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Comparison of the orthodontic treatment outcomes with the extraction of lower incisors associated with torque control

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Aim: This prospective clinical study evaluated the cephalometric effects of orthodontic treatment with lower incisor extraction associated with buccal torque. **Methods:** Cephalograms were evaluated at the beginning (T1) and the end (T2) of orthodontic treatment of 20 patients with a mean age of 32.2 years, Angle Class I malocclusion, and anteroinferior crowding. Orthodontic treatment was performed with a MBT prescription bracket, 0.022" slot with modified torque programming in the lower incisors (central and lateral: +6º), and a single lower incisor was extracted. Cephalometric measurements were performed using Dolphin® software by a single calibrated examiner. Data analysis was performed using the t-test for dependent samples, with a significance level of 5%. **Results:** No statistically significant differences were observed in the cephalometric measurements evaluated (p≥0.194). **Conclusions:** Orthodontic treatment carried out with extraction of lower incisors and associated with buccal torque did not promote dental and tegumentary cephalometric changes, positively impacting the completion of the treatment.

Keywords: Malocclusion, Angle Class I. Tooth extraction. Cephalometry.

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Introduction

Class I malocclusion is often associated with anterior mandibular crowding and the tooth extractions may be an effective alternative to orthodontic treatment[1,2]. The conventional indication is performed with the extraction of premolars[3] or, atypically, with a lower incisor[4]. The extraction of a single lower incisor must be indicated for patients with a harmonic profile, moderate crowding in the antero-lower segment, a discrepancy in the mesiodistal proportion between upper and lower incisors, and, particularly, in cases of Angle Class I malocclusion[4-6].

According to the literature, mandibular incisor extraction is associated with a reduction in total treatment time, better stability in post-treatment outcomes, and simpler biomechanics. However, increased overjet and overbite have been reported as a disadvantage[6-10]. A probable explanation is a lack of precision in the crowding, the size of the incisor to be extracted, and the biomechanical approach since the usual prescription of negative torque in the lower incisors tend the crown the teeth to tip lingually[11,12]. Clinical studies describe the use of negative prescriptions on mandibular incisors[2,13,14].

In this sense, McLaughlin, Bennet, and Trevisi (MBT) brackets have the highest negative torque values in the lower incisors (-6º)[15-17]. On the other hand, these brackets, specifically those with a .022" slot, have versatility, which allows individualization of torque on the incisors[18]. Positioning lower incisor brackets rotated by 180° allows changing torque from -6° to +6° and possibly restricting incisor retroclination[19,20].

The effects of torque individualization on cephalometric changes in patients who underwent extraction of a single mandibular incisor have not yet been clarified. The present study tested the hypothesis that the extraction of a single mandibular incisor associated with bracket positioning with positive torque (+ 6°) does not affect incisor inclination, overjet, overbite, and lip positioning in patients with Angle Class I molar relationship. This study evaluated the cephalometric effects of orthodontic treatment with lower incisor extraction associated with buccal torque.

Methods

This prospective clinical study was approved by the Human Research Ethics Committee (#42586721.5.0000.5385). The minimum sample of 20 patients was calculated considering a minimum difference of 0.93 (overbite) after orthodontic treatment, with a standard deviation of 0.73, detected in a previous study[14], a significance level of 5% and 80% test power (G Power, version 3.1 for Windows).

The study included 20 adults subjects, aged between 20 and 45 years and a mean age of 32.2 years (± 8.4), with the following clinical characteristics: Angle Class I malocclusion[14], anteroinferior crowding > 5 mm[10], absence of overbite[21-24] and pubertal growth completed (Figure 1)[25].

