Original Article

Third Molar Agenesis and Craniofacial Morphology

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ABSTRACT

Objective: To test the null hypothesis that agenesis of wisdom teeth is not related with any particular craniofacial morphology.

Materials and Methods: Ninety-seven patients (aged 13–19 years) were selected and divided into three groups: (1) bilateral agenesis of maxillary third molars, (2) bilateral agenesis of mandibular third molars, and (3) control group without agenesis. Presence or absence of third molars was determined using ortopantomographs. Cephalometric analysis was carried out from lateral teleradiographs, which included linear, angular, and proportional measurements. When data obtained were distributed normally it was analyzed by means of single-factor variance analysis and the Scheffé test ($P < .05$). When data did not show normality, the Kruskal-Wallis test ($P < .05$) and the Mann-Whitney test were applied using Bonferroni correction ($P < .017$). Multivariance discrimination analysis was also carried out.

Results: Values obtained for the mandibular plain of Groups 1 and 2 were significantly lower than those of the Control Group ($P = .00$ and $P = .00$, respectively). For Group 2 lower face height was significantly less than for the control group ($P = .01$), whilst the mandibular arch and the articular angle were significantly greater than in the Control Group ($P = .000$ and $P = .02$, respectively). Multivariance discrimination analysis obtained a correct classification in 58.8% of cases.

Conclusion: The hypothesis is rejected. Agenesis of the maxillary third molars was related to a reduced mandibular plane angle. Patients with agenesis of the mandibular third molars showed a diminished lower third and a mandibular morphology characteristic of the brachyfacial pattern. (*Angle Orthod.* 2009;79:473–478.)

KEY WORDS: Agenesis; Third molar; Craniofacial morphology

INTRODUCTION

Dental agenesis can be defined as any situation in which one or more teeth are missing because they have never formed. This can also be called oligodontia, dental aplasia, and congenital absence of teeth or hypodontia. The term "oligodontia" is usually limited to those cases in which three or more teeth are missing; anodontia is the type of agenesis in which all the teeth are missing.[1] When agenesis is of one or a few teeth, it tends to be present more distally.[2]

The third molar is a tooth characterized by the variability in the time of its formation, by widely varying crown and root morphology, and by its varying presence or absence[3] in the mouth cavity. Agenesis of this tooth is frequent, although its frequency ranges widely, varying from zero among an unspecified sample of craniums in Tasmania to 49% in an unspecified sample of Hungarian craniums.[4] Other radiographic studies of white populations locate its prevalence between 7% and 26%.[5–7] The prevalence obtained from a sample in Valencia, Spain, was 17.5%.[8]

According to Banks[7] the most frequent agenesis is of both third molars, followed by one, three and all four third molars whilst for Nanda[6] the most frequent agenesis was of one, two, three and four molars in that order. Furthermore, Trisovic and colleagues[9] found a high correlation between the phases of development of the contralateral third molars so that when agenesis occurs it is often bilateral.

Hypodontia is found to be associated with widely

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Accepted: July 2008. Submitted: May 2008.

varying irregularity in size, morphology,[10] and times of development of the teeth in the mouth.[10–12] Some authors[13,14] suggest that subjects with agenesis of one or more third molars are 13 times more likely to show agenesis of other teeth than subjects without third molar agenesis. Although any teeth can be susceptible to agenesis, lateral incisors and second premolars show a greater probability of absence concomitant with the agenesis of third molars; this is due to the greater variability and lesser stability of incisors and second premolars. Generally, 75% of agenesis of any tooth is related to agenesis of the third molar.

Although agenesis influences the chronology of tooth eruption and the number of teeth present in the dental arch, it also influences dentofacial structure. Few studies have evaluated the relation between different kinds of agenesis and craniofacial structure, and those that do show conflicting results.[15–19]

Barrachina and Bravo,[17] in a sample of patients with agenesis of one or more teeth (excluding third molars), suggest that, although the influence of hypodontia on craniofacial morphology is limited, agenesis affects the maxilla more than the mandible. Some authors have shown a relation between agenesis of different teeth and retrognathic maxillas[15] of reduced size.[18] Others, however, conclude that dental agenesis exerts little influence on dentofacial structures[16] and that the typical dentofacial structure in persons with advanced hypodontia may be due to dental and functional compensation rather than to a different growth pattern.[19] Studies that evaluate the relation between agenesis of a single type and dentofacial structures are far fewer.[20,21] As far as we know, in spite of the fact that third molar agenesis is the most frequent agenesis, only two studies has been carried out to evaluate the relation of this agenesis with maxillary anteroposterior dimensions[20] and mandibular growth.[21]

