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Soft tissue facial profile changes after orthodontic treatment with or without tooth extractions in Class I malocclusion patients: A comparative study

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ABSTRACT

Objective: To analyze the soft tissue facial profile changes in Class I malocclusion patients after orthodontic treatment with or without tooth extraction.
Methods: Forty lateral cephalograms of 20 individuals with Angle Class I malocclusion submitted to orthodontic treatment were included in this study. The individuals were divided in two groups: no tooth extraction (Group A) and extraction of four first premolars (Group B). Cephalometric measurements related to the soft tissue facial profile (Nasolabial Angle, Mentolabial Angle, Interlabial Angle, Facial Convexity Angle, Total Facial Convexity Angle, Lower Face Angle, MAFH/LAFH Proportion, Lower Face Vertical Proportion, H.NB Angle, Ricketts E Line) were collected in two stages (pre-treatment and post-treatment). The Student T, Wilcoxon and Mann-Whitney tests analyzed the results. The significance level was 5%.
Results: Among the cephalometric variables evaluated, only the measurements Interlabial Angle and H.NB Angle showed statistically significant changes during treatment. Increase was observed in the Interlabial Angle and decrease in H.NB Angle in both groups, resulting in a less convex facial profile with lip retraction.
Conclusion: The findings suggest that changes in the soft tissue facial profile are similar in Class I patients treated with or without tooth extraction.

1. Introduction

The facial esthetics is a known factor that may have positive influence in interpersonal relationships and the self-esteem.[1,2] The increasing search for this esthetic ideal in contemporary society has reinforced the importance to address facial harmony as an objective of orthodontic treatment, in addition to a stable functional occlusion.[3] Thus, it is desirable to establish measurements to quantify and qualify possible changes in the soft tissue profile during monitoring of orthodontic therapy.

The adoption of dental and skeletal cephalometric measurements as a fundamental tool for the diagnosis, planning and evaluation of orthodontic treatment allowed the establishment of measurable normality references.4 However, the purely dentoskeletal cephalometric analysis only provides a brief reference on the facial contour balance, requiring the inclusion of soft tissue profiles to aid the facial morphological analysis.[5]

Among the main concerns of orthodontists are the supposed harmful effects on the facial esthetics caused by orthodontic treatment with extraction of premolars. Several investigations have analyzed the effect of orthodontic treatment with extraction on the soft tissue profile,[6–14] presenting controversial outcomes. Some studies suggest that the extraction of premolars flattens the facial profile.[8,11,13] Conversely, other studies state that this finding has no evidence in most cases,[7,9,14] reporting that, if tooth extraction is based in correct diagnostic criteria, it will not impair the facial profile.

Considering the lack of consensus of studies on the effects of tooth extraction during orthodontic treatment on the facial contour, this study compared the changes observed in facial profile of individuals with Angle Class I malocclusion orthodontically treated with and without extraction, by analysis of cephalometric measurements of the soft tissue profile.

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2. Material and methods

2.1. Study design

This comparative clinical study analyzed the initial (pre-treatment) and final (post-treatment) cephalometric measurements obtained on lateral cephalograms of individuals submitted to orthodontic treatment without tooth extraction (Group A) or with extraction of four first premolars (Group B). The study was carried out in compliance with the Helsinki Declaration ethical principles in medical research involving human subjects.

The sample was composed of cephalograms (initial and final) of 20 individuals (10 in Group A and 10 in Group B) selected from the files of the Specialization Course in Orthodontics at Centro de Educação Continuada do Maranhão (São Luís/MA). The eligibility criteria: young individuals of both genders, diagnosed with Angle Class I malocclusion at treatment onset by analysis of dental casts and photographs, treated with fixed appliances by the edgewise technique, with cephalograms that allowed good observation of the landmarks of interest, no tooth losses or hypodontia, no previous orthodontic treatment, no orthognathic surgery and/or use of functional orthopedic appliance. The decision to extract the four premolars in individuals in Group B was based on evaluation of the tooth-size discrepancy and maxillomandibular sagittal relationship.

The two groups included individuals of both genders; the group with extraction was composed of 6 young females and 4 males, and the group without extraction comprised 5 young females and 5 males. The initial mean age of individuals was 12.3 years. The mean treatment time was 3 years and 1 month.

