REVISTA DE ODONTOLOGIA DA UNESP
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Original Article

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Three-dimensional analysis of dental arch changes after first premolar extractions and en masse or two-step retraction in Class I biprotrusions

Análise tridimensional das alterações da arcada dentária após extração de primeiros pré-molares e retração em massa ou em dois tempos em Classes I biprotrusões

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How to cite: Gandini AS, Furtado TO, Menezes CC, Gandini Junior LG, Brandão HB, Santos-Pinto A. Three-dimensional analysis of dental arch changes after first premolar extractions and en masse or two-step retraction in Class I biprotrusions. Rev Odontol UNESP. 2025;54:e20250019. https://doi.org/10.1590/1807-2577.20250019

Resumo

Introdução: A extração de dentes permanentes, particularmente pré-molares, tem sido objeto de debate na ortodontia centrado nos requisitos de espaço para a resolução da má oclusão e seu potencial impacto no desenvolvimento das arcadas dentárias. **Objetivo:** Este estudo avaliou as alterações dimensionais nas arcadas dentárias superior e inferior após extrações de primeiros pré-molares e fechamento de espaço utilizando retração em massa (EMR) e retração em duas etapas (TSR) em casos de Classe I biprotrusão. **Material e método:** Modelos de estudo de 46 adultos brasileiros pré e pós extração de pré-molares e fechamento de espaço por ERM ou TSR, foram digitalizados em scanner 3D e analisados usando o 3Shape OrthoAnalyzer™. Os parâmetros avaliados incluíram overjet, overbite, distâncias intercaninos e intermolar (nível de cúspide e cervical), comprimento e perímetro de arco. **Resultado:** Não foram observadas diferenças significativas entre EMR e TSR. Ambas as técnicas resultaram em reduções significativas no overjet (0,7 mm) e nas dimensões da arcada, incluindo diminuição nas distâncias intermolar (cúspide: 1,57 mm; cervical: superior 1,74 mm, inferior 1,25 mm) e redução no comprimento de arco (superior: 7,25 mm; inferior: 6,40 mm) e perímetro de arco (superior: 16,17 mm; inferior: 14,5 mm) da arcada. Por outro lado, as distâncias cervicais intercaninos aumentaram (superior: 1,73 mm; inferior: 2,21 mm). **Conclusão:** EMR e TSR produziram resultados comparáveis nas alterações dimensionais dos arcos dentários. A extração de pré-molares com fechamento de espaço manteve o overbite, reduziu o overjet e as larguras intermolar, enquanto aumentou as distâncias cervicais intercaninos. Ambas as técnicas levaram a reduções significativas no comprimento e perímetro de arco.

Descritores: Ortodontia corretiva; imagem tridimensional; modelos dentários; arco dentário; extração dentária.

Abstract

Introduction: The extraction of permanent teeth, particularly premolars, has been a subject of debate in orthodontics centered on the space requirements for resolving malocclusion and its potential impact on the development of dental arches. **Objective:** This study evaluated dimensional changes in the upper and lower dental arches following first premolar extractions and space closure using en masse retraction (EMR) and two-step retraction (TSR) in Class I biprotrusion cases. **Material and method:** Study models of 46 Brazilian adults pre- and post-premolar extraction and space closure by ERM or TSR, were scanned in a 3D scanner and analyzed using the 3Shape OrthoAnalyzer™. The parameters evaluated included overjet, overbite, intercanine and intermolar distances (cusp and cervical level), arch length and arch perimeter. **Result:** No significant differences were observed between EMR and TSR. Both techniques resulted in significant reductions in overjet

(0.7 mm) and arch dimensions, including decreased intermolar distances (cusp: 1.57 mm; cervical: upper 1.74 mm, lower 1.25 mm) and reduced arch length (upper: 7.25 mm; lower: 6.40 mm) and perimeter (upper: 16.17 mm; lower: 14.5 mm). Conversely, cervical intercanine distances increased (upper: 1.73 mm; lower: 2.21 mm). **Conclusion:** EMR and TSR produced comparable outcomes in arch dimensional changes. Premolar extraction with space closure maintains the overbite, reduced overjet and intermolar widths while expanding cervical intercanine distances. Both techniques led to significant decreases in arch length and perimeter.

