

In vivo study to investigate gender differences for the efficacy of different types of orthodontic separators

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Abstract

Aim: To evaluate gender differences for effectiveness of different types of separators - Kansal, Kesling, Ni-Ti and Elastomeric separators.

Materials and method: 50 males and 50 females (100 subjects), aged 18-30 years were included in the present cross-sectional study. Four different types of separators (Kansal, Kesling, Ni-Ti and Elastomeric separator) were placed in the same subjects on the mesial and distal sides of the first permanent molar region. The amount of separation was measured after 1st, 2nd and 3rd day of separator placement over 24 hours intervals by using a commercially available leaf gauge.

Results: Independent t-test revealed non-significant gender difference in space gained on the mesial side with Ni-Ti and Elastomeric separator while Kesling, Kansal and Ni-Ti separator on the distal side after day 1. The significant difference with more mean after day 2 and day 3 for Elastomeric separator in males on mesial and distal side ($P < 0.05$). Statistically highly significant difference was found for Kesling, Kansal and Ni-Ti separator after day 2 and 3 on the mesial side, Kesling after day 3 while Kansal and Ni-Ti after day 2 on the distal side ($P < 0.001$).

Conclusion: Gender difference varies after days 2 and 3 with more mean separation in males for all separators and it was more with Elastomeric than Kesling, Kansal and

Ni-Ti separators respectively on the mesial and distal side, whereas non-significant difference for Ni-Ti on mesial side and Kesling and Kansal separators on the distal side after day 1. Clinician need to have consider gender and prefer suitable separator.

Keywords: Kansal separator, Leaf gauge, separation

Introduction

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 types of separators using metal, elastomeric, Kesling separators etc.

In 1907, Angle first discussed the need to separate the teeth for the placement of bands, using brass wire.¹ Dr Thurow was the first to mentioned elastomeric separators and Calvin case in 1921³ recommended the use of flax waxed tape wrapped around the contact. Nickel-titanium springs were introduced in the form of NEET springs by Donald McGann in 1991. The most recent separator is the Kansal separator introduced by Kansal in 2012. Graber suggested that the duration of the separator placement should be as per personal preference. However, few research highlight about the length of time, the separators are to be placed and the amount of space that has to be gained for males and females. So, in the present study efficacy of four different types of orthodontic separators was evaluated.

Objectives

To compare the space gained between Kansal, Kesling, Ni-Ti and Elastomeric separator over 24 hrs interval.

Materials and method

In a Vivo Study of 100 subjects (50 males and 50 females) aged 18-30 years with tight interproximal contact at the site of separator placement in the molar and premolar regions were included, and there was the absence of dental caries, periodontal problems, TMJ disorders, systemic

disorders and no previous history of trauma and orthodontic treatment.

Four different types of separators were placed in 1st permanent molar region in the same subject. The separators used were Kesling and Kansal (made with 0.020 inch A J Wilcock SS wire) on the maxillary right and left side respectively while elastomeric and Ni-Ti separators on the mandibular right and left side respectively.



Fig 1: Kesling separators



Fig 2: Kansal separator



Fig 3: Elastomeric separators



Fig 4: Ni-Ti separators

molar after 1st, 2nd and 3rd day of separator placement over 24 hrs intervals.

