Is dental agenesis associated with sella turcica morphology? A systematic review

Agenesia dentária está associada a morfologia da sela túrcica? Uma revisão sistematizada

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ABSTRACT
Tooth development occurs synchronously with the development of the turcica sella; a structure responsible for accommodating the pituitary gland. Recent evidence suggests the relationship between sella turcica morphology and dental anomalies as well as, the influence of hormones excreted by the pituitary gland and craniofacial development. This study aimed to perform a systematic review to explore the association between tooth agenesis and the morphological variations of the sella turcica. The studies were included in this systematic review according to the PRISMA recommendations, following PECOS parameters. The search was carried out in the PubMed database using the following descriptors: tooth agenesis, oligodontia, hypodontia, congenital missing tooth, dental agenesis, congenital missing teeth, anodontia, sella turcica. The data from the included studies were compiled and organized according to the study’s characteristics. The search retrieved 20 titles and abstracts. Only six articles were eligible for full article evaluation. Five studies evaluated isolated tooth agenesis, while one study evaluated tooth agenesis in non-syndromic oral cleft patients. Two articles were identified through a manual search. Almost all the studies showed that there is a significant association between sella turcica bridging and tooth agenesis. In conclusion, there is an association between tooth agenesis and the morphological variations of the sella turcica.

Keywords: tooth agenesis, anodontia, sella turcica.
RESUMO
O desenvolvimento dentário transcorre em sincronia com o desenvolvimento da sela türçica; uma estrutura responsável por acomodar a glândula pituitária. Evidências recentes sugerem uma estreita relação entre a morfologia da sela türçica e anomalias dentárias, bem como a influência de hormônios excretados pela glândula pituitária e o desenvolvimento craniofacial. Este estudo teve como objetivo realizar uma revisão sistematizada explorando a associação entre a agenesia dentária e as variações morfológicas da sela türçica. Os estudos foram incluídos nesta revisão sistematizada de acordo com as recomendações do PRISMA, seguindo os parâmetros do PECOS. A busca foi realizada na base de dados PubMed utilizando os seguintes descritores: “tooth agenesis”, “oligodontia”, “hypodontia”, “congenital missing tooth”, “dental agenesis”, “congenital missing teeth”, “anodontia”, “sella türçica”. Os dados dos estudos incluídos foram compilados e organizados de acordo com as características do estudo. A pesquisa recuperou 20 títulos e resumos. Apenas seis artigos foram elegíveis para avaliação do artigo completo. Cinco estudos avaliaram a agenesia dentária isolada, enquanto um estudo avaliou a agenesia dentária em pacientes com fissura oral não sindrômica. Dois artigos foram identificados por meio de busca manual. Quase todos os estudos mostraram que existe uma associação significativa entre a ponte da sela türçica e a agenesia dentária. Em conclusão, existe uma associação entre a agenesia dentária e as variações morfológicas da sela türçica.

Palavras-chave: agenesia dentária, anodontia, sela türçica.

1 INTRODUCTION
Tooth agenesis is an anomaly of the craniofacial complex characterized by the congenital absence of development of a tooth/teeth germ (Al-Ani et al., 2017). Tooth agenesis has a multifactorial etiology, involving mainly genetic factors (Al-Ani et al., 2017; Li et al., 2018; Aslam et al., 2020). Individuals with tooth agenesis have more malocclusions, speech and esthetic problems (Costa et al., 2017; Sahoo et al., 2019; Stefani et al., 2021). A systematic review and meta-analysis demonstrated that the prevalence of tooth agenesis varies according to the studied population and type of tooth. They calculated that the overall prevalence was 6.4%, excluding third molars (Khalaf et al., 2014).

