation Effect and Perception of Pain using Two Different Orthodontic Separators. J Ind Orthod Soc 2011;45(4):183-188.

INTRODUCTION

Fixed orthodontic mechanotherapy requires separation of the molars to create adequate space for the placement of bands that anchor the appliance and support auxiliary labial/lingual attachments.¹ If an orthodontic band measuring 0.15 mm thickness is placed around a tooth having an average periodontal ligament (PDL) space of 0.25 mm without proper separation, there is a risk of contacting the alveolar bone, producing hyalinization areas in the PDL and evoking pain response of resident mechanoreceptors.²

The ideal separators should give rapid and adequate separation without causing the patient discomfort or pain. They should also be easy to clean and remain in place till the bands are placed.³

Different types of separators have been used in orthodontics (e.g. brass wires, latex elastics, elastomeric thread,⁴ elastomeric and spring-type steel separators). Separators are usually placed for a few days to a week. Due to the occlusal interferences, they inevitably cause discomfort that can last the whole week.^{5,6}

Davidovitch⁷ et al stated that elastomeric separators can achieve adequate separation in 8 to 12 hours depending on the tightness of contact point. However, in their study, they placed separators mesial to the first molars in the mandibular arch only. It has been reported that the contact point distal to first molar is tighter than the mesial.^{8,9}

Two types of separators which are commonly used today are elastomeric and spring separators. Elastomeric are easily available and spring separators can be easily fabricated in the clinic.

A study was undertaken to evaluate the time taken to achieve adequate separation and perception of pain with elastomeric and spring separators in maxillary and mandibular arches.

MATERIALS AND METHODS

A total of 60 patients (30 males and 30 females) in the age group of 18 to 25 years seeking orthodontic treatment with no previous history of orthodontic treatment were selected. They had all permanent teeth erupted in both the arches except third molars. Contact tightness of first permanent molar with second

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Received on: 12/9/11

Accepted after Revision: 9/11/11



Fig. 1: Elastomeric separators

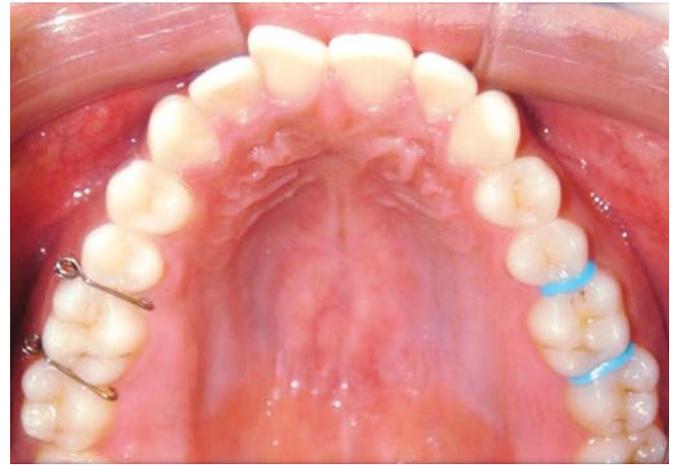


Fig. 4: Placement of separators at mesial and distal contacts of permanent first molars in maxillary and mandibular arches



Fig. 2: Spring separators

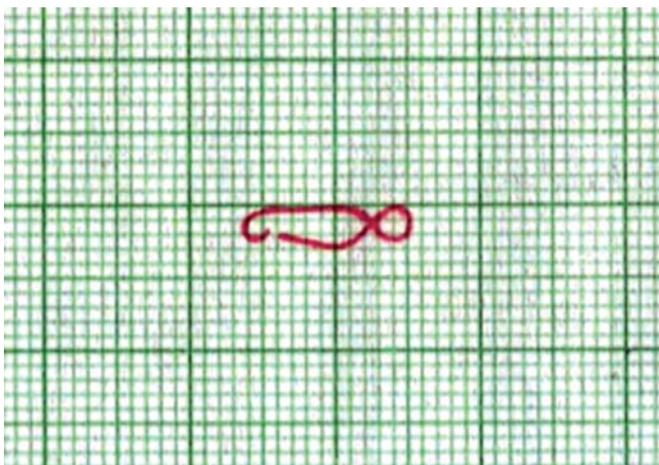


Fig. 3: Template for fabrication of spring separators



Fig. 5: Feeler gauge to measure the amount of separation at tooth contacts

premolar and second permanent molar was checked with the help of dental floss.

