

Evaluation of the Alveolar Process of Mandibular Incisor in Class I, II and III Individuals with Different Facial Patterns

Avaliação do Processo Alveolar em Indivíduos Classe I, II e III com Diferentes Padrões Faciais

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Abstract

In this study the thickness of the alveolar process was evaluated, and the morphology of the alveolar process of the mandibular symphysis was correlated with the Mesofacial, Brachyfacial and Dolicofacial facial skeletal patterns with Class I, II and III malocclusions, and their dependence on age. One hundred and thirty-five lateral telerradiographs were obtained, of subjects of both genders, between the ages of 11 years and 11 months and 36 years of age. The sample was divided into nine groups (n=15) according to the pattern of facial growth and malocclusion. The variables that indicated the morphology of the alveolar process of the mandibular symphysis were evaluated: C-C', P-B, P'-B', S-A and S'-A. The data were submitted to the analysis of variance and the Tukey test (p<0.05). Pearson's correlation analysis (rP) was performed to evaluate the correlation among the measurements C-C', P-B, P'-B', S-A, and S'-A and ANB, AOBO, FMA, and SNGoGn. There was no influence (p>0.05) of the facial pattern or malocclusion on the variables P'-B' and S'-A. Nevertheless, the facial pattern was determinant for the variables C-C' (only for Classes I and III), P-B and S-A. Malocclusion was determinant for C-C' and the Brachyfacial and Dolicofacial patterns of Class III presented higher values than those of the other Classes. The Brachyfacial pattern of Class I also presented higher values for the variable S-A than for the other Classes. It was concluded that there was no significant correlation between the thickness of the alveolar process of the mandibular symphysis with malocclusion or with age.

Keywords: Malocclusion. Alveolar Process. Mandible.

Resumo

Neste estudo foram avaliadas em telerradiografias a espessura e a morfologia do processo alveolar da sínfise mandibular nos diferentes padrões esqueléticos e maloclusões. Cento e trinta e cinco telerradiografias laterais foram obtidas de indivíduos de ambos os sexos, com idades entre 11 anos e 11 meses e 36 anos de idade. A amostra foi dividida em nove grupos (n = 15) de acordo com o padrão de crescimento facial (braquifacial, mesofacial e dolicofacial) e má oclusão (Classe I, Classe II e Classe III). As variáveis que indicaram a morfologia do processo alveolar da sínfise mandibular foram avaliados: C-C', P-B, P'-B', S-A e S'-A. Os dados foram submetidos à análise de variância e teste de Tukey (p < 0,05). A análise de Pearson foi realizada para verificar a correlação entre as medidas C-C', P-B, P'-B', S-A e S'-A; e ANB, AOBO, FMA e SNGoGn. Não houve influência (p > 0,05) do padrão facial ou má oclusão nas variáveis P'-B' e S'-A. No entanto, o padrão facial foi determinante para as variáveis C-C' (apenas para as maloclusões Classe I e III), P-B e S-A. Má oclusão foi determinante para a C-C', e os padrões braquifacial e dolicofacial de Classe III apresentaram valores superiores aos das outras classes. Dentro do padrão braquifacial com maloclusão Classe I, o valor de S-A foi significativamente maior do que nas outras classes. Concluiu-se que não houve correlação significativa entre a espessura do processo alveolar da sínfise mandibular com má oclusão.

Palavras-chave: Má Oclusão. Processo Alveolar. Mandíbula.

1 Introduction

Since it began, Orthodontics has been the branch of dentistry concerned with facial balance and harmony, and restoring form, function and esthetics. The facial esthetics and the stability of orthodontic treatment depend on the position of the mandibular incisors, which are contained in the alveolar process of the mandibular symphysis. The symphysis width contributes to the outline of the face, particularly the profile, in addition to being a reference for the position of the incisors by the degree of its protrusion¹. Knowing about its development and morphology helps to achieve results in cases requiring treatment².

The region of the mandibular symphysis is involved in

delicate and limited movements, not only in esthetics, but with regard to bone and tooth resorptions. Therefore, knowledge of the adequate limits of tooth movement and establishment of parameters for the thickness of the alveolar process in the mandibular symphysis region may have a significant influence on the diagnosis, and consequently, the end result of orthodontic treatment. Orthodontists must therefore know not only the morphology but also the pattern of craniofacial growth, which show them the limits of orthodontic treatment. Previous studies have shown that individuals with a vertical growth pattern have a longer and narrower symphysis; in those with horizontal growth it is shorter and wider^{3,4}. Thus, the facial pattern may help the diagnosis the shape of the

symphysis⁵.