2.2. Cephalometric analysis

The cephalometric analysis was performed by a single examiner (MFR). The angular and linear cephalometric measurements were obtained on 40 initial and final lateral cephalograms. Each radiograph received a transparent acetate sheet with size 20" × 20" and thickness of 0.003". The cephalograms were manually traced in a dark room on a film viewer. The anatomical landmarks and cephalometric points were marked with a Pentel automatic pencil with 0.5 mm HP lead. The reference lines and planes were also traced with a transparent ruler for achievement of linear (in millimeters) and angular measurements (in degrees). The angular measurements were obtained with a protractor.

The anatomical landmarks of the skull and face traced were: sella turcica, frontal bone, nasal bones, orbit, external auditory meatus, pterygomaxillary fissure, maxilla, mandible, maxillary and mandibular central incisors, maxillary and mandibular first molars, as well as the soft tissue profile. The Profile Numeric Facial Analysis was used, considering some measurements suggested by Burstone,[15] Burstone and Legan,[16] Holdaway[17] and Ricketts[18] to evaluate the profile changes promoted by orthodontic treatment in cases with and without extraction, comparing the profiles before and after orthodontic treatment (Table 1).

The examiner was calibrated before data collection. To evaluate the intra-examiner method error, ten cephalograms of the sample were randomly selected and the tracing and achievement of cephalometric measurements were performed twice consecutively, with a 15-day interval. Data were analyzed by the paired Student T test. No statistically significant differences ($P > 0.05$) were observed for angular and linear measurements between the two evaluations.

2.3. Statistical analysis

Data were plotted in an Excel worksheet and analyzed on the software SPSS 17.0 (IBM, Chicago, IL, EUA). A descriptive analysis of data was initially performed by means and standard deviation. The normality distribution of variables was assessed by the Shapiro-Wilk test. To analyze the equality between pre- and post-treatment values, the Wilcoxon or paired Student T test were applied. Also, the values related to the difference between final and initial measurements were calculated for later comparison of changes observed in Groups A and B by the Mann-Whitney or independent Student T test. The significance level adopted in this study was 5% ($P < 0.05$).

3. Results

It is known that conclusion of the final value (post-treatment) achieved may be good or bad depending on the initial value (pre-treatment) of each individual, thus becoming an individual aspect. However, this study considered the mean values of the group and thus the overall outcomes are presented.

The soft tissue cephalometric characteristics were compared between Groups A and B in pre- and post-treatment periods (Table 2). Only the measurement Facial Convexity Angle presented statistically significant difference in the initial evaluation ($P = 0.01$). In the final evaluation, the measurements Facial Convexity Angle ($P = 0.004$), Total Facial Convexity Angle ($P = 0.03$) and Ricketts E Line ($P = 0.01$) presented statistically significant means.

Table 3 presents the descriptive statistics of means of initial and final cephalometric measurements and changes in the soft tissue facial profile during orthodontic treatment in Group A (without tooth extraction). Statistically significant changes were observed only for the mean increase of 10.8° ± 14.6° in the measurement of Interlabial Angle ($P = 0.036$) and mean reduction in the post-treatment measurement of 1.9° ± 2.01 of the H.NB Angle ($P = 0.02$).

Similarly, Group B (with tooth extraction) presented statistically significant changes for the variable Interlabial Angle ($P = 0.005$) and H.NB Angle ($P = 0.035$). A mean increase of 22° ± 16.7 was observed in the final value of the Interlabial Angle and decrease of 3.2° ± 4.1 fort the H.NB Angle (Table 4).

No statistically significant differences were detected for any cephalometric alteration between the two groups (Table 5), suggesting similarity of changes in these measurements during orthodontic treatment in both groups, with or without tooth extraction.

4. Discussion

Among the main concerns of orthodontists are the effects of orthodontic treatment concerning the decision to extract teeth or not. According to Kocadereli,[19] the extraction of premolars causes a harmful effect on facial esthetics, flattening the facial profile, due to retruded upper and lower lips. For this reason, many justify the rejection of tooth extraction in individuals with discrepancy between tooth size and arch length. However, several studies provide data suggesting that the influence of premolar extractions on facial profile is often overestimated in most cases.[7,9,14]

This study investigated the hypothesis of difference in changes in the soft tissue facial profile in individuals submitted to orthodontic treatment with or without tooth extraction. In the present sample, it was observed that the measurements Interlabial Angle and H.NB Angle were similar for both groups. In the first there was an increase in the post-treatment value, and in the second measurement the value was reduced, providing a less convex facial profile with less retruded lips.