Two types of separators, i.e. elastomeric separators (Ortho Organizers) (Fig. 1) and spring separators, made with 0.020" AJ Wilcock wire using a bird beak plier¹⁰ by the operator according to a template were used (Figs 2 and 3).

Oral prophylaxis of all the patients was done prior to the placement of separators. The elastomeric separators (EL) and spring separators (SP) were placed, at the mesial contact (MC) and distal contact (DC) of the first permanent molars in the maxillary arch (Mx) and mandibular arch (Md); with only one type of separator being placed on one side of each arch (Fig. 4).

Elastomeric and spring separators were placed alternately on the right or left side in each patient to avoid bias. Elastomeric separators were placed with a separator placing plier and the spring separators with the light wire pliers.

Sample was then divided into three groups with 20 subjects each (10 males and 10 females). Group day 1, 2 and 3 were evaluated after 1, 2 and 3 days of separator placement respectively for the degree of separation and pain perception.

Patients were informed that separators may cause discomfort in the days following placement. They were instructed to take over-the-counter pain medication (400 mg Ibuprofen) as needed.

All the separators were removed on the follow-up appointments. After air drying of the interdental spaces which were created with the separators, the amount of separation at each contact point was measured with the help of a feeler gauge (Fig. 5).

All patients were asked to record their discomfort level on the follow-up appointment ranging from no discomfort to extreme discomfort according to the six point verbal rating scale (VRS).^{11,12}

The statistical analysis was done using SPSS version 15.0 statistical analysis software.

RESULTS

There were no statistical differences in the amount of separation achieved and perception of pain with either of the separators in males and females, hence their data were pooled.

Mean and standard deviation for all the measurements at both contacts in both arches with both types of separators on day 1, 2 and 3 were calculated (Table 1).

In the maxillary arch, no statistically significant difference was seen in the amount of separation achieved at mesial contact and distal contact on day 1 and 2 with either of the separators. On day 3, the amount of separation remained same at mesial contact and distal contact with elastomeric separators but significantly more separation was seen at distal contact than mesial contact with spring separators.

In the mandibular arch, the amount of separation achieved by elastomeric separators at mesial contact and distal contact showed no difference but that at distal contact was found to be less than mesial contact on day 2 and 3. The amount of separation achieved by spring separators was less at distal contact than mesial contact on day 1 but that remained same at both the contact areas, i.e. mesial contact and distal contact on day 2 and 3 (Table 2).

On comparing the maxillary and mandibular arch, the amount of separation achieved at mesial contact by the elastomeric separators remained same in both arches on all days. The amount of separation achieved at mesial contact by spring separators remained same in both arches on day 1 and day 3 except day 2 when separation at mesial contact in maxillary arch was more than in mandibular arch. The amount of separation achieved at distal contact was different in both the arches, being less in the mandibular arch than the maxillary arch on all days irrespective of separators used (Table 3).

Elastomeric and spring separators achieved adequate amount of separation required for fitting of bands in both maxillary and mandibular arch at all the locations after 2 days of separator placement.

On day 2, the amount of separation achieved with spring separators was same at both the contacts irrespective of the dental arch but both the contacts in the mandibular arch were found to have less amount of separation as compared to that in the maxillary arch. The amount of separation achieved with elastomeric separators was same at maxillary mesial, maxillary distal and mandibular mesial contact but that at mandibular distal contact showed comparatively less separation as compared to mandibular mesial and maxillary distal contacts.

