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The Effect of Degree of Crowding on the Time Required to Create Space for Molar Bands by Using Elastomeric Separators

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ABSTRACT

Background: Crowding is one of the most common malocclusions affecting esthetic, function, and stability. After treatment planning, the next step is to create interproximal space by using separators, which facilitate molar band placement. The degree of crowding significantly influences how efficiently space is created. About 0.16 mm of space is required on each side of the molar to accommodate the stainless-steel band. Elastomeric separators typically create that much space within 12–24 hours. **Objective:** To determine the effect of the degree of crowding and the time required to create sufficient space for molar band placement by using elastomeric separators. **Study Design:** Prospective observational comparative study. **Settings:** Department of Orthodontics Allied Hospital, Faisalabad Pakistan. **Duration:** March 7, 2025, to September 7, 2025. **Methods:** A total of 60 Patients aged 16-25, receiving orthodontic treatment at Allied Hospital, Faisalabad, will be selected using non-probability consecutive sampling. Dental casts will categorize patients into mild, moderate, or severe crowding groups (20 patients in each group). Elastomeric separators will be placed in the interproximal areas of the mandibular first molars. Space creation will be assessed on the 2nd, 4th, and 7th days using a leaf gauge. ANOVA / Kruskal–Wallis was used to compare mean times among the groups. **Results:** Patients with severe crowding required significantly more time to achieve adequate space compared to those with mild or moderate crowding ($p < 0.05$). The majority of patients with mild crowding achieved sufficient space within [2 days], whereas those with severe crowding often required 7 days**. Conclusion:** The degree of crowding has a direct impact on the time required for space creation with elastomeric separators.

Keywords: *Dental crowding, Elastomeric separators, Molar bands, Space creation.*

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INTRODUCTION

Orthodontic treatment often requires the placement of molar bands to anchor appliances such as arch wires, headgears, or palatal expanders. However, due to tight interproximal contacts, particularly in crowded dentitions, initial space must be created to facilitate band placement.[1] There are different types of separators according to the material, like brass wire, steel spring clips, and elastomeric separators.[2] Studies show elastomeric separators generate adequate space within two days.[3,4] Elastomeric separators are considered superior to all of them owing to their ease of application, lower cost, and effectiveness in producing interproximal separation within a short duration, typically between 24 to 48 hours.[5,6] For band placement, we need almost 0.16mm space on each interproximal area. An elastomeric separator can create approximately 0.3–0.5 mm space.[7,8] However, the time required to create enough space for band placement depends on several factors, including periodontal health, size and shape of teeth, skeletal base pattern, occlusion, and degree of crowding.[9]

Crowding is basically an arch length discrepancy, which is the difference between the space available and the space required. We need a cast analysis to assess the degree of crowding. The time required to create space is directly proportional to the severity of crowding. More time is required for more crowding. In severe crowding, contact points between teeth are tightly engaged and need more time to push both teeth away during space creation. Despite the routine use of elastomeric separators in orthodontic practice, limited research has explored the influence of varying degrees of crowding on the time required to achieve adequate interproximal space. Most existing studies focus on comparing different types of separators or evaluating pain responses, while overlooking the role of initial dental alignment.[10,11]

Multiple studies on the topic of Time Required for Adequate Separation & Contact Tightness, Types of Separators, Separation Amount, and Patient Discomfort, Elastomeric vs Brass Wire Separators, and Comparative Efficacy of Multiple

Separator Designs, but there is no study available on the association between time and severity of crowding.

The rationale of my study is to understand how the degree of crowding influences the time required to achieve sufficient separation is critical for planning treatment timelines, reducing patient discomfort, and improving the efficiency of orthodontic procedures. It may also guide the clinician in selecting the appropriate type of separator or adjusting the duration for which it should be applied. Therefore, this study aims to find the effect of the degree of crowding on the time required to create interproximal space using elastomeric separators for molar band placement. The results could contribute to more personalized and efficient orthodontic treatment protocols.

Therefore, this study aims to find the association between the degrees of crowding on the time required to create sufficient interproximal space using elastomeric separators for molar band placement. The findings could provide valuable clinical guidance for tailoring separation protocols based on individual malocclusion severity.

METHODS

This research was carried out at Allied Hospital, Faisalabad's Department of Orthodontics. For the study, participants were drawn from the orthodontic outpatient department at Allied Hospital, Faisalabad Medical University. My work uses a cross-sectional analytical design. My study took place in the dental OPD of Allied Hospital, Faisalabad, and lasted for six months, from March 7, 2025, to September 7, 2025. Before being included in the study, each subject provided a written agreement. The FMU Research Ethics Board approved the project under letter number F.48-ERC/FMU/2024-25/42, dated March 7, 2025, and conducted in compliance with ethical guidelines.