In two consensus conferences it was suggested that there is no evidence that a third molar is needed for the development of the basal skeletal components of the maxilla and mandible.[22] This compromise agrees with Ades and colleague,[21] also quoted by Bishara,[22] who observed that persons with third molars that erupted into satisfactory function do not have a different mandibular growth pattern than those with third molars that are impacted or congenitally missing, after measuring the length of their mandibles. However, Kajii and colleagues[20] found that agenesis of third molar germs does not depend on anteroposterior dimensions of the mandible but depends instead on anteroposterior dimensions of the maxilla. No studies relate third molar agenesis with skeletal pattern.

The objective of the present study was, therefore, to determine the existence of any relation between bilateral agenesis of the third upper or lower molars with the anteroposterior dimensions of the maxilla and mandible and with the skeletal pattern in an ampler meaning. This involves discounting the null hypothesis that third molar agenesis is unrelated to any particular craniofacial morphology or array of craniofacial parts.

Table 1. Age Range in Each Group

Group	n	Mean age	Standard Deviation	95% CI
Agenesis 18/28	27	14.5	2.1	13.7–15.4
Agenesis 38/48	35	15	2	14.2–15.7
Control group	35	14.8	1.8	14.1–15.4

MATERIALS AND METHODS

Subjects

Ninety-seven patients (53 men and 44 women) from exclusively orthodontic clinics in the Murcia and Valencia areas of Spain were chosen for study. All subjects were between 13 and 18 years old, had not received previous orthodontic treatment, and had nocongenital deformities.

Materials

A before and after treatment orthopantomograph of each patient was used to determine the presence or absence of third molars. Subjects were divided into three groups with a similar average age (Table 1):

Agenesis 18/28 (n = 27): Patients with bilateral agenesis of maxillary third molars.
Agenesis 38/48 (n = 35): Patients with bilateral agenesis of mandibular third molars.
Control (n = 35): Patients without third molar agenesis.

Teleradiographs taken before treatment were used to carry out cephalometric analysis. Linear, angular, and proportional measurements were made. The following four linear measurements were taken[20] (Figure 1):

Distance a (anteroposterior length of the nasal floor: ANS-PNS)
Distance b (anteroposterior length of the maxillary basal bone: A-Ptm)
Distance c (anteroposterior length of the mandibular corpus: Go-Pog)
Distance d (anteroposterior length of the mandibular basal bone: ABR-B)

Angular measurements obtained were Steiner,[23] Rickets,[24] and Jarabak[25] cephalometric measurements:

Steiner analysis[23]: SNA, SNB, and ANB (Figure 2)