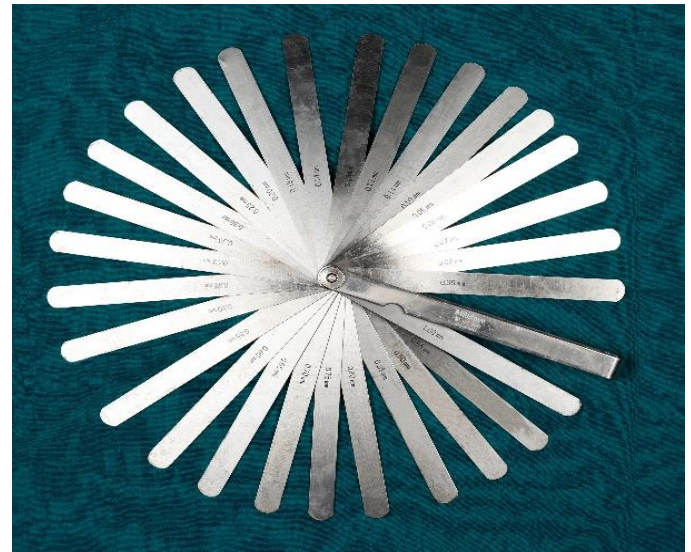


Fig 6: Leaf gauge.

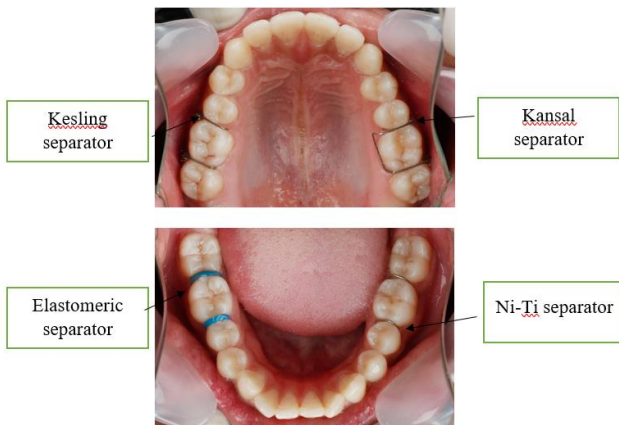


Fig 5: Different types of separators.



Fig 7: Leaf gauge used for measurement of amount of space gained.

Commercially available leaf gauge [Mitutoyo no.184-303s] was used for measurement of the amount of space gained on mesial and distal surface of 1st permanent

Result

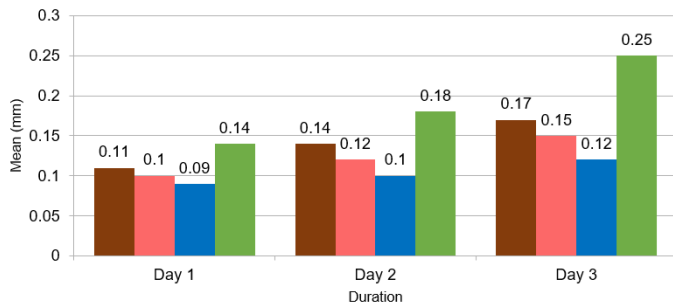
Data was collected and analysed using SPSS version 23. Independent T test and one way ANOVA were done for comparison between various groups.

Table 1: Comparison of Space gained between different separators (Mesial side)

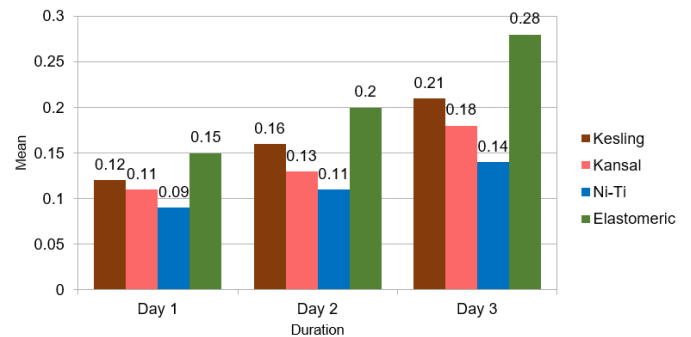
Gender	Group	N	Day 1		Day 2		Day 3	
			Mean	SD	Mean	SD	Mean	SD
Female	Kesling	50	.11	.02	.14	.03	.17	.04
	Kansal	50	.10	.02	.12	.02	.15	.03
	Ni-Ti	50	.09	.01	.10	.01	.12	.01
	Elastomeric	50	.14	.03	.18	.04	.25	.04
	F value		61.283		84.366		150.855	
	P value		<0.001**		<0.001**		<0.001**	

