Assessment of facial profile changes in Class I biprotrusion adolescent subjects submitted to orthodontic treatment with extractions of four premolars

Claudia Trindade Mattos[1], Mariana Marquezan[1], Isa Beatriz Barroso Magno Chaves[2], Diogo Gonçalves dos Santos Martins[2], Lincoln Issamu Nojima[3], Matilde da Cunha Gonçalves Nojima[4]

Objective: To evaluate cephalometric changes in tooth and profile position in young adolescent individuals with Class I biprotrusion submitted to orthodontic treatment with extractions of four first premolars.

Methods: Pre and posttreatment lateral cephalometric radiographs from 20 patients with Class I biprotrusion malocclusion were used to evaluate the following measurements: nasolabial angle, distance from lips to E line, distance from lips, incisors, tip of the nose and soft tissue pogonion to Sy line.

Results: All measurements showed significant changes after treatment ($p<0.05$), except the distance from lips and soft tissue pogonion to Sy line. There was a positive correlation between the retraction of incisors and the change of upper and lower lips (0.803/0.925; $p<0.001$).

Conclusion: The profile retrusion observed occurred more due to nose growth than to lips retraction. The response from soft tissues to incisors retraction showed a great variability.

Keywords: Class I Angle malocclusion. Dental extraction. Dental esthetics. Facial profile.

[1] PhD in Orthodontics, UFRJ.

[2] Graduated in Dentistry, Dentistry School, UFRJ.

[3] Coordinator of Post-Graduation Program in Dentistry, Dentistry School, UFRJ. Adjunct Professor of Post-Graduation Program in Dentistry and Orthodontics, UFRJ.

[4] Adjunct Professor of Post-Graduation Program in Dentistry and Orthodontics, School of Dentistry, UFRJ.

How to cite this article: Mattos CT, Marquezan M, Chaves IBBM, Martins DGS, Nojima LI, Nojima MCG. Assessment of facial profile changes in Class I biprotrusion adolescent subjects submitted to orthodontic treatment with extractions of four premolars. Dental Press J Orthod. 2012 May-June;17(3):132-7.

Submitted: October 16, 2009 - **Revised and accepted:** December 29, 2010

» The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.

Contact address: Matilde da Cunha Gonçalves Nojima
Av. Professor Paulo Rocco, 325 – Cidade Universitária – Ilha do Fundão
Zip code: 21941-617 – Rio de Janeiro/RJ – Brazil – E-mail: matildenojima@uol.com.br.

INTRODUCTION

More and more facial esthetics have been a concern for patients and professionals, while soft tissues have been increasingly emphasized on the orthodontic diagnostic methods. Facial harmony is included in the main objectives of orthodontic treatment, once the correct positioning of teeth over the basal bone may alter the profile, including the upper and lower lips position, the nasolabial and the labiomental angles.

Numerous factors are able to influence the changes that the soft tissues may suffer as a consequence of retraction or protrusion movements made on incisors, such as soft tissues morphology, thickness, tonicity and muscular pattern of the patient.[6,14]

Among the individuals which complain over unpleasant facial esthetics and search orthodontists with the main objective of regaining balance on their facial profile, are those which show biprotrusion, a condition where upper and lower anterior teeth are protruded, creating a convex profile and difficulty in sealing the lips.

The correction of biprotrusion is frequently obtained through the extraction of four first premolars and retraction of anterior teeth with maximum anchorage avoiding mesial movement of the posterior teeth. This conduct may result in lip retraction, in an improvement of esthetics and of the lip seal due to an enhanced harmony and balance between skeletal, dental and soft tissues structures.

On the other hand, the follow-up of growing patients show that the normal maturation process associated with continuous mandibular growth and nasal development promote alone an enhancement on the profile, independent of extractions.[20] This maturation tends to continue after adolescence, resulting on an increase of this relative lip retraction.

Therefore, the objective of the present study was to assess changes in tooth position and in profile due to orthodontic treatment and facial growth of adolescent Class I biprotrusive patients treated with extraction of four first premolars.

