Conjecturas

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Dental agenesis is associated with mesiodistal dental dimensions: A study in a Brazilian population

Agenesia dentária está associada com a dimensão dentária mesiodistal: Um estudo em uma população brasileira

Marcos Rikio Kuabara[1], Isabela Ribeiro Madalena[2,3,4*], Thainá Beatriz Soares[1], Igor Domingos dos Anjos[2], Guido Artemio Marañón-Vásquez[5], João Armando Brancher[1], Mirian Nakane Matsumoto[6], Maria Bernadete Sasso Stuani[6], Erika Calvano Küchler[7], João César Zielak[1]

ABSTRACT

The aimed to evaluate the association between dental agenesis and mesiodistal dimensions of permanent teeth in a Brazilian population. Dental agenesis was diagnosed using panoramic radiographs and anamnesis. Dental dimensions were evaluated using dental casts for orthodontic diagnosis and a digital caliper. Mann-Whitney test compared the tooth measurements between groups ($p<0.05$). The associations between dental agenesis and mesiodistal dimensions were analyzed by a general linear model adjusted by sex ($p<0.05$). Statistical differences were observed in the total group and the other agenesis group. Maxillary right canine, mandibular left second premolar, mandibular left first molar, and mandibular right first molar demonstrated dental dimensions were bigger in the total dental agenesis group ($p<0.05$). Maxillary right canine, maxillary right first molar, mandibular left first premolar, mandibular left second premolar, mandibular left first molar, and mandibular right first molar demonstrated bigger dental dimensions in the other agenesis group ($p<0.05$). Dental agenesis were associated with mesiodistal dimensions of permanent teeth in a Brazilian population.

Key-words: Dental development; Orthodontic; Tooth agenesis

RESUMO

O objetivo deste estudo foi avaliar a associação entre agenesia dentária e dimensão dentária mesiodistal de dentes permanentes em uma população brasileira. A agenesia dentária foi diagnosticada por meio de radiografias panorâmicas e anamnese. As dimensões dentárias foram avaliadas usando modelos de gesso para diagnóstico ortodôntico e mensuradas por meio de paquímetro digital. O teste de Mann-Whitney comparou as medidas dos dentes entre os grupos ($p<0,05$). A associação entre agenesia dentária e dimensão

[1] Positivo University, Curitiba, Brazil.
[2] Presidente Tancredo de Almeida Neves University Center, São João del Rei, Brazil.
[3] University of Joinville Region, Joinville, Brazil.
[4] Federal University of Juiz de Fora, Juiz de Fora, Brazil.
[5] Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.
[6] School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil.
[7] University of Regensburg, Regensburg, Germany.
*E-mail: isabelarmadalena@hotmail.com

mesiodistal foi analisada por um modelo linear geral ajustado por sexo ($p<0,05$). Diferenças estatísticas foram observadas no grupo total e no outro grupo agenesia. O canino superior direito, o segundo pré-molar inferior esquerdo, o primeiro molar inferior esquerdo e o primeiro molar inferior direito demonstraram que as dimensões dentárias eram maiores no grupo de agenesia dentária ($p<0,05$). Canino superior direito, primeiro molar superior direito, primeiro pré-molar inferior esquerdo, segundo pré-molar inferior esquerdo, primeiro molar inferior esquerdo e primeiro molar inferior direito demonstraram dimensões dentárias maiores no outro grupo de agenesia ($p<0,05$). Agenesias dentárias são associadas à dimensão mesiodistal de dentes permanentes em uma população brasileira.