This result in both groups is considered as favorable, since the measurements obtained after treatment tended to the standard value. In Group A, the measurement Interlabial Angle presented initial mean of 101.3° ± 19.3 and final of 112.1° ± 12.3, while Group B changed the mean measurement of 102.4° ± 27.5 to 124.4° ± 17.2 ($P = 0.005$) after treatment, tending to the normative measurement suggested by Morris[20] of 133.02° ± 10.95. The H.NB angle also presented significant change ($P < 0.05$) in both groups; the mean final measurements were 11.4° ± 2.6 for the group without extraction and 12.1° ± 3.7 for the group with extraction, and the post-treatment values of both groups

Table 1
Definition of cephalometric measurements analyzed.

Measurement	Definition
Nasolabial Angle (°)	Angle between the nasal base and upper lip, analyzing the protrusion of the upper lip in relation to the nasal base.
Mentolabial Angle (°)	Angle between the lower lip and anterior mentum projection, analyzing the protrusion of the lower lip in relation to the mentum.
Interlabial Angle (°)	Angle between the upper and lower lips, determining the degree of lip protrusion.
Facial Convexity Angle (°)	Supplement of the angle between the intersection of glabella-subnasal and subnasal-soft tissue pogonion lines, determining the degree of facial profile convexity.
Total Facial Convexity Angle (°)	Angle between the intersection of glabella-nose tip and nose tip-soft tissue pogonion lines, determining the degree of facial profile convexity involving the nasal projection.
Lower Face Angle (°)	Angle between the subnasal-soft tissue gnathion and soft tissue gnathion-cervical lines, analyzing the anterior projection of the mentum.
MAFH/LAFH Proportion	Analyzes the proportion between glabella-subnasal and subnasal-soft tissue mentum distances.
Lower Face Vertical Proportion	Proportion between subnasal-stomion and stomion-soft tissue mentum distances.
H.NB Angle (°)	Angle between intersection of NB and H lines, line formed by the union of soft tissue pogonion (Pg') and the most prominent point in the upper lip (Ls).
Ricketts E Line (mm)	Determined by the union of soft tissue pogonion (Pg') and nasal projection (En), describing the position of the lower lip 2 mm behind the E line as ideal.

Table 2
Comparison of cephalometric measurements between groups without tooth extraction (Group A) and with tooth extraction (Group B) in pre- and post-treatment stages.

Cephalometric variables	Pre-treatment measurements				p*	Post-treatment measurements				p*
	Without extraction		With extraction			Without extraction		With extraction		
	Group A		Group B			Group A		Group B		
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Nasolabial Angle (°)	95.1	± 14.1	102.9	± 12.5	0.24	97.1	± 11.2	106.4	± 8.6	0.05
Mentolabial Angle (°)	109.1	± 21.8	117.5	± 17.6	0.38	117.5	± 15.5	124.8	± 10.9	0.32
Interlabial Angle (°)	101.3	± 19.3	102.4	± 27.5	0.73	112.1	± 12.3	124.4	± 17.2	0.10
Facial Convexity Angle (°)	13.1	± 2.5	16.4	± 2.5	0.01**	11.4	± 2.6	16.5	± 2.2	0.0004**
Total Facial Convexity Angle (°)	142.1	± 4.3	138.7	± 4.4	0.11	141.9	± 3.6	138.5	± 2.3	0.03**
Lower Face Angle (°)	105.1	± 33.7	116.7	± 6.7	0.51	102.8	± 33.1	115.4	± 9.2	0.47
MAFH/LAFH Proportion	0.93	± 0.08	0.87	± 0.11	0.27	0.91	± 0.09	0.89	± 0.10	0.51
Lower Face Vertical Proportion	0.50	± 0.07	0.48	± 0.04	0.93	0.47	± 0.06	0.46	± 0.05	0.76
H.NB Angle (°)	13.3	± 4.1	15.3	± 4.7	0.30	11.4	± 2.6	12.1	± 3.7	0.79
Ricketts E Line (mm)	0.20	± 3.5	2.6	± 3.8	0.09	0.15	± 2.4	2.4	± 1.3	0.01**

* Mann-Whitney or independent Student T test. ** Statistically significant differences ($p < 0.05$). MAFH = medium anterior facial height. LAFH = lower anterior facial height. SD = standard deviation.

were within the normal values of 7° to 15°.[17] The mean reduction in the H.NB angle observed in both groups may also be caused by the mandibular growth observed in individuals in the growth stage due to retraction of the upper lip and anterior movement of soft tissue pogonion.[21] The other facial measurements did not present significant mean changes. These results suggest that the extraction of premolars does not necessarily imply a harmful effect on facial esthetics.