MATERIAL AND METHODS

Material

Pre and posttreatment cephalometric lateral radiographs from adolescents submitted to orthodontic treatment in the Post-Graduation course in Orthodontics of the Federal University of Rio de Janeiro (UERJ) were assessed. All radiographs were taken in the Department of Pathology and Oral Diagnosis of the School of Dentistry of the UERJ. Among the radiographs evaluated, 20 individuals (5 boys and 15 girls) were selected. Their mean age was 12 years and 4 months at the beginning of treatment, and 17 years by the end of treatment. The inclusion criteria were the following: a) Class I skeletal pattern (ANB angle between 0 and 4°), b) Class I malocclusion with biprotrusion, c) permanent dentition, d) no dental agenesis, e) treatment plan including four first premolars extraction, f) interincisal angle lower than 131°, g) 1-NA angle higher than 22°, h) 1-NB angle higher than 25°, i) 1-NA distance greater than or equal to 5 mm, j) 1-NB distance greater than or equal to 5 mm, k) no previous orthodontic treatment, l) individuals under 15 years of age at the beginning of treatment. Orthodontic treatment was standardized with fixed appliances, Edgewise standard system, with extraction of the four first pre-molars, followed by lower and upper canine and incisive retraction.

Methods

Pre (T_1) and post-treatment (T_2) cephalometric radiographs of each patient were traced by a single operator. The cephalometric points used in this research are identified in Figure 1. In order to confirm if the cases selected fulfilled the inclusion criteria, the following planes and lines were traced: N-A, N-B, upper incisor long axis and lower incisor long axis. Measurements from Steiner's analysis were also calculated: ANB angle, interincisal angle, 1-NA angle, 1-NB angle, 1-NA distance and 1-NB distance. Three lines were constructed for data collecting: a) Sx (horizontal reference line), traced 7° clockwise from SN line, registered at S point; b) Sy (vertical reference line), perpendicular to Sx, registered at S point; c) Ricketts' E line, line connecting Prn and Pog' points. The comparison between pre-treatment and post-treatment profiles, as well as the assessment of nose and chin growth in the facial profile were made through the following measurements: nasolabial angle (Prn-Sn-Ls), E-Ls distance, E-Li distance, Sy-Ls distance, Sy-Li distance, Sy-Is distance, Sy-Ii distance, Sy-Prn distance, Sy-Pog' distance. All measurements were

performed by a single operator and 40% of them (16 randomly chosen radiographs) were repeated after a month for error analyses.

Statistical analysis

Intraclass correlation coefficient analysis was performed to assess measurement errors and descriptive analysis of data was performed, including mean, standard deviation and median of all variables.

After normal distribution was confirmed through the Kolmogorov-Smirnov test, pre and post-treatment measurements were compared through a paired t test. Spearman test was applied to assess correlations among the measurements. The level of significance of 0.05 was adopted for all tests. The software used in the statistical analyses was the SPSS Statistics version 17.0.

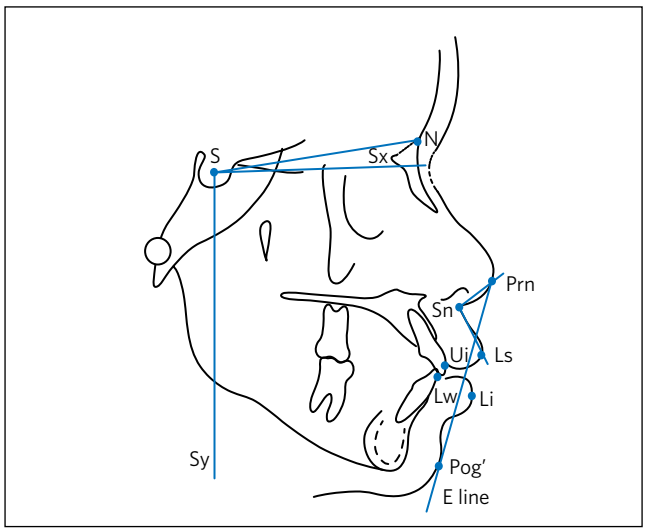

Figure 1 - Points used: S (Sella), N (Nasion), Ls (Labrale superius), Li (Labrale inferius), Ui (Upper incisor), Lw (Lower incisor), Prn (Pronasale), Sn (Subnasale), Pog' (Soft tissue pogonion). Lines used: Sx (horizontal reference line, traced 7° clockwise from the SN line, registered at S), Sy (vertical reference line, perpendicular to the Sx line, registered at S), Ricketts' E line (Prn–Pog').