Palavras-chave: Desenvolvimento dentário; Ortodontia; Agenesia dentária

INTRODUCTION

Dental development is an intricate process that relays on the connection between the oral ectoderm and the ectomesenchyme cells/tissues derived from the neural crest. Teeth are created due to the sequential and reciprocal series of signals transmitted between the epithelium and neural crest derived mesenchyme and leads to specific patters of dental phenotype associations (KÜCHLER et al., 2008). Evidences support an association between decreased mesiodistal dimensions and some dental anomalies (KHALAF et al., 2014; HIGASHIORI et al., 2018; GORUCU-COSKUNER; ATIK; AKARSU-GUVEN, 2021). In particular, dental agenesis/oligodontia has been widely studied and correlated with dimensional tooth changes (MIRABELLA; KOKICH; ROSA, 2012, HIGASHIORI et al., 2018; GORUCU-COSKUNER; ATIK; AKARSU-GUVEN, 2021). Dental agenesis is characterized by the absence of development of a single tooth organ. Oligodontia is used to describe more severe forms of dental agenesis, typically the absence of more than six teeth and the entire dentition (AL-ANI et al., 2017). It is proposed that its etiology of dental agenesis/oligodontia is multifactorial, including mainly genetic and environmental factors (AL-ANI et al., 2017, LI et al., 2018, ASLAM et al., 2020). In clinical and orthodontic practice the cases of dental agenesis and oligodontia is highly prevalent (AL-ANI et al., 2017, SAHOO et al., 2019, ALBU et al., 2021).

A meta-analysis study stated that the world's mean prevalence of dental agenesis is 6.4% of the population (KHALAF et al., 2014). There is a significant difference in the prevalence of dental agenesis according to the continent suggesting a strong influence of phenotypic characteristics of a population (KHALAF et al., 2014). In parallel, mesiodistal

dimensions also vary between different phenotypic characteristics of a population (CUNHA et al., 2021) and ethnicities (AYOUBI; DEZFULLY; MADLÉNA, 2020). Studies establish an association between mesiodistal dimensions and dental agenesis/oligodontia in Japanese (HIGASHIHORI et al., 2018), Turkeys (GUNGOR; TURKKAHRAMAN, 2013), North Americans (GARN; LEWIS, 1970) among others populations. Given the above, the aim of the present study was to evaluate the association between dental agenesis and mesiodistal dimensions of permanent teeth in a Brazilian population.

METHODS

Ethical aspects

This study was approved by the Ethics Committee of the School of Dentistry of Ribeirão Preto, University of São Paulo, Brazil (CAAE: 01451418.3.0000.5419/3.150.551) and follow the Helsinki declaration. All the patients who agreed to participate in this study signed the consent form.

Sample characterization

This retrospective study evaluated 144 orthodontic records (x-rays, anamnesis and dental casts) of patients who started orthodontic treatment at the Postgraduate Orthodontics Clinic of the Ribeirão Preto Dental School, University of São Paulo, Brazil (FORP/USP) between the years 2016 to 2018. The sample was obtained for convenience. All patients who had a complete orthodontic record were initially included. Patients who had systemic disease and syndromes were excluded. Tooth /teeth elements that were semi-erupted, with occlusal wear, affected by dental caries and restored on the surface mesial/distal were not evaluated and excluded from the analysis.

Analysis of dental agenesis and tooth dimensions

Dental agenesis was diagnosed using panoramic radiographs and anamnesis. The evaluation was performed by a single examiner previously trained and calibrated. The inclusion criterion in the dental agenesis group was that at least one permanent tooth was congenitally missing. Dental agenesis cases were also divided into third molar agenesis

and other permanent agenesis subgroups (incisors, canine and premolars) for the analysis (KÜCHLER et al., 2021).

Dental dimensions were evaluate using dental casts for orthodontic diagnosis and a digital caliper (Mitutoyo 500-752-20 Compasso Digital Digimatic). The maximum mesiodistal dimension of the crown of all dental elements was individually measured in millimeters and with an accuracy of 0.1 mm. Maximum distances were defined as the most extreme points of proximal anatomical contact, mesial and distal, in a line perpendicular to the long axis of the tooth (CUNHA et al., 2021). All measurements were performed by only one previously calibrated operator with strict criteria to reduce variation (CUNHA et al., 2021).

Statistical analysis

Shapiro-Wilk test was used to verify the normality of data. Mann-Whitney test compared the tooth-measurements between. Multivariate analysis was also performed by General Linear Model adjusting the models by sex. The tests were performed by IBM SPSS version 25.0 (IBM Corp. Armonk, USA) and the alpha value was set at 0.05.