Descriptors: Corrective orthodontics; three-dimensional imaging; dental models; dental arch; tooth extraction.

INTRODUCTION

The decision to extract permanent teeth, specifically premolars, has been the subject of intense debate in orthodontics and has long represented a crucial issue in orthodontic treatment planning[1-3]. This decision is based on the need for space in the dental arches to align the remaining permanent teeth. Alternatives to premolar extraction have been associated with relapse (instability), risks of bone and gingival recession, and changes in facial aesthetics due to excessive dental volume and protrusion of anterior teeth. Although premolar extractions avoid these negative factors, they are associated with changes in the dimensions of the dental arches, particularly contraction[3-5].

According to Gianelly[1], an undocumented criticism of extraction treatment is that it results in narrower dental arches compared to non-extraction therapy. Edward Angle, in 1907 (apud [6]), suggested that the alignment of the mandibular arch determines the form and alignment of the maxillary arch. The mandibular arch would serve as a model around which the maxillary arch would develop and function. However, in 1925, Lundstrom (apud [6]) emphasized the need to consider the apical base in determining occlusion, later reinforced by William and Laurence Andrews (apud [6]), who termed it the “Walla edge,” representing the dentoalveolar basal limits.

Lee[2] noted that most studies on orthodontic treatment stability and retention have focused on changes in the mandibular arch because most relapses occur in mandibular anterior alignment. Perhaps the assumption that the mandibular arch determines the maxillary arch is incorrect, and the opposite occurs: the mandibular arch adapts to the occlusion of the maxillary arch. If true, relapse in lower anterior alignment could simply be a functional adaptation of the lower arch to the upper arch, which would then be more stable. Consequently, the two arches may behave differently after orthodontic treatment, and the size and shape of the dental arches have significant implications for diagnosis and treatment planning, affecting space for permanent teeth, dentofacial aesthetics, and dental stability.

The objective of this study was to evaluate the dimensional changes in the upper and lower dental arches after treatment involving extraction of four first premolars and space closure using two protocols: en masse retraction (EMR) and two-step retraction (TSR), utilizing digital technology. Specific objectives included evaluating overbite, overjet, intercanine and intermolar distances, as well as arch perimeter and length before and after treatment.

MATERIAL AND METHOD

This study analyzed a set of 46 patients from a 2010 randomized clinical trial, consisting of 46 participants aged 18 to 34 years with Class I biprotrusion malocclusion and crowding of 4 to 6 mm in the upper and lower incisors, requiring extraction of all four first premolars. All patients had similar initial skeletal and dental characteristics[7]. Participants were randomly assigned to two groups in a 1:1 ratio based on the space closure protocol following the extraction of the upper and lower first premolars: en masse retraction (single-step retraction of anterior teeth) and two-step retraction (complete canine retraction followed by retraction of the remaining anterior teeth) (Table 1). All patients used straight-wire appliances with .022” slots, Roth prescription, InOvation (GAC, Bohemia, NY, USA).

Table 1. Sample composition

Group	Sex	n	Age (years)	SD	Min	Max
En Mass Retraction (EMR)	Female	13	23.9	3.8	19	32
	Male	9	23.5	2.8	19	28
Two-Step Retraction (TSR)	Female	16	22.1	5.1	17	34
	Male	8	21.6	3.3	17	28

The research was approved by the Ethics Committee of the Araraquara School of Dentistry, UNESP nº 01/09 e CAAE: 59098622.3.0000.5416 Revisão 7.122.659, and patients who agreed to participate signed the Informed Consent Form.