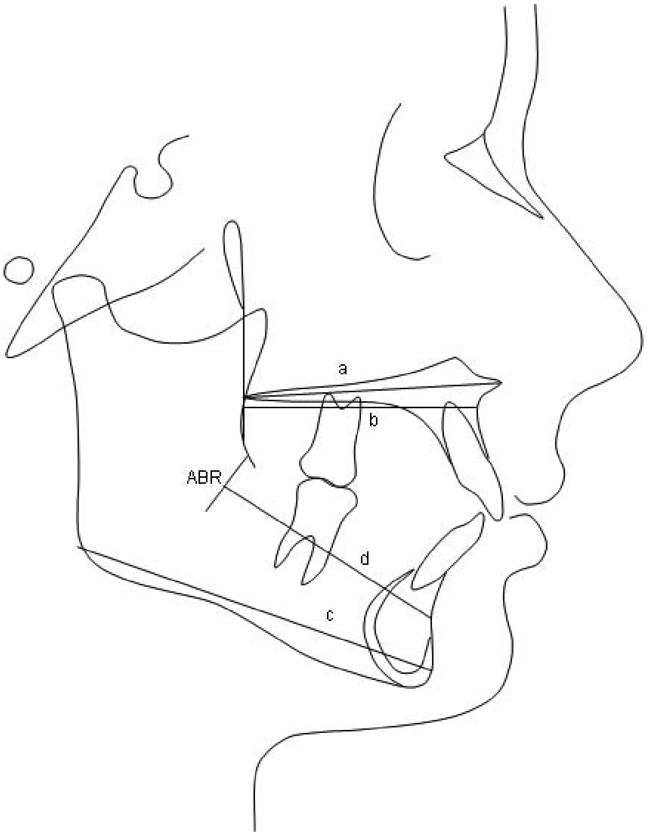

Figure 1. Linear measurements[22]: distance a (distance from ANS to PNS), distance b (distance from point A to Ptm), distance c (distance from gonion to pogonion), and distance d (distance from ABR to point B). ABR: cross point between occlusal plane and anterior edge of the ramus.

Ricketts analysis[24]: facial axis, mandibular plain, lower face height, and mandibular arch (Figure 2)
Jarabak analysis[25]: sella angle, articular angle, gonial angle, upper gonial angle, and lower gonial angle (Figure 3)

Regarding proportional measurements, proportion of facial height (PFH) was the relationship between posterior and anterior facial height (constructed sella-gonion; nasion-menton).[25]

Statistical Analysis

The Kolmogorov-Smirnov normality test and the Levene's homogeneity of variance test were applied to the cephalometric data. When data fulfilled the criteria for normality and homogeneity of variance, the existence of significant differences was analyzed by analysis of variance for one factor and the Scheffé test for multiple comparisons ($P < .05$). When it was seen that data were not distributed normally or failed to fulfill the criteria for variance homogeneity, they were analyzed using the Kruskall-Wallis test ($P < .05$) to find those groups that were significantly different with the

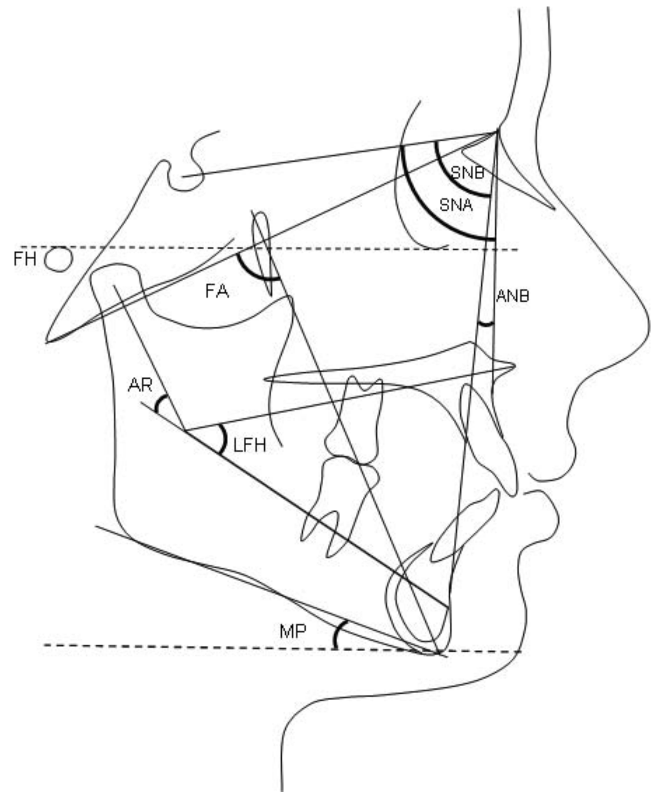

Figure 2. The angular measurements of Steiner[23] and Rickets[24]: SNA, SNB, ANB, Facial axis (FA), mandibular plane (MP), lower facial height (LFH), and mandibular arch (MA); Frankfort horizontal plane (FH).

Mann-Whitney test for two independent samples. To avoid an accumulation of errors because of multiple comparisons, the significance level ($P < .05$) was modified and divided between the number of comparisons made (Bonferroni correction); thus, $P < .017$ was considered significant.

To determine percentages of correct and incorrect assignation obtained from the original data, discrimination multivariance analysis was carried out. This included those variables in which significant differences were detected between groups (mandibular plain, mandibular arch, lower face height, and articular angle) and the three cephalometric measurements that characterize mandibular morphology (gonial angle, lower gonial angle, and upper gonial angle). Multivariance discrimination analysis was carried out for the three study groups and again when the sample was divided into the control group and an inclusive agenesis group (both upper and lower wisdom teeth).