RESULTS

The sample consisted of 50 (58.22%) women and 35 (41.18%) men. Fifteen (65.22%) of the women had tooth agenesis; Eight (34.78%) of the men had tooth agenesis. There was no significant difference between sexes ($p=0.076$). Fourteen (60.86%) patients present third molar agenesis, 9 (39.13%) presented premolar agenesis, 1 (4.34%) presented upper lateral incisor agenesis and 6 (26.08%) presented other agenesis.

Tables 1, 2 and 3 shows the tooth-measurements comparisons between dental agenesis and control groups and also between tooth agenesis sub groups. Some statistical differences were observed in the total group (table 1) and also in the other agenesis group (dental agenesis excluding third molars) (table 3) ($p<0.05$). Tooth dimensions were bigger in the dental agenesis group.

The multivariate analysis performed by general linear model adjusting the models by sex was performed. The table 4 shows the values that remained associated after the multivariate analysis.

Table 1. Tooth-measurements comparisons between dental agenesis and control groups.

Tooth	Control					Dental Agenesis					*p-value*
	Mean	Standard Deviation	Median	25th Percentile	75th Percentile	Mean	Standard Deviation	Median	25th Percentile	75th Percentile	
Maxillary Right Central Incisor	8.78	0.65	8.83	8.49	9.21	8.78	0.64	8.96	8.43	9.23	0.714
Maxillary Right Lateral Incisor	6.87	0.83	6.86	6.57	7.27	7.02	0.74	7.00	6.48	7.59	0.360
Maxillary Right Canine	7.56	0.60	7.54	7.19	8.07	8.01	0.53	8.06	7.71	8.36	**0.005**
Maxillary Right First Premolar	7.11	0.59	7.08	6.73	7.38	7.24	0.53	7.29	6.93	7.54	0.170
Maxillary Right Second Premolar	6.62	0.66	6.53	6.10	6.92	6.97	0.97	6.78	6.48	7.22	0.095
Maxillary Right First Molar	9.73	0.51	9.74	9.43	10.06	9.94	0.68	9.89	9.45	10.32	0.288
Maxillary Left Central Incisor	8.88	0.69	8.90	8.52	9.29	8.81	0.66	8.91	8.27	9.18	0.547
Maxillary Left Lateral Incisor	6.81	0.67	6.81	6.58	7.15	6.97	0.67	7.19	6.59	7.37	0.316
Maxillary Left Canine	7.65	0.63	7.66	7.16	8.06	7.89	0.43	7.79	7.59	8.40	0.085
Maxillary Left First Premolar	7.08	0.65	7.12	6.63	7.40	7.15	0.45	7.19	6.84	7.49	0.469
Maxillary Left Second Premolar	6.73	0.81	6.52	6.26	6.99	6.92	1.01	6.63	6.25	7.21	0.671
Maxillary Left First Molar	9.68	0.67	9.74	9.37	10.18	9.92	0.59	9.94	9.46	10.32	0.237
Mandibular Left Central Incisor	5.47	0.48	5.45	5.18	5.75	5.61	0.41	5.65	5.41	5.94	0.206
Mandibular Left Lateral Incisor	6.03	0.51	6.07	5.76	6.41	6.02	0.43	5.93	5.73	6.28	0.730
Mandibular Left Canine	6.83	0.57	6.87	6.45	7.26	6.90	0.52	6.75	6.58	7.28	0.734
Mandibular Left First Premolar	7.19	0.57	7.19	6.85	7.53	7.41	0.56	7.40	7.13	7.80	0.059
Mandibular Left Second Premolar	7.12	0.82	6.96	6.70	7.49	7.69	1.25	7.37	6.96	8.11	**0.040**
Mandibular Left First Molar	10.82	0.65	10.81	10.43	11.25	11.35	0.65	11.28	10.86	11.71	**0.004**
Mandibular Right Central Incisor	5.56	0.46	5.55	5.24	5.84	5.63	0.44	5.48	5.38	5.79	0.666
Mandibular Right Lateral Incisor	6.06	0.49	6.08	5.74	6.35	6.13	0.48	6.15	5.68	6.58	0.615
Mandibular Right Canine	6.76	0.50	6.72	6.45	7.17	6.89	0.68	6.89	6.50	7.23	0.457
Mandibular Right First Premolar	7.18	0.67	7.17	6.76	7.46	7.36	0.57	7.36	7.09	7.76	0.714
Mandibular Right Second Premolar	7.05	0.83	6.97	6.58	7.33	7.45	1.12	7.23	6.85	7.70	0.360
Mandibular Right First Molar	10.79	0.64	10.81	10.32	11.32	11.30	0.56	11.21	10.83	11.80	**0.005**

