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Growth and Treatment Changes Distal to the Upper and Lower First Molars: Holding the E-Spaces *vs* Extractions of Upper First and Lower Second Premolars

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Abstract

Aim: This study was designed to examine the three-dimensional changes in the positions of the upper and lower first molars, following two different contemporary treatment methods.

Method: Retrospective records of 82 fixed appliance orthodontic patients were divided into two groups. In one group, 43 patients had been treated with upper first and lower second premolar extractions, with no deliberate attempt to hold the upper or lower molars back other than for individual anchorage requirements. In the other group, 39 patients had been treated by holding the E-spaces, with definite attempts to limit the forward movement of the maxillary first molars with utility arches and headgear. Follow-up written treatment records and radiographs were also examined to determine whether mandibular third molars, if initially present, were ultimately extracted or retained.

Results: The results confirmed that treatment methods involving the holding of E-spaces do tend to limit the amount of forward movement of the first molars, whereas treatment involving the extractions of upper first and lower second premolars tends to result in some forward movement of the first molars during planned movements and space closure.

Conclusions: Such a difference in molar movement is likely to significantly influence the amount of space available for the eventual favorable eruption of the second and third molars. The results also suggested that, within premolar extraction groups, the amount of growth occurring during and after treatment is likely to play the most significant role in determining the space available for eventual third molar eruption.

Introduction

Orthodontic treatment that involves the distalization or the holding back of molars, aimed at somehow creating space in the anterior part of the arch and preventing the extractions of premolars, tends to create a space deficiency in the posterior region of the arch. This may have a significant effect on the developing second and third molars [1]. Although third molars are generally the last teeth to develop and are located at the posterior limits of the dentition, the eruption or impaction of these teeth is an important consideration for the orthodontist in treatment planning and long-term maintenance of the dentition [2]. Many factors can influence the eruption potential of the third molars, however it has been established that the eruption of third molars is primarily dependent upon the space available in the posterior regions of the arch. This, in turn, is influenced by an increase in mandibular length, remodelling resorption at the anterior border of the mandibular ramus and a forward eruptive trend in the mandibular dentition [3-6]. In the maxilla, posterior space or arch-lengthening is essentially created by periosteal apposition at the posterior borders of the maxillary tuberosities [7,8].

Several previous authors have suggested that so-called 'non-extraction' orthodontic treatment, which involves the holding-back or posterior up righting, tipping or translation of the first and second molars may actually limit the amount of posterior arch space. This, in turn, may lead to the impaction of the third molars [9-12]. Such treatment would include the distalization of the maxillary posterior teeth with a headgear [13-16] or other so-called "non-compliant" appliances, [17-22] or the preservation of Leeway spaces with the use of lingual arches, [23-25] utility arches, [12,26] or lip bumpers [27-29]. Other authors have found that the prevalence of third molar impaction is reduced after extractions of premolars [30-33] or other teeth, [34-36] due to the likely mesial movement of the molars as a result of consequent space closure. In contrast to these findings, others have concluded that the removal of first premolars does not, itself, directly improve the overall chances of eruption of third molars [37,38].

In more recent studies the effects of specific extraction and non-extraction treatments on the ultimate space conditions at the posterior ends of the arch have been assessed [39-41]. The results of these studies would suggest that lower second premolar extractions may well reduce the frequency of later third molar impaction [41] while non-extraction approaches seem to lead to the likely impaction and eventual extractions of the third molars [39,40].

With all this in mind, this study was designed to determine

- If there are any predictable differences in the combined growth and treatment space changes distal to the upper and lower first molars in orthodontic patients treated either with the extractions of upper first and lower second premolars or without premolar extractions, by holding the so-called 'E-spaces;'
- If such extraction treatment improves the chances of third molar eruption, and
- Which, if any, factors might significantly influence third molar eruption and impaction.

