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Comparative Study of Efficacy of Four Different Types of Orthodontic Separators in Growing and non-growing patients –In Vivo Study

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Abstract

To evaluate the amount of separation produced by four different types of orthodontic separators in two different groups by using commercially available leaf gauge and also investigate gender differences for all types of separators in relation with amount of separation. viz. the Elastomeric separator, Kesling separator, Kansal separator and Ni-Ti separators. Total 60 subjects (30 male and 30 female) were selected between age 8–30-years that were divided into two groups. Group A (8-17years) and Group B (18-30) years in which each group contain 15 male and 15 female subjects for a study. Separators were placed in 1st permanent molar region. The patient was evaluated for 3 days for amount of

separation. Time taken for adequate separation was significant in all the 4 separators.; being the fastest followed by elastomeric separator whereas no significant difference between kesling and kansal and Ni-Ti separator respectively on mesial and distal side at all durations in subject group A (8-17 years) than subject group B (18-30 years) in time taken to achieve adequate separation. Also, Elastomeric separator show Gender difference varies after day 2 and 3 with more mean separation gained in males for all separators on mesial and distal side, whereas non-significant gender difference with Ni-Ti separator after day 1 on mesial and distal side and with kesling and Kansal separator only on distal side after day 1.

Keywords: Ni-Ti separator, Efficacy, Kesling, Kansal, Separators.

Introduction

Separation is a term coined- as the act state or intense of being separate or disconnected. Separator is used to force or wedge the teeth apart and are left in place long enough to keep them slightly separated by the appointment at which bands are to be fitted. An important step to begin orthodontic treatment is the separation of the teeth by loosening the tight interproximal contacts for banding of the posterior teeth, which can be achieved by different methods using metal separators, elastomeric separators, etc. Banding in posterior region is preferred over bonding, as posterior teeth encountered heavy masticatory force. The average periodontal ligament (PDL) space is 0.25 mm and placement of a 0.16 mm thick metal band without adequate tooth separation can lead to contraction of the alveolar bone which in turn shall produce hyalinization areas in the PDL and evoke pain. Some factors which affect the separation are the age, occlusion, types of contact area, the proximal caries, restoration, periodontal condition, etc. Graber suggested that duration of the separator placement should be as per the personal preference. However, no mention was made about the length of time the separators are to be placed or amount of space that has to be gained. Orthodontic separators though used daily in orthodontic practice is the least researched auxiliary till date. Hence, the present in vivo study was carried out to determine the efficiency of different types of separators in growing and non-growing patients.

Materials And Methods

The present "In Vivo Study to Determine and Compare the Efficacy of Different Types of Orthodontic Separators" was carried out in the Department of Orthodontics and Dentofacial Orthopaedic, K.D. Dental college and Hospital, Mathura, India. The ethical clearance was obtained from the Institutional Ethics Committee. Total 60 subjects (30 male and 30 female) were selected between age 8–30-years that were divided into two groups. Group A (8-17years) and Group B (18-30) years in which each group contain 15 male and 15 female subjects for a study.

Inclusion criteria

- Age group 8-30 years and patients coming to orthodontic department who has to undergo fixed orthodontic appliance.
- Tight interproximal contact at the site of separator placement in molar and premolar region.

Exclusion criteria

- Presence of dental caries and any endodontic treatment in posterior teeth.
- Presence of periodontal and mucogingival problems and any systemic disorders.
- Presence of TMJ disorders, habit of bruxism and presence of attrition.
- Previous history of trauma and orthodontic treatment

Armamentarium

- 139 light wire pliers.
- Weingart plier.
- Heavy wire cutter.
- Separator placement plier.
- 0.020 inch A J Wilcock SS wire.
- Four different types of Orthodontic Separators i.e., Kesling, Kansal, Elastomeric and Niti separators.