Note: Mann-Whitney test was performed. Bold forms means statistical significance difference.

Table 2. Tooth-measurements comparisons between third molar agenesis and control groups.

Tooth	Control					Third Molar Agenesis					*p-value*
	Mean	Standard Deviation	Median	25th Percentile	75th Percentile	Mean	Standard Deviation	Median	25th Percentile	75th Percentile	
Maxillary Right Central Incisor	8.78	0.65	8.83	8.49	9.21	8.64	0.75	8.74	8.38	9.06	0.698
Maxillary Right Lateral Incisor	6.87	0.83	6.86	6.57	7.27	6.87	0.71	6.92	6.39	7.56	0.984
Maxillary Right Canine	7.56	0.60	7.54	7.19	8.07	7.81	0.55	7.83	7.38	8.06	0.242
Maxillary Right First Premolar	7.11	0.59	7.08	6.73	7.38	7.24	0.52	7.23	7.05	7.54	0.220
Maxillary Right Second Premolar	6.62	0.66	6.53	6.10	6.92	7.07	1.18	6.70	6.47	7.54	0.228
Maxillary Right First Molar	9.73	0.51	9.74	9.43	10.06	9.68	0.66	9.48	9.27	10.09	0.493
Maxillary Left Central Incisor	8.88	0.69	8.90	8.52	9.29	8.70	0.81	8.82	8.06	9.08	0.292
Maxillary Left Lateral Incisor	6.81	0.67	6.81	6.58	7.15	6.84	0.60	6.86	6.47	7.33	0.854
Maxillary Left Canine	7.65	0.63	7.66	7.16	8.06	7.79	0.43	7.68	7.38	8.24	0.348
Maxillary Left First Premolar	7.08	0.65	7.12	6.63	7.40	7.12	0.48	7.15	6.83	7.51	0.680
Maxillary Left Second Premolar	6.73	0.81	6.52	6.26	6.99	7.06	1.23	6.63	6.10	7.26	0.749
Maxillary Left First Molar	9.68	0.67	9.74	9.37	10.18	9.73	0.64	9.76	9.36	10.13	0.834
Mandibular Left Central Incisor	5.47	0.48	5.45	5.18	5.75	5.58	0.36	5.64	5.26	5.84	0.451
Mandibular Left Lateral Incisor	6.03	0.51	6.07	5.76	6.41	5.92	0.44	5.78	5.71	6.28	0.334
Mandibular Left Canine	6.83	0.57	6.87	6.45	7.26	6.75	0.50	6.65	6.29	7.11	0.537
Mandibular Left First Premolar	7.19	0.57	7.19	6.85	7.53	7.32	0.59	7.34	7.13	7.59	0.256
Mandibular Left Second Premolar	7.12	0.82	6.96	6.70	7.49	7.69	1.36	7.36	6.96	7.89	0.108
Mandibular Left First Molar	10.82	0.65	10.81	10.43	11.25	10.97	0.42	10.90	10.59	11.37	0.425
Mandibular Right Central Incisor	5.56	0.46	5.55	5.24	5.84	5.56	0.44	5.41	5.37	5.72	0.920
Mandibular Right Lateral Incisor	6.06	0.49	6.08	5.74	6.35	6.03	0.48	5.96	5.66	6.33	0.721
Mandibular Right Canine	6.76	0.50	6.72	6.45	7.17	6.84	0.64	6.68	6.33	7.23	0.849
Mandibular Right First Premolar	7.18	0.67	7.17	6.76	7.46	7.32	0.58	7.30	7.09	7.75	0.218
Mandibular Right Second Premolar	7.05	0.83	6.97	6.58	7.33	7.42	1.14	7.33	6.84	7.72	0.127
Mandibular Right First Molar	10.79	0.64	10.81	10.32	11.32	11.11	0.48	11.00	10.81	11.32	0.130

Note: Mann-Whitney test was performed.

