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Original Research

Mapping tooth number anomalies: a radiographic cross-sectional study in pediatric dentistry

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ABSTRACT

Objectives: Understanding the prevalence of dental anomalies is crucial for improving diagnosis and treatment by dentists. Additionally, documenting these anomalies is vital in Legal Medicine, where dental records are instrumental in forensic investigations. Tooth number anomalies, such as agenesis and supernumerary teeth, significantly impact a child's oral health and development. This study aimed to determine the prevalence of tooth number anomalies in a pediatric population and highlight the significance of detecting and documenting such anomalies.

Methods: Tooth number anomalies were identified in a pediatric population (6–18 years old) attending the Pedagogical Dental Clinics of the Faculty of Health Sciences of Fernando Pessoa University, through panoramic radiographs. Statistical analysis was conducted using IBM© SPSS© Statistics version 25.0.

Results: Analysis of 147 panoramic radiographs revealed that 10.8% exhibited tooth number anomalies, with 8.8% presenting agenesis and 2.0% supernumerary teeth. The mandibular second premolar was the most frequently affected by agenesis, followed by the maxillary second premolar. Three cases of supernumerary teeth were identified: two in the maxilla and one in the mandible, all within the midline area.

Conclusions: Agenesis was the most prevalent tooth number anomaly in this study. No significant correlation was found between sex and tooth number anomalies identified. Though infrequent, detecting and documenting these anomalies hold immense significance within the patient's clinical history, serving as a crucial asset for future identification endeavors. (Rev Port Estomatol Med Dent Cir Maxilofac. 2025;66(2):65-71)

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Introduction

Forensic dentistry plays a crucial role in forensic sciences, especially in identifying victims and suspects in criminal cases or mass disasters.[1] When only dental remains are available, identification depends on comparing post-mortem dental records with pre-existing clinical documentation.[2] Unique features of each arch, such as anatomical factors, dental anomalies, trauma, caries, and treatments (e.g., restorations, crowns, and prosthetics), aid in this process. These traits make each dental arch unique.[3] Anomalies like irregular tooth counts expedite identification. Dentists must record such alterations in patients' clinical charts.[4]

Tooth number anomalies stem from complex etiological factors during dental development, manifesting as an excess of teeth (supernumerary) or a deficit (agenesis).[5] These anomalies vary in severity, with hypodontia (absence of 1–6 teeth), oligodontia (absence of more than six teeth), and anodontia (complete absence of teeth) providing insights into human dental development.[6] The most affected teeth are the upper lateral incisors, particularly in females.[7,8] Some complications often involve occlusal and aesthetic issues, requiring multidisciplinary treatment.[9]

Agenesis is usually associated with genetic syndromes like ectodermal dysplasia and Down syndrome, or cleft lip/palate, but there are also many cases of isolated tooth agenesis, with no underlying systemic condition. Agenesis usually happens in teeth that develop later, especially the mandibular second premolar. This tooth starts to develop around the ages of 10–12, making it more susceptible to genetic or environmental issues in earlier tooth formation stages. Thus, second premolar agenesis is more frequent in the lower jaw, on both sides. [6,10]

Supernumerary teeth exceed typical counts, offering diverse variations.[11,12] They can present in the midline, adjacent to molars, or distally, and are usually linked to syndromes like cleidocranial dysostosis. However, many cases of supernumerary teeth appear in healthy children with no underlying systemic pathology. These anomalies can cause crowding, impaction, or displacement, often requiring extraction.[13,14]

This study aimed to explore the prevalence of tooth number anomalies in pediatric patients, focusing on sex and location. These anomalies play a crucial role in forensic identification and understanding pediatric dental variations.

Material and methods

The pilot study involved the analysis of 190 panoramic radiographs. Of these, 43 duplicate radiographs from the same patients were excluded, resulting in a final sample of 147 unique panoramic radiographs. Demographic data, including date of birth and sex, were retrieved from clinical records of patients aged 6 to 18 years who had visited the Pedagogical Dental Clinics of the Faculty of Health Sciences, Fernando Pessoa University (CPMD-UFP), Porto, Portugal, within the past 5 years. Radiographs were meticulously examined to identify the presence of tooth number anomalies.