On day 3, the amount of separation achieved with spring separator was same at maxillary mesial, mandibular mesial and mandibular distal contacts but that at maxillary distal contact comparatively more separation was seen as compared with the maxillary mesial and mandibular distal contact. The amount of separation achieved with elastomeric separators was same at maxillary mesial, maxillary distal and mandibular mesial

Table 1: Descriptive analysis of amount of separation achieved with elastomeric and spring separators

Groups	Location	Amount of separation achieved with EL (n = 20)		Amount of separation achieved with SP (n = 20)	
		Mean (mm)	SD	Mean (mm)	SD
Day 1	Mx.MC	0.14	0.03	0.12	0.04
	Mx.DC	0.15	0.04	0.14	0.05
	Md.MC	0.13	0.03	0.13	0.04
	Md.DC	0.11	0.04	0.10	0.04
Day 2	Mx.MC	0.19	0.03	0.20	0.05
	Mx.DC	0.19	0.05	0.22	0.05
	Md.MC	0.18	0.03	0.18	0.04
	Md.DC	0.16	0.04	0.17	0.04
Day 3	Mx.MC	0.23	0.04	0.23	0.05
	Mx.DC	0.22	0.05	0.26	0.04
	Md.MC	0.21	0.03	0.22	0.04
	Md.DC	0.18	0.04	0.22	0.05

EL: Elastomeric separators; SP: Spring separators; Mx: Maxillary arch; Md: Mandibular arch; MC: Mesial contact; DC: Distal contact

Table 2: Comparison of separation achieved at mesial and distal contacts with two types of separators in the maxilla and mandible

Groups		Type of separator	Mean difference (MC vs DC)	Level of significance
Mx	Day 1	EL	-0.01	NS
		SP	-0.02	NS
	Day 2	EL	0.00	NS
		SP	-0.02	NS
	Day 3	EL	0.01	NS
		SP	-0.03	*
Md	Day 1	EL	0.02	NS
		SP	0.03	**
	Day 2	EL	0.02	**
		SP	0.01	NS
	Day 3	EL	0.03	**
		SP	0.00	NS

EL: Elastomeric separators; SP: Spring separators; Mx: Maxillary arch; Md: Mandibular arch; MC: Mesial contact; DC: Distal contact
 NS: Not significant; *p < 0.05, **p < 0.01

Table 3: Comparison of separation achieved between maxillary and mandibular arches with both separators

Separator type	Groups	Location	Mean difference (Mx vs Md)	Level of significance
EL	Day 1	MC	0.01	NS
		DC	0.04	***
	Day 2	MC	0.01	NS
		DC	0.03	**
	Day 3	MC	0.02	NS
		DC	0.04	***
SP	Day 1	MC	-0.01	NS
		DC	0.04	**
	Day 2	MC	0.02	*
		DC	0.05	***
	Day 3	MC	0.01	NS
		DC	0.04	***

EL: Elastomeric separators; SP: Spring separators; Mx: Maxillary arch; Md: Mandibular arch; MC: Mesial contact; DC: Distal contact; NS: Not significant; *p < 0.05, **p < 0.01, ***p < 0.001

Table 4: Comparison of separation achieved by elastomeric and spring separators

Groups	Location	Mean difference (EL vs SP)	Level of significance
Day 1	Mx.MC	0.02	*
	Mx.DC	0.01	NS
	Md.MC	0.00	NS
	Md.DC	0.01	NS
Day 2	Mx.MC	-0.01	NS
	Mx.DC	-0.03	***
	Md.MC	0.00	NS
	Md.DC	-0.01	NS
Day 3	Mx.MC	0.00	NS
	Mx.DC	-0.04	*
	Md.MC	-0.01	NS
	Md.DC	-0.04	**

