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Perception of pain and discomfort during tooth separation

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Objectives: To evaluate patients' perceptions of pain and discomfort during tooth separation and to compare the effectiveness of brass wire and elastomeric separators.

Methods: The participants were 87 adults with a mean age of 22.1 ± 1.9 years. Elastomeric and brass wire separators were inserted mesial and distal to upper right (elastomeric separators) and upper left first molars (brass wire separators) in each subject. After seven days, the amount of tooth separation was measured with a leaf gauge, and pain perception and discomfort were evaluated with a visual analogue scale and questionnaire.

Results: The elastomeric separators produced significantly more separation than the wire separators. There was a statistically significant difference in the subjects' perceptions of pain and discomfort at rest and during chewing between the different separators ($p < 0.001$). In general, the brass wire separators caused the greatest pain and discomfort immediately after insertion. Pain from the wire separators subsided over seven days, whereas elastomeric separators caused the greatest pain on the first two days after insertion. Eating was negatively influenced by the separation in 61 per cent of the subjects on the first day. On the other hand, other daily activities were affected minimally.

Conclusions: The different levels of pain and discomfort caused by these separators, together with their advantages and disadvantages, can help the clinician to choose an appropriate separator. Patients should be warned that pain due to separation may affect their chewing, social life, school work and sleeping. Analgesics and soft food are recommended following placement of separators.

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Introduction

Separators are usually placed prior to banding to lessen the pain and discomfort of banding, prevent injury to both hard and soft tissues and ensure that a band fits the tooth.[1] Separators are also used to disimpact partially erupted teeth,[2,3] to create space for safe interproximal reduction of adjacent teeth[4] and to gain space for crown restorations.[5,6] To comfortably seat a band, the space between adjacent teeth should equal the average width of the periodontal ligament (approximately 0.25 mm).[1,7,8] When a molar band is seated without adequate separation the root may contact the alveolus, produce 'hyalinised' areas in the periodontal ligament (PDL) and cause pain.[9–11]

Different types of separators are available, and they vary in the amount of pain they cause during separation, their effectiveness in separating teeth and maintenance of the separation gained.[1] Some separators, such as brass wire separators and separating springs, are inclined to irritate the buccal mucosa and make tooth cleaning more difficult than other types of separators. Separating springs and elastomeric separators are more easily placed and removed than brass wire separators, but they can loosen and fall out.[1,8,12–14] Because serious periodontal problems can arise if an elastomeric separator is pushed into the interproximal space,[1,14,15] radiopaque and brightly coloured elasto-meric separators should be used. Furthermore, elastomeric separators that remain in place can be uncomfortable for up to a week.[7,16,17]

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Figure 1. Measurement of the tooth separation with a leaf gauge.

Although the pain and discomfort experienced by patients during tooth separation can vary widely, they are the main patient complaints at the start of orthodontic treatment and can discourage some patients from seeking treatment and others from continuing with their treatment.[7,16–25] The aims of this study were to determine patients' perceptions of pain and discomfort during tooth separation and to compare the effectiveness of brass wire and elastomeric separators.

Materials and methods

Following ethical approval, 100 adults with an age range of 18 to 25 years volunteered to participate in this study. Informed consent was obtained from all subjects. The inclusion criteria were: healthy periodontium, no missing or extracted upper teeth, no upper midline diastema, no orofacial pain, no interproximal caries or restorations, fully erupted upper second molars, tight mesial and distal contact areas on both upper first molars. The tightness of a contact point was confirmed by the failure to pass a leaf gauge (Huffman Dental Products L.L.C., Springfield, OH, USA) between the upper first molars and the adjacent teeth (Figure 1).