The Technical Directorate of the Dental Medicine Pedagogical Clinics of the Fernando Pessoa University and the Ethics Committee of the Fernando Pessoa University approved this study prior to its onset. Only patients who had previously signed an informed consent form, usually at the screening appointment, were included.

The study included patients aged 6–18 years, with informed consent from the minor's legal representative, typically obtained during the initial screening consultation. Exclusion criteria were a lack of panoramic radiography and poor radiographic quality. Evaluation of third molars was omitted from panoramic radiographs due to challenges in assessment at such early ages.

The panoramic radiographs were read by two examiners (B.I.T.C. and S.P.G.), both students from the Integrated Master's Degree in Dental Medicine of Fernando Pessoa University, at the CPMD-UFP facilities. Before analyzing the clinical files, an intra-examiner calibration was carried out, where each examiner individually assessed the presence/absence of dental anomalies in ten panoramic radiographs. Subsequently, inter-examiner agreement was calculated for the entire sample, using the kappa coefficient for each tooth assessed and considering all the readings made by the two examiners. Each examiner independently assessed the panoramic radiographs as part of the evaluation system.

Following data collection, information was stored in a Microsoft Excel® database (Microsoft Office Plus Professional 2016, Microsoft USA). Subsequent statistical analyses were performed using IBM© SPSS© Statistics v. 25.0 software (Statistical Package for the Social Sciences, IBM, USA). Categorical variables were presented as absolute counts and percentages, and comparisons were made using the chi-square test. Inter-examiner reliability was assessed using the kappa coefficient, with values ranging from 0.828 to 0.913, all statistically significant ($p<0.001$). Given this high level of agreement, the data from the first examiner were used for final analysis.

Results

The analysis of the panoramic radiographs revealed a similar representation of both sexes (Table 1). Tooth number anomalies affected 10.88% (n=16) of the children. Among these anomalies, agenesis was the most common, occurring more frequently than hyperdontia and accounting for 81.25% (13/16) of the cases; hypodontia was the only form of agenesis (Table 1).

Table 2 presents the distribution of missing teeth in the pediatric population. Most affected children (61.54%, 8/13) had

Table 1. Sample characteristics (n=147).

	Male	Female	Total
Sample	78/147 (53.06%)	69/147 (46.94%)	147 (100.0%)
Agenesia	7/13 (53.85%)	6/13 (46.15%)	13 (8.84%)
Supernumerary teeth	2/3 (66.67%)	1/3 (33.33%)	3 (2.04%)

Table 2. Total number of teeth affected by agenesia and distribution per sex.

Total	Male	Female
134/147 (91.16%)	63/134 (47.01%)	71/134 (52.99%)
5/147 (3.40%)	1/5 (20.00%)	4/5 (80.00%)
7/147 (4.76%)	5/7 (71.43%)	2/7 (28.57%)
1/147 (0.68%)	0/1 (0%)	1/1 (100%)

multiple missing teeth, with an average of 1.77 ± 0.83 missing teeth per child (range: 1–4). Only one child presented with four missing teeth. The chi-square test was used to compare the prevalence of agenesis between sexes, revealing no statistically significant association ($\chi^2 = 0.234$, $p = 0.890$).

Table 3 shows the individual distribution of missing teeth in the studied population. The absence of more than one tooth is predominantly bilateral, occurring in 87.5% (7/8) of the cases. Although agenesis was identified in all quadrants (Table 4), it was more common in the lower dental arch (82.61%), with the highest occurrence in the fourth quadrant (43.48%).

The prevalence of missing teeth is highlighted in Table 5. Agenesis affected the second premolar most frequently (73.9%), and in all quadrants (teeth 15, 25, 35, and 45). The most commonly affected tooth was the lower right second premolar

Table 3. Individual distribution of missing teeth (n=23).

Age (years)	Sex	Missing teeth
7	M	25, 45
7	F	35, 45
8	F	35, 45
8	M	32, 42
8	F	35, 45
10	F	36, 46
11	M	15, 25, 35, 45
12	M	35
13	F	44, 45
14	M	36
14	F	35
14	M	45
18	M	15

(M – Male; F – Female)

Table 4. Quadrant distribution of missing teeth.