Tooth germs are formed from neural crest cells (Messer; Till, 2013), the same structure that leads to sella turcica formation (Leonardi et al., 2006). It is worth mentioning that the sella turcica is an intracranial bone depression located in the sphenoid bone that contains the pituitary gland (Tekiner; Acer; Kelestimur, 2015). The pituitary gland and the hormones excreted by it play an important role throughout the development and harmonious maintenance of the craniofacial complex (Omori et al., 2020; Spiller et al., 2020; Bergamo et al., 2021; Küchler et al., 2021; Reis et al., 2021).
Interestingly, in the past two decades, some studies have been proposing the association between tooth agenesis with morphological variations of the sella turcica (Leonardi et al., 2006; Scribante et al., 2017; Sato; Endo, 2020; Zaheer et al., 2020; Antonarakis; Ghislanzoni; Fischer, 2021; Kaya et al., 2021). Thus, the purpose of this study was to perform a systematic review to explore the association between tooth agenesis and the morphological variations of the sella turcica.

2 METHOD
2.1 PROTOCOL, ELIGIBILITY CRITERIA AND FOCUSED QUESTION

The inclusion criteria were according to the recommendations of the PRISMA statement (Page et al., 2021), following the PECOS parameters, as follows:

P - Patients: patients with and without tooth agenesis in permanent teeth;

E – Exposition: Presence of tooth agenesis

C - Comparison: with and without tooth agenesis;

O - Outcome: variations in the sella turcica;

S - Study type, Study design: clinical studies, observational studies, cohort and cross-sectional studies.

Literature and systematic reviews, case reports, animal studies, in vitro studies, studies missing a control group and book chapters were excluded.

The focus question was: Do tooth agenesis patients present morphological variations in the sella turcica?

2.2 INFORMATION SOURCES

A broad literature search was performed until October 13, 2021, in the following databases: MEDLINE (PubMed).

In addition, to ensure a comprehensive literature search, a handsearching was also conducted to identify studies that could have been missed by the primary electronic search.

2.3 SEARCH

MeSH (Medical Subject Headings) terms (https://www.ncbi.nlm.nih.gov/pubmed), Health Sciences Descriptors terms (http://decs.bvs.br), related terms and free terms were included. The Boolean operators “AND” and “OR” were applied to combine the keywords “tooth agenesis” OR
“oligodontia” OR “hypodontia” OR “congenital missing tooth” OR “dental agenesis” OR “congenital missing teeth” OR “anodontia” AND “sella turcica” through PubMed. Duplicates were later removed.

2.4 SOURCES OF EVIDENCE, DATA CHARTING PROCESS, DATA ITEMS

Before beginning screening for this review, a data-charting form was jointly developed to determine, which variables to extract. The reviewer charted the data, discussed the results and continuously updated the data-charting form in an iterative process. All these processes were later revised by an experience examiner.

The data from the included studies were compiled and organized according to the study characteristics.

Meta-analysis was not performed due to the heterogeneity of the studies (type of missing tooth investigated and sella turcica analysis variability).

3 RESULTS

Our initial search strategy retrieved a total of 20 titles and abstracts. Two articles were identified through the manual search. Upon exclusion, only 6 articles were eligible for full article assessment. These 6 articles were qualified for final analysis. The flow of retrieved, excluded and included articles are summarized in Figure 1.

Figure 1. Flow diagram reporting items for systematic reviews

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Identification
Records identified from:
Database (Pubmed): n = 20
Manual search: n=2

Screening
Records removed before screening: n = 0
Records screened: n = 22
Records excluded: n = 16
Reasons: Records out of the proposed theme

Included
Records included: n = 6
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Table 1 shows the characteristics of the included articles. The sample size ranged from 56 patients (Antonarakis; Ghislanzoni; Fischer, 2021) to 2995 patients (Sato; Endo, 2020). Only one study investigated tooth agenesis in non-syndromic oral cleft patients (Antonarakis; Ghislanzoni; Fischer, 2021), the other studies evaluated patients with isolated tooth agenesis (Leonardi et al., 2006, Scribante et al., 2017, Sato; Endo, 2020; Zaheer et al., 2020 and Kaya et al., 2021). The methods to investigate sella turcica phenotypes ranged among the studies and are presented in Table 1.
Table 1. Characteristics of the included articles