Comparison of post-treatment values of the groups with standard values revealed that the group with extraction exhibited mean measurements closer to the standard values than the group without extraction. This finding is contrary to thoughts that treatments without extraction produce better faces. One reason for that might be the result of a previous period of occasional overtreatment, bad diagnoses or procedures adopted to compensate for the severe skeletal patterns

Table 3
Mean and standard deviation of variables related to the initial and final soft tissue profile of individuals submitted to orthodontic treatment without tooth extraction (Group A).

Cephalometric variables	Without tooth extraction (n = 10) (Group A)						p**
	Pre-treatment		Post-treatment		Change*		
	Mean	± SD	Mean	± SD	Mean	± SD	
Nasolabial Angle (°)	95.1	± 14.1	97.1	± 11.2	2.05	± 8.20	0.507
Mentolabial Angle (°)	109.1	± 21.8	117.5	± 15.5	18.4	± 11.9	0.059
Interlabial Angle (°)	101.3	± 19.3	112.1	± 12.3	10.8	± 14.6	0.036***
Facial Convexity Angle (°)	13.1	± 2.5	11.4	± 2.6	−1.7	± 2.3	0.064
Total Facial Convexity Angle (°)	142.1	± 4.3	141.9	± 3.6	−0.2	± 3.5	0.766
Lower Face Angle (°)	105.1	± 33.7	102.8	± 33.1	−2.3	± 47.8	0.171
MAFH/LAFH Proportion	0.93	± 0.08	0.91	± 0.09	−0.02	± 0.09	0.634
Lower Face Vertical Proportion	0.50	± 0.07	0.47	± 0.06	−0.03	± 0.05	0.448
H.NB Angle (°)	13.3	± 4.1	11.4	± 2.6	−1.9	± 2.01	0.020***
Ricketts E Line (mm)	0.20	± 3.5	0.15	± 2.4	−0.05	± 1.9	0.887

* Difference between post-treatment and pre-treatment values. ** Wilcoxon or paired Student T test. *** Statistically significant differences ($p < 0.05$). MAFH = medium anterior facial height. LAFH = lower anterior facial height. SD = standard deviation.

Table 4
Mean and standard deviation of variables related to the initial and final soft tissue profile of individuals submitted to orthodontic treatment with tooth extraction (Group B).

Cephalometric variables	With tooth extraction (n = 10) (Group B)						p**
	Pre-treatment		Post-treatment		Change*		
	Mean	± SD	Mean	± SD	± SD	Mean	
Nasolabial Angle (°)	102.9	± 12.5	106.4	± 8.6	3.5	± 9.8	0.285
Mentolabial Angle (°)	117.5	± 17.6	124.8	± 10.9	7.3	± 8.9	0.052
Interlabial Angle (°)	102.4	± 27.5	124.4	± 17.2	22	± 16.7	0.005***
Facial Convexity Angle (°)	16.4	± 2.5	16.5	± 2.2	0.2	± 3.1	0.259
Total Facial Convexity Angle (°)	138.7	± 4.4	138.5	± 2.3	−0.2	± 3.2	0.552
Lower Face Angle (°)	116.7	± 6.7	115.4	± 9.2	−1.3	± 10.9	0.574
MAFH/LAFH Proportion	0.87	± 0.11	0.89	± 0.10	0.01	± 0.05	0.762
Lower Face Vertical Proportion	0.48	± 0.04	0.46	± 0.05	−0.02	± 0.06	0.208
H.NB Angle (°)	15.3	± 4.7	12.1	± 3.7	−3.2	± 4.1	0.035***
Ricketts E Line (mm)	2.6	± 3.8	2.4	± 1.3	−0.2	± 3.7	0.066

* Difference between post-treatment and pre-treatment values. ** Wilcoxon or paired Student T test. *** Statistically significant differences ($p < 0.05$). MAFH = medium anterior facial height. LAFH = lower anterior facial height. SD = standard deviation.

Table 5
Comparison of cephalometric changes related to the soft tissue profile between groups without tooth extraction (Group A) and with tooth extraction (Group B).