Materials and Methods

Study sample

The study sample consisted of pre and post treatment lateral cephalograms and study casts of 82 patients, treated by one experienced orthodontist with pre-angulated Edgewise appliances. Human research ethics approval for this retrospective study was obtained from the Departmental Advisory Group of the University of Melbourne (DHEAG no: 1033996). Patient records were selected retrospectively at random from completed cases to make up each sub-sample as follows:

Forty-three patients (23 males and 20 females) had been treated with upper first and lower second premolar extractions (4/5s). Thirty-nine patients (17 males and 22 females) had been treated without premolar extractions by holding the E-spaces. In all these E-space patients, the upper and lower primary second molars were present at the commencement of treatment. Utility (4 × 2) arches and cervical pull headgear were subsequently placed, as necessary. No other adjunctive appliances, such as trans-palatal arches or rapid maxillary expanders, were used in any patient. Inter-arch elastics were used as necessary in both groups of patients.

The mean ages at commencement of treatment and the duration of treatment for various groups are presented in Table 1. The mean female and male ages at commencement of treatment were 12.5 years and 13.0 years respectively. On average, the subjects in the E-space groups for each gender were considerably younger at commencement than those in both premolar extraction groups.

Occlusal and cephalometric analysis

The study cast measurements used in this study are listed in table 2 and illustrated in figures 1 and 2. A digital calliper (Mitutoyo Digimatic Calliper) was used to measure distances between various occlusal landmarks. The amount of crowding was not simply estimated from the pre-treatment study casts. The space required for alignment and leveling was determined from comparison of the pre and post-treatment casts using the segmental method of Proffit and Fields [42].

The cephalometric measurements used in this study are listed in table 3 and illustrated in figures 3 and 4. All cephalograms were taken using the same calibrated cephalostat and were traced under the same viewing conditions, in a darkened room. Measurements were made using WestCef software (a customised research cephalometric analysis program written for the University of Melbourne by Mr. Geoffrey West) which automatically rotates the digitized landmarks so that the pterygomaxillary line [8,12,43] through sphenoethmoidale is in fact

Table 1: Age at commencement of treatment and duration of active treatment.

Group	n	Age at commencement of treatment (years)		Duration of active treatment (years)	
		Mean	SD	Mean	SD
Total sample	82	12.8y	1.2y	2.4y	0.6y
Total E-spaces	39	11.9y	1.3y	2.4y	0.5y
Males	17	12.0y	1.5y	2.5y	0.6y
Females	22	11.9y	0.9y	2.4y	0.5y
Total premolar extractions	43	13.6y	1.3y	2.2y	0.5y
Males	23	14.1y	1.5y	2.2y	0.6y
Females	20	13.1y	0.9y	2.2y	0.4y

Table 2: Study cast measurements.

No.	Measurement	Definition
1	Overbite (mm)	Vertical overlap of the maxillary and mandibular incisors measured perpendicular to the occlusal plane
2	Overjet (mm)	Horizontal distance between the maxillary and mandibular incisors measured parallel to the occlusal plane
3	Crowding (mm)	Space required for the relief of crowding and levelling, calculated using Proffit and Fields' segmental method i.e., by subtracting the pre-treatment segmental total from the posttreatment segmental total, then adding it back into the mesiodistal widths of the 2 extracted premolars
4	Chordal arch length (mm)	Distance from the mesial contact points of the first molars to the contact point of the central incisors
5	Arch depth (mm)	Perpendicular distance from the line joining the mesial contact points of the first molars to the contact point of the central incisors
6	Interpremolar width (mm)	Horizontal distance between the palatal cusp tips of the most anterior maxillary premolars-Maxilla Only
7	Intercanine width (mm)	Horizontal distance between the tips of the mandibular canines-Mandible Only
8a	Intermolar width (mm)	In the Maxilla-Horizontal distance between the mesiopalatal cusp tips of the maxillary first molars
8b		In the Mandible-Horizontal distance between the mesiolingual cusp tips of the mandibular first molars
9	Arch segments (mm)	Distance between the lines perpendicular to the contact points of a segment of teeth; between the first molar and the distal surface of the lateral incisor and between that distal surface and mesial surface of the central incisor
10	Molar relationship (mm)	Distance between the mesiobuccal cusp tip of the maxillary first molar and the buccal groove of the mandibular first molar measured parallel to the occlusal plane