Table 3. Tooth-measurements comparisons between other agenesis and control groups.

Tooth	Control					Other Agenesis					
	Mean	Standard Deviation	Median	25th Percentile	75th Percentile	Mean	Standard Deviation	Median	25th Percentile	75th Percentile	***p-value***
Maxillary Right Central Incisor	8.78	0.65	8.83	8.49	9.21	8.99	0.37	9.06	8.66	9.26	0.235
Maxillary Right Lateral Incisor	6.87	0.83	6.86	6.57	7.27	7.15	0.70	7.01	6.69	7.64	0.220
Maxillary Right Canine	7.56	0.60	7.54	7.19	8.07	8.07	0.59	8.31	7.84	8.38	**0.017**
Maxillary Right First Premolar	7.11	0.59	7.08	6.73	7.38	7.36	0.63	7.47	6.70	8.04	0.190
Maxillary Right Second Premolar	6.62	0.66	6.53	6.10	6.92	6.95	0.89	6.96	6.48	7.22	0.119
Maxillary Right First Molar	9.73	0.51	9.74	9.43	10.06	10.18	0.61	10.20	9.71	10.66	**0.031**
Maxillary Left Central Incisor	8.88	0.69	8.90	8.52	9.29	8.94	0.36	9.06	8.66	9.20	0.888
Maxillary Left Lateral Incisor	6.81	0.67	6.81	6.58	7.15	7.07	0.71	7.22	6.62	7.53	0.228
Maxillary Left Canine	7.65	0.63	7.66	7.16	8.06	7.86	0.46	7.73	7.57	8.41	0.248
Maxillary Left First Premolar	7.08	0.65	7.12	6.63	7.40	7.16	0.38	7.15	6.89	7.33	0.574
Maxillary Left Second Premolar	6.73	0.81	6.52	6.26	6.99	6.88	0.98	6.63	6.33	7.12	0.710
Maxillary Left First Molar	9.68	0.67	9.74	9.37	10.18	10.00	0.59	10.11	9.66	10.43	0.114
Mandibular Left Central Incisor	5.47	0.48	5.45	5.18	5.75	5.64	0.53	5.71	5.41	5.95	0.253
Mandibular Left Lateral Incisor	6.03	0.51	6.07	5.76	6.41	6.05	0.45	6.02	5.73	6.26	0.934
Mandibular Left Canine	6.83	0.57	6.87	6.45	7.26	6.99	0.53	6.91	6.69	7.28	0.498
Mandibular Left First Premolar	7.19	0.57	7.19	6.85	7.53	7.60	0.48	7.60	7.20	8.08	**0.040**
Mandibular Left Second Premolar	7.12	0.82	6.96	6.70	7.49	8.38	1.61	7.79	7.19	9.61	**0.017**
Mandibular Left First Molar	10.82	0.65	10.81	10.43	11.25	11.80	0.57	11.71	11.27	12.46	**<0.001**
Mandibular Right Central Incisor	5.56	0.46	5.55	5.24	5.84	5.71	0.54	5.58	5.44	6.01	0.411
Mandibular Right Lateral Incisor	6.06	0.49	6.08	5.74	6.35	6.21	0.50	6.30	5.84	6.62	0.378
Mandibular Right Canine	6.76	0.50	6.72	6.45	7.17	6.92	0.77	7.01	6.26	7.34	0.452
Mandibular Right First Premolar	7.18	0.67	7.17	6.76	7.46	7.53	0.48	7.75	7.29	7.86	0.029
Mandibular Right Second Premolar	7.05	0.83	6.97	6.58	7.33	7.81	1.54	7.22	6.86	7.76	0.189
Mandibular Right First Molar	10.79	0.64	10.81	10.32	11.32	11.54	0.53	11.38	11.21	11.81	**0.001**

Note: Mann-Whitney test was performed. Bold forms means statistical significance difference.