RESULTS

The intraclass correlation coefficient was 0.99 and the measurements performed were considered reliable.

Descriptive data for each measurement and the results from the paired t test are depicted in Table 1. Only the position of upper and lower lip and of soft tissue pogonion in relation to the Sy line did not show significant changes with treatment.

The results obtained in the analysis of correlations among the cephalometric measurements observed by the Spearman test are shown in Table 2.

DISCUSSION

Extractions on orthodontic treatment are still a motive for debates and controversies, even though there is a consensus about the need to position teeth

Table 1 - Comparison between pre and posttreatment mean values of the measurements taken through a paired t test.

Measurements	Pre-treatment (t_1)		Post-treatment (t_2)		Change (t_2 - t_1)		p
	Mean	sd	Mean	sd	Mean	sd	
Nasolabial angle (degree)	101.0	12.28	104.8	10.07	3.8	7.27	0.030*
E-Ls (mm)	-0.9	1.87	-4.1	2.47	-3.2	2.08	0.000*
E-Li (mm)	2.0	2.16	-1.6	2.20	-3.6	1.95	0.000*
Sy-Ls (mm)	88.1	4.16	88.0	3.82	-0.1	3.48	0.899
Sy-Li (mm)	86.0	4.88	85.4	3.84	-0.6	4.46	0.539
Sy-Is (mm)	77.0	3.73	73.9	3.84	-3.1	2.92	0.000*
Sy-Ii (mm)	72.5	5.01	70.9	3.93	-1.6	3.65	0.043*
Sy-Pnr (mm)	98.2	4.92	102.1	5.28	3.9	4.57	0.001*
Sy-Pog' (mm)	75.4	5.60	77.3	5.30	1.9	4.93	0.102

*Statistically significant difference ($p<0.05$).
sd – standard deviation.

Table 2 - Correlation between the mean difference of pre and post-treatment cephalometric measurements through the Spearman analysis.

		Nasolabial	E-Ls	E-Li	Sy-Ls	Sy-Li	Sy-Ui	Sy-Lw	Sy-Pnr	Sy-Pog'
Nasolabial	Corr. coef.	1	0.020	-0.351	-0.201	-0.249	0.068	-0.099	-0.036	-0.125
angle	Sig. (P)		0.935	0.129	0.396	0.289	0.776	0.677	0.881	0.600
E-Ls	Corr. coef.	0.020	1	0.573	-0.225	-0.461	-0.222	-0.318	-0.567	-0.506
	Sig. (P)	0.935		0.008*	0.341	0.041*	0.347	0.172	0.009*	0.023*
E-Li	Corr. coef.	-0.351	0.573	1	0.161	0.018	0.050	0.060	-0.284	-0.186
	Sig. (P)	0.129	0.008*		0.497	0.939	0.834	0.803	0.225	0.432
Sy-Ls	Corr. coef.	-0.201	-0.225	0.161	1	0.907	0.803	0.946	0.797	0.752
	Sig. (P)	0.396	0.341	0.497		0.000*	0.000*	0.000*	0.000*	0.000*
Sy-Li	Corr. coef.	-0.249	0.461	0.018	0.907	1	0.817	0.925	0.829	0.917
	Sig. (P)	0.289	0.041*	0.939	0.000*		0.000*	0.000*	0.000*	0.000*
Sy-Ui	Corr. coef.	0.068	-0.222	0.050	0.803	0.817	1	0.854	0.621	0.753
	Sig. (P)	0.776	0.347	0.834	0.000*	0.000*		0.000*	0.003*	0.000*
Sy-Lw	Corr. coef.	-0.099	-0.318	0.060	0.946	0.925	0.854	1	0.839	0.788
	Sig. (P)	0.677	0.172	0.803	0.000*	0.000*	0.000*		0.000*	0.000*
Sy-Pnr	Corr. coef.	-0.036	-0.567	-0.284	0.797	0.829	0.621	0.839	1	0.736
	Sig. (P)	0.881	0.009*	0.225	0.000*	0.000*	0.003*	0.000*		0.000*
Sy-Pog'	Corr. coef.	-0.125	-0.506	-0.186	0.752	0.917	0.753	0.788	0.736	1
	Sig. (P)	0.600	0.023*	0.432	0.000*	0.000*	0.000*	0.000*	0.000*	