A total of 60 patients,[20] aged 16 to 25 years, undergoing fixed orthodontic treatment were selected using non-probability consecutive sampling. Sample size and power. The study include total 60 patients equally distributed into three groups (20 per group). With $\alpha = 0.05$ and 80% power, a one-way ANOVA with Cohen's $f \approx 0.41$ (a large effect). I assumed a within-group standard deviation of 2.2 days, which corresponds to a difference of ≈1.1 days between adjacent group means. We used the Power G sample size calculator for my study.

Patients aged 16–25 years, indicated for fixed orthodontic treatment requiring molar band placement, no prior orthodontic treatment, fully erupted mandibular first molars, good oral hygiene, and periodontal health were included in this study. Patients with missing or grossly decayed mandibular first molars, periodontal disease or active caries, systemic health conditions affecting tooth movement, use of medications affecting bone metabolism, or inflammation were not eligible to participate in this study.

Pre-treatment dental casts were prepared for all patients. The degree of crowding in the mandibular arch was assessed using Little's Irregularity Index. Based on the index scores, patients were divided into three groups:

Mild crowding: 2–4mm (n = 20)
Moderate crowding: 4–8 mm (n = 20)
Severe crowding: >8 mm (n = 20)

Standard elastomeric separators (3M Unitek) were placed in interproximal areas of the mandibular first molars using a separator placement instrument. Care was taken to ensure a uniform placement technique in all patients. Interproximal space creation was measured using a leaf gauge (0.05 mm increment accuracy) at three time intervals: Day 2, Day 4, and Day 7.

On each visit, the separator was gently removed, and the mesial and distal interproximal spaces were measured. The minimum space required for molar band placement was set at ≥0.16 mm. If adequate space was achieved, the separator was not replaced. If not, it was reinserted until the next evaluation.

After entering the data into Microsoft Excel, SPSS version 24 was used to conduct a statistical analysis. Kruskal–Wallis (Non-parametric test for comparing three or more independent groups) was used to the ordinal nature of the crowding groups and the likely skewed distribution of time-based outcomes. Post-hoc test was used to identify specific intergroup differences. Chi-Square was applied to compare proportions of successful space creation across different groups at each evaluation time (Day 2, Day 4, Day 7). A significant P-value (probability value) was defined as 0.05.

RESULTS

60 patients aged between 16–25 years (mean age: 20.4 ± 2.3 years), comprising an equal number of males and females, were divided into three groups based on the degree of mandibular anterior crowding as measured by Little's Irregularity Index:

- **Mild crowding** (2–4 mm)
- **Moderate crowding** (4–8 mm)
- **Severe crowding** (>8 mm)

Interproximal Space Creation Over Time

The primary outcome measured was the number of days required to achieve ≥0.16 mm of interproximal space necessary for molar band placement. Space creation was evaluated on Day 2, Day 4, and Day 7 using a 0.05 mm precision leaf gauge.

Table 1: Comparison of time required to achieve ≥0.16 mm interproximal space among different degrees of crowding using elastomeric separators

Crowding Group	Day 2	Day 4	Day 7
Mild (n = 20)	16 (80%)	4 (20%)	0 (0%)
Moderate (n = 20)	9 (45%)	7 (35%)	4 (20%)
Severe (n = 20)	2 (10%)	6 (30%)	12 (60%)

***Chi-square test** revealed a statistically significant difference in patients achieving adequate space at each time point across the three groups (**p < 0.001**).*

Time Required for Adequate Separation

The average time required (in days) to reach ≥0.16 mm of separation for each group was:

- **Mild crowding**: **2.2 ± 0.6 days**
- **Moderate crowding**: **3.6 ± 1.3 days**
- **Severe crowding**: **5.2 ± 1.2 days**

Kruskal–Wallis test showed a statistically significant difference in time required for space creation among three groups (**H = 34.82**, **p < 0.001**). **Post-hoc Dunn's test** identified significant pairwise differences between groups:

- Mild/Moderate: **p = 0.004**
- Mild /Severe: **p < 0.001**
- Moderate/Severe: **p = 0.01**

Summary

- **Patients with mild crowding achieved sufficient space by Day 2 in 80% of cases, with the remainder achieving it by Day 4.**
- **Moderate crowding patients** showed a more staggered pattern of space creation, with nearly half achieving it by Day 2, and some requiring up to 7 days.
- **Severe crowding patients** predominantly required a full week (60% on Day 7) to achieve adequate separation.

