

Evaluation of maxillary atresia associated with facial type

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Abstract

Objectives: To associate maxillary atresia with facial types, investigating whether dimorphism occurs between males and females and evaluating the percentage of such dimorphism according to gender and facial type. **Methods:** Initially, the sample consisted of 258 lateral cephalometric radiographs. After analyzing Ricketts' VERT index, 108 radiographs were excluded for not meeting the selection criteria. Therefore, the sample consisted of 150 lateral cephalometric radiographs and 150 models of 150 Caucasian individuals aged 14 years to 18 years and 11 months, regardless of malocclusion type. The sample was divided into 50 mesofacials, 50 brachyfacials and 50 dolichofacials. The Schwarz's analysis was applied to all 150 models. **Results:** The presence of maxillary atresia in the sample consisted of 64% in dolichofacials, 58% in brachyfacials and 52% in mesofacials. **Conclusions:** There was no evidence showing that atresia is in any way associated with facial type. Gender dimorphism was proportionally greater in dolichofacial males while females did not exhibit different proportions.

Keywords: Maxillary atresia. Schwarz's analysis. Facial types.

INTRODUCTION AND LITERATURE REVIEW

Dental arch shape is essential for the diagnosis of malocclusion given the fact that ideal stability and function require perfect dental intercuspation.

Maxillary atresia is a dentofacial deformity

characterized by a discrepancy in the maxilla/mandible relationship in the transverse plane, which may exhibit unilateral or bilateral posterior crossbite. It consists of a narrowing of the upper arch with a deep gothic palate often associated with respiratory dysfunction.

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It may be hidden due to the sagittal position of the maxilla and mandible with no apparent transverse deficiency.³

Witzig and Spahl¹⁰ affirm that Pont, in 1909, after assessing Basque individuals of southern France, established a fixed constant for the ideal shape of the dental arches in the premolar (80 mm) and molar (64 mm) regions using the formula: SI x 100 divided by 80 or 64, respectively.

Later, however, in disagreement with Pont, Schwarz and Gratzinger¹² developed a formula for each facial type.

For a better diagnosis of maxillary atresia Schwarz's analysis system is commonly used to determine the magnitude of the discrepancy, in millimeters, by measuring the actual arch width versus the ideal width of the upper and lower dentitions, thus indicating whether there is more need for anterior or posterior expansion.¹²

Arch morphology can assume different forms given their relationship with face width. Brachyfacials feature a larger transverse axis than do dolichofacials, whose faces are longer and narrower.⁴

The combined analysis of models and facial pattern can assist in choosing the mechanical procedure to be adopted by professionals, thereby optimizing the chances of a successful treatment.

By analyzing the maxilla transversely using Ricketts analysis and Schwarz's analysis, we realized it is possible to contribute with more evidence to orthodontic treatment diagnosis and planning, thereby increasing the likelihood of stability and successful results.

OBJECTIVE

The purpose of this study was to employ Ricketts vertical growth (VERT) analysis and Schwarz's model analysis to evaluate:

- The percentage of maxillary atresia in the dolichofacial, mesofacial and brachyfacial

facial types.

- Gender dimorphism, considering these facial types.
- Association of atresia with these facial types.

MATERIAL

Initially, our sample consisted of 258 lateral cephalometric radiographs. When performing cephalometry using Ricketts (VERT) analysis we selected 150 lateral cephalometric radiographs, i.e., 50 of brachyfacials, 50 of mesofacials and 50 of dolichofacials. Inclusion criteria required that all subjects should have complete permanent dentition with no agenesis, supernumerary teeth, extractions or extensive restorations.

The sample also comprised 150 stone casts of maxillary arches of 150 Caucasian individuals of both genders, aged 14 years to 18 years and 11 months, regardless of malocclusion type.

The models were analyzed using Schwarz's analysis to determine the extent of maxillary atresia.

METHODS

On the lateral cephalometric radiographs we highlighted the landmarks to perform Ricketts' (VERT) analysis and determine the facial pattern of each individual in the sample.

The following measurements were evaluated (Fig 1, Tables 1 and 2): lower facial height (angle formed by lines Xi-ENA and Xi-Pm), facial axis (posterior angle formed by the basion-nasion line and Pt-Gn), facial depth (angle formed by the intersection of the facial and Frankfurt planes), mandibular plane angle (formed by the intersection of the Frankfurt and mandibular planes), and the mandibular arch [obtained by extending the Xi-Pm and Xi-DC lines (condyle axis)]. With the resulting measurements we calculated the VERT index using the age standard, obtained according to the growth prediction method used by Ricketts to determine normal values for 9 year-old children.