RESULTS

Table 2 shows the results obtained by linear, angular, and proportional cephalometric measurement. Significant differences between the groups were not

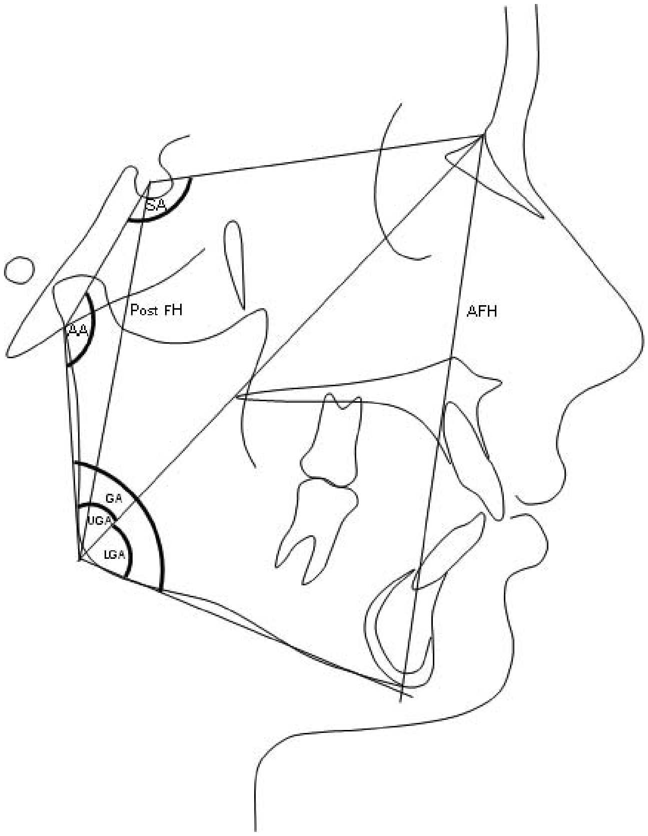

Figure 3. Jarabak[25] angular measurements: sella angle (SA), articular angle (AA), gonial angle (GA), upper gonial angle (UGA), and lower gonial angle (LGA). Posterior facial height (Post FH), anterior facial height (AFH), PFH: PostFH/AFH.

detected for the following values: distance a ($P = .63$), distance b ($P = .46$), distance c ($P = .24$), distance d ($P = .14$), SNA ($P = .53$), SNB ($P = .72$), facial axis (p= .55), ANB ($P = .78$), sella angle ($P = .63$), gonial angle ($P = .26$), upper gonial angle ($P = .46$), lower gonial angle ($P = .08$), and face height proportion ($P = .78$).

Mandibular plane values for the maxillary third molar agenesis group and the mandibular third molar group were significantly lower than for the control group ($P = .00$ and $P = .00$, respectively). In the mandibular agenesis group, lower face height was significantly less than in the control group, whereas values for the mandibular arch and articular angle were significantly greater than in the control group ($P = .000$ and $P = .02$, respectively).

In the discrimination test carried out on all three groups, correct classification was obtained in 58.8% of cases. When the sample was divided into an inclusive agenesis group (both upper and lower third molars) and a control group, classification was correct in 80% of the original cases.

DISCUSSION

Studies carried out by Garn[26] and Gravely[3] determined that the possible time limit for the formation of the third molar germ is 13 years. For this reason the present study was carried out on subjects older than 13 years; younger patients were not included in the groups with agenesis to avoid the problem of false-negatives. Subjects who had received previous orthodontic treatment were also excluded from the sample to avoid the possible effects of such treatment on the

Table 2. Linear, Angular, and Proportional Cephalometric Measurements[a]