Results

Table and Graph(a): Growing and Non growing group comparison of space gained by different separators at various durations (Mesial side)

Separators Group	Duration	Group A (8-17 years)		Group B (18-30 years)		Mean Difference	P value
		Mean	SD	Mean	SD		
Kesling	Day 1	.13	.02	.12	.02	.01	0.007*
	Day 2	.15	.03	.13	.03	.02	<0.001**
	Day 3	.20	.02	.18	.03	.02	<0.001**
Kansal	Day 1	.11	.01	.10	.01	.01	0.009*
	Day 2	.12	.01	.11	.01	.01	<0.001**
	Day 3	.17	.02	.15	.03	.02	<0.001**
Ni-Ti	Day 1	.09	.01	.08	.01	.01	0.384 NS
	Day 2	.11	.01	.09	.01	.02	<0.001**
	Day 3	.13	.01	.11	.01	.02	<0.001**
Elastomeric	Day 1	.16	.03	.14	.03	.02	0.075 NS
	Day 2	.18	.02	.16	.03	.02	0.009*
	Day 3	.27	.03	.25	.04	.02	0.013*

**-Highly significant (p<0.001), *-Significant (p<0.05), NS – Not Significant (p>0.05)

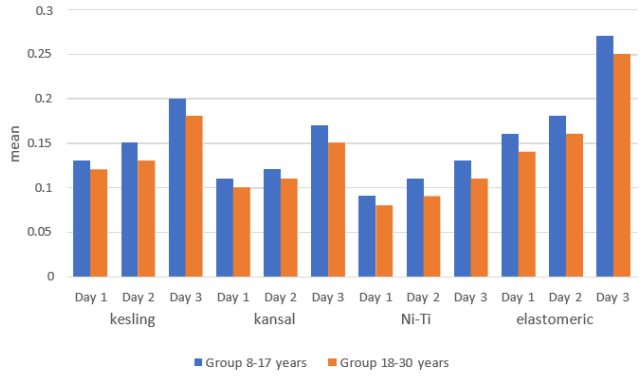


Table and Graph(b): Growing and Non growing group comparison of space gained by different separators at various durations (Distal side)

Group	Duration	Group A (8-17 years)		Group B (18-30 years)		Mean Difference	P value
		Mean	SD	Mean	SD		
Kesling	Day 1	.12	.02	.11	.02	.01	0.007*
	Day 2	.14	.03	.12	.02	.02	<0.001**
	Day 3	.19	.02	.17	.03	.02	<0.001**
Kansal	Day 1	.10	.01	.09	.02	.01	0.009*
	Day 2	.11	.01	.10	.01	.01	<0.001**
	Day 3	.15	.02	.14	.01	.01	<0.001**
Ni-Ti	Day 1	.08	.01	.08	.01	.00	0.387 NS
	Day 2	.10	.01	.09	.01	.01	<0.001**
	Day 3	.11	.01	.10	.01	.01	<0.001**
Elastomeric	Day 1	.15	.03	.14	.03	.01	0.075 NS
	Day 2	.17	.02	.15	.03	.02	0.009*
	Day 3	.25	.03	.26	.04	-.01	0.013*

**-Highly significant (p<0.001), *-Significant (p<0.05), NS – Not Significant (p>0.05)

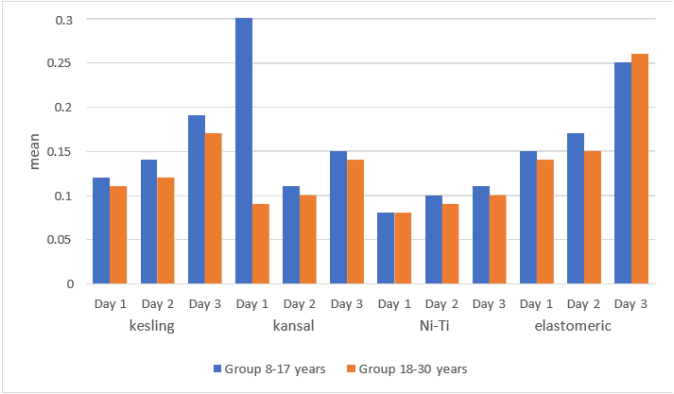
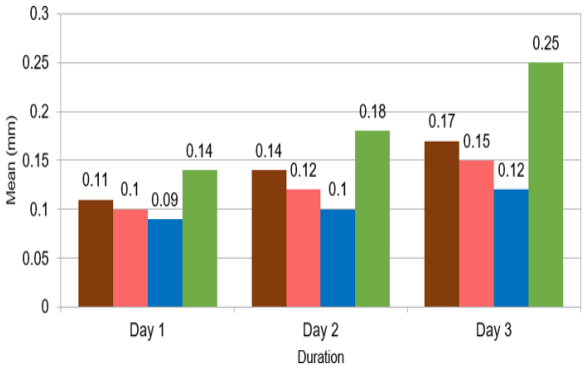