The cephalometric analysis was performed

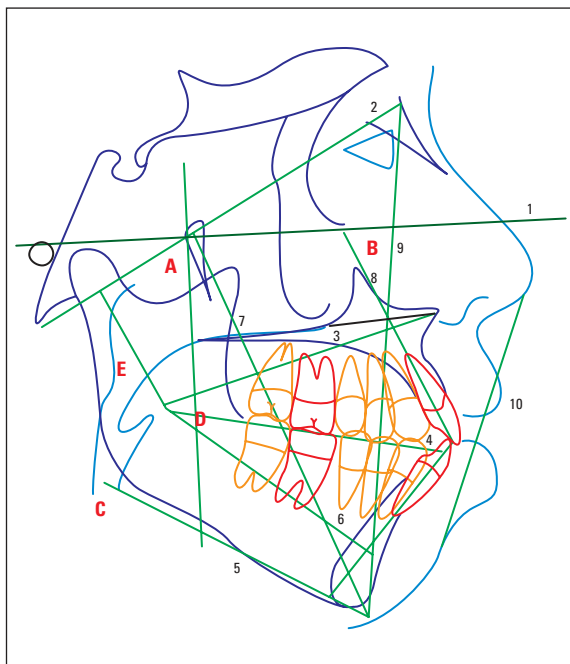


FIGURE 1 - Ricketts cephalometric analysis with lines, planes and angles in the CFX 2000 software.

Angles	
A	Lower facial height
B	Facial axis
C	Facial depth
D	Mandibular plane angle
E	Mandibular arch

TABLE 1 - Ricketts' VERT angles.

Lines and Planes	
1	Horizontal Frankfurt plane
2	Cranium-base plane
3	Xi-ENA line
4	Occlusal plane
5	Mandibular plane
6	Axis of the mandibular body
7	Facial axis
8	Long axis of the upper incisors
9	Facial plane
10	Aesthetic plane (line E)

TABLE 2 - Lines and planes in Ricketts' cephalogram.

in a Radiology Center with the aid of a computer program (CFX 2000, Cuiabá, Mato Grosso, Brazil).

In maxillary arch dental casts a pencil was used to mark landmarks on the occlusal surfaces of the following teeth: distal fossae of the first premolars and distal fossae of the first molars (Fig 2).

A bow divider was positioned over the landmarks on the first right and left premolars and subsequently, on the landmarks of the first right and left molars (Fig 5). The measurements (in mm) were recorded. With this procedure we obtained the transverse measurements between the first premolars and first molars in order to determine the presence of maxillary atresia.

Using a bow divider we measured the mesiodistal widths of the central and lateral maxillary incisors (in mm) (Fig 3 and 4).

The sum total of the mesiodistal diameters of the four incisors was represented by SI. The standard formulas of Schwarz used to compare models and cephalometric radiographs were: SI+6 = ideal premolar width and SI+12 = for molars (for leptoprosopics or dolichofacials), SI+7 = ideal premolar width and SI+14 = for molars (for mesoprosopics or mesofacials), SI+8 = ideal premolar width and SI+16 = for molars (for eurioprosopics or brachyfacials).

The value of SI, added to the value for each facial type, resulted in the ideal width of the transverse distances between first maxillary premolars and first maxillary molars.

Ub and um acronyms were used: the optimal distance measured in a linear fashion directly on the arch between the distal fossae of the first premolars was represented by ub and the ideal arch distance between the central fossae of the first molar was defined as um.

The actual distances between the distal fossae of the first premolars and the distal fossae of the first molars were measured with a bow divider.

The actual values were subtracted from the ideal values. When ub and um were identical in



FIGURE 2 - Landmarks (distal fossa of the first premolars and distal fossa of the first upper molars).



FIGURE 3 - Measurement of mesiodistal widths of upper central incisors.



FIGURE 4 - Measurement of mesiodistal widths of upper lateral incisors.



FIGURE 5 - Bow divider measuring the actual inter first premolar and intermolar widths.



terms of discrepancies, it indicated that they required identical lateral expansion of the maxillary arch, when discrepancy $ub > um$ it indicated that it required further anterior lateral expansion, and when discrepancy $ub < um$ it indicated that it required more posterior lateral expansion. All of these results were defined as maxillary atresia.

On the other hand, when the two discrepancies equaled zero, or when the actual distance was greater than the ideal distance, such discrepancies were not defined as maxillary atresia.

To investigate the association of atresia and gender with facial type the Pearson's chi-square test was used. For the comparison between the

TABLE 3 - Facial types and atresia.

Facial Types	Atresia		Total (%)
	Yes (%)	No (%)	
Dolichofacial	32 (64.00)	18 (36.00)	50 (100.00)
Mesofacial	26 (52.00)	24 (48.00)	50 (100.00)
Brachyfacial	29 (58.00)	21 (42.00)	50 (100.00)
Total	87 (58.00)	63 (42.00)	150 (100.00)

mean deviations of the premolars and molars in relation to gender for each facial type the Student's t test was used when the data approached a normal distribution (Shapiro-Wilk test) and the Mann-Whitney U test was used for data without normal distribution. $P < 0.05$ values were considered significant.