DISCUSSION

My research aimed to find an association between the severity of crowding and the time required to create sufficient interproximal space for molar band placement using elastomeric separators. After the selection of a patient for orthodontic treatment,[12] record completion, and case discussion, the next step is to pass the separators in interproximal areas where we need band placement. Stainless steel bands with 0.16mm thickness need space between teeth. There are a number of types of separators we use according to the material, like steel spring clip separators, brass wire separators, or elastomeric separators. The most efficient type is elastomeric separators. After passing elastomeric separators by using separating pliers, we give the next appointment to the patient because it takes time for the separators to create space by pushing the adjacent teeth. The time required depends upon multiple factors like periodontal health, tooth shape and size, bone loss, skeletal pattern, tightness of contact point, and occlusion.

The contact point surface area tightness is one of the major factors affecting the time for creating space between teeth. The tighter the contact point, the longer the time required. The longer the next appointment of the patient. My study results indicate that the mild and moderate crowding groups require less time compared to the severely crowded group to create enough space.

The study results showed that patients with severe arch length discrepancies took more time for space creation as compared to the mild and moderate groups. After 2 days of appointment out of 20, only 2 patients with severe crowding presented with the required space created. While within the same duration mildly crowded group showed 80% positive results. These results indicate that our hypothesis was 100% correct.

Previous studies have shown that almost 0.2mm to 0.5mm interproximal space can be created within one to two days by using elastomeric separators.[13,14] This is one of the biggest advantages of these separators. De-La-Rosa-Gay et al. also emphasize the importance of the choice of separator and the time required to create enough space for stainless steel band placement.[15] These bands are indicated in cases where both buccal and lingual attachments are needed during treatment or where heavy extraoral forces like headgear have to be applied, or where heavy restorations are present in teeth, etc. Otherwise, buccal tubes can also be used instead of bands.

There are lots of previous studies on the topic of the association between the type of separators and patients' discomfort, the association between effectiveness and the material of separators.[16,17] But very limited attention has been paid to the effect of malocclusion on the time required for the separation of teeth. Our study's main purpose was to assess the time duration required for space creation, and also to help in scheduling the next appointment for the patient.

Previous studies have shown that brass wire or steel spring clip separators exert continuous force and produce faster results as compared to elastomeric separators.[18] If the patient presents with severe crowding, and as our study reveals that it will take a longer time to create space for bands, then we can shift to another type of separator, like a brass wire or steel spring clip separator. The other option is to counsel the patient about a slightly longer duration of treatment.

Lew KK and Soh G worked on finding a relation between patients' discomfort level during space creation by using elastomeric separators.[19] After activation of orthodontic appliances, the patient feels pain and discomfort for the first 3 days. There are areas of compression and tension of the periodontal ligament fibers in the root. There are areas of apposition and resorption of bone. In the same way, after passing separators between teeth patient feels pain, which usually continues for one to two days. The patient is advised to take medicine during these days to relieve this discomfort. Greater severity of crowding is associated with delayed space achievement, which should be considered when planning the initial phase of orthodontic treatment.

Crowding in arches develops when there is not enough space in the jaws to accommodate all teeth. Despite its contributions, this study has some limitations. First, it did not account for other anatomical or biological factors such as tooth morphology, bone density, or root angulation, which could also influence the rate of separation.[20] Second, the sample size was relatively small and limited to a single institution, which may affect the generalizability of the findings. Future multicenter studies with larger samples and longer follow-up periods could offer more comprehensive insights. Additionally, comparing different types of separators within each crowding group could be an area for further investigation.

CONCLUSION

The degree of crowding has a direct impact on the time required for space creation with elastomeric separators**.**

LIMITATIONS / SHORTCOMINGS

This study did not consider anatomical or biological factors such as tooth morphology, bone density, or root angulation, which may also influence the time required to create space for band placement. Additionally, the single-institution sample limits the generalizability of the results.

SUGGESTIONS / RECOMMENDATIONS

Future multicenter studies with larger samples and longer follow-up periods could offer more comprehensive insights. Additionally, comparing different types of separators within each crowding group could be an area for further investigation.

CONFLICT OF INTEREST / DISCLOSURE

There is no conflict of interest related to the conduct or publication of this study. No financial or personal relationships influenced the research outcomes.

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