Before placement and after removal of the separators, the Gingival and Plaque Indices and the depths of the gingival sulci around both upper first molars were measured. The separators used were a 0.022 inch brass wire separator (Dynaflex, Saint Ann, MO, USA) and an elastomeric separator (Ormco, Glendora, CA, USA). The elastomeric separators were inserted around the mesial and distal contact areas of the upper right first molars using universal separation pliers (AEZ, Ormco, Glendora, CA, USA), and the brass wire separators were placed around the mesial and distal contact areas of the upper left first molar and tightened using a Matthiew plier. All separators were placed by the same investigator. The brass wire separators were not reactivated during the observation period.

Each subject was given a worksheet containing a visual analogue scale (VAS) and a questionnaire and asked to assess their perception of pain and discomfort at rest and during chewing before insertion of the separators (TB), immediately after insertion of the separators (T0), 4 hours after insertion (T04) and then daily for 7 days. Each subject was asked to record the level of pain for each time period and answer questions on the impact of any pain and discomfort from the separators on their chewing, social life, school work and at night. The questionnaire required fixed answers. The VAS was anchored at the ends by the descriptors, 'No pain' and 'Extreme pain' and the subjects were asked to mark the scale according to how they perceived the severity of the pain. The right and left molars were scored separately for perceived pain levels. A score was obtained by measuring the millimetre distance of a mark made by the subject from the left end of the scale (i.e. the 'No pain' end of the scale). On the seventh day the amount of tooth separation was measured with the leaf gauge.

The replies were evaluated with NCSS 2007 software for Windows. The means and standard deviations at each time period were calculated and ANOVA was used to compare the measurements at each time point. Post-hoc Newman Keuls multiple comparisons tests were used for pair-wise comparisons, the paired *t*-test was used in the assessment of pain before and after the insertion of the separators and Student's *t*-test was used to compare the separator groups. Statistical significance was set at $p < 0.05$.

Results

A total of 13 subjects were excluded from the study. Of these, nine subjects lost their elastomeric separators, three used analgesics and one subject did not complete the worksheet. No brass wire separators were lost. The mean age of the remaining 87 subjects (32 males, 55 women) was 20.1 ± 9 years. As there

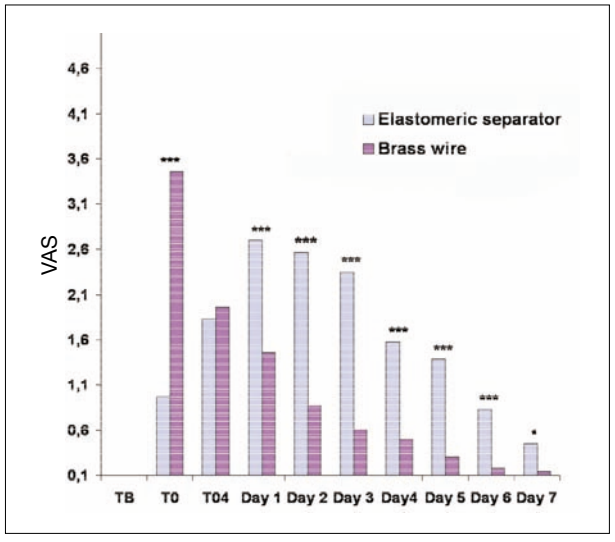

Figure 2. Mean pain scores (VAS) at rest (*, $p < 0.05$; ***, $p < 0.001$).

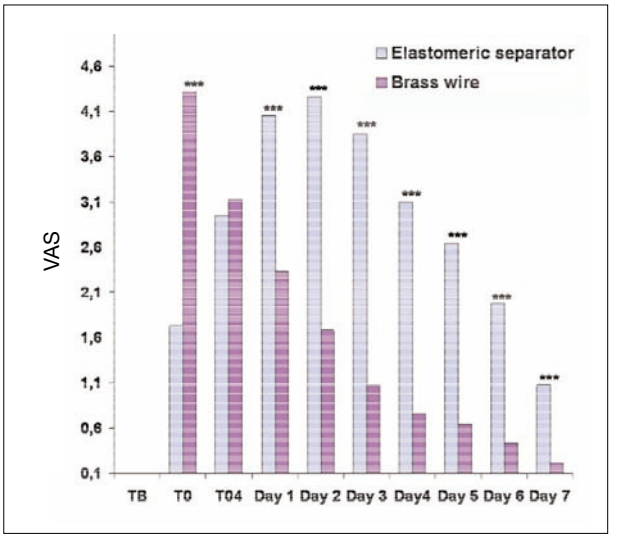

Figure 3. Mean pain scores (VAS) during chewing (***, $p < 0.001$).