Male	Kesling	50	.12	.02	.16	.03	.21	.03
	Kansal	50	.11	.01	.13	.01	.18	.03
	Ni-Ti	50	.09	.01	.11	.01	.14	.01
	Elastomeric	50	.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)



Graph 1: Comparison of Space gained between different separators in females (Mesial side)

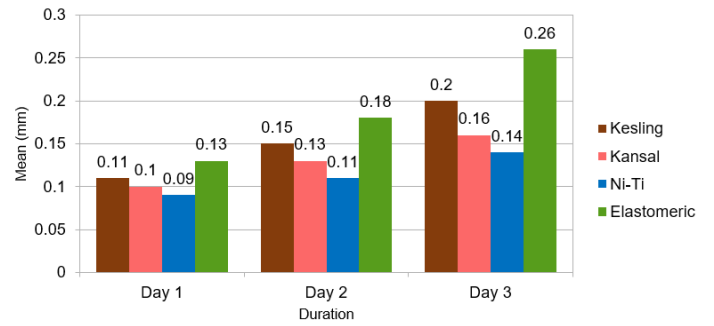
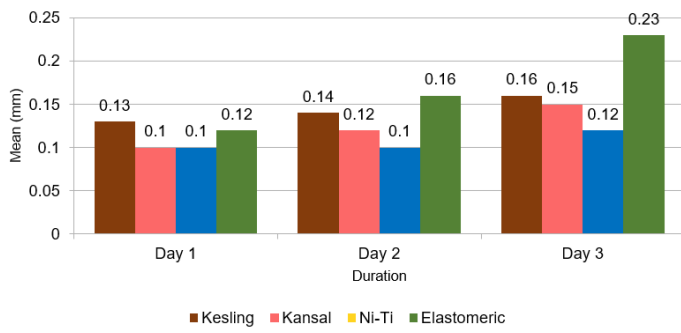


Graph 2: Comparison of Space gained between different separators in males (Mesial side)

Table 2: Comparison of space gained between different separators (Distal side)

Gender	Group	N	Day 1		Day 2		Day 3	
			Mean	SD	Mean	SD	Mean	SD
Female	Kesling	50	.13	.14	.14	.03	.16	.03
	Kansal	50	.10	.02	.12	.02	.15	.03
	Ni-Ti	50	.10	.10	.10	.01	.12	.01
	Elastomeric	50	.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	50	.11	.02	.15	.02	.20	.03
	Kansal	50	.10	.02	.13	.01	.16	.02
	Ni-Ti	50	.09	.01	.11	.01	.14	.04
	Elastomeric	50	.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)



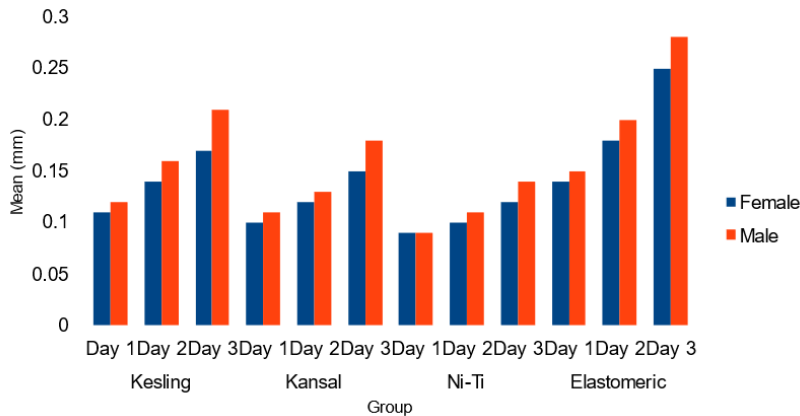
Graph 3: Comparison of space gained between different separators in females (Distal side)

Graph 4: Comparison of space gained between different separators in males (distal side)