After the installation of fixed orthodontic appliances from second molar to second molar, the arches were aligned and leveled until a 0.020” steel wire was achieved. The extraction of the four first premolars was performed, and space closure began 7 to 14 days later. In Group 1 (en masse retraction), the second molars, first molars, and second premolars on each side were tied with a 0.25 mm ligature, and 0.017” x 0.025” steel wires were inserted for one-stage retraction. In Group 2 (two-step retraction), the same teeth were tied with a 0.25 mm ligature, and for two-stage space closure, 0.020” steel wires with omega loops mesial to the first molar tubes were used. No additional anchorage systems were employed. For Group 1 retraction, 200 g NiTi springs (GAC, Bohemia, NY, USA) were used, while for Group 2, 100 g NiTi springs were used during the two-stage retraction. Both groups had springs stretched to 17 mm (approximately 2.5 times the original size) from end to end, reactivated every 4 to 5 weeks to maintain elongation. For Group 1, the springs were tied from the cervical hook tubes of the first molars to hooks soldered to the arch between the lateral incisor and canine, with all anterior and posterior teeth tied with a 0.25 mm ligature. For Group 2, the springs were tied from the cervical hooks of the first molars to the canine bracket hooks to avoid interference with sliding. After canine retraction and full contact with the second premolar, the canine was tied to all posterior teeth, and anterior retraction began after a three-month interval. In the second stage, retraction of the four incisors was performed, all tied with a 0.25 mm ligature, with springs from the cervical hooks of the first molars tied to hooks soldered to the arch distal to the lateral incisor.

From the complete orthodontic diagnostic and planning records of these participants, pre-treatment and post-treatment study models were selected, which included all permanent teeth up to the upper and lower second molars, intact, with good anatomical reproduction and no bubbles, deformations, breaks, wear, or any other interference in their reproduction. Study models of all participants in group 2 (n=24) were included and of all participants in group 1, except for two participants who did not meet these inclusion criteria for failures in the reproduction of teeth (n=22). The study models were digitized using laser scanning with the 3D R700 Scanner (3Shape, Denmark) and analyzed using the 3Shape OrthoAnalyzer™ Advanced Orthodontic Diagnosis and Treatment Planning software. The digital models were evaluated for overjet, overbite, intercanine distance (cusp/cervical), intermolar distance (mesiobuccal cusp/cervical), arch perimeter, and arch length (Figures 1 and 2 and Table 2).

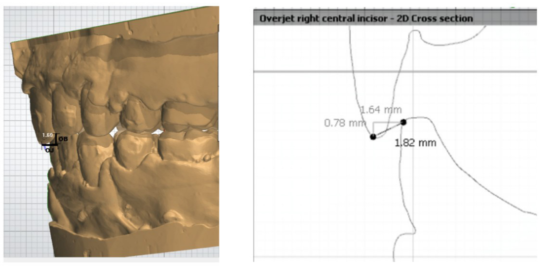

Figure 1. Characterization and space measurements obtained in the digital models of the sample – Overjet and Overbite.

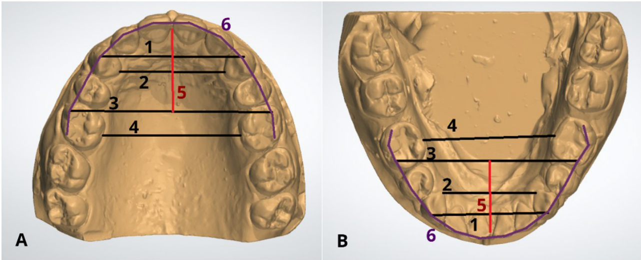

Figure 2. Measurements of the upper (A) and lower (B) arch dimensions. 1. Cusp inter canine distance 2. Cervical inter canine distance, 3. Cusp intermolar distance 4. Cervical intermolar distance 5. Arc length and 6. Modified arc perimeter.

