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ORIGINAL ARTICLE

Bibliometric Study of Publications on Eruption of Deciduous and Permanent Teeth

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ABSTRACT

Objective: To perform a bibliometric analysis on deciduous and permanent eruption publications to discuss the global trends and prospects on the topic. **Material and Methods:** A systematic search was conducted on the Scopus database. The characteristics of the publications, including co-cited authors, organizations, countries, most cited sources, publications, and keyword co-occurrence, were analyzed using VOSviewer software version 1.6.18. **Results:** After applying exclusion criteria, 492 studies were included in the analysis. The majority of research centers were located in Europe. "Archives of Oral Biology" emerged as the most frequently cited journal. The United States and Brazil were the most frequently cited countries in the publications. Notable co-authors included Kuchler E. C. and Hägg U. The most frequently cited keywords were associated with oral pathologies, tooth development, odontogenesis, and genetics. The most recent papers were published in journals focused on oral diseases. **Conclusion:** This bibliometric analysis highlights that the future of research in this field is likely to be focused on the investigation of tooth eruption in both deciduous and permanent teeth, with an emphasis on genetics, tooth development, timing of tooth eruption, and syndromic conditions. While well-accepted in the fields of Pediatrics and Orthodontics, there is a growing interest in this topic within oral biology and pathology journals in the Americas, with the United States and Brazil leading in terms of publications and citations.

Keywords: Tooth, Deciduous; Dentition, Permanent; Tooth Eruption; Bibliometrics.

Introduction

Tooth eruption is considered one of the biological phenomena present in the development and growth of the child [1], classified as the emergence of the dental germ in the oral cavity, which occurs in two moments: the eruption of the deciduous teeth and that of the permanent teeth. Both dentitions are important for phonation, swallowing, chewing, occlusion, and aesthetics [2-4].

The chronology and sequence of tooth eruption are conceptualized as the timing of tooth replacement and the order in which teeth appear, respectively [5,6]. The scientific understanding gained in this context is valuable for treatment planning, determining physiological age, diagnosing developmental abnormalities, and addressing medical-legal issues [7-9].

The biological processes that lead to tooth eruption in both phases are inherent to the natural course of dental development. However, numerous syndromes and dental anomalies exist that can impact occlusion development, leading to malocclusion, space closure due to dental absences or alterations, and impairment of tooth-related functions [10,11]. Furthermore, various factors can accelerate or delay these processes, including gender, ethnicity, nutritional factors, systemic and endocrine conditions, low birth weight, prematurity, as well as socioeconomic and genetic factors [12-14].

Bibliometric analysis has gained significant recognition in scientific literature, as it collects ample information regarding citations, topics, and keyword occurrences. This process results in maps of scientific information that provide a robust foundation for identifying knowledge gaps and obtaining a well-informed view of ongoing research [15]. This type of study conducts comprehensive data extraction, allowing selected studies to be correlated with the central theme. This correlation aids in gaining a deeper understanding of the directions in which scientific research has been focused within this theme, thereby facilitating further exploration of underexplored topics and the planning of new scientific research in related areas.

In light of this, the present study aims to conduct a bibliometric analysis of tooth eruption in both deciduous and permanent teeth, with the goal of discussing global trends and prospects in this field.

Material and Methods

Data Source and Search Strategy

A search strategy in the Scopus database was designed. No restriction of year of language was applied. The search strategy was done on 14th January 2023. Table 1 shows descriptors used and the search strategy for the Scopus database. A filter about area was used to include papers only of dentistry.

Table 1. Search strategy in Scopus database.