	First	Second	Third	Fourth	Total
Missing teeth	2	2	9	10	23
Frequency	8.70%	8.70%	39.13%	43.48%	100%

Table 5. Prevalence of missing teeth (n=23).

Missing tooth	Frequency (%)
15	2/23 (8.70%)
25	2/23 (8.70%)
32	1/23 (4.35%)
35	6/23 (26.09%)
36	2/23 (8.70%)
42	1/23 (4.35%)
44	1/23 (4.35%)
45	7/23 (30.43%)
46	1/23 (4.35%)

Table 6. Prevalence of supernumerary teeth (n=3).

Age (years)	Gender	Supernumerary teeth
7	M	25, 45
7	F	35, 45
8	F	35, 45

(M – Male; F – Female)

(30.43%), followed by the lower left second premolar (26.09%). Agenesis of the upper second premolars (right and left) was equally prevalent (8.70%). Agenesis only affected the first premolar (tooth 44) in the fourth quadrant (4.3%) and the lateral incisors in the third and fourth quadrants (8.6%), specifically teeth 32 and 42.

The three cases of supernumerary teeth identified were all located in the midline (Table 6). Since this anomaly was rarely found in the sample (2.04%), no statistical test was performed to examine the potential relationship between the anomaly and the child's sex.

Discussion

Panoramic radiographs are an effective, low-cost, low-radiation method for diagnosing dental anomalies that offers a comprehensive view of both dental arches in a single image, among other advantages.[15]

Some researchers argue that including different age groups in the same study complicates interpretation if results are not analyzed by age range.[15-18] For instance, in pediatric populations, the formation of follicular sacs may not have occurred yet, while adults might have already had supernumerary teeth extracted. Despite these challenges, hyperdontia is most identified during the first decade of life.

Since calcification of tooth germs in permanent dentition starts around 2–3 years of age, it was appropriate to include children aged 6 to 18 years. This range allows for identifying both tooth agenesis and supernumerary teeth that have not yet been extracted. Given the even distribution of dental anomalies across all ages in this extensive sample, analyzing

the data by age range was unnecessary.[19] However, the potential loss of information due to early extractions of supernumerary teeth cannot be ruled out.

Third molars were excluded from the analysis due to the difficulty in accurately assessing their presence or absence at early ages. Some studies suggest that excluding third molars increases the reliability of the study.[3,20] Including them could raise the total number of identified patients with hypodontia by 27-30%.[21] Therefore, excluding third molars helps ensure accurate results regarding dental anomalies in younger populations.

In this study, 8.8% of the panoramic radiographs showed hypodontia, and 2.04% showed hyperdontia. These values are consistent with results from similar university settings, where agenesis prevalence ranged between 6.47% and 17.5%, and the prevalence of supernumerary teeth between 0.72% and 4.8%. The variability in prevalence can be attributed to differences in inclusion and exclusion criteria, such as assessing third molars and varying age ranges from 4 to 21 years.

Regarding sex and the presence of agenesis, no statistically significant difference was found. While some results identify females as the most affected,[9] other studies found no significant differences, corroborating our findings.[6,14,17,19,20,22-24]

Tooth agenesis was more prevalent in the third and fourth quadrants, particularly in the posterior regions. The mandibular second premolar was the most frequently missing tooth (56.5%), followed by the maxillary second premolar (17.4%). These findings align with other studies.[9,25] In turn, only one case of mandibular first premolar agenesis (4.3%) and two cases of lateral incisor agenesis (one upper and one lower, each 4.3%) were found in the present study.

In this study, multiple-tooth agenesis was more common (61.5%) than single-tooth. This result contrasts with findings from previous studies, where 54.3% of patients exhibited single-tooth agenesis, and 45.7% had multiple missing teeth. This discrepancy may be attributed to differences in sample sizes and study populations.[18]

Regarding supernumerary teeth, this anomaly was identified in only three patients: two males and one female. The maxilla was the most affected arch, and mesiodens was the most frequently found supernumerary tooth (66.7%). One study reported similar results[11] in a sample of 1438 panoramic radiographs of children aged 6 to 15 years. That study found an equal number of supernumerary cases for both sexes (50% for females and males), with 82.5% of supernumerary teeth located in the maxilla. Mesiodens was the most detected supernumerary tooth, with a prevalence of 60%.

