International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 02-02-2020; Accepted: 03-03-2020; Published: 04-04-2020
www.medicalsciencejournal.com
Volume 6; Issue 4; 2020; Page No. 07-09

Separation efficacy of four different orthodontic separators

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Abstract
For treatment with a fixed orthodontic appliance, interproximal separation in between molars and premolars is necessary to create enough space for the bands that anchor the appliance. The ideal separator should give rapid and good separation without causing the patient discomfort or pain, thereby making the fitting of the band to the tooth. During the past 10 years, springs, brass wire and elastomerics have most often been used. If an orthodontic band measuring 0.16 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. Hence based on above findings the present study was planned for Evaluation of Different Type of Teeth Separators to observe the Separation effect.
The present study was planned in Department of Orthodontics and Dento-facial Orthopaedic, Buddha Institute of Dental Sciences and Hospital, Patna, Bihar. Total 60 cases of males and females of age between 14 to 22 years were enrolled in the present study. Four types of separators, Elastomeric separators, dumbbell separators Kesling separators and Kansal separators were used for separation before placement of orthodontic bands. So, 15 cases were included in each separator group. Hence every patient had only one type of separator in all 4 quadrants.
The present study concludes that Dumbbell separator showed maximum separation followed by elastomeric and Kesling separators. Kansal separator showed least amount of separation as compared to other three types of separators. On comparing time taken by all four separators for adequate separation, dumbbell separator took minimum time, followed by elastomeric. Kesling and Kansal separator took maximum time among all four separators in the present study. So we conclude by saying that if we are using Elastomeric or Dumbell separator then after 2 days we get sufficient space to insert band but if we are using Kesling or Kansal then we have to wait for atleast 3 days.

Keywords: teeth separators, separation effect, orthodontic separator, etc.

Introduction
Orthodontic separators are rubber bands or metal appliances used to create space between adjacent teeth. Separators are placed in the molars region at the second orthodontic appointment before molar bands are applied. They are usually added a week before application of braces, but can sometimes be added after. Spacers are either circular rubber bands about a centimeter in diameter placed between maxillary and mandibular molars; there may be small metal spring clips (spring separators) that push the molars apart. In 1907, Angles first discussed the need to separate the teeth for placement of bands. He used brass wire for this purpose [1]. The contact point of posterior teeth is almost three times tighter than that of anterior teeth, so more force is required to place molar bands. Tighter contact point exists at the distal aspect of these teeth compared with the mesial aspect. Therefore, their separation is required for the placement of orthodontic bands. This can be accomplished by various commonly practiced methods of using separators.
Orthodontic separators are devices that when inserted between adjacent teeth exhibits an increase in compressive force after insertion between adjacent teeth in the oral environment. The separator, after insertion, exerts sufficient force on the adjacent teeth to push the teeth apart. There are different kinds, but the principle is the same with any type of separator used: the separator is inserted so that it can force or wedge the teeth apart, and it is left in place long enough for initial tooth movement to occur. Thus banding can be performed by the next patient visit. Separators often cause pain and discomfort. The separators cause high levels of discomfort between 4 hour to 24 hour after placement, and that the discomfort is significantly reduced by analgesics [2]. Average periodontal ligament space is 0.25 mm, placement of a 0.16-mm orthodontic band without proper separation will risk contact with alveolar bone, producing hyalinization areas and evoking the pain response hindering patients from performing routine oral functions [3]. According to Oliver, adequate separation reduces physical pains to the lowest possible degree, prevents injury to the tooth structure from excess pressure, prevents injury of the soft tissue while forcing band material to place and reduces physical and mental tensions of the patient by having the band material conveniently carried to place. It also prevents distortion of the band material by not having to force it unduly to position during band construction [4].
Elastomeric modules are the most common devices used today for tooth separation. The module is first stretched with a placement instrument, and then ‘sawed’ through the contact until the gingival portion of the separator passes the contact point. This method sometimes breaks the elastomeric module, causing tissue damage, or distorts the module, resulting in insufficient space for banding.
Dumb-bell shaped (Mexican) elastic separator is dumb-bell in shape. This type of separator resembles a wide rubber

band with thick rolled edges. They are obtained in strips and cut to size by the operator to accommodate various teeth. It is stretched and passed through the contacts between adjacent teeth. These separators are used for carrying out rapid separation. They are recommended to be placed 30 minutes before band fitting, but can be painful to the patient [5]. Special pliers are not required for its placement.