Database	Search Strategy
Scopus	#1 (TITLE-ABS-KEY ("deciduous tooth") OR TITLE-ABS-KEY ("deciduous teeth") OR TITLE-ABS-KEY ("primary teeth") OR TITLE-ABS-KEY ("primary tooth") OR TITLE-ABS-KEY ("primary dentition*") OR TITLE-ABS-KEY ("deciduous dentition*") OR TITLE-ABS-KEY ("permanent dentition*") OR TITLE-ABS-KEY ("permanent tooth") OR TITLE-ABS-KEY ("permanent teeth")) #2 (TITLE-ABS-KEY ("Tooth eruption") OR TITLE-ABS-KEY ("Chronology of tooth eruption") OR TITLE-ABS-KEY ("Dental eruption chronology") OR TITLE-ABS-KEY ("Tooth Eruption sequence") OR TITLE-ABS-KEY ("Tooth Eruption sequence"))

Eligibility Criteria and Selecting Articles Process

Two researchers (BAF and TOF) selected the studies based on the eligibility criteria. It included clinical, observational studies and cases reports that addressed tooth eruption and only adult population samples were excluded. As exclusion criteria, it was considered studies outside the proposed theme that was not related to

tooth eruption, such dental abnormalities, orthodontic treatment, traumatic dental injuries, dental caries or in vitro, letters to the editor, editorials, and protocols.

Bibliometric Analysis

The search result was exported in the format of a CSV file with all data, including information on citation, bibliography, abstract and keywords. This file was imported to VOSviewer software version 1.6.18 for Mac [16] to construct and analyze the publications characteristics, including cited organizations co-cited authors, co-cited organizations, co-cited, co-cited countries, most cited sources, most cited publications e co-occurrence of keywords resulting in network resulting in network, overly or density maps for visualization.

In network visualization, items are demonstrated by nodes and labels, and classified in clusters. The size of the node and the label of an item is determined by the weight of the item. The larger the weight of an item, the bigger the label and the circle denoting the item. The weight of an item is determined by the links and the total link strength attributes. Links indicate the number of links of an item with other items and the total link strength represents the overall strength of the links of an item with other items [17]. Clustering is a method to set items into groups by similarity and detect closely associated items [18]. In these maps, clusters of items are presented by different colors to represent the cluster to which a node has been allocated.

The overlay visualization is identical to the network visualization, except that items are colored differently. A color bar is shown in the bottom right corner of the visualization. The color bar is shown only if colors are determined by scores of items. If items have scores, the color of an item is determined by 10 the score of the item, whereby default colors range from blue (lowest score) to green to yellow (highest score) [19].

The item density visualization helps detect dense and important areas in the map. The more frequency of occurrence of the item, the denser the area. In this visualization, attention has been paid to the color and distribution of each point. Each point has a color depending on the density of items at that point. The range of colors is from blue to green to yellow. The yellow color indicates the highest number of items about the item and the highest weights of the neighboring items density, followed by green and then blue. Conversely, the smaller the number of items in the neighborhood of the item and the lower the weights of the neighboring items density, the closer the color of the point is too blue [17].

To simplify the maps and reduce term density, the threshold of minimum number of occurrences was set for each case. To set a threshold is a desirable number to cancel misspelled keywords as well as nugatory ones.

Results

Search Process

After the search, 1280 indexed references on Scopus database were retrieved for analyses. After applying the exclusion criteria, 492 articles were included (Supplementary Material).

VOSviewer Analysis

1) Co-Authorships, Unit of Analysis

Top Researchers in Terms of Citation

Among the 492 studies included in the bibliometric analysis, a total of 1467 researchers were identified in the citation visualization. However, when a document threshold of 3 was applied, only 52 researchers (3.54%) met the criteria. In Figure 1, the network visualization revealed the presence of more than 10 clusters, indicating that researchers publish within distinct groups. Notably, the clusters with larger nodes were represented by the

Red group (led by Kuchler E. C.), Purple group (led by Hägg U.), Blue group (led by Declerck D.), Green group (led by Cavalcanti A. F. C.), and Yellow group (led by Janicha J.). In the density analysis (Supplementary Material), these groups were found to have the highest citation counts. In overlay analysis (Supplementary Material), it was observed that Janicha J.'s group had publications dating back to 1980, whereas the other groups had more recent publications.