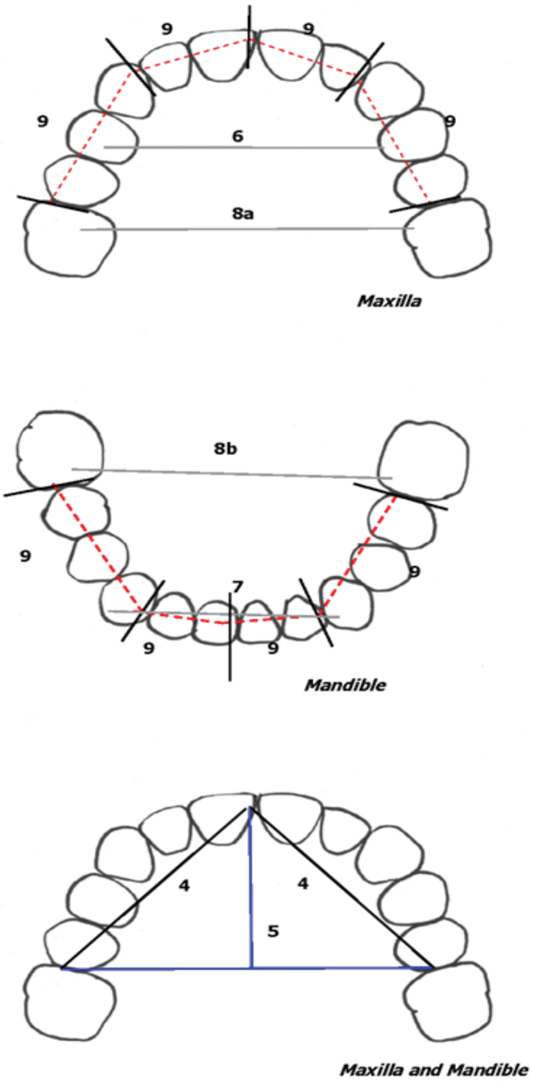

Figure 1: Arch Dimensional Measurements.

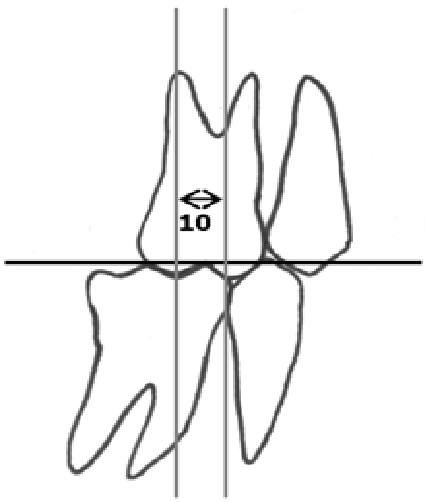

Figure 2: Molar Relationship.

Table 3: Cephalometric measurements.

No.	Description	Landmarks
11	MPA (deg)	Mandibular Plane angle
12	U6-ANS, PNS (mm)	Vertical distance between U6 mid-occlusal point and the palatal plane
13	U6 Horiz (mm)	Distance between U6 distal point and PM line
14	11,21 Horiz (mm)	Horizontal distance between 11,21 incisal edge and PM line
15	11,21 Angle (deg)	Angle formed by the intersection of the long axis of the maxillary incisor and SE perpendicular line
16	U6 Angle (deg)	Angle formed be the intersection of the long axis of the maxillary first molar (line between mid-occlusal point and furcation) and a perpendicular to the PM line
17	ML (mm)	Distance between articulare and pogonion
18	L1/MP Angle (deg)	The angle formed by the intersection of the long axis of the lower incisor and the mandibular plane
19	Xi-Symph (mm)	Distance from Xi point to the most distal point on the inner lingual cortical contour of the symphysis measured along corpus axis
20	L6-Symph (mm)	Distance from the distal of the mandibular 1st molar to the most distal point on the inner lingual cortical contour of the symphysis measured along corpus axis
21	ABR-Symph (mm)	Distance from deepest point of the anterior border of the ramus to the most distal point on the inner lingual cortical contour of the symphysis measured along corpus axis