Kesling metallic ring separator is a spring made up of 0.016 round Australian wire. It comprises of coil/helix, occlusal arm, gingival arm, retentive arm [6]. It can be made by using Weingart light wire or bird beak pliers. It is grasped with pliers and then placed in such a way that coil part of separator should be on buccal side.

Kansal separator is also known as "2-in-1" self-secured orthodontic spring separator. It is a single separator which separates both mesial and distal aspects of tooth simultaneously, individually, yet efficiently. It has a self-locking connecting bar for prevention of premature dislodgement of the separator [7]. This separator works on the principle of double helix torsion spring which consists of a right hand and left hand round spring coil sections which are connected together, and work in parallel. When the separator is engaged, the spring coil generates force in predetermined direction. Some components of the force applied by the spring assembly (mesial/distal) are counter-balanced by each other and the resultant force in lateral (horizontal) direction pushes the two adjacent teeth such that the space is created between the mesial and distal surfaces of the desired teeth. The spring assembly produces forces in two ways; i.e. wedging action and lateral action of spring assembly.

For treatment with a fixed orthodontic appliance, interproximal separation in between molars and premolars is necessary to create enough space for the bands that anchor the appliance. The ideal separator should give rapid and good separation without causing the patient discomfort or pain, thereby making the fitting of the band to the tooth. During the past 10 years, springs, brass wire and elastomerics have most often been used. Hence based on above findings the present study was planned for Evaluation of 4 Different Type of Teeth Separators to observe the Separation Effect.

Methodology

The present study was planned in Department of Orthodontics and Dentofacial Orthopaedic, Buddha Institute of Dental Sciences and Hospital, Patna, Bihar. Informed consents taken from all the patients. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study. The inclusion and exclusion criteria for the present study is mentioned in Table 1.

Table 1

Inclusion Criteria	Exclusion Criteria
1. Cases without history of previous orthodontic treatment, 2. Presence of all the permanent teeth in both the arches, except third molars, 3. No restoration on the proximal surface of 1st and 2nd permanent molar.	1. Cases with history of previous orthodontic treatment

Total 60 cases of males and females of age between 14years to 22 years were enrolled in the present study. We used 4 different types of separators: Elastomeric separators, Kesling separators, Kansal separators and dumbbell separators (Table 2). We enrolled 15 case in each separator group. So every patients should have only one type of separator in all quadrant. So for each separator 60 reading were taken. The separating effect of four different types of separators was assessed for three days and the separated space between the molars was duly noted separately for each day, starting from the day of placement. The amount of separation between molars in each quadrant will be measured separately with leaf gauges (sensitivity 5/100mm) and noted on every day for 3 days in continuity.

The Kesling and Kansal separators (0.16 AJ Wilcock wire) were applied with light wire pliers by holding the gingival end with the plier and inserting it below the contact point by taking support from the other end. The elastomeric and Dumbbell separators were inserted with separator placing pliers (Separator placement Plier and Mathews Plier). All four separators were placed randomly in each quadrant of the maxilla and mandible.

Table 2

Four different types of Orthodontic Separators	
1	Elastomeric Separators (Libral traders)
2	Kesling Separators (A.J.Wilcock, 0.016")
3	Kansal separators (A.J.Wilcock, 0.016")
4	Dumbell separator (Libral traders)

Statistical Analysis

Data was maintained in Microsoft Office Excel sheet. Fischer's T test and ANOVA Test applied to know if any significant difference exist between the groups. A p-value ≤ 0.05 was considered statistically significant.