Table 4. General Linear Model adjusted by sex per tooth and condition

Tooth	Condition	β	Standard Error	95% Wald's Confidence Interval		Hypothesis test		
				Lower	Upper	Wald's chi-square	DF	*p-value*
Maxillary Right Canine	Dental Agenesis	0.373	0.1406	0.097	0.648	7.025	1	**0.008**
Maxillary Right First Molar	Other Agenesis	0.365	0.1677	0.037	0.694	4.743	1	**0.029**
Mandibular Left Second Premolar	Dental Agenesis	0.552	0.2442	0.074	1.031	5.117	1	**0.024**
	Other Agenesis	1.221	0.3535	0.528	1.914	11.927	1	**0.001**
Mandibular Left First Molar	Dental Agenesis	0.448	0.1552	0.143	0.752	8.314	1	**0.004**
	Other Agenesis	0.824	0.2120	0.409	1.240	15.111	1	**<0.001**
Mandibular Right First Molar	Dental Agenesis	0.404	0.1424	0.124	0.683	8.029	1	**0.005**
	Other Agenesis	0.561	0.1913	0.186	0.936	8.604	1	**0.003**

Note: DF means degree of freedom.

DISCUSSION

In the past decades, numerous evidence suggests the association between dental agenesis/oligodontia and mesiodistal dimension of the remaining teeth. Scientific evidence demonstrates that dental agenesis/oligodontia is associated with decreased mesiodistal dimension in Japanese, Turkish, North American populations, among others (GARN; LEWIS, 1970, RICHARDSON; MALHOTRA, 1975, GUNGOR; TURKKAHRAMAN, 2013; WRIGH et al., 2016, HIGASHIHORI et al., 2018). It is noteworthy, however, the lack of studies in Brazilian populations. It is important to know the physiological process of the craniofacial complex since strategies for health promotion, disease prevention and treatment can be optimized (COSTA et al., 2017, RODRIGUES et al., 2020, ÜNAL; DELLALOĞLU, 2021). Thus, meaningful assertions justify the aims of this study. Our results also demonstrate an association between dental agenesis and dental mesiodistal dimensions, in which dental agenesis was associated with an increase in mesiodistal dimension of the upper right canine, lower left second premolar, lower right first molar, lower left first molar.

Tooth development starts from the dental lamina and then begins to interact with the epithelium and underlying mesenchyme. As tooth development progresses, enamel nodes mediate crown size and cusp formation (BROOK et al., 2014). It is noteworthy that cases of oligodontia, in particular, have been associated with decreased mesiodistal tooth width (GARN; LEWIS, 1970, RICHARDSON; MALHOTRA, 1975, GUNGOR; TURKKAHRAMAN, 2013, WRIGHT et al., 2016, HIGASHIHORI et al., 2018). Further scientific evidence is needed about dental agenesis of fewer teeth (hypodontia) (HIGASHIHORI et al., 2018). Furthermore, the tooth development process is still influenced by sexual dimorphism, genetics, and environmental factors (HAMPL et al., 2017, LI et al., 2018, YOUSSEF et al., 2019). In parallel, dental anomalies can also occur due to the disturbance of processes by genetic influences and/or environmental factors (ANTUNES et al., 2013, AL-ANI et al., 2017, CUNHA et al., 2021).