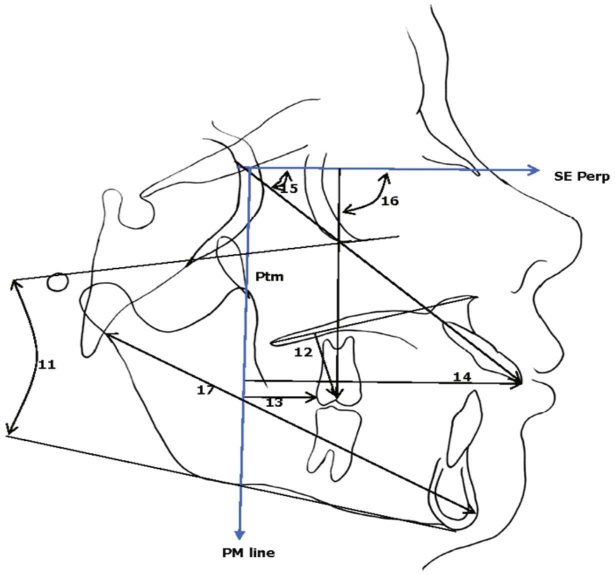

Figure 3: Cephalometric Measurements.

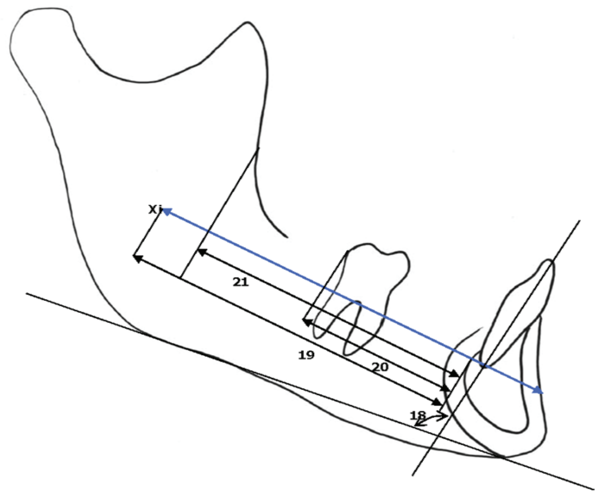

Figure 4: Cephalometric Measurements.

vertical. Absolute horizontal and vertical distances between maxillary landmarks were then measured using the X and Y co-ordinates of the landmarks. Mandibular space changes were measured along Ricketts' corpus axis [31] by first drawing a tangent from the landmark of interest, perpendicular to the corpus axis. Measurements were then made relative to an offset point tangent to the inner lingual cortical contour of the mandibular symphysis. This had previously been shown to be a stable reference structure by Bjork A, et al. [6].

Statistical analysis

Mean changes for all cephalometric and study cast measurements were calculated. Analysis of variance was then used to identify any statistically significant differences in the mean changes between the growth and treatment groups. In two previous studies, [39,40] a logistic regression model was used to analyse the various pre-treatment measurements in all study subjects. The score arising from this logistic regression was used to assess the propensity for one or other treatment to have been chosen. The subjects chosen for final analysis in those studies were those in whom the propensity score overlapped. The propensity score was essentially used in those studies to remove bias from the selected sample by reverse-engineering the clinician's decision whether to treat a particular patient with either method because of certain pre-treatment characteristics, such as different underlying vertical muscular patterns [44,45]. Analysis of variance (ANOVA) was then carried out for the changes in each clinical variable, after adjustment for the propensity score.