Measurements	Control Group Mean ± SD	Agenesis 18/28 Mean ± SD	Agenesis 38/48 Mean ± SD
Distance a	55.0 ± 4.8	53.8 ± 4.7	54.5 ± 3.8
Distance b	48.9 ± 3.5	48.3 ± 3.5	49.4 ± 3.6
Distance c	75.9 ± 5.2	76.0 ± 4.5	77.7 ± 4.7
Distance d	50.5 ± 5.6	48.1 ± 3.8	49.3 ± 5.5
SNA	80.4 ± 4.5	79.4 ± 4.2	80.5 ± 3.6
SNB	77.6 ± 4.8	76.6 ± 3.4	77.8 ± 3.7
ANB	2.8 ± 3	2.8 ± 3	2.7 ± 3.8
Facial axis	89.8 ± 4.6	89.5 ± 4.0	90.5 ± 3.3
Mandibular plain*	29.9 ± 8.7A	22.1 ± 6.3B	22.8 ± 6.4B
Lower face height*	46.6 ± 8.9A	43.5 ± 4.9	41.5 ± 5.2B
Mandibular arch**	32.7 ± 7.3A	35.5 ± 8.6	39.7 ± 7.9B
Sella angle	126.7 ± 5.9	125.7 ± 7.2	127.2 ± 7.2
Articular angle*	142.8 ± 8.3A	144.7 ± 5.7	146.4 ± 7.4B
Gonial angle	125.0 ± 7.7	122.6 ± 6.3	123.6 ± 7.6
Upper gonial angle	49.6 ± 4.2	49.7 ± 3.5	50.6 ± 5.0
Lower gonial angle	75.4 ± 5.9	72.8 ± 3.9	72.9 ± 5.1
PFH	65.4 ± 5.2	66.0 ± 5.6	65.1 ± 5.1

[a] For each row, different upper case letters indicate significant differences (Scheffé test * $P < .05$, Mann-Whitney test applying Bonferroni correction ** $P < .017$). The groups unmarked with upper case letters did not show significant differences with any other.

craniofacial complex. Subjects with congenital deformities were also excluded as these may involve severe irregularities in craniofacial development.

In a study of a group of Japanese, Kajii and colleagues[20] evaluated the relationship of third molar agenesis to anteroposterior maxillary dimensions. They reported that subjects with bilateral maxillary agenesis of the third molar were associated with lesser sagittal dimensions of the basal bone of the upper maxilla (distance b). Nevertheless, no significant association was shown between the sagittal dimension of the mandibular basal bone (distance d) and third molar agenesis. The results of the present study did not coincide with these results as significant differences between sagittal dimensions of the upper maxilla and mandible were not found in the three groups studied.

Perhaps the difference in results could be linked to racial differences. Such differences are interesting and suggest that some polygenetic inheritance controlling maxillary dimensions and the formation of third molar germs may vary across different populations and races.[27] No studies have evaluated the relation between third molar agenesis and skeletal pattern in the way we did in our study, so it is not possible to compare our results with those obtained by others.

The results of this study showed that the mandibular plane was significantly less in the two groups with maxillary and mandibular agenesis than in the control group. Values below the norm indicate a horizontal growth pattern. This reduction is usually associated with a reduction in vertical face dimension or with a vertically long ramus accompanied by an anticlockwise rotation of the mandible.[28]

Lower face height was significantly less for the mandibular agenesis group than for the control group. The lower values indicate hypodivergent or horizontal growth patterns. This may be due to the lack of vertical development associated with reduction in the number of teeth.[28]

The mandibular arch was significantly greater in the mandibular agenesis group than in the control group. The increased angles indicate an upward and forward rotation of the menton, a closed gonial angle, and a vertical mandibular ramus. All of these are characteristic of a horizontal growth pattern.[28]

Lastly, when the articular angle was measured, significantly greater values were obtained for the mandibular agenesis group than the control group. Wider angles are related to increased vertical growth of the ramus, typical of euryprosopic or brachyfacial patterns and strong musculature.[28]

When the discrimination multivariance analysis was applied to the three groups, correct classification was obtained in 58.8% of cases. Given that chance classification is 33%, this is an acceptable result. When the sample was divided into two groups, a single inclusive agenesis group (with both mandibular and maxillary agenesis) and the control group, correct subject classification was obtained in 80% of cases, chance classification for two groups being 50%. In this way the results support the rejection of the null hypothesis that agenesis of wisdom teeth is not related with any particular craniofacial morphology. The results do support the acceptance of the alternative hypothesis that there is a certain relationship between craniofacial shape and third molar agenesis. This assertion is not in conflict with the results of the previous work of Ades and colleagues[21]; we did not measure the length of the mandible in our samples because we do not think that this is the most sensible way to detect changes in the mandibular growth pattern.

CONCLUSIONS

- Cases of maxillary third molar agenesis are related to reduced mandibular plane angles.
- Patients with mandibular third molar agenesis showed a diminished lower third and mandibular morphology characteristic of brachyfacial patterns.

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