*Significant correlation ($p<0.05$).

over their basal bone. Biprotrusive individuals who have a Class I malocclusion many times search professionals spontaneously, unsatisfied with their facial esthetics and difficulty to seal lips. In these specific cases, one of the solutions is the treatment with extractions of the four first premolars and retraction of anterior teeth. Tweed[18] already asserted in 1966 that he had observed a better balance and harmony of facial lines, stability of dentition, healthy oral tissues and an efficient masticatory system when their patients had their incisors well positioned over the basal bone at the end of treatment. He also noticed that the lack of facial harmony occurred in a direct proportion with the degree of projection of the dentition. Thus, the present study aimed to cephalometrically assess the dental and facial profile changes in 20 biprotrusive adolescents with Class I malocclusion submitted to treatment with extraction of four first premolars and retraction of anterior teeth.

There are still doubts about the influence that the orthodontic treatment and craniofacial growth have on the results obtained by treatment of patients during their growth. Therefore, frequently almost all merits are attributed to the orthodontic therapy, when growth has had a fundamental role in changes. Erdinc et al[6] reported that many authors did not eliminate the effect of growth in facial changes observed with treatment, once it is difficult to separate the effects of growth and therapy. In order to answer these questions, this study made an effort to observe changes that could be attributed to growth or to orthodontic therapy.

The measurement of horizontal changes in dental and skeletal structures and in soft tissues was performed related to a reference line perpendicular to the Sx line, which is traced 7° clockwise from the S-N line. This method has already been validated in scientific literature[9,10,14,17] and it was used in order to facilitate the comparison among the studies.

After establishing the necessary references and method the results were obtained and discussed with the pertinent literature. Initially, they showed that the upper incisors were retracted a mean of 3.1 mm and the lower incisors a mean of 1.6 mm in relation to the Sy line, similarly to the study of Oliveira et al.[14]

The difference in the nasolabial angle found in this research was similar to the one found by Bravo.[4] The change in the nasolabial angle was significant;

this change, however, showed no positive correlations with any other measurement taken. This is probably due to the great individual variance, as other studies reported.[4,10] According to Lai et al[11] and Oliveira et al,[14] the variations in the response of the soft tissues are very extensive and difficult to predict or correlate in a perfect way to dental changes.

The changes in the upper and lower lips in relation to E line was very similar to the amount observed by Bravo.[4] The change in the upper lip in relation to the E line, which was significant and evidences the retraction of the profile, could not be correlated to the change in the position of the upper incisor, but showed a significant correlation with the growth of the nose and of the soft pogonion. As the change in the upper lip in relation to the Sy line was not significant, it can be suggested that the profile changes were probably more due to the growth of the nose and chin than to the retraction of lips. The change of the lower lip in relation to the E line was significant, showing the retraction of the profile, but it could not be correlated to the position change of the lower incisor or to the nose and chin growth.