Table I. Separation obtained with elastomeric and brass wire separators.

Amount of separation (mm)	Brass wire separator	Elastomeric separator	*p*
Mesial	0.16 ± 0.07	0.24 ± 0.08	**< 0.001**
Distal	0.17 ± 0.07	0.29 ± 0.1	**< 0.001**

Statistically significant differences in bold

Table II. Subjects adversely affected by tooth separation.

	Chewing (%)	Social life (%)	School work (%)	Night pain (%)
T04	59	6	1	1
Day 1	61	14	10	6
Day 2	60	14	7	5
Day 3	51	9	6	-
Day 4	40	4	2	-
Day 5	30	2	1	-
Day 6	9	1	1	-
Day 7	1	1	-	-

were no gender differences in the amount of tooth separation after 7 days, in the subjects' perceptions of pain or the plaque and gingival scores, the data from the males and females were combined.

The elastomeric separators produced significantly ($p < 0.001$) more separation (0.24 ± 0.08 mm and 0.29 ± 0.10 mm on the mesial and distal contact points, respectively) than the brass wire separators (0.16 ± 0.07 mm and 0.17 ± 0.07 mm on the mesial and distal contact points, respectively) (Table I).

There were statistically significant differences ($p < 0.001$) in the subjects' perceptions of pain at rest from the two types of separator for the whole week except T04 and T7. The brass wire separators produced the highest pain and discomfort levels immediately after the insertion (Figure 2). The pain levels from both separators gradually diminished over the 7-day observation period and approached baseline levels on the seventh day. Elastomeric separators were significantly less painful than the brass wire separators immediately after the placement ($p < 0.001$), but resulted in significantly more pain than the brass wire separators between day 1 and day 7. The reduction in pain from both separators followed a similar pattern from day 1.

During chewing, the brass wire separators were significantly more painful than the elastomeric separators immediately after insertion ($p < 0.001$) (Figure 3). By the fourth hour, there was no significant difference between the two separators ($p > 0.05$), but from day 1 to day 7 the elastomeric separators were significantly more painful than the brass wire separators. The elastomeric separators were most painful two days after insertion ($p < 0.001$), thereafter, the

pain from these separators subsided, but it failed to reach the baseline level by day 7.

Approximately 5 per cent of the subjects reported that elastomeric separators were painful for the first two nights after insertion, whereas the brass wire separators were not painful at night. Table II gives the percentage of subjects influenced by tooth separation in their daily activities. More than half of the respondents considered their eating habits were negatively influenced by the separation from insertion to day 3. By day 7, only one per cent had changed their eating habits because of the separation. On day 1, school and social activities were adversely affected by the pain associated with tooth separation in 10 and 14 per cent of the subjects, respectively. There was no statistically significant difference between the plaque and gingival scores of the molars with brass wire separators and those with elastomeric separators.

Discussion

For many patients placement of separators marks the start of their orthodontic treatment, which they have been told will be free of pain and discomfort. The findings of our study show that in young adults the pain from tooth separation can last up to seven days, and for the first few days the pain and discomfort will adversely affect the daily activities of approximately one third of them. Brass wire separators were initially more painful than elastomeric separators, but the pain from the elastomeric separators lasted longer and elastomeric separators were more likely to be lost than wire separators.