Table 2. Measurements obtained from the digital sample models

Characterization measurements – inter-arch relationship (Figure 1)			
Overjet	**OJ**	**Horizontal distance from the buccal aspect of the upper incisor to the buccal aspect of the lower incisor**	
Overbite	**OB**	**Vertical distance from the buccal aspect of the upper incisor to the buccal aspect of the lower incisor**	
Measurements of the dimensions of the upper and lower arches (Figure 2)			
Variables	Upper Arch	Lower Arch	Measurements
1.Intercanine Distance	U33D	L33D	Distance from right canine cusp tip to left canine cusp tip (obtained from upper and lower arch).
2.Cervical Intercanine Distance	U33CD	L33CD	Distance from the cervical midpoint of the lingual aspect of the right canine to the cervical midpoint of the lingual aspect of the left canine (obtained in the upper and lower arches).
3.Intermolar distance	U66D	L66D	Distance from the mesio buccal cusp of the right maxillary first molar to the mesio buccal cusp of the left maxillary first molar. Distance from the mesio buccal cusp of the right mandibular first molar to the mesio buccal cusp of the left mandibular first molar.
4.Cervical Intermolar distance	U66CD	L66CD	Distance from the cervical midpoint of the lingual aspect of the right first molar to the cervical midpoint of the lingual aspect of the left molar (obtained in the upper and lower arches).
5.Arch length	UAL	LAL	Perpendicular distance from the mesial surfaces of the first molars to the midpoint of the incisors (obtained in the upper and lower arches).
6.Arch Perimeter modified	UPer	LPer	Distance from the distal face of the right first molar to the distal face of the left first molar following the cusps of the posterior teeth and incisal of the anterior teeth (obtained in the upper and lower arches).

Measurements were obtained by two researchers blindly, randomly, and at two different times, then transferred to SPSS (version 16, SPSS, Chicago, Ill) for statistical analysis. To assess the reproducibility of the data collection method, replicated measurements were analyzed using the Intraclass Correlation Coefficient (ICC) and t-test for dependent samples (degree of accuracy of intra-examiner reproducibility). In exploratory statistics, it was verified whether the data were normally distributed by evaluating the kurtosis and skewness of the measurements. Normality was confirmed using the Shapiro-Wilk test.

In descriptive analysis, mean values were obtained by gender with their respective standard deviations and confidence intervals. Inferential analysis determined whether there were significant differences between pre- and post-treatment values for each variable using the t-test for dependent samples. For arch dimension measurements, a 95% significance level ($p < 0.05$) was adopted. Considering an effect size of 0.826, the statistical analysis had a power of 0.8 (adequate according to Jamovi software version 1.6).

RESULT

Table 1 shows the demographic distribution of the two groups within the total sample of patients, divided by gender. There was a predominance of women, with 13 in the EMR group and 16 in the TSR group.

Table 3 presents the mean, standard deviation, maximums and minimums values of the variables in both groups, em masse retraction (EMR) and two step retraction (TSR) at the beginning (initial) and end (final) of treatment. Table 4 evidenced that groups 1 and 2 showed minimal non-significant differences in the measurements analyzed at the beginning of treatment, with the greatest differences referring to UAL and LAL (0.92 and 0.51 mm, respectively) and to the L66CD measurement of 0.65 mm. The other measurements showed values below 0.40 mm. Similarly, at the end of the treatment, groups 1 and 2 showed minimal non-significant differences, and the greatest difference was in the UAL measurement, which was very close to the initial difference. The LAL and L66CD measurements revealed smaller differences from the beginning to the end of treatment. The L66D measurement, in turn, showed a greater difference between the groups at the end of the treatment (1.08 mm) and the UPer measurement showed a negative difference at the beginning of the treatment and a positive difference at the end of the treatment (-0.21 and 0.98 mm, respectively). Since the groups did not present statistically significant differences in any of the variables studied at the beginning (initial) or post-treatment (end), as shown in Table 4, the entire sample was used for further analysis, as shown in Table 5.

Table 3. Mean values, standard deviation, maximums and minimums values of the variables in both groups em masse retraction (EMR) and two step retraction (TSR) at the beginning (initial) and end (final) of treatment

	Descriptives		Initial				Final			
	TRAT	N	Mean	SD	Min	Max	Mean	SD	Min	Max
OJ	EMR	22	3.07	1.42	0. 66	6.08	2.39	0.80	1.09	4.27
	TSR	24	2.92	1.11	1.49	5.99	2.20	0.84	1.32	4.43
OB	EMR	22	1.06	1.43	-2.09	4.45	1.50	0.63	0.05	2.66
	TSR	24	1.30	1.16	-1.30	3.33	1.61	1.07	0.13	3.99
U33D	EMR	22	35.76	2.24	32.04	39.71	36.26	1.83	31.48	38.97
	TSR	24	35.71	2.43	32.02	41.60	36.55	1.58	34.19	41.49
L33CD	EMR	22	19.96	1.71	15.67	23.56	22.32	1.28	20.52	25.08
	TSR	24	19.85	1.47	16.59	22.69	21.92	1.18	19.33	24.37