A similar logistic regression model was used for this study to obtain propensity scores from the pre-treatment cephalometric and study cast arch-dimensional data. In contrast to the previous studies, however, minimal overlap (only 4 patients) was found between the two groups. This meant that the two groups were distinctly different in their pre-treatment characteristics. They were therefore considered as two different samples with different treatments having been assigned according to the presenting pre-treatment characteristics. The main focus of this study was on the likely residual post-treatment distance between the ramus and the first molar, and first molar and the symphysis. After first considering what differences in measurement might be considered clinically significant (eg. 3 to 4 mm, with a standard deviation of approximately 2 mm), relevant sample sizes (36) were identified, according to the power calculations described by Pandis N [46]. In this case, all available cases were then included in the study (39 E-spaces, 43 premolar extractions) [46] Analysis of variance (ANOVA) was then carried out for changes in each clinical variable, allowing for comparison of treatment effects in these two groups.

Eventual fate of the mandibular third molars

Following the analysis of space changes occurring in the maxilla and mandible with combined growth and treatment, an assessment was made of the relationship existing between successful eventual third molar eruption or full or partial impaction and either treatment method. This sample consisted of retention and follow-up radiographs and written clinical notes for all patients. A total of 64 patient records were included in this part of the study -34 from the premolar extraction group (16 females and 18 males) and 30 from the E-space group (18 females and 12 males). The follow-up radiographs were taken a minimum of four years after the removal of fixed appliances. In this sample, mandibular third molars were apparently extracted if they became impacted, with or without partial eruption. Since it had been difficult to obtain complete follow-up data of all patients because some had failed to return during retention while the third molars were still being monitored, it was decided to quantify the total number of mandibular third molars present in each treatment group. Third molars present before the commencement of treatment were classified at follow-up as either 'extracted', 'definitely kept' or 'unknown'. The 'unknown' category included the following situations: (a) the clinician had anticipated in writing through the retention period that the patient would keep their third molars but they had not been formally discharged from treatment; (b) the clinician was undecided about the fates of the third molars; or (c) where the patient did not return during retention. A conservative statistical analysis was then made using Fisher's exact test, by dividing these results into "definitely kept" and "not definitely kept".

Using the available data from the premolar extraction group, a two-sample t-test was carried out to assess which measurements seemed to have had some influence on third molar outcomes. The premolar extraction group was divided into two groups: those patients in whom the third molars had been extracted and those in whom the third molars had erupted favourably.

Error study

In order to determine measurement error, 20 randomly-selected study cast and cephalometric measurements were repeated one month later. The standard measure of error as described by Dahlberg and the coefficient of reliability were calculated [47,48]. This analysis showed that there were no clinically significant differences between the two sets of measurements at the 95% confidence level.

Results

Arch dimensional changes

Mean arch dimensional changes for the E-space and extraction groups are presented in tables 4 and 5. No statistical evidence of sexual dimorphism was found. Both maxillary and mandibular arch depths and chordal lengths showed significantly greater mean reductions in the extraction groups than in the E-space groups. While significant mean reduction in intermolar width was observed in the extraction groups, there was a small mean increase in the E-space groups. In the maxillary arch there was a mean increase in interpremolar width in both treatment groups. The mean amount of pre-treatment crowding was significantly greater in the extraction groups.

Table 4: Mean maxillary arch dimensional changes with treatment; pre-treatment crowding and molar relationship.