Table 3: Gender comparison of space gained by different separators at various durations (Mesial side)

Group	Duration	Female		Male		Mean Difference	P value
		Mean	SD	Mean	SD		
Kesling	Day 1	.11	.02	.12	.02	-.01	0.009*
	Day 2	.14	.03	.16	.03	-.02	<0.001**
	Day 3	.17	.04	.21	.03	-.04	<0.001**
Kansal	Day 1	.10	.02	.11	.01	-.01	0.007*
	Day 2	.12	.02	.13	.01	-.02	<0.001**
	Day 3	.15	.03	.18	.03	-.03	<0.001**
Ni-Ti	Day 1	.09	.01	.09	.01	.00	0.386 NS
	Day 2	.10	.01	.11	.01	-.01	<0.001**
	Day 3	.12	.01	.14	.01	-.02	<0.001**
Elastomeric	Day 1	.14	.03	.15	.03	-.01	0.075 NS
	Day 2	.18	.04	.20	.03	-.02	0.007*
	Day 3	.25	.04	.28	.04	-.02	0.013*

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

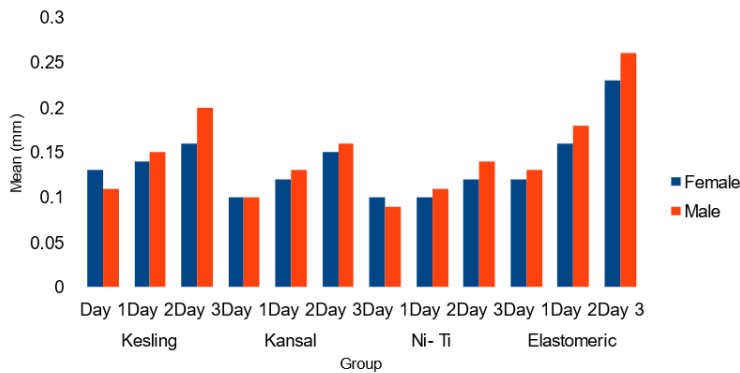


Graph 5: Gender comparison of space gained by different separators at various durations (Mesial side)

Table 4: Gender comparison of space gained by different separators at various durations (Distal side)

Group	Duration	Female		Male		Mean Difference	P value
		Mean	SD	Mean	SD		
Kesling	Day 1	.13	.14	.11	.02	.02	0.435 NS
	Day 2	.14	.03	.15	.02	-.01	0.042 *
	Day 3	.16	.03	.20	.03	-.04	<0.001**
Kansal	Day 1	.10	.02	.10	.02	.00	0.329 NS
	Day 2	.12	.02	.13	.01	-.01	<0.001**
	Day 3	.15	.03	.16	.02	-.01	0.021 *
Ni- Ti	Day 1	.10	.10	.09	.01	.01	0.484 NS
	Day 2	.10	.01	.11	.01	-.01	<0.001**
	Day 3	.12	.01	.14	.04	-.02	0.001 *
Elastomeric	Day 1	.12	.02	.13	.02	-.01	0.035 *
	Day 2	.16	.03	.18	.03	-.01	0.030 *
	Day 3	.23	.03	.26	.04	-.03	0.001 *

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



Graph 6: Gender comparison of space gained by different separators at various durations (Distal side)

Discussion

In fixed orthodontic therapy, tight interproximal contacts make it impossible to seat the band on the first molars. The separator must provide adequate separation for proper band fitting. Different separators vary in the amount of separation and their efficacy. Therefore, the present study was carried out to assess the amount of separation for consecutive 3 days after placement of four

different types of separators in the first permanent molar on the mesial and distal side.

Space gained comparison between different separators were statistically highly significant after day 1, day 2 and 3 in males (Table 1a) which was also in females (table 1b), with more separation seen in Elastomeric separator followed by Kesling, Kansal and Ni-Ti on the mesial and distal side at all durations. Tripathi T et al.