Table 3. Continued…

	Descriptives		Initial				Final			
	TRAT	N	Mean	SD	Min	Max	Mean	SD	Min	Max
U66D	EMR	22	52.38	2.50	47.33	55.92	51.07	2.01	47.10	54.97
	TSR	24	52.47	3.07	49.36	61.16	50.66	1.94	47.74	56.35
L66D	EMR	22	45.14	3.12	38.94	51.00	43.06	1.95	39.57	46.17
	TSR	24	45.23	3.04	40.95	50.78	44.14	2.12	40.74	49.02
U66CD	EMR	22	36.21	2.42	31.21	41.23	34.61	2.10	30.83	39.30
	TSR	24	36.35	2.84	32.63	42.81	34.47	1.84	31.48	38.14
L66CD	EMR	22	33.65	2.78	28.22	39.54	31.95	2.13	26.96	35.11
	TSR	24	33.00	2.75	28.72	39.75	32.15	1.59	29.66	36.39
UAL	EMR	22	27.02	1.84	22.65	29.65	19.76	1.46	15.46	22.30
	TSR	24	27.95	1.88	23.02	31.62	20.71	1.77	17.93	26.33
LAL	EMR	22	22.73	1.78	17.80	24.96	16.62	1.37	12.77	18.85
	TSR	24	23.24	1.66	19.12	27.00	16.57	1.77	13.02	20.20
UPer	EMR	22	101.16	4.02	93.33	107.48	85.61	4.36	74.39	91.54
	TSR	24	101.37	4.70	94.86	114.83	84.62	2.62	81.33	90.67
LPer	EMR	22	91.84	5.05	82.78	99.30	77.70	3.38	70.81	84.61
	TSR	24	92.15	4.50	84.59	102.22	77.32	3.08	72.32	83.20

Table 4. Comparison of intergroup differences at the beginning (initial) and the end (final) of treatment

Variables	Initial				Final			
	Independent Samples T-Test				Independent Samples T-Test			
			Difference				Difference	
	t	p	Mean	SE	t	p	Mean	SE
OJ	0.418	0.678	0.16	0.37	0.771	0.445	0.19	0.24
OB	-0.627	0.534	-0.24	0.38	-0.434	0.666	-0.11	0.26
U33D	0.080	0.937	0.06	0.69	-0.571	0.571	-0.29	0.50
L33D	-0.615	0.541	-0.40	0.65	-1.147	0.258	-0.48	0.42
U33CS	0.025	0.980	0.02	0.59	0.853	0.398	0.34	0.40
L33CD	0.230	0.819	0.11	0.47	1.100	0.277	0.40	0.36
U66D	-0.110	0.913	-0.09	0.83	0.709	0.482	0.41	0.58
L66D	-0.098	0.923	-0.09	0.91	-1.790	0.080	-1.08	0.60
U66CD	-0.177	0.860	-0.14	0.78	0.242	0.810	0.14	0.58
L66CD	0.793	0.432	0.65	0.82	-0.363	0.719	-0.20	0.55
UAL	-1.680	0.100	-0.92	0.55	-1.969	0.055	-0.95	0.48
LAL	-1.007	0.319	-0.51	0.51	0.091	0.928	0.04	0.47
UPer	-0.159	0.874	-0.21	1.29	0.937	0.354	0.98	1.05
LPer	-0.220	0.827	-0.31	1.41	0.398	0.693	0.38	0.95

Note: H_A μ EMR ≠ μ TSR.