As reference the computer software Statistica (version 6, from StatSoft Inc., 2001, www.statsoft.com) was employed.

The presence of maxillary atresia in the sample consisted of 64% in dolichofacials, 58% in brachyfacials and 52% in mesofacials.

No evidence was found ($p = 0.4776$) of any association between atresia and facial type (Table 3).

Regarding gender dimorphism, however, Table 4 shows that the presence of atresia in men is proportionally higher in dolichofacials ($p = 0.0455$), while women, as shown in Table 5, did not show different proportions ($p = 0.5229$).

DISCUSSION

In this study we found 32 dolichofacial individuals with maxillary atresia, 26 mesofacials with maxillary atresia and 29 brachyfacials with maxillary atresia (Fig 6) in a total of 50 individuals for each facial type. We found that 64% of dolichofacials, 52% of mesofacials and 58% of brachyfacials presented with maxillary atresia. However, there was no evidence indicating that maxillary atresia is in any way associated with facial type. These results confirm findings showing no statistically significant differences

TABLE 4 - Atresia in males and facial types.

Facial Types	Male Atresia		Total (%)
	Yes (%)	No (%)	
Dolichofacial	19 (70.37)	8 (29.63)	27 (100.00)
Mesofacial	10 (38.46)	16 (61.54)	26 (100.00)
Brachyfacial	11 (44.00)	14 (56.00)	25 (100.00)
Total	40 (51.28)	38 (48.72)	78 (100.00)

TABLE 5 - Atresia in females and facial types.

Facial Types	Female Atresia		Total (%)
	Yes (%)	No (%)	
Dolichofacial	13 (56.52)	10 (43.48)	23 (100.00)
Mesofacial	16 (66.67)	8 (33.33)	24 (100.00)
Brachyfacial	18 (72.00)	7 (28.00)	25 (100.00)
Total	47 (65.28)	25 (34.72)	72 (100.00)

between the three facial types in a study⁷ that used transverse maxillary measurements. A later study⁸ eventually found no correlation between the asymmetry of the maxillary hemiarches and the three facial types, and no statistical difference between the asymmetries.

By comparing Pont's index with mesofacials and dolichofacials, no differences were found in the interpremolar and intermolar widths associated with the facial types. These findings, however, disagreed with the report⁵ in which the transverse measurements were correlated with the mandibular plane angle because it was found that any increase in this angle (in dolichofacials) contributed to a higher incidence of atretic arches. It was also observed that in dolichofacial individuals with nasal obstruction there was a greater prevalence of maxillary atresia.⁹

When distributing the sample by gender (Figs 7 and 8) we found that 51.28% presented with maxillary atresia with a significant proportion of dolichofacials (70.37%). This disagrees with the study¹ in which the Class I and Class II male dolichofacial groups had significantly increased interpremolar and intermolar widths

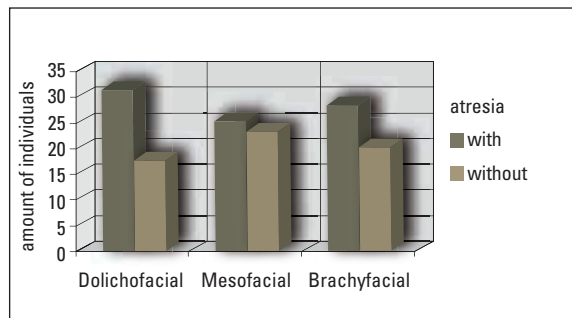


FIGURE 6 - Association of maxillary atresia with facial type.

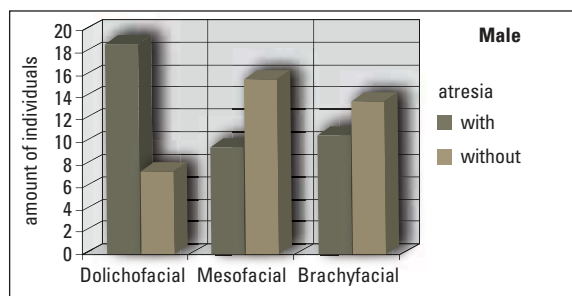


FIGURE 7 - Association of maxillary atresia with facial types in males.