Group	n	Arch Depth (mm)	Chordal Arch Length (mm)	Interpremolar Width (mm)	Intermolar Width (mm)	Initial crowding (mm)	Initial Molar Relationship (mm)
E-spaces	39						
Males	17	-0.5 ± 2.5+	1.4 ± 4.0+	2.0 ± 2.1ns	1.6 ± 2.5+	1.1 ± 3.3+	2.1 ± 1.2*
Females	22	-1.0 ± 2.6+	-0.7 ± 4.8+	0.6 ± 2.4ns	0.5 ± 2.0+	-0.6 ± 4.2+	1.5 ± 1.1*
Premolar extractions	43						
Males	**23**	-6.5 ± 2.5+	-11.5 ± 4.0+	2.5 ± 2.5ns	-2.4 ± 3.2+	3.1 ± 4.5+	0.8 ± 2.1*
Females	20	-5.9 ± 1.7+	-11.0 ± 2.3+	2.4 ± 2.2ns	-3.1 ± 2.5+	2.8 ± 2.2+	0.7 ± 0.7*

Differences in treatment effects between premolar extraction and E-space groups using ANOVA.
(+ p ≤ 0.01, *p ≤ 0.05, ns not significant).

Table 5: Mean mandibular arch dimensional changes with treatment; pre-treatment crowding.

Group	n	Arch Depth (mm)	Chordal Arch Length (mm)	Intercanine Width (mm)	Intermolar Width (mm)	Initial crowding (mm)
E-spaces	39					
Males	17	-0.9+1.9+	-0.6+3.0+	1.5+1.6ns	0.9+2.4+	-0.7+3.0+
Females	22	-1.1+1.9+	-2.0+3.6+	0.9+2.1ns	0.1+1.8+	-2.0+3.3+
Premolar extractions	43					
Males	23	-6.0+2.1+	-11.0+3.6+	-0.3+2.0ns	-3.9+1.8+	3.3+2.6+
Females	20	-5.6+1.1+	-11.0+1.8+	0.3+1.5ns	-3.9+3.4+	3.8+2.3+

Differences in treatment effects between premolar extraction and E-space groups using ANOVA.
(+p<0.01, ns not significant).

Cephalometric changes with growth and treatment

Mean cephalometric changes for the E-space and the extraction groups are presented in tables 6 and 7. No statistical evidence of sexual dimorphism was found with the maxillary measurements. Several mandibular measurements, however, (ML, L6-Symph, ABR-Symp and Xi-Symp) did show sexual dimorphism. For these measurements, there appeared to be significant combined effects of gender and treatment. Mandibular length (ML, ABR-Symp and Xi-Symp) increased on average in all groups, with significantly more growth occurring in males and the E-space groups. On average, the Mandibular Length (ML) increased in all groups, but significantly more in male groups than in female groups, and E-space groups than in extraction groups.

From these tables, it can also be seen that there were significant differences between the groups in measurements relating to the horizontal positions of the upper and lower first molars and incisors. For instance, the upper and lower first molars moved significantly more forward, on average, in the extraction groups than in the E-space groups. Similarly, the upper and lower incisors in the E-space groups moved further forward, on average, while those in the extraction groups moved back.

Eventual fate of the mandibular third molars

From the available follow-up records (Tables 8 and 9), it was found that 100 per cent of third molars had eventually been extracted in the E-space groups. In the premolar extraction groups it was found that 32 per cent of the third molars had definitely been extracted and 24 per cent had definitely been kept. A conservative statistical analysis was made using Fisher's exact test by dividing these results into "definitely kept" and "not definitely kept". However they were assessed, statistically significant differences were found between the E-space and premolar extraction groups (P<0.001) in both male and female groups.

