

# Separation Effect and Perception of Pain and Discomfort from Kesling and Elastomeric Orthodontic Separators: An *In Vivo* Study

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## ABSTRACT

**Aim:** To scrutinize Kesling and elastomeric orthodontic separators, focusing on the separating effect as well as patients' perception of pain together with discomfort.

**Materials and methods:** The separators tested were elastomeric as well as Kesling separators. Thirty subjects, scheduled for treatment having a fixed orthodontic appliance, were categorized into two groups. In group I subjects, elastomeric separators were placed, whereas in group II subjects, Kesling separators were placed. After 3 days, the extent of separation was recorded with a leaf gauge. A questionnaire of eight questions and visual analog scale were used to note the patient perceptions of pain and discomfort.

**Results:** The mean separation formed by elastomeric and Kesling separator was 0.0457 and 0.0437 mm, respectively, of which elastomeric separator had made highest separation than the other separator used for the generation of separation at day 1 whereas the mean separation created by the elastomeric and Kesling separator at day 2 was 0.2327 mm and 0.1903 mm, respectively. 46.7% of patients on day 1, and on day 2, 56.7% of patients reported discomfort but not pain, while 73.3% of patients on day 3 reported discomfort but not pain from both types of separator. On day 1, 6.7% of patients, 13.3% on day 2, and 6.7% again on day 3 reported feeling pressure but no pain or discomfort.

**Conclusion:** Elastomeric separators exhibited the highest separation compared to Kesling used for the separation, at all three days. The Kesling separator was a separator of choice in cases where the interproximal contact was tight.

**Clinical significance:** Discomfort and pain due to separator will be minimized by reducing the duration of separator placement. Hence treatment acceptability will be more. There is no significant difference found in separation by increasing the day.

**Keywords:** Elastomeric separator, Kesling separator, Separators.

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## INTRODUCTION

Orthodontic discomfort is a significant clinical concern that is sometimes overlooked by doctors but is highly valued by patients. Patient's fears of discomfort might lead them to relinquish orthodontic therapy, as well as pain during the early stages of treatment can severely impact patient's compliance and cause treatment pauses.<sup>1,2</sup>

Separation of the molars is necessary for the placement of bands that secure the appliance, support auxiliary labial/lingual attachments, and survive the application of rather strong extraoral stresses in fixed orthodontic mechanotherapy. Separation is an orthodontic operation that involves pushing or wedging the teeth apart for 1 week in order to relieve the tight interproximal contacts amid teeth and provide room for the placement of orthodontic bands.<sup>3</sup> Bands are recommended over bonding in the posterior area because posterior teeth are subjected to more masticatory stress than anterior teeth.<sup>4</sup> Elastic ring separators are little polyurethane elastic rings. To create spacing between two neighboring teeth for the banding technique, rings of varied thickness are put around the interproximal contact site. Elastic ring separators are the most pleasant for the patient since they fit tightly in the interdental area. However, if they get dislodged into the interproximal region, they might create issues; hence, their location along with number should be documented in the chart at the time of installation. During the banding appointment, the region should be properly examined in case a separator is missing.<sup>5</sup>

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The Kesling separator is a metal ring or spring composed of 0.016 round Australian wire. It is made up of a coil/helix, an occlusal arm, a gingival arm, and a retentive arm. It is grabbed with pliers and then positioned such that the separator's coil

is on the buccal side. It achieves separation for banding in approximately 2 days.<sup>5</sup>

Elastomeric separators, according to Davidovitch<sup>6</sup> and others, might produce appropriate separation in 8–12 hours, on the basis of the tightness of the contact point. Nevertheless, in their investigation, separators were only put mesial to the first molars in the mandibular arch. The contact point distal to the first molar has been reported to be tighter than the mesial. Hence further studies are required to evaluate the effectiveness of the above protocol on the distal contact points. Another aspect that needs to be assessed further is the possibility of a varied response in separation effect and pain perception in the maxilla and mandible in males and females.<sup>6,7</sup> The aim of the study is to examine Kesling and elastomeric separators, separating effect and optimal duration for separator placement as well as patient's perception of pain and discomfort.