In a similar way, other studies[11,17,20] showed that mandibular growth and nasal growth contribute further to the flattening of the profile than the retraction of lips. Ricketts[15] observed a growth of the tip of the nose of about 1 mm/year in relation to the anterior nasal spine in growing patients. He claims that the nasal and mandibular growth associated to the retraction of teeth was responsible for esthetic changes often observed in the treated cases. Anderson et al[1] noted a greater flattening of the profile after the orthodontic treatment due to an additional growth of nose and chin during maturation of the studied individuals. Bishara et al[3] emphasized that the movement of the tip of the nose in an anterior and inferior direction during growing, as it is greater than the displacement of the point A and of the upper lip, makes the nose more prominent. They also suggest that the treatment planning of growing patients must take into account that future changes may affect the profile in an adverse way. Erdinc et al[6] observed a significant growth of the nose in patients treated with and without extraction of four first pre-molars. Halazonetis[8] noted a relative increase in the nose and chin in both genders in patients with similar age.

Additionally, it is important to consider that the soft tissues of nose and chin still growing in the adulthood, which may lead to a greater retrusion of the profile. Variations in gender have been reported in the literature. Formby et al[7] evaluated lateral radiographs of 24 male and 23 female subjects, from 18 to 42 years of age and observed a greater flattening of the profile in male individuals, which presented a greater increase in the dimensions of the nose and in the width of the soft tissue in the region of the pogonion, similarly to the findings of Nanda et al[12] in 17 male and 23 female subjects, from 7 to 18 years of age. In the female gender, lips did not appear to be retruded because despite the increase in the dimensions of the nose, the width of the soft tissue in the region of pogonion decreased in women. In the present study it was not possible to make that comparison, as there were too few male patients.

As to the facial esthetics, it is important to emphasize that it is questionable whether the esthetic facial models from the past are still applicable to the faces considered esthetic today.[13] There is a current tendency to value profiles with more prominent lips. Nguyen and Turley[13] observed that the ideal Caucasian male profile has changed significantly across time and nowadays more projected lips with a greater exposure of lip vermilion are considered more attractive. Similarly, Yehezkel and Turley[19] described a current tendency to adopt esthetic patterns with fuller and more anteriorly positioned lips in the Afro-American female profile, and this change occurred along the twentieth century. Auger and Turley[2] showed that patterns for an esthetic profile in Caucasian women also tend to adopt fuller and more anteriorly positioned lips. Scott et al[16] noted that thicker vermilion borders were considered more attractive. Coleman et al[5] reported in a study about the influence of the prominence of the chin in the esthetic preference of labial profile, that fuller anterior lips in relation to the Ricketts E line were generally preferred in extreme retrognathic and prognathic profiles, while retracted lips were preferred for more regular profiles. Thus, it is important to consider this tendency in the planning and performance of treatment in biprotrusion cases, and the orthodontist must avoid a flattening of the profile.

A positive correlation between upper lip retraction and the retraction of upper and lower incisor

was observed in the present study. The same correlation was observed for the lower lip retraction. These data confirm that the retraction of anterior teeth influences the lips position, although the difference between pre and post-treatment measurements of the position of the lips in relation to the Sy line was not significant. These results were similar to other studies.[1,9,10] However, there is still discordance about the response from the soft tissues to the dental changes and in the alveolar process.[6] According to Lai et al,[11] the attempts to establish a mean rate to detect a tendency or predict the response of soft tissues to the incisors movement were not well-succeeded due to the large variability of soft tissues among individuals.

CONCLUSIONS

The results from the present study lead to the following conclusions:

1. Nasolabial angle presented a significant increase with treatment, which could not be correlated to any measurement assessed.
2. Upper and lower lips presented an increased distance to Ricketts' E line by the end of treatment, showing a retrusion in the profile. However, there was just a small variation between pre and post-treatment measurements of the position of lips in relation to the Sy line. Therefore, it is suggested that the change in the lips in relation to the E line is due more to the growth of nose and chin than to a real change in their position.
3. Upper and lower incisors were significantly retracted. This retraction was positively correlated to the change in the lips position. Although the change in the profile is attributed in great part to growth, the retraction of the incisors influenced the retraction of lips and thus the changes in the profile.