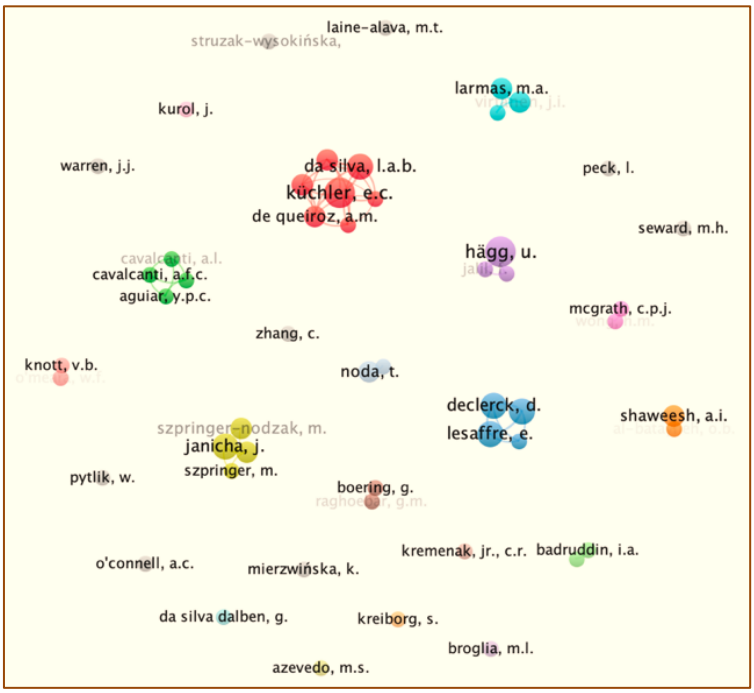

Figure 1. Co-autorship: network visualization.

Most Cited Organization Centers

In the comprehensive citation analysis, a total of 819 organization centers were identified. Among these, 19 organization centers (2.31%) met the predefined thresholds, which included a minimum document publication count of 2 and a minimum citation count of 1. It was observed that there was a lack of a network or connections between the organization centers, and nodes were distributed in a similar proportion (Supplementary Material). The top 5 organization centers of research, according to citation, are presented in Table 2. It was evident from the data that research on the topic of tooth eruption is predominantly conducted by research centers in Europe.

Table 2. Top cited research centers.

Rank	Research Centers	University/Institution	Country	Number of Citations (Scopus)
1	Institute of Orthodontics	Royal Dental College	Denmark	604 (3 documents)
2	Department of Orthodontics	University of Florence	Italy	145 (2 documents)
3	Department of Oral and Maxillofacial Surgery	University Hospital Groningen	Netherlands	79 (2 documents)
4	Department of Orthodontics, Institute of Dentistry	University of Oulu	Finland	56 (2 documents)
5	Department of Pedodontics, School of Dentistry	University of Bergen	Norway	43 (2 documents)

Top Countries in Terms of Citation

In terms of the geographical distribution of citations and publications related to the theme of tooth eruption, VOSviewer settings were configured to consider countries with a minimum of 5 documents and a minimum of 1 citation. This analysis revealed a total of 80 countries, of which 25 countries (31.25%) met the specified thresholds. Among these countries, three stood out with the highest number of citations, totaling 2,033. The United States ranked first, contributing to 41.71% (n=848) of the citations in the theme, followed by the United Kingdom at 30.89% (n=628) and Brazil at 27.39% (N=557). Figure 2 illustrates the 25 countries with the highest number of publications, and these countries collectively accounted for 350 publications/documents. The United States maintained its leading position in terms of the number of publications at 19.42% (n=68), with Brazil ranking second at 14.00% (n=49).

