Original Article

Changes in pogonion and nose according to breathing patterns

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Abstract

Introduction: The soft tissue profile results from complex changes in the hard and soft tissues of the face. The pogonion and the nose are dominant facial structures that determine the degree of profile convexity and should, therefore, be analyzed and included in orthodontic treatment planning. **Objective:** To conduct a longitudinal evaluation of the anteroposterior dimensional changes of the pogonion and the nose of individuals with Angle Class II, division 1 malocclusion at two time points during craniofacial development. **Methods:** Lateral cephalograms were obtained for 40 individuals — 23 nasal breathers (NB) and 17 mouth breathers (MB). **Results:** Linear and angular measures were obtained: UL'-Pog', UL'-B', B'-Pog', Pog'-PogTeg', NB Line, Pog-NB, N'-Prn, Prn-NPog, N-Prn-Sn and Prn-Sn-UL. Two-way ANOVA was used to detect differences between mean values according to time points and/or breathing patterns. The UL'-B', Pog'-PogTeg', NB line and Pog-NB, N'-Prn, Prn-NPog, N-Prn-Sn and Prn-Sn-UL variables had significant differences ($p \leq 0.05$) between the two time points, but there were no significant differences between breathing patterns. No interaction was found between breathing patterns and time points for any variable. **Conclusion:** The pogonion and the nose undergo significant changes in the anteroposterior plane during growth, but breathing patterns do not significantly affect changes.

Keywords: Nose. Pogonion. Nose breathing. Mouth breathing.

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INTRODUCTION

An individual's soft tissue profile results from changes that affect facial bones and soft tissues. The interrelationship between facial soft tissue components (the nose, lips and pogonion) changes during growth and along orthodontic treatment. Therefore, normal growth trends of these structures should be understood.[18] At birth, the pogonion is retruded in relation to the maxilla, and this difference tends to decrease as the mandible grows. Men tend to have larger structures than women,[28] and the menton modification is not specific of any type of malocclusion.

The nose, the most dominant of all the profile elements,[17] has received little attention in orthodontic analysis, although the ones made by Steiner,[29] Ricketts,[21] Holdaway[12] and Chaconas[4] use the nose either as a reference point or just as one more facial element.

Several studies in the literature have evaluated the effect of breathing patterns on the morphology of the dentoskeletal complex, but there remains substantial disagreement between authors. Some reported that nasal obstruction affects growth and facial development; for others, the changed growth of the dentofacial complex results from environmental and genetic factors.[30]

Dentists should understand the pogonion and nose growth, and their association with the face. The prediction of the amount and direction of growth is valuable information, particularly in mouth breathing and nose breathing patients.

OBJECTIVES

To longitudinally evaluate the anteroposterior dimensional changes in the pogonion and nose of individuals with Angle Class II, division 1 malocclusion at two time points during craniofacial development.

MATERIAL AND METHODS

The study sample was composed of lateral cephalograms of 40 individuals with Angle Class II, division 1 malocclusion: 23 nasal breathers (NB) and 17 mouth breathers (MB). The patient ages ranged from 10 years and 9 months to 14 years at time point 1, and 13 years and 4 months to 16 years and 6 months at time point 2.

Breathing pattern was classified using the multidisciplinary method described by Wieler et al,[24] which consisted of a clinical evaluation of lip competence by a dentist; a questionnaire to the parents about their children breathing habits; an ear, nose and throat evaluation by an otolaryngologist; and a speech test performed by a speech pathologist. Based on these tests, scores and weighted values were assigned to each evaluation, and an index was defined to classify the predominant breathing pattern for each individual.

Cephalograms were obtained using manual and computerized methods.[25] The anatomical structures were outlined manually. After digitalization, the landmarks were marked, and values were calculated using the Radiocef 2000® cephalometric software. Study models were used to aid in tracing tooth positions.

The following parameters were used:

Linear measures referring to pogonion

» UL'-Pog' – measure from UL' to Pog', corresponding to the greatest anteroposterior dimension of the lateral image of the mandibular symphysis (total symphysis thickness).

» UL'-B' – measure from UL' to B', corresponding to the greatest anteroposterior dimension of the lateral image of the mandibular symphysis.

» B'-Pog' – measure from B' to Pog', corresponding to the greatest anteroposterior dimension of the lateral image of the mandibular symphysis.

» Pog'-PogTeg' – measure from Pog' to PogTeg', corresponding to the greatest anteroposterior dimension of the lateral image of the mandibular symphysis.