REFERENCES

1. Anderson JP, Joondeph DR, Turpin DL . A cephalometric study of profile changes in orthodontically treated cases ten years out of retention. Angle Orthod. 1973 Jul;43(3):324-36.
2. Auger TA, Turley PK. The female soft tissue profile in fashion magazines during the 1900s: A photographic analysis. Int J Adult Orthodon Orthognath Surg. 1999;14(1):7-18.
3. Bishara SE, Jakobsen JR, Hession TJ, Treder JE. Soft tissue profile changes from 5 to 45 years of age. Am J Orthod Dentofacial Orthop. 1998 Dec;114(6):698-706.
4. Bravo LA. Soft tissue facial profile changes after orthodontic treatment with four premolars extracted. Angle Orthod. 1994;64(1):31-42.
5. Coleman GG, Lindauer SJ, Tüfekçi E, Shroff B, Best AM. Influence of chin prominence on esthetic lip profile preferences. Am J Orthod Dentofacial Orthop. 2007 Jul;132(1):36-42.
6. Erdinc AE, Nanda RS, Dandajena TC. Profile changes of patients treated with and without premolar extractions. Am J Orthod Dentofacial Orthop. 2007 Sep;132(3):324-31.
7. Formby WA, Nanda RS, Currier GF. Longitudinal changes in the adult facial profile. Am J Orthod Dentofacial Orthop. 1994 May;105(5):464-76.
8. Halazonetis DJ. Morphometric evaluation of soft-tissue profile shape. Am J Orthod Dentofacial Orthop. 2007 Apr;131(4):481-9.
9. Jamilian A, Gholami D, Toliat M, Safaeian S. Changes in facial profile during orthodontic treatment with extraction of four first premolars. Orthodontic Waves, 2008 Jul;67(4):157-61.
10. Kusnoto J, Kusnoto H. The effect of anterior tooth retraction on lip position of orthodontically treated adult Indonesians. Am J Orthod Dentofacial Orthop. 2001 Sep;120(3):304-7.
11. Lai J, Ghosh J, Nanda RS. Effects of orthodontic therapy on the facial profile in long and short vertical facial patterns. Am J Orthod Dentofacial Orthop. 2000 Nov;118(5):505-13.
12. Nanda RS, Meng H, Kapila S, Goorhuis J. Growth changes in the soft tissue facial profile. Angle Orthod. 1990 Fall;60(3):177-90.
13. Nguyen DD, Turley PK. Changes in the Caucasian male profile as depicted in fashion magazines during the twentieth century. Am J Orthod Dentofacial Orthop. 1998 Aug;114(2):208-17.
14. Oliveira GF, Almeida MR, Almeida RR, Ramos AL. Alterações dentoesqueléticas e do perfil facial em pacientes tratados ortodonticamente com extração de quatro primeiros pré-molares. R Dental Press Ortodon Ortop Facial. 2008 Mar-Abr;13(2):105-14.
15. Ricketts RM. The influence of orthodontic treatment on facial growth and development. Angle Orthod. 1960 Jul;30(3):103-33.
16. Scott CR, Goonewardene MS, Murray K. Influence of lips on the perception of malocclusion. Am J Orthod Dentofacial Orthop. 2006 Aug;130(2):152-62.
17. Stephens CK, Boley JC, Behrents RG, Alexander RG, Buschang PH. Long-term profile changes in extraction and nonextraction patients. Am J Orthod Dentofacial Orthop. 2005 Oct;128(4):450-7.
18. Tweed CH. Clinical Orthodontics. St. Louis (MO): C. V. Mosby; 1966.
19. Yehezkel S, Turley PK. Changes in the African American female profile as depicted in fashion magazines during the 20th century. Am J Orthod Dentofacial Orthop. 2004 Apr;125(4):407-17.
20. Zierhut EC, Joondeph DR, Artun J, Little RM. Long-term profile changes associated with successfully treated extraction and nonextraction Class II division 1 malocclusions. Angle Orthod. 2000 Jun;70(3):208-19.