It is known that the facial growth pattern influences not only the morphology of the mandibular symphysis, but also the thickness of the alveolar process in this area, and consequently, the position of the mandibular incisors. The wider the symphysis, the greater the possibility to tip forwards the mandibular incisors⁶. Moreover, one speculates that the negative vertical overlap is another factor influencing the symphysis morphology⁷.

When the maxillary and mandibular incisors are retracted there is a risk of adverse effects. A more recent study used the cone beam tomography technique to evaluate the thickness of the alveolar process around the mandibular incisors⁸. In spite of the appearance of new imaging technologies, it is believed that diagnosis of the morphology of alveolar process of the mandibular symphysis is still based on the interpretation of lateral teleradiography.

In view of these considerations, the aim of this study was to evaluate and correlate the thickness of the alveolar process of the mandibular symphysis with the facial pattern and malocclusion. This evaluation may contribute to the diagnosis and planning of orthodontic mechanics used, preventing unsuitable movements in the antero-inferior region.

2 Material and Methods

2.1 Inclusion and exclusion criteria

The research protocol was previously submitted and approved by the Human Research Committee of UNIRARAS University, Brazil (Protocol 005/2009). The sample was selected in accordance with the following inclusion criteria: teleradiographs with good quality images and clarity, taken for orthodontic documentation of patients between the ages of 11 years and 11 months and 36 years, of both genders, leukodermas, with permanent dentition. None of them had been submitted to previous orthodontic treatment. The facial pattern was evaluated by the FMA⁹ and SN.GoGn angles¹⁰, in compliance with the following values: Mesofacial pattern: Angular value of FMA between 21° and 29° and angular value of SN.GoGn between 30° and 35°; Dolico-facial pattern: angular value of FMA greater than 30° and angular value of SN.GoGn greater than or equal to 36°; Brachy-facial pattern: angular value of FMA smaller than 20° and angular value of SN.GoGn smaller than or equal to 29°.

The relationship of the bony bases in compliance with the following values^{11,12}: Class I: linear value of AO-BO between 0 and 4 mm and ANB between 0° and 4°; Class II: linear value of AO-BO equal to or over 4.5mm and ANB over 5°; Class III: Linear value of AO-BO equal to or smaller than -0.5mm and ANB below 0°.

Finally, the sample with one hundred thirty-five subjects was divided in nine groups with fifteen subjects in each, according to the facial growth pattern and malocclusion.

2.2 Cephalometric analysis

Mandibular plane orientation was performed in the mandibular symphysis for orientation measurements in the cervical, middle and apical height of the most forward mandibular incisor diagnosed in the lateral cephalometric radiograph. Three planes were traced: The most superior plane was traced in the cervical region of the incisor at the level of the alveolar crest (the most superior point of the anterior alveolar process of the mandibular symphysis); the most inferior plane was traced at the level of the root apex; the third plane was traced at equidistant measurements from the other planes, all planes being parallel to one another. To evaluate the thickness of the alveolar process of the mandibular symphysis, the cephalometric measurements presented in Table 1 were used, and are represented graphically in Figure 1.

Table 1: The cephalometric measurements

Measurements	Description
C-C'	Width of the alveolar process of the mandibular symphysis at the level of the vestibular and lingual bone crests.
P-B	Vestibular bone at the level of half the root of the mandibular incisor. From half the root of the most vestibularized mandibular incisor to the external limit of the vestibular cortical of the mandibular symphysis.
P'-B'	Lingual bone at the level of half the root of the mandibular incisor. From half the root of the most vestibularized mandibular incisor to the external limit of the lingual cortical of the mandibular symphysis.
S-A	Vestibular bone to the apex of the mandibular incisor. From apex of the most vestibularized mandibular incisor to the external limit of the vestibular cortical of the mandibular symphysis.
S'-A	Lingual bone to the apex of the mandibular incisor. From apex of the most vestibularized mandibular incisor to the external limit of the lingual cortical of the mandibular symphysis.