In this study, the other supernumerary tooth was in the lower incisor area, with a prevalence of 33.3%. This finding differs from previously published results, which identified 40 patients in which 36 (90.0%) had a single supernumerary tooth, 3 (7.5%) had 2, and one (2.5%) had 3, totalling 45 supernumerary teeth, with an average of 1.13 per affected child.[11] This discrepancy may stem from the small number of hyperdontia cases with supernumerary teeth identified in our study (three cases).

Panoramic radiographs may have hindered the identification of supernumerary teeth. This technique often shows several overlapping structures, especially in the anterosuperior region, obscuring the detection of supernumerary tooth germs. Utilizing other diagnostic methods, such as periapical or occlusal radiographs, may improve the identification of supernumerary teeth in these areas.

Larger sample sizes are recommended for future studies to enhance statistical power. Larger samples yield more data, facilitating precise population mean values. Additionally, exploring the correlation between prevalence and variables such as sex and location would provide insights into the distribution of dental anomalies based on population affinity, revealing potential associations with specific ethnic groups. Given the diverse ethnic makeup of patients at CPMD-UFP, incorporating information on population affinity into clinical records could yield valuable insights for future research. Doing studies across multiple centers or populations is important to understand if the patterns observed, like more cases of agenesis in the lower arch, are just local issues or part of larger global trends. By looking at patients from different ethnic, genetic, and social backgrounds, researchers can determine if aspects like diet, access to dental care, or family history affect the occurrence of tooth number issues. This wider sampling also allows for comparisons that lead to better connections with other factors (like socioeconomic status or overall health). These larger and more varied datasets improve the accuracy of prevalence estimates and help develop better clinical and preventive strategies that can be customized for different communities or ethnic groups.[26,27]

Thorough documentation in patients' clinical records is vital for diagnosing dental anomalies regarding the history of supernumerary teeth extraction. Despite the limited sample size in this study, it significantly enhanced our comprehension of the pediatric patient cohort at CPMD-UFP regarding tooth number anomalies. This study predominantly served as an exploratory endeavor, underscoring the need for further research in this domain, building upon the methodologies and findings outlined here. Therefore, dental practitioners must remain vigilant in identifying and documenting any deviations in the oral cavity in patient records.

This meticulous documentation enhances the effectiveness of forensic dental investigations.[4,27,28] Careful and precise noting of tooth differences is very important for identifying people, as each person's teeth serve as a unique "fingerprint." The existence of missing or extra teeth and their position, especially in certain areas or types, can greatly limit identification options when comparing post-death evidence with pre-death dental records. This documentation is crucial in cases of severe decay or mass disasters, where dental remains might be one of the few signs of identity. Accurate recording of these differences in patient files—whether through x-rays, clinical notes, or other images—enhances forensic work. Additionally, careful and regular filing of this data makes cross-checking easier and contributes to a faster and more precise identification. The forensic implications of these results extend beyond simple identification, as missing or extra teeth could provide valuable insights into genetic conditions or developmental patterns, aiding in broader forensic investigations. By marking and noting every difference, dental professionals are not just aiding patient

treatment but also offering useful information that could help legal and forensic groups if future identification issues arise.[26-28] Another clinical relevance of these findings is how these anomalies might influence orthodontic or prosthodontic treatment planning.

One of the limitations of this study is that the diagnosis of agenesis was based solely on radiographic observation in a population aged 6 to 18 years. Although radiographs were meticulously examined to identify tooth number anomalies, it remains unclear how cases of agenesis were distinguished from cases in which teeth had been extracted, potentially affecting the accuracy of the findings. Similarly, in assessments at older ages, it is uncertain whether supernumerary teeth had been extracted, which could also influence the results. Recognizing the possibility of missing data due to extractions or imaging limitations strengthens the credibility of the findings. Additionally, the small sample size limits the generalizability of the results.