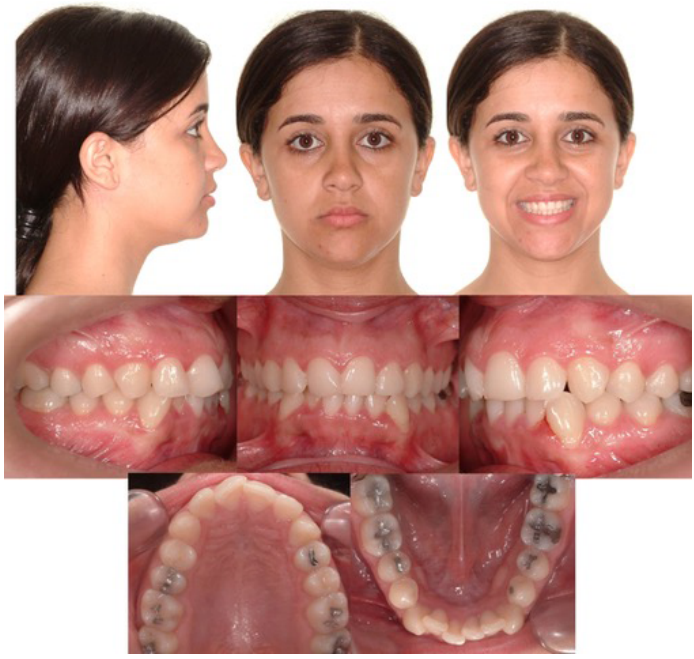

Figure 1. Pretreatment photographs.

Treatment planning included extraction of a single mandibular incisor and the use of a MBT prescription bracket, slot .022" (Abzil, São José do Rio Preto, São Paulo, Brazil) with modified torque programming on the mandibular incisors (central and side: +6°). The decision about the extracted incisor was based on the compatibility between the mesiodistal dimension of the tooth to be extracted and the amount of crowding. The remnant incisors received brackets with a positive torque prescription (+6º) to avoid the reduction of the lower intercanine dimension with this therapy[26]. In this way, the brackets of the lower incisors and canines were positioned with a 180º rotation.

The treatment of all study participants followed the same arch sequence. In the alignment stage, .014" and .016" nickel titanium arcs were used. Closing the spaces for crowding correction was initiated by applying gentle forces provided by installing metallic ligatures under the arches in the remaining incisors. In the leveling stage, .018" and .020" steel arches diagrammed and flat were used[27]. Finally, the rectangular steel arch .019" x .025", also diagrammed, with hooks welded between canines and lateral incisors, was used to install retro ligatures to close residual spaces when present, using sliding mechanics[28]. After the complete closure of the spaces, this arch remained installed for another three months, with metallic ligatures conjugated over the arches of the first molars to the arch hooks to provide time for the expression of torques (Figure 2).

Figure 2. Posttreatment photographs.

The initial (T1) and final (T2) lateral cephalograms were selected and digitized using a scanner (Microtek Scanmaker i800) to the Joint Photographics Experts Group (JPEG) format with a resolution of 300 dpi. The cephalometrics analysis of each patient was performed, and the variables were measured by the digital method directly on the computer, as well as the correction of the magnification of the radiographic images. All analyzes were conducted with Dolphin software (Dolphin Imaging Sciences, Chatsworth, CA, U.S.A – Version 11.0.03.36.) by a single examiner, who remained blinded throughout the study to the objectives and methodologies adopted.

Cephalometric measurements from the analyzes of Steiner[21], Jacobson[22], Ricketts[23], and McNamara[24] were used to evaluate the results of orthodontic treatment.

Method error

The systematic and casual errors of the method applied to analyze outcomes were measured by the Intra-Class Correlation Coefficient and Dahlberg's Formula[29], respectively. Initial and final cephalometric measurements of the volunteers were obtained in duplicate, by the same examiner, with an interval of one month between the evaluations. Casual errors remained ≤ 0.28. As it is not a test of statistical significance, no standard value of error size is acceptable or not when measured by the Dahlberg formula[30]. For the analysis of systematic errors, CCI values (0.79 – 0.96) was observed, indicative of excellent correlation and lower systematic error[31].

Statistical methodology

Descriptive data analysis was initially performed, and data was presented using means and standard deviations. The normality of data distribution was verified by

the Shapiro-Wilk test (p≥0.056), and the t-test for paired samples was applied. The analyzes were performed using the Statistical Package for Social Sciences software (SPSS for Windows, version 22.0, SPSS Inc. Chicago, IL, USA) with a significance level of 5%.