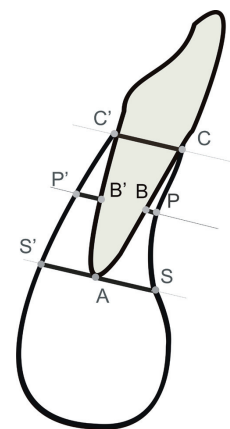


Figure 1: Representative diagram of the mandibular symphysis and the mandibular incisor, at the points where the bone thickness measurements were made at the three levels (cervical, middle and apical), according to the orientation planes

2.3 Statistical analysis

The test of the reliability of the method of measurement performed by the same operator initially and 15 days later, was the intraclass correlation test – ICC, confirming replicability.

The data were submitted to statistical analysis using the Analysis of Variance (ANOVA), observed between facial patterns or malocclusion class and Tukey test with a level of significance of 5%.

Pearson's correlation analysis (rP) was performed to evaluate the correlation among the measurements C-C', P-B, P'-B', S-A, and S'-A and ANB, AOBO, FMA, and SNGoGn. For interpreting the correlation, the following values were adopted: rP<0,2 – slight correlation, practically without any relationship between the measurements; rP between 0.21

and 0.40 – little correlation; rP between 0.41 and 0.70 – moderate correlation, substantial relationship between the measurements; rP between 0.71 and 0.90 – high correlation, strong relationship between the measurements; rP>0.9 – very high correlation.

3 Results and Discussion

According to Table 2, there was no influence (p>0.05) of the facial pattern or malocclusion on the variables P'-B' and S'-A. Nevertheless, the facial pattern was determinant for the variables C-C' (only for Classes I and III), P-B and S-A, while malocclusion was determinant for C-C'. The Brachyfacial pattern of Class I presented higher values for the variable S-A than for the other Classes.

Table 2: Mean values of the variables that indicated the morphology of the alveolar process of the mandibular symphysis

Class	Facial patterns	Variable				
		C-C'	P-B	S-A	P'-B'	S'-A
Class I	Brachyfacial	5.8 (± 0.3) ab, A	2.5 (± 1.3) a, A	8.1 (± 2.4) a, A	1.8 (± 0.9) a, A	4.1 (± 1.4) a, A
	Dolicofacial	5.6 (± 0.3) a, A	1.3 (± 1.0) b, A	4.4 (± 2.9) b, A	1.2 (± 0.7) a, A	3.7 (± 1.4) a, A
	Mesofacial	6.1 (± 0.5) b, A	1.3 (± 0.5) b, A	5.1 (± 1.8) b, A	1.6 (± 0.7) a, A	4.5 (± 1.3) a, A
Class II	Brachyfacial	5.8 (± 0.6) a, A	1.6 (± 0.8) a, B	6.0 (± 1.9) a, B	1.7 (± 0.5) a, A	4.0 (± 0.9) a, A
	Dolicofacial	5.8 (± 0.4) a, A	1.0 (± 0.6) b, A	3.2 (± 1.2) b, A	1.3 (± 0.6) a, A	3.7 (± 0.8) a, A
	Mesofacial	5. (± 0.5) a, A	1.5 (± 0.9) a, A	5.7 (± 1.9) a, A	1.3 (± 0.7) a, A	3.7 (± 1.1) a, A
Class III	Brachyfacial	6.2 (± 0.3) a, B	1.7 (± 0.7) a, A	6.0 (± 1.7) a, B	1.8 (± 0.9) a, A	4.8 (± 1.4) a, A
	Dolicofacial	6.1 (± 0.5) a, B	1.1 (± 0.5) ab, A	3.7 (± 1.4) b, A	1.4 (± 0.9) a, A	4.2 (± 1.4) a, A
	Mesofacial	5.8 (± 0.4) b, A	0.9 (± 0.4) b, A	4.5 (± 1.6) b, A	1.3 (± 0.7) a, A	4.2 (± 1.3) a, A
P		0.0013	0.0002	< 0.0001	0.2036	0.1837

* - No statistically significant difference (ANOVA) was observed between facial patterns or malocclusion class.

Mean values followed by different lowercase letters differ statistically by the Tukey's test at 5% level between facial patterns. () Standard Deviation. Mean values followed by different capital letters differ statistically by the Tukey's test at 5% level between malocclusion class. () Standard Deviation.