In a previous recent study from Cunha et al. (2021) in Brazilians, some dental agenesis-related genes, including FGFs, MSX1 and PAX9, were associated with permanent tooth size of patients without dental agenesis. Lee et al. (2012) investigated if the gene PAX9 are associated with normal variations in dental agenesis and dental morphology, the authors concluded that common variants in PAX9 contributed to

morphological variation in permanent teeth in humans. Because of the phenotypic variations of a population, the different result of the population involved in this study is justified. Regarding environmental influence, sample size and quality can also justify our results. A systematic review from 2014 concluded that there is a statistically significant difference in the prevalence of dental agenesis by continent. Prevalence of dental agenesis was the highest in Africa 13·4% (95% CI: 9·7, 18·0), followed by Europe (7% CI: 6·0–8·0%), Asia (6·3% CI: 4·4, 9·1) and Australia (6·3% CI: 5·3, 7·4) with a lower prevalence in North America (5·0% CI: 4·1–5·9) and Latin America and Caribbean (4·4% CI: 3·2–6·1), in which Brazil is located (KHALAF et al., 2014).

Third molars are the most common teeth affected by dental agenesis, followed by premolars and maxillary lateral incisors (KHALAF et al., 2014, HIGASHIORI et al., 2018). Although our results are in agreement with such studies, some studies point out that lateral incisor agenesis is more common than premolar agenesis (ENDO et al., 2006; SYMONS; STRITZEL; STAMATION, 2012). Regardless of the change in order, these teeth are the last teeth to form in your family, which supports the claim that the last teeth that formed are more susceptible to dental agenesis. In particular, third molar agenesis is a highly frequent condition in patients (KÜCHLER et al., 2021). However, third molar agenesis has been poorly studied, in contrast with other permanent teeth. One study investigated a large sample of twins (both monozygotic and dizygotic) and the authors concluded that genetics is an important factor for third molar agenesis (TRAKINIENE et al., 2018). Therefore, we decided to include third molar agenesis in the present study. Interestingly, in the evaluation of third molar agenesis only, a statistical difference in tooth size was not observed. Although we did not observe any association, we suggest that a study with a larger sample size of third molar agenesis should be performed.

One more consideration is that tooth dimension and dental agenesis presents sexual dimorphism. Women have smaller teeth (CUNHA et al., 2021) and a higher prevalence of dental agenesis (KHALAF et al., 2014). Thus, we decided to perform a multivariate analysis adjusting by sex. Dental agenesis patients present maxillary right canine and right first molar and mandibular left second premolar, left first molar and right first molar teeth size different than control patients. The need for further studies to complement the correlated and specific literature is highlighted. Our studies add evidence on the association of dental agenesis and tooth dimensions in a Brazilian population.

CONCLUSION

Our study supports that dental agenesis and mesiodistal dimensions of permanent teeth are associated phenotypes in Brazilian population.

REFERÊNCIAS

KÜCHLER, E. C. et al. Studies of dental anomalies in a large group of school children. **Arch Oral Biol,** v. 53, n. 10, p. 974-946, 2008.

KHALAF, K. et al. Prevalence of hypodontia and associated factors: a systematic review and meta-analysis. **J Orthod,** v. 41, n. 4, p. 299-316, 2014.

HIGASHIHORI, N. et al. Frequency of missing teeth and reduction of mesiodistal tooth width in Japanese patients with tooth agenesis. **Prog Orthod**, v. 19, n. 1, p. 30, 2018.

GORUCU-COSKUNER, H.; ATIK, E.; AKARSU-GUVEN, B. Symmetry of crown widths in subjects with unilateral maxillary lateral incisor agenesis. **J Orofac Orthop,** 2021.

MIRABELLA, A. D.; KOKICH, V. G.; ROSA, M. Analysis of crown widths in subjects with congenitally missing maxillary lateral incisors. **Eur J Orthod,** v. 34, n. 6, p. 783-787, 2012.

AL-ANI, A. H. et al. Hypodontia: An update on its etiology, classification, and clinical management. **Biomed Res Int,** v. 2017, p. 9378325, 2017.

LI, C. et al. Epigenetics in odontogenesis and its influences. **Curr Stem Cell Res Ther,** v. 13, n. 2, p. 110-117, 2018.

ASLAM, K. et al. The molecular genetics of selective tooth agenesis. **J Pak Med Assoc,** v. 70, n. 11, p. 2023-2027, 2020.

SAHOO, N. et al. Comparison of frequency of congenitally missing upper lateral incisors among skeletal class I, II and III malocclusions. **J Contemp Dent Pract,** v. 20, n. 9, p. 1019-1023, 2019.