EL: Elastomeric separators; SP: Spring separators; Mx: Maxillary arch; Md: Mandibular arch; MC: Mesial contact; DC: Distal contact;
 NS: Not significant; *p < 0.05, **p < 0.01, ***p < 0.001

Table 5: VRS scores at different time intervals

Types of separator	Day 1 (n = 20)			Day 2 (n = 20)			Day 3 (n = 20)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Elastomeric	2.1	2	1.12	2.7	3	1.03	2.65	2.5	1.23
Spring	2.55	2.5	1.28	2.95	3	1.1	2.6	2.5	1.27

Table 6: Demographic data of sample population taken analgesics

Groups	Males	Females	Total	Percentage
Day 1	1	4	5	25%
Day 2	5	7	12	55%
Day 3	3	5	8	40%

contact but that at mandibular distal contact showed comparatively less separation as compared to mandibular mesial and maxillary distal contacts (Table 4).

VRS recorded at different time intervals showed increased intensity of pain on day 2 as compared to that on day 1 after separator placement, following reduction in intensity on day 3 irrespective of the type of separators (Table 5).

A total of 25% of the sample population studied for 1 day after placement of separators had consumed analgesic. A total of 55% of the sample population studied for 2 days had taken medication whereas 40% of the sample population studied for 3 days after separator placement had taken medication. It was noted that more number of females consumed analgesic compared to males on all days (Table 6).

DISCUSSION

With elastomeric separators, no statistically significant difference was seen in the amount of separation at mesial and distal maxillary contacts on day 1, 2 and 3. Similar results were found in the study conducted by Bondemark.¹³ The amount of separation achieved at the mesial and distal contact with spring separators was same on day 1 and 2 but on day 3, more separation was noted at the maxillary distal contact ($p < 0.05$). This contradicts the findings of Bondemark¹³ where even after day 4, the amount of separation was same for both mesial and distal contacts.

In the mandibular arch, no statistically significant difference was seen in the extent of separation achieved with elastomeric separators at the mesial and distal contacts on day 1. But on day 2 and 3, the amount of separation was significantly less at the distal contact as compared to the mesial contact with elastomeric separators ($p < 0.01$). Whereas with the spring separators, distal contact showed significantly less separation on day 1 ($p < 0.01$) as compared to mesial contact, but on day 2 and 3 separation achieved was same. On day 3, the amount of separation at distal contact in the mandibular arch could not be achieved to the same extent as that at the mesial contact with elastomeric separators, but spring separators resulted in the same amount of separation at distal contact as that at mesial contact. These results can be explained on the basis that the tightness of the contact increases posteriorly.³ It has been reported that a quantitatively tighter CP exists at the distal aspect of posterior teeth compared with the mesial aspect.⁴

The amount of separation achieved with elastomeric separator and that with spring separators remained same at all locations on day 1, except at the maxillary mesial contact, where significantly more separation was observed with elastomeric

than that with spring separators ($p < 0.05$). This was in accordance with the clinical trial conducted by Hoffman (1972)¹⁴ in which elastomeric separators achieved relatively more separation as compared to spring separators. On day 2, the amount of separation achieved with elastomeric separators and that with spring separators remained same at all locations except at the maxillary distal contact which showed significantly more separation with spring separators than that with elastomeric separators ($p < 0.001$). On day 3, more separation was seen with spring separators as compared to elastomeric separators at the distal contact in both maxillary ($p < 0.05$) and mandibular arches ($p < 0.001$). However, this was contrary to the findings obtained by Hoffman;¹⁴ where even at the end of day 3, elastomeric separators continued to separate more than spring separators.