Table 5 shows that the variables OJ, U33CD, L33CD, U66D, L66D, U66CD, L66CD, UAL, LAL, UPer, and LPer exhibited statistically significant differences in their means between the beginning (initial) and the end (final) of treatment. There was a reduction in overjet (0.7 mm), maintenance of overbite, and an increase in upper and lower intercanine distances in the cervical region (1.73 mm and 2.21 mm, respectively). The intermolar distances decreased in both the cusp and cervical regions, with reductions of 1.57 mm at the cusp level and 1.74 mm and 1.25 mm in the upper and lower cervical regions, respectively. Both arch length and perimeter showed significant reductions in the upper and lower arches: 7.25 mm and 6.40 mm for length, and 16.17 mm and 14.5 mm for perimeter, respectively.

Table 5. Comparative analysis of variables at the beginning (initial) and end (final) of treatment

	Initial			Final		Student's t-test		Difference	
	N	Mean	SD	Mean	SD	t	p	Mean	SE
OJ	46	2.99	1.26	2.29	0.82	3.189	0.002	-0.71	0.22
OB	46	1.19	1.29	1.56	0.88	-1.628	0.107	0.37	0.23
U33D	46	35.73	2.31	36.41	1.69	-1.604	0.112	0.68	0.42
L33D	46	27.35	2.17	27.93	1.43	-1.515	0.133	0.58	0.38
U33CD	46	25.62	1.98	27.35	1.36	-4.888	< .001	1.73	0.35
L33CD	46	19.90	1.57	22.11	1.24	-7.481	< .001	2.21	0.30
U66D	46	52.43	2.78	50.86	1.96	3.133	0.002	-1.57	0.50
L66D	46	45.19	3.05	43.62	2.09	2.879	0.005	-1.57	0.55
U66CD	46	36.28	2.62	34.54	1.95	3.623	< .001	-1.74	0.48
L66CD	46	33.31	2.75	32.06	1.85	2.557	0.012	-1.25	0.49
UAL	46	27.51	1.90	20.26	1.68	19.400	< .001	-7.25	0.37
LAL	46	23.00	1.72	16.60	1.57	18.648	< .001	-6.40	0.34
UPer	46	101.27	4.34	85.09	3.55	19.566	< .001	-16.17	0.83
LPer	46	92.00	4.72	77.50	3.19	17.257	< .001	-14.50	0.84

DISCUSSION

According to Mitra et al.[8], bimaxillary dentoalveolar protrusion is a common malocclusion found in orthodontic patients. It usually involves a convex incisor proclination, minimal crowding, class I or II molar ratio, decreased or normal overjet and overbite, mild class I or class II skeletal ratio, and moderate or mild vertical growth pattern. Contemporary fixed orthodontics is often used after extraction of all first premolars to reduce incisor proclination in most cases of bimaxillary dentoalveolar protrusion[7-10]. Among the different space closure options (anterior retraction, posterior protraction, or a combination of both) that are available today in pre-adjusted mechanotherapy, the sliding mechanics for mass retraction have gained substantial popularity, particularly after the evolution of the MBT philosophy[11].

The optimal protocol for space closure—single-stage or en mass retraction(EMR) or two-stage (TSR) remains debated, particularly concerning the preservation of posterior anchorage. While some studies[12-17] have indicated no discernible difference between the two procedures, another study[18] revealed that TSR significantly extends treatment duration, with the retraction phase taking nearly twice as long compared to EMR. However, no study has evaluated dimensional alterations in dental arches using models when comparing EMR and TSR. Therefore, the objective of this study was to assess dental arches following these two retraction modalities.

The lack of significance in the pre- and post-treatment variables shown in Table 4 pointed to a similarity between the groups in the pre-treatment characteristics analyzed, due to the randomly prospective selection. Following the trend of previous studies[7,10,12,13], no statistically significant differences were observed in the models in the post-treatment when comparing the two methods and a homogeneity in the changes resulting from the treatment performed by REM or RDE. This may be explained by the fact that all cases were treated with continuous wires and the same type of appliances and prescription.

Given this lack of statistically and clinically significant differences between REM and RDE, the two groups were combined, and the analysis focused on the differences observed in arch dimensions before and after treatment. As expected, many variables changed, but in the anterior region, overbite remained stable, and overjet was reduced from initial to final models.