## MATERIALS AND METHODS

Thirty patients aged between 16 and 25 years (both male as well as female) who consulted to the Orthodontics Department in search of orthodontic therapy exhibiting normal occlusion with appealing (orthognathic) profiles were chosen for the current research. Participants, with Angle class I malocclusion, no previous history of Orthodontic Treatment, no caries or restoration on the proximal surfaces of first and second permanent molars and second premolars, no evidence of periodontal or gingival problems, no previous history of extractions and generalized spacing, good interproximal tooth contacts at the site of separator placement are included in the study.

### Exclusion Criteria

History of previous orthodontic treatment was taken and patients with Angle class II and class III were excluded from the study.

### Measuring the Separating Effect

The separating effect of two different types of separators was divided into two groups: Group I: elastic separator; Group II:

Kesling separator, both groups assessed for 3 days, first and fourth quadrant; elastic separator and second and third quadrant Kesling separator were placed. It was a split mouth study. Patients were recalled every day to assess the separator and answer the questionnaire. The separated mesial space between the molars and premolars was duly noted separately for 3 days, starting from the day of placement. The amount of separation between molar and second premolar and first and second molar in each quadrant was measured separately with two leaf gauges (sensitivity 50/100 mm) and noted on each day. The number as well as types of lost separators were noted at the same time.

### Investigation of Patient's Perception of Pain or Discomfort

The pain perception was brought about by the different separators assessed by a Visual Analog Scale and a Questionnaire. The Questionnaire<sup>8</sup> comprises eight questions evaluating the presence, severity, and location of pain (Table 1). A sample group of 30 patients (age-group: 16–25 years) of both genders had to complete a Questionnaire comprising eight questions evaluating the pain's presence, severity, and location. The patients were given oral instructions, and the questions had to be answered on each day of the separator placement and had to be performed at home at the same time every day.

### Statistical Analysis

The data were recorded followed by analysis utilizing the Statistical Package for Social Sciences (SPSS) for Windows 26.0 (SPSS, Inc. Chicago, Illinois). Confidence intervals were set at 95%, and a  $p \leq 0.05$  was considered statistically significant. Descriptive statistics were applied to the questionnaire. Unpaired *t*-test was used to compare Kesling and elastomeric orthodontic separators.

## RESULTS

Thirty patients aged between 16 and 25 years (both male as well as female) who consulted to the Orthodontics Department in search

**Table 1:** Questionnaires

Sl. No.	Question	Day 1	Day 2	Day 3
1.	Has it hurt so much that you have changed your food habits to soft foods like curd, banana, poha, etc? Yes/No			
2.	Has it hurt so much that your leisure activities were influenced, e.g., music, sports, time with family/friends? Yes/No			
3.	Has it hurt so much that your work was influenced? Yes/No			
4.	Has it hurt so much that you have been awake in the night? Yes/No			
5.	Are you absolutely sure that what you are experiencing is pain and not pressure or discomfort? It is pain It is pressure It is discomfort			
6.	Has it hurt so much that you have had to take painkillers? Yes/No			
7.	Comment regarding the loss of separators?			
8.	Any other observations (which type of separator hurts the most)?			

of orthodontic therapy exhibiting normal occlusion with appealing (orthognathic) profiles were chosen for the current research. Table 2 compared the amount of separation by the two separators. The unpaired *t*-test revealed the mean separation formed by elastomeric and Kesling separator was 0.0457 mm and 0.0437 mm, respectively, of which elastomeric separator had made highest separation at day 1. In contrast, the mean separation created by the elastomeric and Kesling separators at day 2 was 0.2327 mm and 0.1903 mm, respectively. The elastomeric separator (0.3743 mm) showed the highest separation on day 3. We observed nonsignificant difference in separation measured for elastometric and Kesling separators at day 1 and day 2, whereas we observed significant difference in separation at day 3. The observed mean difference between elastometric vs Kesling was 0.0020. For question number one (Table 3), 26.7% of the samples on day 1, 36.7% on day 2, and 43.3% on day 3 did not have alteration in their food habits to soft diet, whereas