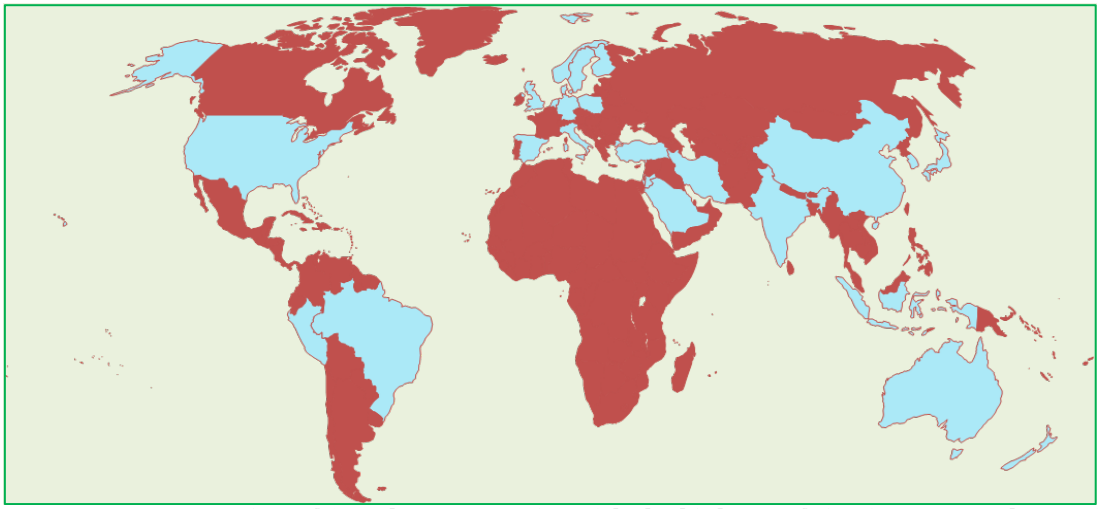

Figure 2. Country analysis: In blue, the 25 countries with the highest publications on tooth eruption.

The Figure 3 visually demonstrates that the United States has been actively researching this topic for an extended period, while Brazil has recently emerged as a significant contributor to this theme.

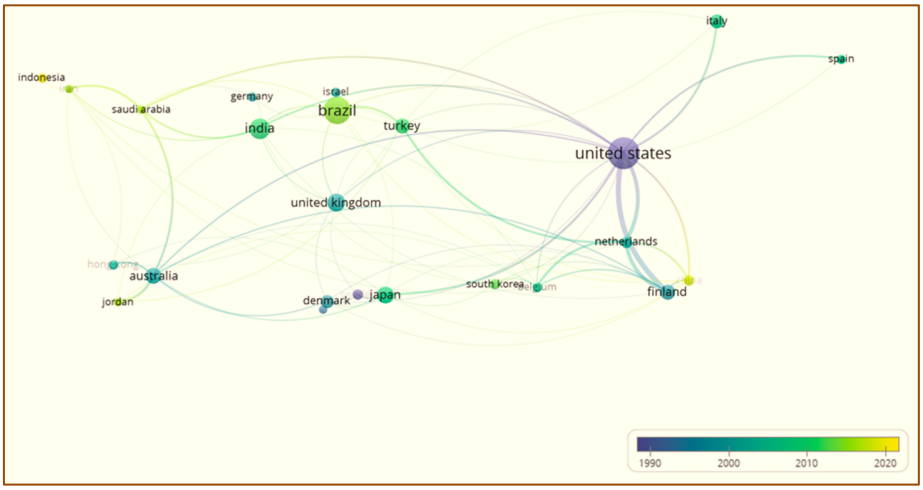

Figure 3. Country analysis: Evidence that the United States is working on this topic a long time and Brazil recently emerged on tooth eruption theme.

The Figure 4 displays the network visualization of the countries, highlighting the United States and Brazil as the largest nodes connecting research related to tooth eruption.