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Studies' aim</th>
<th>Population</th>
<th>Sample size</th>
<th>Evaluated missing teeth</th>
<th>Method to evaluate sella turcica and parameters investigated</th>
<th>Type of measurement</th>
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</thead>
<tbody>
<tr>
<td>Leonardi et al. (2006)</td>
<td>To investigate the association between sella bridging and second mandibular premolar agenesis or the presence of a palatal displaced canine</td>
<td>Italians</td>
<td>Total sample (n=169)</td>
<td>Agenesis of mandibular second premolar (n=16)</td>
<td>Lateral Cephalograms. The degree of sella turcica bridging was scored as type I, II, and III according to length.</td>
<td>Manual measurements</td>
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<td>Palatal displaced Canine (n=18)</td>
<td>Agenesis of mandibular second premolar (n=18)</td>
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<td>Control (n=135)</td>
<td>Agenesis of mandibular second premolar (n=135)</td>
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<tr>
<td>Scribante et al. (2017)</td>
<td>To investigate the association between sella turcica dimensions or bridging and canine impaction, tooth agenesis and supernumerary teeth</td>
<td>Italians</td>
<td>Total sample (n=205)</td>
<td>Upper lateral incisors agenesis (n=32), lower second premolars agenesis (n=31), supernumerary teeth (n=17) and control group (n=47)</td>
<td>Lateral cephalograms. The degree of sella turcica bridging was scored as type I, II, and III according to length.</td>
<td>Software measurements. DeltaDent, Outside Format, Paullo, Italy.</td>
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<td>Agenesis of upper lateral incisors and lower second premolars (n=32)</td>
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<td>Lateral cephalograms. The degree of sella turcica bridging was scored as type I, II, and III according to length.</td>
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<td>Severe tooth agenesis (five or more teeth missing) (n=43)</td>
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<td>Sato, Endo (2020)</td>
<td>To investigate the association between the size and bridging of the sella turcica and tooth agenesis</td>
<td>Japanese</td>
<td>Total sample (n=2995)</td>
<td>Maxillary second premolar (n=34) Mandibular second premolar (n=34) Severe tooth agenesis (n=43) Control (n=2867)</td>
<td>Lateral cephalograms. The degree of sella turcica bridging was scored as class I, II, III and IV according to the interclinoid distance.</td>
<td>Software measurements. Image J analysis software program (version 1.51)</td>
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<td>Agenesis of second premolars and severe agenesis (n=34)</td>
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<td>Agenesis of maxillary second premolar (n=43)</td>
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<td>Agenesis of mandibular second premolar (n=2867)</td>
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<td>Zaheer et al. (2020)</td>
<td>To investigate the association between sella turcica bridging with third molar impaction/agenesis</td>
<td>Pakistani</td>
<td>Total sample (n=99)</td>
<td>third molar agenesis (n=30) Control (n=69)</td>
<td>Lateral cephalograms. The degree of sella turcica bridging was scored as type I, II, and III according to length.</td>
<td>Manual measurements</td>
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<td>Agenesis of third molar (n=99)</td>
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<td>Agenesis of severe tooth agenesis (five or more teeth missing) (n=43)</td>
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<tr>
<td>Antonarakis; Ghislanzoni; Fischer (2021)</td>
<td>To investigate differences in sella turcica size and bridging in children with unilateral cleft lip and palate with or without dental anomalies</td>
<td>Canadian</td>
<td>Total sample (n=56)</td>
<td>Agenesis of cleft-side maxillary lateral incisor (n=26) Supernumerary cleft-side maxillary lateral incisor (n=7) Peg-shaped maxillary cleft-side lateral incisor (n=19)</td>
<td>Lateral Cephalograms. The following points of the sella turcica was investigated: most anterior point of the posterior clinoid process, tuberculum, the most posterior, anterior and deepest points of the sella using the Frankfort horizontal plane. The degree of sella turcica bridging was scored as type I, II, and III according to length.</td>
<td>Software measurements. Viewbox 4 cephalometric software (dHAL Software).</td>
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<td>Agenesis of cleft-side maxillary lateral incisor (n=56)</td>
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<td>Agenesis of maxillary second premolar (n=26)</td>
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<td>Agenesis of mandibular second premolar (n=7)</td>
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<td>Agenesis of maxillary lateral incisor (n=7)</td>
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<td>Agenesis of maxillary lateral incisor (n=19)</td>
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<td>Agenesis of maxillary lateral incisor (n=19)</td>
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<tr>
<td>Kaya et al. (2021)</td>
<td>To compare the bridging and dimensions of the sella turcica and calcification of the ponticulus posticus in subjects with different dental anomalies</td>
<td>Turkish</td>
<td>Total sample (n=550)</td>
<td>Impacted canines (n=95), mandibular second premolar agenesis (n=45), maxillary lateral incisor agenesis (n=75), tooth transpositions (n=25), peg-shaped maxillary lateral incisors (n=30), third molar agenesis (n=145) and control group (n=145)</td>
<td>Lateral cephalograms. The degree of sella turcica bridging was scored as type I, II, and III according to length.</td>
<td>Manual measurements</td>
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<td>Agenesis of mandibular second premolar (n=45)</td>
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<td>Agenesis of maxillary lateral incisor (n=75)</td>
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<td>Agenesis of mandibular second premolar (n=145)</td>
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<td>Agenesis of maxillary lateral incisor (n=145)</td>
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</table>
Table 2 shows the results and conclusions of the included articles. Five studies investigated the calcification of sella turcica bridging and showed that there is a significant association between sella turcica bridging and tooth agenesis (Leonardi et al., 2006, Scribante et al., 2017, Sato; Endo, 2020, Kaya et al., 2021 and Antonarakis; Ghislanzoni; Fischer, 2021). Children with unilateral cleft lip and palate and sella turcica bridging are more likely to present tooth agenesis of the cleft-side maxillary lateral incisor (Antonarakis; Ghislanzoni; Fischer, 2021).