Discussion

As previously described, a logistic regression model was used to first obtain propensity scores. The distribution of these scores revealed that the two groups, E-space and premolar extraction groups were distinctly different in their pre-treatment characteristics and, as such, seemed to have been ideally suited to the treatments which were performed. This data also suggested that the original premolar extraction decision had been influenced by three main variables; mandibular crowding, maxillary incisor position and mandibular incisor position. In this sample of patients, crowding was noted to be the most significant factor in influencing the original extraction decision. This finding is consistent with those of several previous studies [49,50]. It is interesting to note that Shearn BN, et al. [51] also found that differences in underlying vertical facial patterns significantly influenced the extraction sequence decision in the mandible [51]. This was not found to be the case in the present study in which the majority of patients were of average vertical pattern. While this is obviously a retrospective study with no discrete control group, no attempt has been made to separate the effects of growth and treatment in this clinical sample. While this has largely been focused on movements of teeth within the alveolus, it is obvious that the whole maxillary complex moves forward with growth at the tuberosities, so that the distance between the pterygoid plates and the distal surface of the first molar would be expected to increase in both extraction and E-space cases. It is the difference between the likely combined effects of extractions (plus growth) and holding E-spaces (plus growth) that is the main feature of this work.

Table 6: Mean maxillary cephalometric changes with treatment.

Group	n	MPA (deg)	U6-ANS,PNS (mm)	U6 Angle (deg)	U6 Horiz (mm)	11,21 Horiz (mm)	11,21 Angle (deg)
E-spaces	39						
Males	17	1.3 ± 2.0 ns	2.4 ± 1.2 ns	-4.9 ± 6.2 ns	2.4+1.9*	3.2 ± 3.2+	4.8 ± 7.7+
Females	22	0.5 ± 2.1 ns	2.8 ± 1.1 ns	-4.1+6.1 ns	2.0 ± 2.0*	2.2 ± 3.0+	5.3 ± 7.5+
Premolar extractions	43						
Males	23	0.2 ± 2.2 ns	3.4 ± 1.9 ns	-4.5 ± 6.5 ns	4.9 ± 2.1*	-0.6 ± 2.6+	-2.4 ± 6.8+
Females	20	-0.5 ± 2.3 ns	3.0 ± 2.0 ns	-4.7 ± 5.2 ns	4.6 ± 1.7*	-2.4 ± 2.2+	-4.0 ± 4.6+

Differences in treatment effects between premolar extraction and E-space groups using ANOVA.
(+p<0.01, *p<0.05, ns not significant).

Table 7: Mean mandibular cephalometric changes with treatment; pre-treatment mandibular plane angle.

Group	n	ML (mm)	L1/MP Angle (deg)	Xi-Symph (mm)	L6-Symph (mm)	ABR-Symph (mm)	Initial MPA Angle (deg)
E-spaces	39						
Males	17	6.5+3.3*A	1.1+6.7+	5.5+2.9+B	0.3+1.3+B	5.9+3.4+B	26.0+48ns
Females	22	5.7+2.7*A	2.3+5.1+	4.1+2.7+B	1.3+1.7+B	3.3+2.9+B	24.0+5.4ns
Premolar extractions	43						
Males	23	5.1+3.0*A	-4.2+7.2+	3.8+2.5+B	3.3+2.2+B	3.3+2.3+B	26.1+3.9ns
Females	20	3.0+ 1.7*A	-0.2+5.2+	2.1+ 1.8+B	4.0+ 1.8+B	1.2+ 2.1+B	23.7+ 3.8ns

Differences in treatment effects between premolar extraction and E-space groups using ANOVA.
(*p<0.05, +p<0.01, ns not significant).
Differences in gender effects within premolar extraction and E-space groups using ANOVA.
(Ap<0.05, Bp<0.01.

Table 8: Number of third molars eventually extracted or kept in E-spaces and premolar extraction groups.

Group		Total	Definitely Extracted	Definitely Kept	Unknown
Premolar extractions	Male	36	8	12	16
	Female	32	14	4	14
E-spaces	Male	23	23	0	0
	Female	36	36	0	0

Table 9: Percentage of third molars eventually extracted or kept in overall E-spaces and premolar extraction groups.

Group	Definitely Extracted	Definitely kept	Unknown
Premolar extraction	32	26	42
E-Spaces	100	0	0

p ≤ 0.001.