Results

Cephalometric measurements performed at the beginning and the end of orthodontic treatment are shown in Table 1. No statistically significant differences were observed in any of the cephalometric measurements evaluated (p≥0.194). Figure 3 shows the cephalometric superimposition.

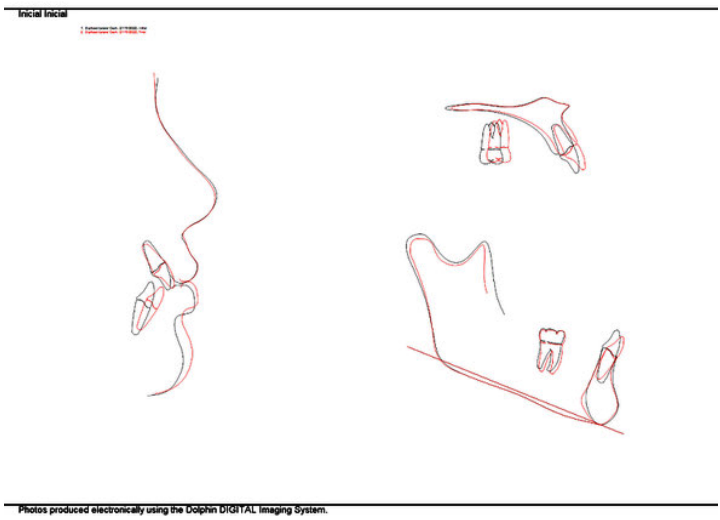

Figure 3. Overall, maxillary and mandibular superimposition.

Table 1. Mean values and standard deviations of initial and final measurements of cephalometric measurements.

Variable	Norm	Treatment			P value [1]
		Initial	Final	Difference	
Upper Incisors					
1-NA (mm)		5.08 ±2.55	5.63 ±2.82	0.55 ±0.38	0.367
1-Aperp (mm)		4.99 ±1.43	5.36 ±1.79	0.37 ±1.09	0.453
1.NA (°)		26.83 ±5.48	28.27 ±5.31	1.41 ±0.63	0.280
1.SN (°)		112.24 ±8.26	112.49 ±7.18	0.24 ±1.91	0.860
1-PP (mm)		27.97 ±3.65	27.63 ±3.77	- 0.34 ±0.43	0.311
Lower Incisors					
1-NB (mm)		4.97 ±1.02	5.44 ±1.99	0.46 ±0.74	0.262
1-AP (mm)		3.56 ±1.37	4.05 ±1.59	0.48 ±0.81	0.278

Continue

Continuation				
1.NB (°)	27.81 ±9.35	29.61 ±6.27	1.55 ±0.36	0.357
IMPA (°)	95.21 ±5.34	96.89 ±8.12	1.67 ±1.15	0.270
1-MP (mm)	38.81 ±4.89	37.79 ±4.46	- 0.86 ±0.53	0.194
Dental Relationship				
Overjet (mm)	3.85 ±1.14	3.58 ±0.66	- 0.27 ±0.97	0.243
Overbite (mm)	2.02 ±0.71	1.96 ±0.74	- 0.06 ±0.31	0.848
Integumentary Profile				
Ls-Line E (mm)	- 4.06 ±1.56	- 4.28 ±0.71	- 0.22 ±0.56	0.537
Li-Line E (mm)	- 1.27 ±0.76	- 1.45 ±0.82	- 0.17 ±0.41	0.599
A-NPog (mm)	2.64 ±1.21	2.14 ±0.51	- 0.50 ±0.97	0.284
ANL (°)	107.71 ±8.76	108.41 ±7.93	0.69 ±0.71	0.657

[1]Test of samples in pairs (α = 0.05).

Discussion

The extraction of a single lower incisor is an orthodontic treatment option[32-41]. The scarcity of scientific evidence on the effectiveness of this treatment justified this clinical study. We evaluated the hypothesis that the association of single mandibular incisor extraction with buccal torque control does not affect cephalometric changes in patients with Angle Class I malocclusion.