» NB line – line from nasion to Point B.
» Pog-NB – distance from Pog to NB line; refers to the most anterior point of the hard chin, measured from the NB line. Values are positive and negative when after and before the NB line, respectively.

Linear measures referring to nose

» N'-Prn – measure of the position of the tip of the nose in relation to the nasion; defines nose prominence.
» Prn-NPog – measure of the nasal depth in relation to the facial plane.

Angular measures referring to nose

» SN-Prn-Sn – measure of the nose prominence in relation to the sella-nasion
» Prn-Sn-UL – nasolabial angle; measure of the inclination of the columella in relation to the upper lip.

RESULTS

Pogonion

All variables had a normal distribution at all time points according to the Kolmogorov-Smirnov test, except B'-Pog' and Pog-NB. Therefore, mean values according to time points were compared using two-way repeated measures ANOVA.

ANOVA results revealed that F was statistically significant ($p<0.05$) for UL'-B', Pog'-Pog Teg', NB line and Pog-NB, and that there was a significant difference between mean values according to time point, breathing pattern, or both. The B'-Pog' and UL'-PogTeg' values were not statistically different ($p>0.05$) between breathing patterns or time points. To identify which conditions (breathing pattern x time points) were different from each other, the Tukey HSD test for multiple comparisons was used (Table 1).

TABLE 1 - Multiple comparison of Tukey HSD breathing patterns (Pogonion).

Breathing pattern	Time points	Nose T_1	Nose T_2	Mouth T_1	Mouth T_2
UL'-B'	Mean	10.08	8.96	9.75	8.95
Nose	Initial	—	0.000225*	0.973068	0.215061
Nose	Final	0.000225*	—	0.516552	1.000000
Mouth	Initial	0.973068	0.516552	—	0.020579*
Mouth	Final	0.215061	1.000000	0.020579*	—
Pog'- PogTeg'	Mean	10.54	10.80	10.40	10.98
Nose	Initial	—	0.327002	0.888784	0.557792
Nose	Final	0.327002	—	0.585907	0.864706
Mouth	Initial	0.888784	0.585907	—	0.049538
Mouth	Final	0.557792	0.864706	0.049538	—
NB Line	Mean	95.95	100.03	98.73	101.48
Nose	Initial	—	0.000166*	0.638323	0.012703*
Nose	Final	0.000166*	—	0.873554	0.924643
Mouth	Initial	0.638323	0.873554	—	0.0029667*
Mouth	Final	0.012703*	0.924643	0.0029667*	—
Pog-NB	Mean	1.85	2.43	1.27	1.87
Nose	Initial	—	0.005911*	0.841574	0.997777
Nose	Final	0.005911*	—	0.108289	0.880566
Mouth	Initial	0.841574	0.108289	—	0.009903*
Mouth	Final	0.997777	0.880566	0.009903*	—

*Statistically significant difference ($p\leq0.05$).

TABLE 2 - Multiple comparison of Tukey HSD breathing patterns (Nose).

Breathing pattern	Time point	Nose T_1	Nose T_2	Mouth T_1	Mouth T_2
N'-Prn	Mean	48.46	51.17	48.65	51.09
Nose	Initial	—	0.000168*	0.998581	0.032712*
Nose	Final	0.000168*	—	0.043527*	0.999881
Mouth	Initial	0.998581	0.043527*	—	0.000426*
Mouth	Final	0.032712*	0.999881	0.000426*	—
Prn-NPog	Mean	31,44	33.37	31.16	33.54
Nose	Initial	—	0.057858	0.996643	0.239205
Nose	Final	0.057858	—	0.200245	0.999237
Mouth	Initial	0.996643	0.200245	—	0.038587*
Mouth	Final	0.239205	0.999237	0.038587*	—
N-Prn-Sn	Mean	99.74	96.09	100.88	98.00
Nose	Initial	—	0.000591*	0.961845	0.763410
Nose	Final	0.000591*	—	0.046302*	0.847989
Mouth	Initial	0.961845	0.046302*	—	0.024001*
Mouth	Final	0.763410	0.847989	0.024001*	—
Pr-Sn-UL	Mean	0.763410	126.48	120.59	122.76
Nose	Initial	0.763410	0.043676*	0.430122	0.719993
Nose	Final	0.763410	—	0.060697	0.372458
Mouth	Initial	0.763410	0.060697	—	0.142717
Mouth	Final	0.763410	0.372458	0.142717	—

*Statistically significant difference ($p \leq 0.05$).