Table and Graph(c): Comparison of Space gained between different separators in male and female subject (Mesial side)

Gender	Group	N	Day 1		Day 2		Day 3	
			Mean	SD	Mean	SD	Mean	SD
Female	Kesling	30	.11	.02	.14	.03	.17	.04
	Kansal	30	.10	.02	.12	.02	.15	.03
	Ni-Ti	30	.09	.01	.10	.01	.12	.01
	Elastomeric	30	.14	.03	.18	.04	.25	.04
	F value		61.283		84.366		150.855	
	P value		<0.001**		<0.001**		<0.001**	
Male	Kesling	30	.12	.02	.16	.03	.21	.03
	Kansal	30	.11	.01	.13	.01	.18	.03
	Ni-Ti	30	.09	.01	.11	.01	.14	.01
	Elastomeric	30	.15	.03	.20	.03	.28	.04
	F value		90.369		146.847		189.368	
	P value		<0.001**		<0.001**		<0.001**	

**-Highly significant (p<0.001)



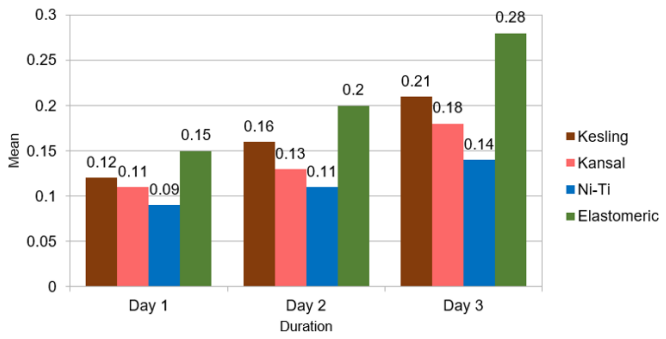
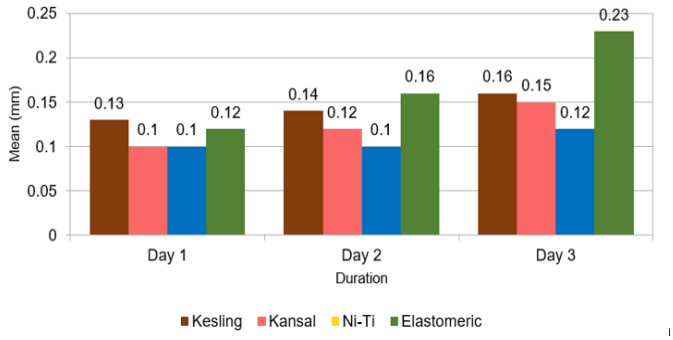
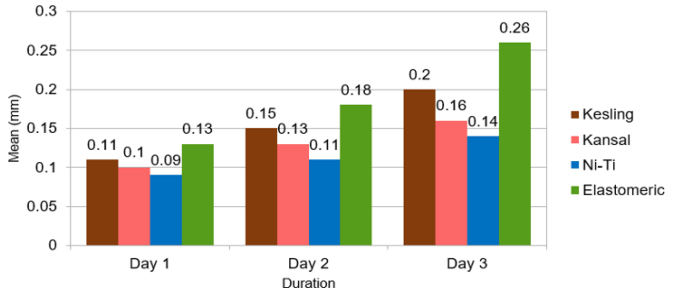


Table and Graph(d): Comparison of Space gained between different separators in total male and female subjects (Distal)

Gender	Group	N	Day 1		Day 2		Day 3	
			Mean	SD	Mean	SD	Mean	SD
Female	Kesling	30	.13	.14	.14	.03	.16	.03
	Kansal	30	.10	.02	.12	.02	.15	.03
	Ni-Ti	30	.10	.10	.10	.01	.12	.01
	Elastomeric	30	.12	.02	.16	.03	.23	.03
	F value		2.068		87.627		132.649	
	P value		0.106 NS		<0.001**		<0.001**	
Male	Kesling	30	.11	.02	.15	.02	.20	.03
	Kansal	30	.10	.02	.13	.01	.16	.02
	Ni-Ti	30	.09	.01	.11	.01	.14	.04
	Elastomeric	30	.13	.02	.18	.03	.26	.04
	F value		72.870		104.509		115.708	
	P value		<0.001**		<0.001**		<0.001**	