(2019)¹¹ observed the maximum separation in the Elastomeric separator, which was statistically significant followed by Kesling and Kansal separator. Results of Malagan MA et al. (2014)⁸ showed a significant difference in separation effects between Elastomeric, Dumbbell, Kesling and NEET separators on days 1, 2 and 3. NEET springs produce a less amount of separation in comparison with Elastomeric, Dumbbell and Kesling springs. Banger C et al. (2016)¹⁰ assessed that separation was less in self-secured springs compared to elastomeric separators because of a difference in force generated by two separators that were statistically less significant. Kumari L et al. (2019)¹² showed a statistically significant difference between the separation effect of Elastomeric, Dumbbell, Kesling and Kansal separators in which elastomeric separators produce more separation. However, the study by Shamsuddin SV et al. (2021)¹⁴ found that dumbbell separator produces more separation followed by Kesling and Elastomeric separator. A comparative study by Padma NP et al. (2020)¹³ evaluated that Dumbbell and Elastomeric separators had greater separation space and lesser time for the separation effect compared to Kesling and Kansal separators. Nalbantgil D et al. (2009)⁵ and Al-Balbeesi HO et al. (2016)⁹ also observed that elastomeric produced significantly more separation. Gurinder Pal Singh Sandhu et al. (2013)⁷ evaluated that elastomeric and Kesling separators had a significant difference between the mean separation on the mesial aspect whereas on the distal aspect mean separation of elastomeric (0.36) was significantly more than Kesling separator (0.28).

In the present study, more mean separation space was gained on the mesial than distal side in the elastomeric separator in females as well as males. The mean and

standard deviation of the elastomeric separator were more and less in the Ni-Ti separator which was statistically highly significant. Kansal separators gained the same mean separation on the mesial and distal sides at all duration and Ni-Ti after days 2 and 3. However, Elastomeric separators gained less mean separation on the distal side and Kesling separators showed variation in females. In males, Kesling and Elastomeric separators gained more mean separation on the mesial side after days 1, 2 and 3. Ni-Ti separators gained the same mean separation on both sides at all duration while kansal showed the same only after day 2. Juneja A et al. (2011)⁶ found a non-significant difference in the amount of separation at mesial and distal contact points with the elastomeric separator in the maxillary arch but in the mandibular arch mesial side achieved significantly more separation than the distal side. This was due to the tightness of the contact increasing posteriorly.

In our study, in spite of using the same gauge wire (0.020 inch A J Wilcock SS wire) for Kesling and Kansal separators and both were placed in the maxillary arch, the difference in design and mechanism of action might be attributed factors for the difference in amount of separation. Kansal is 2 in 1 self-secured spring which separates both mesial and distal aspects of the tooth simultaneously and it works on the principle of a double helix torsion spring and it has a unified arm with one and a half coil and activation was done opposite to the direction of the coil. Kesling separator was placed individually on the mesial and distal aspect of the tooth which comprise of two free arms and a helix with two and a half coils which results in greater flexibility and it works on the principle of closed coil spring in which activation was done in the same direction of the coil which showed reverse Bauschinger effect. The

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

Non extraction healthy young adults were considered for sample size which was the limitation of the present study.

Conclusion

- Elastomeric separators gained more separation space than Kesling, Kansal and Ni-Ti respectively on the mesial and distal sides at all durations in males as well as in females, which was statistically highly significant.
- Gender difference varies after days 2 and 3 with more mean separation gained in males for all separators on the mesial and distal side, whereas non-significant gender difference with Ni-Ti separator after day 1 on the mesial and distal side and with Kesling and Kansal separator only on the distal side after day 1.

Various factors such as difference in design and material, mechanism of action of different separators together with type, position and tightness of contact area in addition to anatomical variation of crown morphology may be the reason for variation in amount of separation between different separators

Further study with more sample size including first and second premolar extraction cases may yield a more conclusive result for comparing the efficacy of different separators.

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