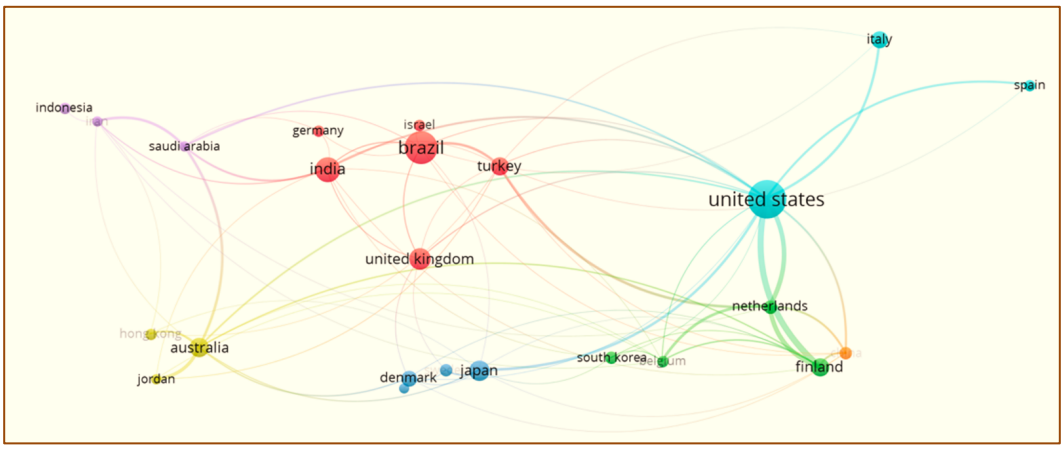

Figure 4. Country analysis: the network visualization of the countries highlighting the United States and Brazil as the biggest nodes connecting research on tooth eruption topic.

2) Co-Occurrence, Unit of Analysis

Analysis of the Main Keywords

In the analysis of keyword co-occurrence, a total of 1,506 keywords were initially identified. To create clear and organized maps, you set a minimum occurrence threshold of 20, resulting in the inclusion of 76 keywords (5.04%) in the analysis. The goal was to focus on keywords directly related to the topic while excluding similar ones.

In the keyword co-occurrence analysis (Figure 5), three clusters were observed in the network, with two well-defined clusters highlighted:

1. Green Cluster: This cluster featured the largest nodes and contained keywords related to the timing of tooth eruption, sex factors (male, female), age factors (newborn, preschool, child, adolescent), and the type of dentition (deciduous, permanent).

2. Red Cluster: In this cluster, keywords were related to tooth eruption pathologies (tooth disease, root resorption, ectopic tooth, unerupted tooth, impacted tooth, tooth abnormalities), tooth development, odontogenesis, and genetics.