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Authors’ main results and conclusion</th>
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<tbody>
<tr>
<td>Leonardi et al. (2006)</td>
<td>The prevalence of a sella turcica bridge in dental anomalies patients is increased compared to controls.</td>
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<tr>
<td>Scribante et al. (2017)</td>
<td>The frequency of partial and complete calcification of the sella turcica in patients with dental anomalies is higher. No statistically significance was observed in sella dimensions.</td>
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<tr>
<td>Sato;Endo (2020)</td>
<td>Maxillary second premolar agenesis and severe tooth agenesis were associated with a reduced interclinoidal distance and increased prevalence of sella turcica bridging.</td>
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<tr>
<td>Zaheer et al. (2020)</td>
<td>An insignificant correlation was found between third molar agenesis and sella turcica bridging. Increased incidence of third molar impaction was associated with third molar agenesis. All skeletal classes were found to be ubiquitous in partial bridging category. Chances of sella turcica bridging increase with age.</td>
</tr>
<tr>
<td>Antonarakis; Ghislanzoni; Fischer (2021)</td>
<td>Children with unilateral cleft lip and palate and sella turcica bridging are more likely to present tooth agenesis of the cleft-side maxillary lateral incisor.</td>
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<tr>
<td>Kaya et al. (2021)</td>
<td>Type II bridging prevalence was lower in patients with mandibular second premolar agenesis, maxillary lateral incisor agenesis, and third molar agenesis, while type III bridging prevalence was significantly higher only in patients with third molar agenesis.</td>
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</table>