73.3% on day 1, 63.3% on day 2, in addition to 56.7% on day 3 had to change their food preference to soft diet. In answer to question 2, 93.3% of samples on day 1, 93.3% on day 2, whereas 96.7% on day 3 sustained their leisure activities regularly, while 6.70% on day 1, 6.70% on day 2, and 3.30% on day 3 complained of obstruction to their leisure activities. In question 3, 100% of the patients on day 1, 93.3% on day 2, and 93.3% on day 3 had no problem carrying out their regular job, but 6.70% on day 2 as well as day 3 had difficulties carrying out their everyday labor. In response to question 4, 13.3% of patients on day 1, 6.7% on day 2, and 93.3% on day 3 said they were conscious at night as a result of pain, whereas 86.7% of patients on day 1, and 93.3% of patients on day 2 and day 3 said no, indicating that they had no difficulty sleeping at night. In response to question number 5, 46.7% of patients on day 1, 30.0% on day 2, and 20.0% on day 3 said they were in discomfort. On day 1, 46.7% of patients, 56.7% on day 2, and 73.3% on day 3 reported discomfort rather than agony. On day 1, 6.7% of patients, 13.3% on day 2, and 6.7% again on day 3 reported feeling pressure but no pain or discomfort.

For question no. 6, 0% of patients, that is, none of the patients, replied Yes to having used painkillers on all 3 days, and 100% of patients said No, indicating that none of the patients had used analgesics on any day (Table 3). About 20% of elastomeric separators were lost on day 2 and 13% on day 3, and 6.67% of Kesling separators were lost on day 1 and 3.3% on day 2

**Table 2:** Comparison of Kesling and elastomeric orthodontic separators

Days	Kesling separators	Elastomeric separators	<i>p</i> value
Day 1	0.0437 ± 0.020	0.0457 ± 0.014	0.28
Day 2	0.190 ± 0.06	0.232 ± 0.074	0.15
Day 3	0.274 ± 0.05	0.374 ± 0.079	0.001*

Unpaired *t*-test, \*indicates statistical significant difference

**Table 3:** Evaluation of pain perception based on the questionnaire

Questionnaires	Day 1	Day 2	Day 3
Q1	Has it hurt so much that you have changed your food habits to soft foods like curd, banana, poha?		
No	8	11	13
Yes	22	19	17
	26.70%	63.30%	43.30%
Q2	Has it hurt so much that your leisure activities were influenced, e.g., music, sports, time with family/friends?		
No	28	28	29
Yes	2	2	1
	93.30%	93.30%	96.7%
Q3	Has it hurt so much that your work was influenced?		
No	30	28	28
Yes	0	2	2
	100.0%	93.30%	93.3%
Q4	Has it hurt so much that you have been awake in the night?		
No	26	28	28
Yes	4	2	2
	86.70%	93.30%	93.3%
Q5	Are you absolutely sure that what you are experiencing is pain and not pressure or discomfort?		
It is pain	14	9	6
It is pressure	2	4	2
It is discomfort	14	17	22
	46.70%	30.0%	20%
Q6	Has it hurt so much that you have had to take painkillers?		
No	30	30	30
Yes	0	0	0
	100%	100%	100%

**Table 4:** Evaluation of percentage loss of separators

Type of separators	Loss on day 1	Loss on day 2	Loss on day 3
Elastomeric	0 (0%)	6 (20%)	4 (13.33%)
Kesling	2 (6.67%)	1 (3.33%)	0 (0%)

(Table 4). Hence results clearly show that elastic separator causes more separation than Kesling separator in 3 days time period; the discomfort and pain perceptions were less and no medication needed for pain.