Nose

The study hypothesis was tested using two-way repeated measures analysis of variance (ANOVA). The two time points and two breathing patterns had a normal distribution for the variables under analysis. The Kolmogorov-Smirnov test was used to test normality, and the level of significance was set at 0.05.

The Tukey HSD test for multiple comparisons was used to detect which conditions (breathing pattern x time points) differed from each other when ANOVA results revealed a difference between the mean values of N'-Prn, Prn-NPog, N-Prn-Sn and Prn-Sn-UL according to time point, breathing pattern, or both (Table 2).

DISCUSSION

Facial analysis has been used as a valuable diagnostic resource since the beginning of orthodontics,[20] and the lips, cheeks and nose, in particular, define the unique facial appearance of each individual.[19]

Skeletal growth and changes in soft tissues affect occlusion and facial esthetics. The amount of soft tissue over the symphysis has a fundamental role in facial harmony and in the response to skeletal changes.[5] In addition, the measures obtained using cephalometry, although two-dimensional, provide concrete data that make comparisons possible and complement diagnoses.[16] For this reason, cephalometry is widely used in several scientific studies.[10,11]

Changes in facial soft and hard tissues should be taken into consideration during orthodontic diagnosis and treatment planning.[2,22,28] Growth differences between sexes and age groups have been documented for these structures.[11]

The results of the present study revealed changes in the hard and soft tissue pogonion at the two time points under analysis, 10-14 and 13-16 years of age, which are in agreement with Koch et al[13] and Maltagliati et al[15] findings. Pogonion thickness, evaluated according to the UL'-Pog' measure, resulted from different bone remodeling patterns due to greater bone deposition in the lingual surface of the pogonion, characteristic of the growth phase, as confirmed by histological[6] and implant[1] studies.

In the present study, the soft tissue pogonion was directly associated with the increase of the skeletal pogonion, which differs from data reported by Genecov, Sinclair and Dechow,[9] who found that the growth of the soft tissue pogonion in patients undergoing orthodontic treatment was constant and relatively independent from the underlying bone.

The analysis of the B'-Pog' showed that this measure is shorter in nasal breathers and greater in mouth breathers. This study, however, did not investigate the reason for this reduction in nasal breathers. A smaller posterior movement of Point B might have occurred in consequence of downward and backward mandibular rotation, although the possibility of less bone deposition in the pogonion region was not ruled out.

The shorter UL'-B' and longer Pog-NB may be explained by the posterior displacement of Point B and the bone deposition in the pogonion surface. Moreover, there were variations in the mandibular plane angle. According to Rosenstein,[23] the UL'-B' line tends to be even shorter in individuals whose treatment includes extractions.

Prahl-Andersen et al[18] found that nose length, prominence and shape are associated with the growth in height and length of the maxilla and the mandible.

The nose projection onto the posteroanterior plane had a statistically significant difference in this study, which is in agreement with findings by Brant et al,[3] who reported significant changes in N-Prn-Sn when groups with and without premolar extractions were compared. According to Chanocas,[4] the tip of the nose grows downward in individuals with Class II malocclusion.

The nasolabial angle (Prn-Sn-UL) had significant changes ($p \leq 0.05$) between the two time points as a result of nasal growth and upper lip retraction, which takes place during the normal development of individuals, when the nasolabial fold may also become longer.[7] The results are in agreement with those reported by Salgado et al,[26] who found significant variations in nasolabial angles of individuals with Angle Class II and Class III malocclusion, and greater values in Class II cases. However, the results differ from those reported by Brant et al,[3] who found no significant differences in the nasolabial angle of individuals that underwent orthodontic treatment with or without extractions.

Nasal breathing is essential for adequate growth and development of the craniofacial complex.[27] Some studies found differences in the craniofacial development of mouth breathers and nasal breathers. In mouth breathers, there seems to be a greater inclination of the angle of the mandibular plane, and the growth pattern is vertical.[14,28] This finding contradicts the results of this study, which found no interaction between breathing patterns and any of the variables under study.

Changes in the thickness of the soft tissues of the nose, lips and pogonion should be taken into consideration during diagnosis, treatment planning, and actual treatment of individuals during growth.

CONCLUSION

There were anteroposterior changes in the skeletal and soft tissue pogonion and in the nose during growth, but breathing patterns were not associated with any significant changes.

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