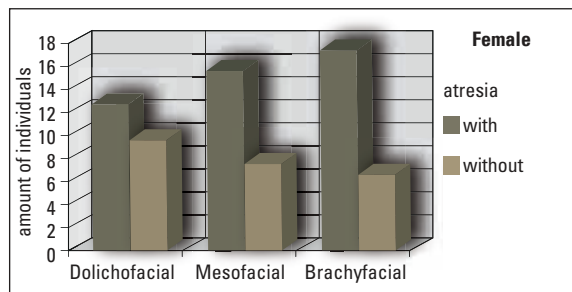


FIGURE 8 - Association of maxillary atresia with facial types in females.

when compared with females. The transverse, intercanine, interpremolar and inter-first-molar dimensions of the male patients exhibited higher values than females.²

A total of 65.28% of female patients had maxillary atresia, although different proportions were not found in terms of facial types, which disagrees with a study⁷ which found a statistically

significant difference when comparing the maxilla of the mesofacial and dolichofacial groups (males and females). The male group showed larger dimensions than the female, while in brachyfacials no significant differences were found.

A thorough analysis of the three facial types disclosed that 62.28% of females and 51.28% of males presented with maxillary atresia. No different proportions were found between the genders.

Regarding the presence of maxillary atresia associated with gender,¹¹ the results confirmed the aforementioned study since we demonstrated that there is a difference in maxillary interpremolar and intermolar widths, which are smaller—indicating maxillary atresia—for both males and females, with no differences between them.⁶

Therefore the study sample did not show an association between maxillary atresia and facial type, but in dolichofacial males, where a statistically significant value was found, it became clear that measuring the transverse width of the maxilla—in both genders—is of paramount importance since it contributes to diagnosis and planning, thereby avoiding unnecessary expansion and ensuring improved orthodontic treatment results.

CONCLUSIONS

The results and discussion of this study indicate that:

1. In our sample, 64% of dolichofacials, 58% of brachyfacials and 52% of mesofacials presented with maxillary atresia.

2. There was no gender dimorphism in terms of facial types and presence of atresia, but in males the percentage of dolichofacials presenting with atresia was proportionally higher. Women, on the other hand, did not show different proportions between facial types.

3. No association was found between maxillary atresia and facial types.

REFERENCES

1. Albuquerque CM, Vigorito JW. Estudo comparativo do índice de Pont com os tipos faciais, em brasileiros apresentando oclusão normal e maloclusão de Classe I e de Classe II divisão 1ª. [dissertação]. São Paulo: Universidade de São Paulo; 1995.
2. Araújo AM, Ursi WJS. Estudo comparativo das dimensões transversais em má-oclusões de Classe I e II, de Angle. *Rev Dental Press Ortod Ortop Facial*. 1997 nov-dez;2(6):69-74.
3. Capelozza Filho L, Silva Filho OG. Expansão rápida da maxila: considerações e aplicações clínicas. In: Interlandi S. *Ortodontia: bases para a iniciação*. 4ª ed. São Paulo: Artes Médicas; 1999. p. 285-328.
4. Filho LA. Arcos dentais. In: Madeira MC. *Anatomia do dente*. São Paulo: Sarvier; 2001. p.17-9.
5. Howes AE. Arch width in the premolar region - still the major problem in orthodontics. *Am J Orthod*. 1957;43(1):5-31.
6. Kageyama T, Domínguez-Rodríguez GC, Vigorito JW, Deguchi T. A morphological study of the relationship between arch dimensions and craniofacial structures in adolescents with Class II division 1 malocclusions and various facial types. *Am J Orthod Dentofacial Orthop*. 2006 Mar;129(3):368-75.
7. Kanashiro LK, Vigorito JW. Estudo das formas e dimensões das arcadas dentárias superiores e inferiores em leucodermas, brasileiros, com maloclusão de Classe II, divisão 1ª e diferentes tipos faciais. *Ortodontia*. 2000;33(2):8-18.
8. Kanashiro LK, Vigorito JW. Estudo comparativo das dimensões transversais dos hemi-arcos dentários superiores nas maloclusões de Classe II divisão 1ª, em diferentes tipos faciais. *Ortodontia*. 2004;37(2):8-13.
9. Mocellin M, Fugmann EA, Gavazzoni FB, Ataíde AL, Ouriques FL, Herrero F. Estudo cefalométrico-radiográfico e otorrinolaringológico correlacionando o grau de obstrução nasal e o padrão de crescimento facial em pacientes não tratados ortodonticamente. *Rev Bras Otorrinolaringol*. 2000; 66(2):116-20.
10. Witzig JW, Spahl TJ. *Ortopedia maxilofacial clínica e aparelhos*. 3ª ed. São Paulo: Ed. Santos; 1995. p. 286-93.
11. Rejman R, Martins DR, Scavone H, Ferreira FAC, Ferreira FV. Estudo comparativo das dimensões transversais dos arcos dentários entre jovens com oclusão normal e má oclusão de Classe II, 1ª divisão. *Rev Dental Press Ortod Ortop Facial*. 2006;11(4):118-25.
12. Schwarz AM, Gratzinger M. *Removable orthodontic appliances*. Philadelphia: WB Saunders; 1966. p. 61-83.

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