4 DISCUSSION

In the present systematic review, we explored the association between two craniofacial phenotypes. The development of the dental-craniofacial complex includes many networks and pathways, which are shared by different structures, such as bone and teeth. The sella turcica is a structure that develops from the same tissues that originate teeth (Leonardi et al., 2006). Furthermore, it is also supposed that morphological variations of the sella turcica can alter the morphology of the pituitary gland and, consequently, cause variations in the hormones excreted by the pituitary gland (Kajear, 2015). In fact, hormones play an important role in craniofacial and tooth development (Omori et al., 2020; Spiller et al., 2020; Bergamo et al., 2021; Küchler et al., 2021; Reis et al., 2021). It is also possible that the connection between variation in the sella turcica and pituitary gland is through the genes that participate in the formation in both structures.
Several studies have been investigating the morphological variations of the sella turcica in different conditions, such as dental anomalies (Leonardi et al., 2006; Scribante et al., 2017; Sato; Endo, 2020; Antonarakis; Ghislanzoni; Fischer, 2021; Kaya et al., 2021; Jankowik et al., 2021), oral cleft (Alam; Alfawzan, 2020), down syndrome (Korayem; AlKofid, 2015) and other genetic syndromes (Roomaney; Chetty, 2021). Given the above, the aim of this study was to systematically evaluate the findings related to the association between tooth agenesis and sella turcica morphology in non-syndromic patient with and without oral cleft.

Our results demonstrate that there is an agreement between the studies included in this systematic review, which suggest that both phenotypes, sella turcica morphological variations and tooth agenesis, are connected (Leonardi et al., 2006; Scribante et al., 2017; Sato; Endo, 2020; Antonarakis; Ghislanzoni; Fischer, 2021; Kaya et al., 2021). The included studies suggested that morphological variations of the sella turcica were mainly associated with mandibular agenesis of second premolar (Leonardi et al., 2006; Scribante et al., 2017; Sato; Endo, 2020; Kaya et al., 2021), incisor superior lateral agenesis (Scribante et al., 2017; Antonarakis; Ghislanzoni; Fischer, 2021) and third molar agenesis (Kaya et al., 2021), which are the most common missing teeth in humans. The same occurred in cleft patients with higher chance of incisor agenesis in the cleft area (Antonarakis; Ghislanzoni; Fischer, 2021).

The included manuscripts used different methods to investigate the morphological variations in the sella turcica. Although all studies investigated the morphology using lateral cephalograms (Leonardi et al., 2006; Scribante et al., 2017; 2020; Zaheer et al., 2020; Antonarakis; Ghislanzoni; Fischer, 2021; Kaya et al., 2021), which is a type of radiography widely used in orthodontic treatment (McNamara Jr; Franchi, 2018), the studies differed in the method used for the evaluation of the sella turcica. Leonardi et al. (2006), Zaheer et al. (2020) and Kaya et al. (2021) performed manually, while Scribante et al. (2017), Sato; Endo (2020) and Antonarakis; Ghislanzoni; Fischer (2021) performed the measurements using a specific software. Also, sella turcica classifications and measurements ranged according to the studies and therefore it was difficult to extract homogeneous results (same type of missing teeth and same classification used to evaluate the sella turcica) in order to perform a meta-analysis.

Another important aspect to be highlighted is that only few populations were investigated and the sample size investigated in some of these studies was small. Therefore, more studies
investigating the association between sella turcica variations and isolated tooth agenesis or tooth agenesis associated with syndromes and oral clefts are necessary.

Finally, the analysis of the included studies supports the hypothesis that tooth agenesis and sella turcica morphology variations are associated. This fact could be due to the concomitant development of the sella turcica and teeth (Leonardi et al., 2006) and the genes involved in the formation of both structures, but is also possible that the pituitary gland influences tooth development. It is also important to highlight that additional well-designed studies are necessary in different populations.

5 CONCLUSION

There is an association between tooth agenesis and the morphological variations of the sella turcica.
REFERENCES


Reis CLB, Guerra KCC, Ramirez I, Madalena IR, de Almeida ACP, de Oliveira DSB. Does suppression levels of testosterone have an impact in the craniofacial growth? a systematic review in animal studies. BJD 2021;7(7):75630-75648.