The view that gender is an important predictor of pain during tooth separation is controversial. Some studies have reported more girls report discomfort and pain associated with orthodontic treatment than boys,[17,23] whereas other studies failed to find any correlation between gender and the pain associated with tooth separation.[7,16] A further study reported non-linear relationships exist between the pain after insertion of separators and placement of initial archwires and gender, age, psychological state and cultural background.[18] We found there were no differences between males and females in the perception of pain and discomfort and the amount of tooth separation. In agreement with Hoffman,[1] we found elastomeric separators consistently produced more tooth separation than brass wire separators, but the difference was small (0.10 mm) and not clinically significant. Bondemark et al.,[7] who compared the effectiveness of elastomeric and spring separators, also found a statistically significant difference of only 0.10 mm and concluded that it was not important clinically.

Davidovitch and coworkers examined the duration of separation and on the initial tightness of contact points, and reported that less space was gained when the contact points were tight.[8] Providing they stay in place, elastomeric separators produce more tooth separation than other types of separators, and should be used in patients with tight initial contact points.[1,7,13] On the other hand, elastomeric separators may cause a localised periodontitis, particularly when they are displaced interproximally, and bacteraemia which contraindicate their use in patients with systemic disorders.[1,14,15,22,26]

Almost 10 per cent of the subjects with elastomeric separators lost their separators in the first week. We recommend that brass wire separators are used if a patient is unable to attend for banding within a week. Although the brass wire separators produced less tooth separation and may need to be reactivated to ensure there is sufficient space for banding, they stayed in place and were less painful than elastomeric separators.[1,8] Previous studies have reported that orthodontic patients experience varying degrees of pain during treatment even after a simple procedure such as separation.[7,8,16,19–22] The pain/discomfort usually starts within 4 hours of a separator being placed, increases over the next 24 hours and subsides to the pre-placement level within 7 days. Elastomeric separators were, however, an exception: they were painful and adversely affected patients' daily activities for seven days. To avoid the discomfort experienced with elastomeric separators we support Davidovitch's recommendation that elastomeric separators are used for short periods of time.[8] Davidovitch et al.[8] also suggested that if a separator is lost, regardless of the type, the patient should be asked to return 3 to 4 hours before his/her appointment and the separator replaced.

We used a VAS to assess the pain and impact of separator-induced discomfort on daily activities, such as eating, social interaction and sleeping. The VAS is an established method for assessing response to pain/discomfort and has several advantages over a descriptive rating scale. A subject can scale his/her response to a changing pattern of pain/discomfort and in this respect it is of value when assessing pain/discomfort in individuals. Comparisons of responses

by groups should be regarded with caution. Identical scores by different individuals at the same time, or even by the same individual at different times, do not permit us to make assertions about the quality of the perceptions of pain/discomfort: identical scores may have quite different meanings. The unmarked scale we used lacked a neutral point so a subject did not know where the range changed from 'mild pain' to 'mild no pain'. Scores in the middle zone could have been due to uncertainty, distractions or even lack of interest on the part of the respondent. The majority of subjects reported discomfort to some degree, but it had a very small impact on their daily life. Of the daily activities, 60 per cent of the subjects considered their eating was most affected four hours after placement of a separator and on the first and second days. These results agree with previous studies of the discomfort following insertion of separators and placement of orthodontic appliances.[7,23] We recommend that analgesics are prescribed at the time of insertion of separators and patients advised to change their diet to soft food in the first 2 to 3 days after placement of separators. Good oral hygiene is important because separators can cause significant bacteraemia and a localised periodontitis.[15,26] Unlike Hoffman we did not find any difference in the accumulation of plaque around the first molars. Therefore, the standard of oral hygiene is not a criterion for the clinician when deciding on the type of separator to use.

Conclusions

Patients should be warned that tooth separation can be painful and the pain/discomfort may affect their chewing, social life, school work and sleeping. Analgesics and soft food are recommended following placement of separators.

The elastomeric separators were found to be more painful than the brass wire separators.

Both types of the separator were most painful during the first 2 days.

There was no difference in the effectiveness of the separators to separate upper first molars with tight interproximal contacts.

Elastomeric separators were more likely to be lost than brass wire separators.

The advantages and disadvantages of each separator should be considered when choosing an appropriate separator.

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