Biprotrusive patients typically have adequate or poor overbite due to excessive labial inclination of the anterior teeth. A previous study demonstrated that incisor movement during retraction and space closure occurs through controlled tipping, where the incisors tip lingually, with crown movement and maintenance of root apex position (center of rotation at the root apex)[12,16,17].

Regarding intercanine dimensions, the distances between upper and lower cusps remained stable, justifiable by respecting arch conformation and the tendency of this distance to remain stable or decrease over time[19] This result contradicts the findings of Herzog et al.[5], who observed an increase in the distances between upper and lower canine cusps. However, the intercanine distance in the cervical dimension showed a slight increase of 1.73 mm in the upper arch and 2.21 mm in the lower arch, likely due to the labial root torque experienced by these teeth as a result of appliance prescription, arch form, and the biomechanics of sliding space closure, which maintains a constant lingual force on the canine crowns while the roots exhibit a tendency to move labially. The literature diverges on this finding regarding transverse dimensional changes, with reports of lower arch contraction and reduced arch width in the anterior and posterior regions, as well as increased arch width in the canine region due to arch rounding[20-22] but agrees on the anteroposterior dimensional change revealed by a reduction in arch length[20-21].

According to Moyers et al.[19], the mesiodistal diameter of the lower first premolar (6.9 ± 0.6 mm in men and 6.8 ± 0.7 mm in women) is on average 0.2 mm larger than that of the upper first premolar (6.7 ± 0.5 mm in men and 6.6 ± 0.5 mm in women). Extraction of first premolars would provide an average of 13.4 mm of space in the upper arch for men and 13.2 mm for women, and 13.8 mm in the lower arch for men and 13.6 mm for women (0.4 mm more space in the lower arch than the upper). These values are smaller than the observed reduction in upper arch perimeter (16.2 mm) and lower arch perimeter (14.5 mm). The data indicate that the upper arch length decreased more (7.25 mm) than the lower arch length (6.4 mm), a difference of 0.85 mm, values greater than the mesiodistal diameters of the extracted premolars, probably influenced by controlled tipping of the incisors which may influence the changes in the upper and lower arch length and perimeters.

Arch perimeters and lengths decreased with treatment, an expected and rational effect for extraction treatments in patients with biprotrusive profile[16,18]. These results align with other studies in the literature that also performed space closure[5,7,16-18]. The literature also indicate that arch depth (length) decreases over time at least up to 26 years of age[20].

Intermolar dimensions decreased in all studied variables, averaging -1.74 mm to -1.25 mm. Considering a 40% anchorage loss[21], a reduction in dental arch width is expected as posterior teeth migrate mesially, following the parabolic shape of most arches and bony bases[5,7,17,18,22,23].

CONCLUSION

1. No significant differences in dental arch dimensions were observed in the treatment of Class I biprotrusion involving the extraction of the first premolars and subsequent space closure, irrespective of whether the procedure was performed in a single session (EMR) or in two stages (TSR).

2. Both techniques led to significant decreases in arch length and perimeter.

3. Premolar extraction with space closure maintains overbite, reduced overjet and intermolar widths.

4. While intercanine distance at the cusp level remained stable, a significant increase was observed in the cervical region, with a more pronounced magnitude observed in the lower arch compared to the upper arch.

AUTHORS' CONTRIBUTIONS

Alyssa Schiavon Gandini: Data acquisition, Writing and Revision of the manuscript. Taynara de Oliveira Furtado: Data acquisition. Carolina Carmo de Menezes: Analysis, Interpretation, Writing and Revision of the manuscript. Luiz Gonzaga Gandini Junior: Conception and Design of the work, Analysis, Interpretation, Writing and Revision of the manuscript. Henrique Barcelos Brandão: Writing and Revision of the manuscript. Ary dos Santos Pinto: Analysis, Interpretation, Writing and Revision of the manuscript.

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CONFLICTS OF INTERESTS

The authors declare that there is no conflict of interest related to this study.

DATA AVAILABILITY

The contents underlying the research text are included in the manuscript.

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Received: July 12, 2025
Accepted: October 16, 2025

Edited by
Editor: Marcos de Mendonça
Associate Editor: Edith Lara Carrillo