**-Highly significant (p<0.001)





Discussion

In fixed orthodontic therapy, tight interproximal contacts make it impossible to seat band on the first molars. Insufficient separation causes pain and discomfort to the patient during banding procedure apart from causing improper seating of bands. The separator must provide adequate separation for proper band fitting and should not dislodge while chewing food and remain till it is removed by the orthodontist. Different separators vary in the amount of separation and their efficacy. Some can irritate the mucosa whereas some tend to loosen easily.

Pain and discomfort due to separator placement was the most common problem and one of the reasons for avoiding orthodontic treatment.14 Therefore, the present study was carried out in 30 males and 30 females, that were equally distributed in two groups according to age and four different types of separators with different design and material were used in the first permanent molar to assessed amount of separation of individual separator for consecutive 3 days after placement. Descriptive statistics of space gained by different separators showed progressively increase in amount of separation in both groups and with females and males on mesial and distal side, mean and standard deviation of elastomeric separator was more and less in NI-Ti separator which was statistically highly significant over a period after day 1,2 and 3. In this study Mean separation space by elastomeric was more on day 1 and day 3 in groups A (8-17 years) on mesial side and distal side but it was consecutively almost same in another group. Separation effect was more in group B (18-30 years) by elastomeric on mesial and distal side. According to means separation effect on both mesial and distal side in present study shows group A (8-17 years) have more separation by elastomeric than group B (18-30 group). Similar studied done by Hoffmann (1972) who found that elastomeric separators gave the best performance. They provide adequate early separation and then continued to separate. In this study mean separation space by kansal separator was same on mesial and distal side in females while in males it was more on mesial side after day 1 and 3 however, in Ni-Ti separator it was same on mesial and distal side in males and in females except after day 1 which was more on distal side. Kesling separator gained more mean separation space on mesial side in males whereas in females it was similar after day 2 on mesial and distal side. More mean separation space gained on mesial than distal side in elastomeric separator in females as well as males in our present study. Some studies not conclude same results as our study that Juneja A et al (2011) found non-significant difference in amount of separation at mesial and distal contact point with elastomeric separator in the maxillary arch but in the mandibular arch mesial side achieved significantly more separation than distal side. This was due to the tightness of the contact increased posteriorly. Yadav JP et al (2018) found statistically significant difference between the separation effect of all separators on comparing efficacy of elastomeric, kesling, kansal and dumbbell separators, separation, and discomfort by elastomeric was more than the kesling separator. Anju Jha et al (2021) had evaluated that elastomeric separator showed highest efficiency in creating separation and pain perception because it exerted highest initial force which show similar result as our study. In a study by Sharma S et al (2017) showed mean separation effect was 0.21 mm for kansal and 0.31 mm for the elastomeric separator but Kansal separator. considered less painful than elastomeric separator which was statistically non-significant. Gurinder pal Singh sadhu et al (2013) concluded that kesling separators achieved less separation and discomfort than elastomeric and brass wire separators. Statistically significant difference was found in amount of separation with all four separators and there was gradual increase in space over a period of 24 hrs. Non-significant gender difference was found in space gained on mesial side by Ni-Ti and elastomeric separator while kesling, kansal and Ni-Ti separator on distal side after day 1. Statistically highly significant difference was found for kesling, kansal and Ni-Ti separator after day 2 and 3 on mesial side, kesling after day 3 while kansal and Ni-Ti after day 2 on distal side, however, significant difference