Cephalometric variables	Change (Post-treatment – Pre-treatment)				p*
	Without tooth extraction (n = 10)		With tooth extraction (n = 10)		
	Mean	± SD	Mean	± SD	
Nasolabial Angle (°)	2.05	± 8.20	3.5	± 9.8	0.76
Mentolabial Angle (°)	18.4	± 11.9	7.3	± 8.9	0.90
Interlabial Angle (°)	10.8	± 14.6	22	± 16.7	0.13
Facial Convexity Angle (°)	−1.7	± 2.3	0.2	± 3.1	0.15
Total Facial Convexity Angle (°)	−0.2	± 3.5	−0.2	± 3.2	0.81
Lower Face Angle (°)	−2.3	± 47.8	−1.3	± 10.9	0.84
MAFH/LAFH Proportion	−0.02	± 0.09	0.01	± 0.05	0.51
Lower Face Vertical Proportion	−0.03	± 0.05	−0.02	± 0.06	0.93
H.NB Angle (°)	−1.9	± 2.01	−3.2	± 4.1	0.62
Ricketts E Line (mm)	−0.05	± 1.9	−0.2	± 3.7	0.67

* Mann-Whitney or independent Student T test. SD = standard deviation.

before the advent of orthognathic surgery. The extractions are characterized by an effort to achieve the best in a bad situation. Therefore, good skeletal patterns and faces tend to be treated without extraction, while poor patterns and faces tend to be treated with extraction.[22]

The study also tested the hypothesis of difference between changes in cephalometric measurements during orthodontic treatment between groups A and B. No significant values were found for any variable. The results suggest that changes in these cephalometric measurements related to the soft tissue profile are similar in both groups.

Similar findings were reported by Kim et al.[23] and Johnson and Smith,[24] that there was no considerable post-treatment difference in the faces of individuals with and without extraction. The final facial profiles were similar in both groups, since all individuals (with and without extraction) were initially diagnosed to solve the tooth size discrepancy with the options with and without extraction. Zierhut et al.[25] observed similarities between the soft tissue facial profile in groups with and without extraction, both immediately after treatment and after a long retention period, and reported progressive flattening of the facial profile in both groups, due to changes in maturation associated with the continuous mandibular growth and nasal development, which are not influenced by tooth extraction.

Several studies are available in the orthodontic literature aiming to evaluate the facial changes in individuals submitted to orthodontic treatment with and without extraction. Machado et al.[26] conducted a longitudinal cephalometric study to comparatively evaluate the changes in facial heights promoted by treatment of Angle Class II division 1 malocclusion with and without extraction of four first premolars. The results demonstrated that there was no significant influence of orthodontic therapy on the changes in facial heights. Boley et al.[22] conducted a study to determine the post-treatment difference in the faces of individuals treated with and without extraction of premolars by analysis of photographs by experienced dentists and orthodontists. In the first stage they were questioned whether the individual had been treated with or without extraction of four premolars, and in the second stage the profiles were analyzed on the basis of cephalometric tracings. They concluded that there is no significant difference between profiles before and after treatment in the groups, and the mean values of the H line for both groups were within the desirable esthetic index. Brant and Siqueira[27] compared the changes in soft tissue profile in individuals initially presenting Class II division 1 malocclusion treated with extraction of four first premolars, and individuals submitted to similar treatment yet without extraction. One of the conclusions indicates that the decision for orthodontic treatment with or without extractions does not impair the facial profile, provided it is based on proper diagnostic criteria.

In the present study, the means of variables of Groups A and B were compared in pre- and post-treatment periods. In the initial evaluation the measurement Facial Convexity Angle presented higher mean in Group B ($P = 0.01$). In the final evaluation, Group B presented higher Facial Convexity Angle and Ricketts Line, and the Total Facial Convexity Angle was less obtuse compared to Group A. These results may be explained by the inclusion of individuals with slightly more convex profile in this group. It should be highlighted that, in the study sample, Group B presented more female individuals than Group A, and females tend to present a more convex profile.[28] Also, the more convex characteristic of Group B was maintained after treatment, thus this group did not present a flatter profile than Group A in the initial evaluation. These results further reinforce the conclusion of Basciftci et al.,[29] that the extraction of first premolars individually does not imply a more retruded profile.

The clinical meaning of the present results demonstrates that the presence or absence of four first premolars is not an exclusively determining factor of harmful effects on the facial appearance. The correct diagnosis and indication of the need of extractions will directly influence the final facial outcomes considered as satisfactory.

5. Conclusion

For the cephalometric measurements analyzed, the present findings indicate that changes in the soft tissue facial profile presents similar behavior in individuals orthodontically treated with or without tooth extraction. Unsatisfactory esthetic effects may be the result of incorrect indications of tooth extractions.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jobcr.2018.07.003.

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