ALBU, C. C. et al. Research algorithm for the detection of genetic patterns and phenotypic variety of non-syndromic dental agenesis. **Rom J Morphol Embryol,** v. 62, n. 1, p. 53-62, 2021.
CUNHA, A. S. et al. Genetic variants in tooth agenesis-related genes might be also involved in tooth size variations. **Clin Oral Investig,** v. 25, n. 3, p. 1307-1318, 2021.

AYOUBI, A. A.; DEZFULLY, A. K.; MADLÉNA, M. Dentoskeletal and tooth-size differences between Syrian and Hungarian adolescents with Class II division 1 malocclusion: a retrospective study. **BMC Res Notes,** v. 13, p. 270, 2020.

GUNGOR, A. Y.; TURKKAHRAMAN, H. Tooth sizes in nonsyndromic hypodontia patients. **Angle Orthod,** v. 83, n. 1, p. 16-21, 2013.

GARN, S. M.; LEWIS, A. B. The gradient and the pattern of crown-size reduction in simple hypodontia. **Angle Orthod,** v. 40, n. 1, p. 51-58, 1970.

KÜCHLER, E. C. et al. Exploring the association between genetic polymorphisms in genes involved in craniofacial development and isolated tooth agenesis. **Front Physiol,** v. 12, p. 723105, 2021.

RICHARDSON, E. R.; MALHOTRA, S. K. Mesiodistal crown dimension of the permanent dentition of American Negroes. **Am J Orthod,** v. 68, n. 2, p. 157-164, 1975.

WRIGHT, J. et al. Maxillary lateral incisor agenesis and its relationship to overall tooth size. **J Prosthet Dent,** v. 115, n. 2, p. 209-2014, 2016.

COSTA, A. M. G. et al. Association between tooth agenesis and skeletal malocclusions. **J Oral Maxillofac Res,** v. 8, n. 2, p. e3, 2017.

RODRIGUES, A. S. et al. Is dental agenesis associated with craniofacial morphology pattern? A systematic review and meta-analysis. **Eur J Orthod,** v. 42, n. 5, p. 534-543, 2020.

ÜNAL, B. K.; DELLALOĞLU, D. Digital analysis of tooth sizes among individuals with different malocclusions: A study using three-dimensional digital dental models. **Sci Prog,** v. 104, n. 3, p. 368504211038186, 2021.

BROOK, A. H. et al. The dentition: the outcomes of morphogenesis leading to variations of tooth number, size and shape. **Aust Dent J,** v. 59, n. 1, p. 131-142, 2014.

HAMPL, M. et al. Role of primary cilia in odontogenesis. **J Dent Res,** v. 96, n. 9, p. 965-974, 2017.

YOUSSEF, A. R. et al. Effects of mineral trioxide aggregate, calcium hydroxide, biodentine and Emdogain on osteogenesis, odontogenesis, angiogenesis and cell viability of dental pulp stem cells. **BMC Oral Health,** v. 19, n. 1, p. 133, 2019.

ANTUNES, L. S. et al. Genetic variations in MMP9 and MMP13 contribute to tooth agenesis in a Brazilian population. **J Oral Sci,** v. 55, n. 4, p. 281-286, 2013.

LEE, W. C. et al. Association of common PAX9 variants with permanent tooth size variation in non-syndromic East Asian populations. **J Hum Genet,** v. 57, n. 10, p. 654-659, 2012.

SYMONS, A. L.; STRITZEL, F.; STAMATION, J. Anomalies associated with hypodontia of the permanent lateral incisor and second premolar. **J Clin Pediatr Dent,** v. 17, n. 2, p. 109-111, 1993.

ENDO, T. et al. A survey of hypodontia in Japanese orthodontic patients. **Am J Orthod Dentofac Orthop,** v. 129, n. 1, p. 29-35, 2006.

TRAKINIENĖ, G. et al. Impact of genetics on third molar agenesis. **Sci Rep,** v. 29, n. 8, p. 8307, 2018.

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