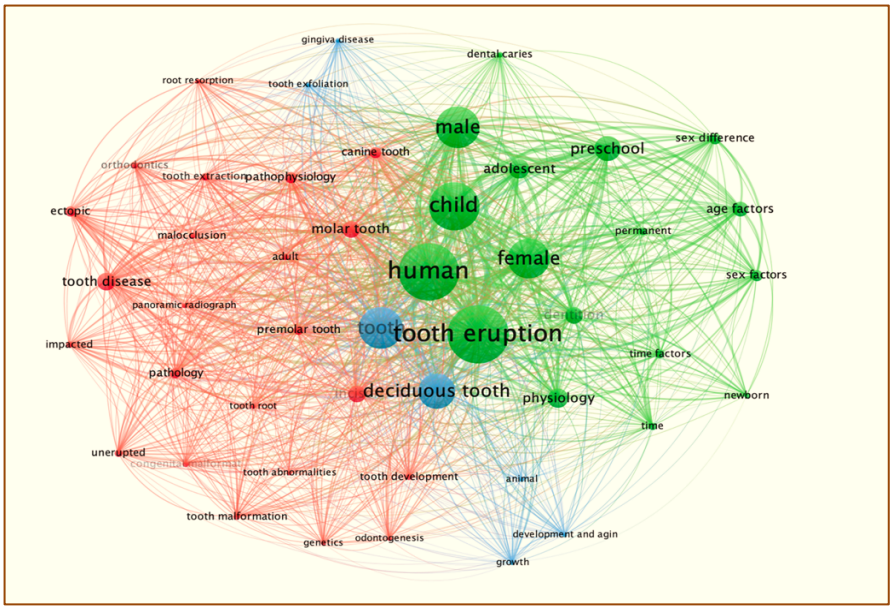

Figure 5. Co-occurrence of Keywords: Network analysis of the Main of Keywords represented by clusters. Each cluster is represented by one color. The cluster one is represented by the color green, the cluster two is represented by the color red and the cluster 3 is represented by the color blue.

It's noteworthy that the cluster containing the latter cited keywords represents more recent publications, as evident in the overlay visualization (Supplementary Material). This suggests a growing interest in exploring the relationships between tooth eruption and various dental pathologies, development, and genetics in recent research.

3) Citation, Unity Analysis

Top Cited Sources (Journals)

A total of 107 sources (journals) were found when applying the criterion of at least 5 citations, and among them, 33 journals met the specified thresholds. The top 15 most cited journals, representing 14.01% of the total, are listed in Table 3. "Archives of Oral Biology" holds the first place with 681 citations in the subject, followed closely by the "Journal of Dental Research" with 667 citations. This data suggests that the topic of tooth eruption is well-received and extensively covered in journals related to pediatric dentistry and orthodontics, as indicated by the presence of these journals among the most cited sources.

Table 3. Top cited Scientific Journals.

Rank	Scientific Journal	Country of Origin	Journal Impact Factor (2021)	H Index	Number of Citations (Scopus)
1	Archives of Oral Biology	United Kingdom	2,640	95	681
2	Journal of Dental Research	United States	7,350	192	667
3	American Journal of Orthodontics	United States	1,550	129	607
4	American Journal of Orthodontics and Dentofacial Orthopedics	United States	1,546	129	485
5	Community Dentistry and Oral Epidemiology	Denmark	2,489	106	457
6	Pediatric Dentistry	United States	2,378	72	399
7	International Journal of Paediatric Dentistry	United Kingdom	3,264	67	375
8	British Dental Journal	United Kingdom	0,834	87	365
9	Journal of the American Dental Association (1939)	England	1,112	123	323
10	Acta Odontologica Scandinavica	United Kingdom	2,331	69	280
11	ASDC Journal of Dentistry For Children	United States	0,662	41	242
12	Angle Orthodontist	United States	2,337	91	230
13	Journal of Dentistry For Children	United States	0,662	41	223
14	Oral Surgery, Oral Medicine, Oral Pathology	United States	2,684	126	177

Journal Impact Factor (JIF), H Index, and country of origin were accessed through the Journal/publishers original pages found through the National Library of Medicine (https://www.ncbi.nlm.nih.gov/). The journal factor impact in the European Journal of Paediatric Dentistry is from the year 2020.

Top 15 Most Cited Publications and More Recent Publications

Among the 492 studies included in the analysis, the top 15 most cited publications, representing 3.04% of the total, are presented in Table 4. Notably, these papers span the years from 1965 to 2009. The top cited papers explored various themes related to tooth eruption, including: dentofacial and occlusion development; genetics, nutritional status, syndromic conditions, timing of eruption, dental abnormalities, tooth impaction and chronology. It is worth mentioning that these themes continue to be areas of investigation, as evidenced by the topics explored in the most recent papers listed in Table 4. Furthermore, the journal "Oral Diseases" has been actively publishing on this theme, with a focus on oral diseases and syndromic conditions related to the timing of eruption.

Table 4. More recent publications.