with more mean after day 2 and day 3 for elastomeric separator in males shows in our study. Space gained comparison between different separators were statistically highly significant after day 1 and also after day 2 and 3 in males as well as in females, with more amount of separation seen in elastomeric separator followed by kesling, kansal and Ni-Ti on mesial and distal side at all durations according to Table a and b. Space gained comparison between different separators were statistically highly significant after day 1 and after day 2 and 3 in group A (8–17 year) as well as in group B (18–30 year), with more amount of separation seen in elastomeric separator on mesial and distal side at all durations. As our studies Tripathi T et al (2019) observed similar result that the maximum separation in elastomeric separator which was statistically significant followed by kesling and kansal separator. Also Result of Malagan MA et al (2014) showed significant difference in separation effect between Elastomeric, dumbbell, kesling and NEET separators on day 1,2 and 3 which is in favour of our study. NEET spring produce less amount of separation in comparison with elastomeric, dumbbell and kesling springs. Bangar C et al (2016) assessed that separation was less in self-secured spring compared to elastomeric separator because of difference in force generated by two separators that was statistically less significant. Kumari L et al (2019) showed statistically significant difference between separation effect of elastomeric, dumbbell, kesling and kansal separators in which elastomeric separator produce more separation which is similar of our study. Inspite of using same gauge wire kesling separator produce more separation than kansal which may be due to design. However, in the study by Shamsuddin SV et al (2021) found that dumbbell separator produces more separation followed by kesling and elastomeric separator. Comparative study by Padma NP et al (2020) evaluated that dumbbell and elastomeric separator had greater separation space and lesser time for the separation effect compared to kesling and kansal separator. Nalbantgil D et al (2009) and Al-Balbeesi HO et al (2016) also observed that elastomeric produced significantly more separation that concluded in our study also. Gurinder pal Singh Sandhu et al (2013) evaluated that elastomeric and kesling separator had significant difference between the mean separation on mesial aspect whereas on distal aspect mean separation of elastomeric (0.36) was significantly more than kesling separator (0.28) which also favour our study. In our study it can be concluded that separation was more with elastomeric separators as compared to kesling, kansal and Ni-Ti on mesial and distal side at all durations. Inspite of using same gauge wire (0.020 inch A J Wilcock SS wire) for kesling and kansal separators and both were placed in maxillary arch, difference in design and mechanism of action might be attributed factors for difference in amount of separation. Kansal is 2 in 1 self-secured spring which separate both mesial and distal aspects of tooth simultaneously and it works on principle of double helix torsion spring and it has unified arm with one and half coil and activation was done opposite to the direction of coil. kesling separator was placed individually on mesial and distal aspect of the tooth which comprise of two free arm and a helix with two and half coils which results in greater flexibility and it works on principle of closed coil spring in which activation was done in the same direction of coil which showed reverse Bauschinger effect. Elastomeric separator (2.1 mm inner diameter without edges) was stretched and inserted mesially and distally, under compression generate sawing action to separate the adjacent teeth. Ni-Ti spring separator (0.018inch diameter) diverge from the vertical so that

force is applied against proximal surface as spring self-secured in embrasure and both were placed in mandibular arch. There was no loosening and dislodgment of any separator was observed, so same separator was inserted at all durations in our study.

Conclusions

So, present in vivo study was carried out in Total 60 subjects (30 male and 30 female) were selected between age 8–30 years that were divided into Group A (8-17years) and Group B (18-30) years in which each group contain 15 male and 15 female subjects for comparison of amount of separation of four different types of separators. Following conclusions were drawn from the study:

Elastomeric separators gained more separation space than kesling, Kansal and Ni-Ti respectively on mesial and distal side at all durations in subject group A (8-17 years) than subject group B (18-30 years).

In Elastomeric separators Gender difference varies after day 2 and 3 with more mean separation gained in males for all separators on mesial and distal side, whereas non-significant gender difference with Ni-Ti separator after day 1 on mesial and distal side and with kesling and Kansal separator only on distal side after day 1.

Elastomeric separators gained more separation space than kesling, Kansal and Ni-Ti respectively on mesial and distal side at all durations in males as well as in females which was statistically highly significant.

Various factors such as difference in design, material, mechanism of action of different separators together with type, position, and tightness of contact area in addition to anatomical variation of crown morphology and release of the inflammatory mediators, diet pattern etc, may be the reason for variation in amount of separation between different separators. Clinicians need to have suitable separator with consideration of the amount of separation. Further study with more sample size including all age group cases may yield a more conclusive result for comparing efficacy of different separators.

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