## DISCUSSION

A study done by Hoffman et al. showed that the separation of 0.48 mm by elastomeric separators in 3 days and 0.33mm separation by brass wire in 3 days, which is 0.1 mm more than the result of this study.<sup>9</sup> Sandhu et al. showed that elastomeric separators showed maximum amount of separation (mean separation of 0.412 mm), followed by Brasswire (mean of 0.40 mm) and then Kesling (0.32) for 7 days.<sup>2</sup> The above result is higher than the result of this current trial but is justified by the difference in duration of both the studies. Al Huwaizi<sup>10</sup> in 2008 concluded that elastomeric separators gave the most amount of separation (0.8 mm and TP Springs gave 0.3–0.5 mm separation) in 7 days as the present study concludes that the elastomeric separators gave the maximum amount of separation. In the present study the amount of separation caused by elastomeric separators on day 1 was 0.0457 ( $\pm 0.0141$ ), on day 2 was 0.2327  $\pm 0.0746$ , whereas on day 3, it was 0.3743  $\pm 0.0793$ . The amount of separation by Kesling separators on day 1 was 0.0437  $\pm 0.0208$  and on day 2 it was 0.1903  $\pm 0.0690$ , and 0.2740  $\pm 0.0551$  on day 3. Hence, we observed a nonsignificant difference in separation measured for elastometric and Kesling materials on day 1 and day 2. In contrast, we observed a significant difference in separation at day 3 between elastometric vs Kesling. Hoffman et al. also concluded that the latex elastics were most recurrently lost, sometimes disappearing subgingivally below the contact. During separation, the elastomeric separators were the most painful, according to the present study.<sup>9</sup> Most of the studies have researched the amount of separation for 7 days. The present study is conducted over a time period of 3 days. A study by Davidovitch et al. contradicts both the methodology. It states that separators could be placed 1 day before the band placement, in contrast to the other trial, which gives a separator placement regime of 5–7 days; as after 12–24 hours of separation, all patients demonstrate space of >0.16 mm, irrespective of the type of separators used.<sup>6</sup> The questionnaire in the study comprises eight questions depicting pain and discomfort. A similar questionnaire used in the trial was conducted by Bondemark et al. in 2004 to examine the separating effect as well as perception of pain along with discomfort by two types of orthodontic separators. The trial concluded that the pain was worst on day 2 which then diminished practically entirely by the last day, which is partially in opposition to our result, which states that pain was worst on day 1 but was markedly less on the final day.<sup>10</sup> A study on the same topic was conducted by Kapoor et al. in 2013 (Questionnaire forms and Visual analog scales). For all three separators, the pain was worst on day 2 and subsided almost completely by day 4.<sup>11,12</sup> About 75 of the 90 patients changed their food habits, and 62 took analgesics due to pain. The above study was not in accordance with our study, although 22 patients on day 1 and 17 patients on day 3 changed their food preferences to soft diet. Ngan et al. studied the response of pain subsequent to separator

placement. They determined that the distress typically initiates after 4 hours of separator placement becoming highest in the subsequent 24 hours.<sup>13</sup> It then starts subsiding for the next 5–7 days. According to Furstman and Bernik, periodontal discomfort is produced by a combination of pressure, ischemia, inflammation, together with edema. There have been two kinds of painful reactions recorded after the application of orthodontic force. The first is a compression-induced first reaction. Another cause of delayed reaction is periodontal ligament hyperalgesia, which is associated and the second one is due to prostaglandin-E which makes the PDL sensitive to secreted halogens like as histamine, bradykinin, serotonin, along with substance-P. Enkephalin, dopamine, glycine, glutamate gamma-aminobutyric acid, leukotrienes, as well as cytokines are among the other mediators identified.<sup>13</sup> Marques et al. in 2013 conveyed that discomfort allied with the usage of fixed orthodontic appliances employed an adverse impact on the quality of life of the adolescents including. The determinants of this association were age, poor oral hygiene, speech impairment, together with tooth mobility.<sup>14,15</sup> All the above studies stand in support of the present study and highlight the disadvantages of having increased plaque retention in the oral cavity due to orthodontic separator placement and its possible control.

## CONCLUSION

It is possible to assume that the positioning of orthodontic separators may alter the aggregation and content of oral microorganisms, resulting in inflammation, bleeding, and periodontal damage.

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