Our findings showed the absence of significant dentoalveolar and soft tissue changes after the association of lower incisor extraction and buccal incisor torque. The null hypothesis was accepted, and the results suggest the effectiveness of prescribed therapies in meeting the particularities of each case. It is also essential to highlight the need for individualized torque prescription according to each situation, proving the effectiveness of lower incisor extraction for the orthodontic treatment of patients with Class I malocclusion treated with buccal torque control.

Previous studies have addressed the effects of lower incisor extraction in orthodontic treatment[2,13,14]. Compared to orthodontic treatment without tooth extractions, the extraction of a single lower incisor can increase the overjet and overjet, which depending on the particularity of the case, is considered a deleterious effect of the therapy[13]. However, this fact cannot be attributed exclusively to incisor extraction. When there is the individualization of incisor torque, the retraction and retroclination of these teeth are minimized[14] and favor orthodontic completion in satisfactory occlusal patterns and good facial esthetics compared to treatments without any extraction or pre-molar extraction[2].

The study sample was treated with the use of MBT prescription brackets with modified torque programming in the lower incisors. Brackets with a 0.022" slot were used, which do not provide orthodontic treatment results different from the 0.018" slot[16,17]. However, the 0.022" slot provides a range of arch sizes for per-

forming orthodontic mechanics[18], and, considering that in this study, there was an individualized prescription of torque in the lower incisors, this requirement became indispensable for the conduct of the proposed treatment. A larger caliber finishing arch could be used to reduce the gap between the arch and bracket and obtain a more effective reading of the prescription used, such as the .021" x .025" steel arch that has a clearance of 3.9° when inserted into slot brackets with dimensions of .022" x .028"[42]. Third-order bending could still be performed in the anteroinferior segment. However, this maneuver would preclude the purpose of this study regarding the individualization of the prescription torque of the brackets of the remaining lower incisors. However, a .019" x .025" steel archwire was used to ensure, in addition to a good reading of the torques, a more significant gap between arch and bracket, providing low friction for the mechanics of closing the residual spaces[26], when present.

Our findings do not support the literature. This contrast can be attributed, among other factors, to the torque modification performed and is the main novelty of this study. This modified torque prescription was probably responsible for limiting incisor retraction and retroclination to satisfactory levels for orthodontic completion.

Although the sample selection criteria and case management were standardized, it is important to highlight the study's limitations. The decision on which incisor to extract was based on the compatibility between the mesiodistal dimension of the tooth to be extracted and the crowding. However, in some situations, the canine was outside the arch, and incisor extraction may have caused greater inclination of the canine with less torque loss of the central incisors.

Finally, the primary clinical study outcome is that the association of lower incisor extraction with the individualized prescription of buccal torque on the incisors is influential if it is well indicated. This implication is supported by previous studies[2,13,14,32], which were carried out to assess the effectiveness of lower incisor extraction, whether compared to therapies that involve no tooth extraction or the extraction of premolars. In this way, our findings add to the existing literature based on indications for each treatment modality already established in orthodontic practice, favoring clinical decision-making based on the balance between advantages and disadvantages with the particularities presented by each case.

In conclusion, orthodontic treatment carried out with extraction of lower incisors and associated with buccal torque did not promote dental and tegumentary cephalometric changes, positively impacting the completion of the treatment.

Conflict of Interest

The authors have no conflict of interest to disclose.

Data availability

Datasets related to this article will be available to the corresponding author upon request.

Author's contribution to the Research

Fernando Pizi Bonini: Conceptualization, Methodology, Data curation, Data analysis, Writing. **Diego Patrik Alves Carneiro:** Conceptualization, Methodology, Data curation, Data analysis, Writing. **Heloisa Cristina Valdrighi:** Writing- Reviewing and Editing. **Carolina Carmo de Menezes:** Writing- Reviewing and Editing. **Silvia Amélia Scudeler Vedovello:** Conceptualization, Methodology, Writing- Reviewing and Editing.

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