Publication Reference
Abaid S, Zafar S, Kruger E, Tennant M. Size estimation of unerupted canines and premolar using various independent variables: A systematic review. J Orofac Orthop 2023; 84(3):164-177. https://doi.org/10.1007/s00056-022-00392-9.
Olazo JAA, Barrueto MAR. Enucleación de quiste dentígero, asociado al incisivo lateral retenido, y tracción ortodóntica de canino superior retenido. Revista Cubana de Estomatologia 2022; 59(4):e3186. [In Spanish].
Reeve-Brook L, Bhatia S, Al-Yaseen W, Innes N, Monaghan N. A questionnaire-based study of Paediatric Dentists' knowledge of teething signs, symptoms and management. BDJ Open 2022; 8(1):7. https://doi.org/10.1038/s41405-022-00099-4
Cavalcanti AFC, Arruda TD, Aguiar YPC, Melo ASO, Leal JIBF, Sakly EH, et al. Systemic manifestations, tooth eruption and enamel defects in children with Congenital Zika Virus Syndrome: 36-month follow-up case series. Pesqui Bras Odontopediatria Clín Integr 2022; 22:e211316. https://doi.org/10.1590/pboci.2022.037
Madalena IR, Reis CLB, De Oliveira DSB, Pecharki GD, Trevilatto PC, Andrades, KMR, et al. Lack of association between delayed tooth emergence and single nucleotide polymorphisms in estrogen receptors. Braz Dent J 2022; 32(6):107-114. https://doi.org/10.1590/0103-6440202104103
Ristaniemi J, Rajala W, Karjalainen T, Melaluoto E, Iivari J, Pesonen P, et al. Eruption pattern of the maxillary canines: features of natural eruption seen in PTG at the late mixed stage-Part I. Eur Arch Paediatr Dent 2022; 23(2):223-232. https://doi.org/10.1007/s40368-021-00650-1
Garg A, Kumar G, Goswami M, Verma D. Impact of socioeconomic factors on deciduous teeth eruption among infants born after low-risk pregnancy compared to infants diagnosed with intrauterine growth restriction. J Indian Soc Pedod Prev Dent 2022; 40(2):118-123. https://doi.org/10.4103/jisppd.jisppd_186_22
Xu H, Tian B, Shi W, Tian J, Wang W, Qin M. Maturation of the oral microbiota during primary teeth eruption: A longitudinal, preliminary study. J Oral Microbiol 2022; 14(1):2051352. https://doi.org/10.1080/20002297.2022.2051352
AlWadiyah M, Athanasiou AE, Makrygiannakis MA, Kaklamanos EG. Does interceptive extraction of multiple primary teeth increase the chances of spontaneous eruption of permanent maxillary canines positioned palatally or centrally in the alveolar crest? A Systematic review. Int Orthod 2022; 20(2):100638. https://doi.org/10.1016/j.ortho.2022.100638
Gomes, PN, Azevedo ID, do Amaral BA, Arrais NMR, Lima KCD. Microcephaly as a risk factor for dental alterations: A case-control study. Oral Dis 2023; 29(5):2265-2271. https://doi.org/10.1111/odi.14199
da Silveira ER, Cademartori MG, dos Santos Costa F, Hartwig A, Barros FC, Bertoldi AD, et al. Number of erupted teeth at the age of 12 and 24 months: a maternal report validation study. Braz J Oral Sci 2022; 21:e227095. https://doi.org/10.20396/bjos.v21i00.8667095
Wu Y, Shaohai H. Surgical treatment of multiple impacted supernumerary teeth in a cleidocranial dysplasia patient. Br J Oral Maxillofac Surg 2022; 15(2):201-207. https://doi.org/10.1111/ors.12701
DeSeta M, Holden E, Siddik D, Bhujel N. Natal and neonatal teeth: A review and case series. Br Dent J 2022; 232(7):449-453. https://doi.org/10.1038/s41415-022-4091-3
Nagayama K, Ogaya Y, Hamada M, Okawa R, Uzawa N, Nakano K. Severe dislocation of mandibular second premolar associated with deep ankylosis of primary molar. Pediatr Dent J 2022; 32(2):116-122. https://doi.org/10.1016/j.pdj.2022.03.003
da Silva Sobrinho AR, Ramos LFS, Maciel YL, Maurício HDA, Cartaxo RDO, Ferreira SJ, et al. Orofacial features in children with microcephaly associated with Zika virus: A scoping review. Oral Dis 2022; 28(4):1022-1028. https://doi.org/10.1111/odi.13804
Cunha B, Salgado M, Caramelo F, Costa AL. Age of first deciduous tooth eruption in a Portuguese children population: a cross-sectional study. Rev Port Estomatol Med Dent Cir Maxilofac 2022; 63(3):141-146. https://doi.org/10.24873/j.rpemd.2022.10.881
Setiawan AS, Abhista N, Andisetyanto P, Indriyanti R, Suryanti N. Growth stunting implication in children: A review on primary tooth eruption. European J Gen Dent 2022; 11(1):7-16. https://doi.org/10.1055/s-0042-1742357
Silva DR, Shahinian AL. Odontoma malformation and disturbances of eruption subsequent to traumatic dental injuries: A literature review and a case report. Dent Traumatol 2022; 38(2):98-104. https://doi.org/10.1111/edt.12728
Fekonja A. Evaluation of the eruption of permanent teeth and their association with malocclusion. Clin Exp Dent Res 2022; 8(4):836-842. https://doi.org/10.1002/cre2.544
Tosheska-Spasova N, Dzipunova B, Volcheski F, Tasevska A, Perchinkovska-Petkova S, Nikoloska M, et al. Family-related maxillary deficiency accompanied by delayed permanent dentition: A case report. J Int Dent Med Res 2022; 15(3):1290-1297.
Vaz FFS, da Silva Sobrinho AR, Athayde FRRS, de Vasconcelos Carvalho M, Sette-de-Souza PH, Ferreira SJ. Might Zika virus-associated microcephaly's severity impact deciduous tooth eruption and orofacial structures? Oral Dis 2023; 29(5):2277-2282. https://doi.org/10.1111/odi.14227
Traver-Ferrando C, Barcia-González J. Early permanent dental eruption in obese/overweigh schoolchildren. J Clin Exp Dent 2022; 14(2):199-204. https://doi.org/10.4317/jced.58568
Medina DT, Santos APPD, Rodrigues FMDF, Oliveira BH. Oral manifestations of congenital Zika virus infection in children with microcephaly: 18-month follow-up case series. Spec Care Dentist 2022; 42(4):343-351. https://doi.org/10.1111/scd.12681