Results

The study revealed that mean separation created by Elastomeric, Dumbell, Kesling & Kansal separator were 0.11021 mm, 0.13247 mm, 0.05632mm 0and 0.04937 mm respectively, out of which Dumbell separator had created highest separation than the other separator used for the generation of separation at Day 1. Whereas the mean separation created by the Elastomeric, Dumbell, Kesling and Kansal separator at Day 2 were 0.19736 mm, 0.24683 mm, 0.14459 mm and 0.15328 mm respectively. Similar to Day 1 Dumbell separator created more separation than the other separator. At Day 3, the mean separation created by the Elastomeric, Dumbell, Kesling and Kansal separator were 0.27856 mm, 0.31567 mm, 0.22987 mm and 0.20756 mm respectively, and again Dumbell separator had created highest separation among all other separator used for generating the separation. Elastomeric and Dumbell separator produce enough space for Orthodontic band in 2 days only, while Kesling and Kansal separator take 3 days for adequate separation. Elastomeric and Dumbell produced significantly higher separation effect than Kesling and Kansal separator.

Table 3: Results of different separator mean in millimetres (mm)

	Separators	N	Mean(mm) ± SD
Day 1	Elastomeric	60	0.11021± 0.051915
	Dumbell	60	0.13247±0.051730
	Kesling	60	0.05632±0.012726
	Kansal	60	0.04937±0.009451
Day 2	Elastomeric	60	0.19736±0.053947
	Dumbell	60	0.24683±0.052103
	Kesling	60	0.14459±0.016203
	Kansal	60	0.15328±0.011730
Day 3	Elastomeric	60	0.27856±0.049672
	Dumbell	60	0.31567±0.034753
	Kesling	60	0.22987±0.013730
	Kansal	60	0.20756±0.011532

Discussion

Separation is an Orthodontic procedure aiming at slightly loosening the slight interproximal contacts between teeth to create space for the fitting of Orthodontic bands by forcing or wedging the teeth apart. The ideal separator should be easy to place in any contact, create little or no discomfort initially and during the separation period and generate enough space for banding, thereby making the fitting of the band to the tooth easy [8].

According to Manjunath *et al.* [8] in 2014, the Dumbell separator provide a higher amount of separation, (mean separation of 0.31 mm) which is accordance with this present study (0.31 mm in 3 days). The Manjunath study was comparative study between Dumbell, NEET, Kesling and Kansal separator, conducted for three days. This study came to a conclusion that Dumbell separators showed a separation of 0.31190±0.038270 on day 3, NEET 0.22220±0.047307 day 3, Kesling 0.22340±0.043802 Elastomeric 0.28143±0.042475 (day 3) which is close to the result of the present study with respect to Elastomeric seperators and similar with respect to Kesling separators.

According to Cureton and Bice *et al.* [9], Elastomeric separator show mean separation of 0.312 mm in 3 days which is similar to our study. According to Bondemark *et al.* [10] in 2004, the elastomeric separators provided a higher amount of separation, (mean separation of 0.3mm from spring type and 0.4mm from elastomeric separators), which does not support my study (0.0278 in 3 days). The Bodenmark study however, was a comparative study between elastomeric and spring type of separators and was conducted over a period of 5 days, whereas the present study was conducted over a period of 3 days and compared separation of Elastomeric, Brasswire, Kansal & Kesling separators.

Hoffman WE *et al.* [11], showed the separation of 0.48 mm by elastomeric separators in 3 days and 0.33 mm separation by brasswire in 3 days. Gurinder PS Sandhu *et al.* [12], showed Elastomeric separators showed maximum amount of separation (mean separation of 0.412 mm). The above result is higher than the result of this present study but is justified by the difference in duration of both the studies.

Most of the studies have conducted the research of the amount of separation for a duration of seven days. The present study is conducted over a time period of 3 days. A study by Davidovitch *et al.* [13], contradicts both the methodology and states that separators could be placed 1 day prior to the band placement unlike the other study which gives a separator placement regime of 5 to 7 days. Present study say that if we are using Elastomeric or Dumbell separator then after 2days we get sufficient space to put band but if we are using kesling or kansal then we have to wait for atleast 3 days.

Conclusion

The present study concludes that Dumbbell separator showed maximum separation followed by Elastomeric and Kesling separators. Kansal separator showed least amount of separation as compared to other three types of separators. On comparing time taken by all four separators for adequate separation, Dumbell and Elastomeric separator and took minimum 2 days, whereas Kesling and Kansal separator took 3 days for sufficient separation in the present study. So we conclude by saying that if we are using Elastomeric or Dumbell separator then after 2 days we get sufficient space to insert band but if we are using Kesling or Kansal then we have to wait for atleast 3 days. But in my view more similar study needed to support my view.

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