Majority of studies related to perception of pain in relation to orthodontic therapy have used the visual analog scale (VAS) for recording pain.^{5,6,13} However, the VAS is time-consuming and requires ability to understand the abstract concept of the VAS line and then relate it to distance from a zero mark. It also requires the use of a paper and pen. As line length in VAS is the response continuum, many patients find it difficult to judge distance accurately. Therefore, the VAS has some practical limitations in a clinic setting.¹⁵

VRS takes less time than the VAS and can be performed without the need of paper and pen. It is relatively simple to understand (e.g. 4 is a higher value number than 3 and so on), and thus provides a correlation which is more definitive than a distance mark.¹⁵ The VRS is recommended over VAS by various investigators.^{16,17}

Some shortcomings of using the VRS have been described such as the patient is forced to translate a feeling into a predefined word that may possibly not fit exactly to the patient's experience and the relative rank or strength between the different words is often unknown. Also, the same word does not necessarily mean the same thing to each patient.¹⁶

In this study evaluation of pain was performed using a 6-point VRS¹² and patients were asked to rate their pain intensity choosing from the following descriptors: None (0), very mild (1), mild (2), moderate (3), severe (4) and very severe (5).

The varying degree of individual pain after placement of orthodontic separators has previously been reported.^{7,18,19} Mild-to-moderate pain scoring 2 to 3 on VRS scale was recorded irrespective of the separators. This was in accordance with the findings Bondemark,¹³ who reported mild-to-moderate pain on VAS scale associated with elastomeric and spring separators.

The pain perceived by the subjects was worst on day 2 and declined on the following day, i.e. day 3. This is well in accordance with the study conducted by Bondemark¹³ but contrary to the findings reported by Bernhardt et al²⁰ and Bergius et al⁶ who found pain to be worst after day 1 of elastomeric separators placement and then declining gradually by day 3.

On comparing the intensity of pain resulted after placement of elastomeric separators with that after placement of spring

separators, no difference was found in the intensity of pain on VRS scale on all days. However, our results did not correspond with the clinical trial conducted by Hoffman¹⁴ where elastomeric separators caused more pain than spring separators.

As has well been documented in literature, perception of same threshold of pain is interpreted differently by different patients as pain is a subjective, multidimensional sensation. It implies that one cannot standardize the amount of pain felt by a person, so is the case after administration of an analgesic. This was one reason why administration of same dosage of analgesic was excluded from the standardization criteria of our sample. All patients were advised to take over-the-counter pain medication (400 mg Ibuprofen), if required.

CONCLUSION

Following conclusions were drawn from the study:

- Both elastomeric and spring separators resulted in adequate separation after 2 days of separators placement at mesial and distal contacts of permanent first molar in maxillary and mandibular arches.
 - Elastomeric separators have shown significantly more separation than spring separators at maxillary mesial contact only on day 1 whereas spring separators yielded significantly more separation at maxillary distal contact on day 2 and; maxillary and mandibular distal contacts on day 3 compared to elastomeric separators.
 - In the maxillary arch, no statistically significant difference was seen in amount of separation at mesial and distal contacts with elastomeric separators on all days whereas spring separators achieved significantly larger separation at distal contact than mesial contact on day 3 but remained same on day 1 and 2.
 - In the mandibular arch, mesial contact achieved significantly larger separation than distal contact with elastomeric separators on day 2 and 3 but remained same on day 1 whereas spring separators achieved significantly larger separation at mesial contact on day 1 but remained same on day 2 and 3.
 - Maxillary teeth responded better in achieving significantly more separation than mandibular teeth at the distal contact for both types of separators.
 - No gender-wise difference in the amount of separation achieved and perception of pain was found with the use of both types of separators.
 - Mild-to-moderate pain with the score of 2 to 3 on VRS was recorded with both types of separators.
 - The pain was worst on day 2 and declined on day 3 with both types of separators. Therefore molar band fitting should be done at least 3 days after inserting the separators considering comfort to the patient.
- Separation of tooth contact depends upon contact tightness of the teeth, which is highly variable from individual-to-individual. Further studies should be done on a larger sample population to evaluate the relationship of separation of the tooth contact with the contact tightness.