FMA and Sn.GoGn presented negative correlation between little and moderate, although significant, with the measurements P-B, P'-B' and S-A, whereas the measurements ANB and AOBO showed slight correlation with the measurements C-C' and S'-A (Table 3).

Table 3: Pearson's correlation analysis (rP)

Measurement	Variable				
	C-C'	P'-B'	P-B	S'-A	S-A
FMA	-0.1125	-0.2051*	-0.3453*	-0.1446	-0.5639**
Sn.GoGn	-0.1146	-0.2498*	-0.3742*	-0.1475	-0.5671**
ANB	-0.1805*	-0.0050	-0.0862	-0.1733*	-0.0337
AOBO	-0.2019*	-0.0203	-0.0205	-0.2028*	0.0712

* Statistically significant difference (ANOVA) - p≤0,05

** Statistically significant difference (ANOVA) - p≤0,01

The eruption movements of the teeth strongly contribute to the vertical growth of the alveolar process, in addition to which, condylar growth, position of the incisors, and/or

mandibular posture should also be taken into consideration¹³. Aki *et al.*¹⁴ found differences in the sizes of the symphysis according to the age group, particularly in the growth stage.

The meticulous and careful measurement of the thickness of the alveolar process of the mandibular symphysis both from the vestibular and lingual aspects in the cervical, middle and apical thirds of the mandibular incisor, made it possible to find out the bone and tooth behavior in this region. The Brachyfacial growth patterns in all the Class I, II and III malocclusions; and Mesofacial Class II presented greater thickness from the lingual than from the vestibular aspect (Table 2). The differences in vestibular and lingual thicknesses are due to the long narrow symphyses having dento-alveolar compensation by dental extrusion to maintain vertical dimension in individuals with a tendency towards vertical growth in the different malocclusions. The alveolar bone accompanies the inclination of the mandibular incisors, and becomes thinner, changing the morphology of the synthesis¹⁵.

The results showed a moderate influence of the facial growth pattern on the anatomy of the mandibular symphysis (Table 3), being a result similar to that found in the study

of Tsunori *et al.*¹⁶ The influence of the growth pattern on the morphology of the mandibular symphysis has been extensively studied and proved in various studies^{3,4,14,17}, showing that the greater the predominance of vertical growth of the face, the longer and narrower is the symphysis; whereas, the greater the predominance of horizontal growth of the face, the broader and shorter will be the mandibular symphysis. Haskell³ comparing the three growth patterns - Mesofacial, Dolico-facial and Brachy-facial - verified that the size of the mandible varied with the growth pattern, and that the mandibular symphysis region undergoes adaptation to the shape of the mandibular arch, and the arches tend to be narrower in cases of predominantly vertical growth, and squarer in cases of predominantly horizontal growth. Hypofunction of the musculature of the face in addition to exaggerated vertical growth promotes a slight mentonian protrusion in response to the myoskeletal. One could also take into consideration that the radiographic method used only proves a two-dimensional image of the mandibular symphysis. Nevertheless, telerradiography is widely used due to its low cost, low radiation emitted and the orthodontist's easy access to it. At present, cone beam tomography provides an image with detailed reconstruction of the facial structures, providing a more refined diagnosis⁸.

The alveolar process of the mandibular symphysis is an area causing extreme concern as far as retraction of the mandibular incisors is concerned. The more detailed the image of this region is, the fewer iatrogenies there would be, the more accurate the diagnosis and the more guaranteed would be the success of treatment. Thus, the mandibular symphysis region, or more precisely, the alveolar process of this area, deserves accurate diagnostic exams and specific therapeutic care.

4 Conclusion

After analyzing the results, it was concluded that the thickness of the alveolar process of the mandibular symphysis at the level of the cervical, middle and apical thirds of mandibular incisor roots, both from the lingual and vestibular aspects, was higher in the Brachy-facial pattern (Class I, II and III) and in the Mesofacial pattern Class II; the Dolico-facial pattern showed the lowest thicknesses both from the vestibular and lingual aspects; there was negative correlation between the facial growth pattern and the thicknesses of the alveolar process of the mandibular symphysis; there was no significant correlation between the thickness of the alveolar process of the mandibular symphysis with malocclusion and there was no correlation between the thickness of the alveolar process in the anterior region of the mandible and age.

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