Conclusions

The prevalence of tooth number anomalies was 8.8% for hypodontia and 2.04% for hyperdontia. Among these anomalies, the most common was agenesis of more than one tooth, with the mandibular second premolar being the most frequently absent, followed by the maxillary second premolar. Additionally, three cases of supernumerary teeth were identified—two in the maxilla and one in the mandible—each located in the midline region.

There remains a need for improvement in the systematic registration of dental anomalies within medical records, as insufficient documentation can limit retrospective analyses. Given the demonstrated role of distinctive dental features in human identification, it is crucial for dentists to meticulously document all aspects of the oral cavity, including detailed descriptions of dental anomalies, tooth orientation, previous conditions, and any treatments performed. Since dental structures are unique to everyone, such documentation is invaluable in forensic contexts.

Future research should focus on larger, more diverse, multicentric samples to enhance statistical power and generalizability. In future studies, it will be important to complement radiographic information with clinical data. Additionally, incorporating genetic analyses, advanced imaging techniques, and longitudinal tracking from early childhood could provide deeper insights into the etiology and progression of tooth number anomalies. Incorporating genetic analyses and detailed family histories may help elucidate hereditary factors influencing tooth number anomalies, particularly given emerging evidence implicating genes. Additionally, longitudinal studies following individuals from early childhood to adolescence would be beneficial in distinguishing truly congenitally missing teeth from those extracted due to routine care.

To improve diagnostic accuracy, future studies should integrate advanced imaging techniques, such as cone-beam computed tomography, which can provide greater detail than panoramic radiographs alone. Furthermore, exploring how tooth number anomalies correlate with other dental anomalies, such as morphological or structural defects, could contribute to a more comprehensive understanding of craniofacial development. These findings will ultimately aid in refining diagnostic, preventive, and treatment strategies, benefiting both pediatric and multidisciplinary dental teams.

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Conflict of interest

The authors have no conflicts of interest to declare.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed their work center protocols on access to patient data and for its publication.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

CRediT authorship contribution statement

Maria Inês Guimarães: Conceptualization, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Isabel Abreu:** Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Beatriz Carneiro:** Conceptualization, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Teresa Sequeira:** Validation, Writing – original draft, Writing – review & editing. **Augusta Silveira:** Validation Writing – original draft, Writing – review & editing. **Cristina Cardoso Silva:** Conceptualization, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing.

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Mapeamento das anomalias de número: estudo radiográfico transversal em odontopediatria

RESUMO

Objetivos: Compreender a prevalência de anomalias dentárias é crucial para melhorar o diagnóstico e o tratamento pelos médicos dentistas. A documentação destas anomalias é também importante na Medicina Legal, onde os registos dentários são úteis em investigações forenses. As anomalias no número de dentes, como agenesia e dentes supranumerários, afetam a saúde oral e o desenvolvimento da criança. Este estudo teve como objetivo determinar a prevalência de anomalias no número de dentes numa população pediátrica.

Métodos: Foram identificadas anomalias no número de dentes numa população pediátrica (6-18 anos) da Clínica Pedagógica de Medicina Dentária da Faculdade de Ciências da Saúde da Universidade Fernando Pessoa, através de radiografias panorâmicas. A análise estatística foi realizada utilizando o IBM© SPSS© Statistics versão 25.0.

Resultados: A análise de 147 radiografias mostrou que 10,8% apresentavam anomalias no número de dentes, com 8,8% de agenesia e 2,0% de dentes supranumerários. O segundo pré-molar mandibular foi o mais frequentemente afetado por agenesia, seguido do segundo pré-molar maxilar. Foram encontrados três casos de dentes supranumerários: dois no maxilar e um na mandíbula, todos na linha média.

Conclusões: A agenesia foi a anomalia dentária mais prevalente neste estudo. Não se observou correlação significativa entre o sexo e as anomalias dentárias. A deteção e documentação destas anomalias é fundamental para o registo clínico e pode ser um recurso crucial para futuras identificações. (Rev Port Estomatol Med Dent Cir Maxilofac. 2025;66(2):65-71)

Palavras-chave:
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