REFERENCES

1. Proffit WR. Contemporary orthodontic appliances. In: Proffit WR, Fields HW, Sarver DM, editors. Contemporary orthodontics. 4th ed. St Louis: Mosby; 2007;412-13.
2. Von Bohl M, Maltha JC, Von Den, Hoff JW, Kuijpers-Jagtman AM. Focal hyalinization during experimental tooth movement in Beagle dogs. *Am J Orthod Dentofacial Orthop* 2004;125:615-23.
3. Kottraba TM. Preventing separator loss. *J Clin Orthod* 1977;11:60.
4. Cook B. Elastomeric thread separators. *J Clin Orthod* 2006;40(2):109.
5. Ngan P, Kess B, Wilson S. Perception of discomfort by patients undergoing orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1989;96:47-53.
6. Bergius M, Berggren U, Kiliaridis S. Experience of pain during an orthodontic procedure. *Eur J Oral Sci* 2002;110:92-98.
7. Davidovitch M, Papanicolaou S, Vardimon AD, Brosh T. Duration of elastomeric separation and effect on interproximal contact point characteristics. *Am J Orthod Dentofacial Orthop* 2008;133:414-22.
8. Southard TE, Behrens RG, Tolley EA. The anterior component of occlusal force. Part 1. Measurement and distribution. *Am J Orthod Dentofacial Orthop* 1989;96:493-500.
9. Vardimon AD, Matsaev E, Lieberman M, Brosh T. Tightness of dental contact points in spaced and nonspaced permanent dentitions. *Eur J Orthod* 2001;23:305-14.
10. Begg PR, Kesling PC. Orthodontic appliances. In: Begg PR, Kesling PC (Eds). *Begg orthodontic theory and technique*. 3rd ed. Philadelphia, PA: WB Saunders; 1977;87-141.
11. Ekblom A, Hansson P. Pain intensity measurements in patients with acute pain receiving afferent stimulation. *Journal of Neurology, Neurosurgery and Psychiatry* 1988;51:481-86.
12. Brunelli C, Zecca E, Martini C, Campa T, Fagnoni E, Bagnasco E, et al. Comparison of numerical and verbal rating scales to measure pain exacerbations in patients with chronic cancer pain. *Health Qual Life Outcomes* 2010;22(8):42.
13. Bondemark L, Fredriksson K, Ilros S. Separation effect and perception of pain and discomfort from two types of orthodontic separators. *World J Orthod* 2004;5:172-76.
14. Hoffman WE. A study of four types of orthodontic separator. *Am J Orthod* 1972;62:67-73.
15. Cork R, Issac I, Elsharydah A, Saleemi S, Zavisca F. A comparison of the verbal rating scale and the visual analog scale for pain assessment. *Internet J Anesthesiol* 2004;8:1.
16. Lund I, Lundeberg T, Sandberg L, Budh CN, Kowalski J, Svensson E. Lack of interchangeability between visual analogue and verbal rating pain scales: A cross-sectional description of pain etiology groups. *BMC Medical Research Methodology* 2005;5:31-39.
17. Herr KA, Spratt K, Mobily PR, Richardson G. Pain intensity assessment in older adults: Use of experimental pain to compare psychometric properties and usability of selected pain scales with younger adults. *Clin J Pain* 2004;20:207-19.
18. Brown DF, Moerenhout RG. The pain experience and psychological adjustment to orthodontic treatment of preadolescents, adolescents, and adults. *Am J Orthod Dentofacial Orthop* 1991;100:349-56.
19. Scheuer PA, Firestone AR, Burgin WB. Perception of pain as a result of orthodontic treatment with fixed appliances. *Eur J Orthod* 1996;18:349-57.
20. Bernhardt MK, Southard KA, Batterson KD, Logan HL, Baker KA, Jakobsen JR. The effect of preemptive and/or postoperative ibuprofen therapy for orthodontic pain. *Am J Orthod Dentofacial Orthop* 2001;120:20-27.