The fact that mandibular length increased during treatment in all groups, with significantly more growth occurring in males and E-space groups is unlikely to be due simply to treatment effects. The patients within the E-space groups were, on average, treated at a younger age than those in the extraction groups, the implication being that a greater amount of mandibular growth may well have occurred during the overall treatment period. The sexual dimorphism may be explained at least in part by the fact that males would generally have more pubertal growth remaining than girls of a similar age, resulting therefore in a greater average amount of measured mandibular growth occurring in the males.

The finding that the reductions in both arch depth and chordal arch length were significantly greater in the extraction groups than in the E-space groups is consistent with those of other authors [51-54] who have also reported such reduction in arch length in extraction patients. The extractions seem to have been mainly related to the amount of pre-treatment crowding in the patients studied. In contrast to the E-space groups, the premolar extraction groups showed a significant mean decrease in intermolar width. This and the observed increase in interpremolar widths in both treatment groups are consistent with previously reported findings [51,54-56].

The trend towards significantly greater forward movement of both maxillary and mandibular first molars in the extraction groups would seem logical, because some mesial molar movement would be expected to occur during residual space closure after initial alignment and correction of anterior tooth positions. It is therefore the individual anchorage requirements in each patient that will determine just how this residual space is managed. This, in turn, will also determine how much posterior arch space is available distal to the first molars [57]. This is consistent with the finding that the mean forward molar movement in the extraction groups seemed to favorably influence the later eruption of the third molars. If this were true, it would confirm the findings of others [30-33,41] including Faubion, [30] who noted that 55 percent of patients in an extraction group retained their mandibular third molars in good position, when compared with only 15 percent of those in a non-extraction group. Consistent with this, Ricketts RM. [31] found a 25 percent increase, on average, in space available for later third molar eruption in patients who had been treated with premolar extractions. Other authors have shown that, although there is considerable individual variation, there is an accepted trend for greater forward molar movement to accompany second rather than first premolar extractions. This, however, would be greatly dependent upon the individual anchorage requirements and methods of anchorage control used during treatment [37,51,54].

From a close assessment of changes occurring in the overall premolar extraction group, it was found that two measurements seemed to separate those mandibular third molars which had either erupted usefully or become partially or totally impacted. These measurements were Xi-Symph and ABR-Symph. This would suggest that both the overall growth of the mandible and resorption at the anterior border of the ramus play important parts in determining the successful eruption or otherwise of third molars in premolar extraction patients, even in those in whom the mean amounts of pretreatment crowding and mesial first molar movement with treatment are similar. Others have also suggested that resorption at the anterior border of the mandibular ramus significantly influences eventual third molar eruption [4,33,58].

Conclusions

Taking into account the limitations of any cephalometric and study cast work, the following conclusions can be drawn:

1. There are likely to be greater increases in the arch space distal to the upper and lower first molars in growing patients treated with the extractions of upper first and lower second premolars than in growing patients treated by holding the E- spaces, without premolar extractions.

2. There is a general trend for forward movement of the first molars to occur following the extractions of upper first and lower second premolars. This, in turn, would appear to result in a clinically-significant reduction in the rate of third molar impaction in patients treated with such premolar extractions, in comparison with patients treated by holding the E-spaces, without premolar extractions.

3. Considerable individual variation is likely to be seen, both in the amount of forward movement of the maxillary and mandibular first molars and in the space increase distal to the first molars, in patients treated with either approach.

4. In many instances, premolar extraction spaces may be used completely during the relief of crowding, leaving little, if any, space available for the forward movement of the molars. Other factors such as the mechanics used, the individual anchorage requirements, the management of any residual space, the final treatment goals for lower incisor positioning and the amount of mandibular growth and anterior border resorption occurring during treatment will all contribute to the actual effects on later third molar eruption or impaction.

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Conflict of Interest

No conflict of interest.

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