Discussion

While tooth eruption is a widely studied subject, a comprehensive bibliometric analysis of the global landscape concerning the eruption of deciduous and permanent teeth has not been undertaken until now.

Examining citations can shed light on intellectual linkages that influence research. Additionally, the convergence of certain authors guiding specific domains suggests that more frequently cited articles may hold greater significance. The utilization of VOSviewer enables the presentation and visualization of essential information through bibliometric graph maps, making it easier to interpret relationships or networks [16]. This approach enhances our understanding of the scholarly landscape in this field and aids in identifying key contributors and research trends.

Current Research Trends (Exploring the Keywords)

The words that appear in the resulting search terms contain significant translations for the current research trends explored in this bibliographic analysis. Even with dentistry a little more accessible to the entire population, tooth eruption is still an unenlightened subject for families. Both, deciduous and permanent dentition are of paramount importance for phonation, chewing, aesthetics and occlusion. The understanding about how tooth exchange works, information about its functions and factors that can alter the chronology and sequence of tooth eruption are the responsibility of the dentist, who needs to educate those responsible about the possible causes and warn of the consequences [14,20-22].

The beginning of the eruption of primary teeth in the oral cavity occurs around 6 months of age, but it can vary, as well around twelve years of age the last permanent tooth emerges. Both dentitions follow a sequence and chronology that can be altered by several factors such as dental anomalies, syndromes, genetics, nutritional status, socioeconomic aspects, systemic and endocrine conditions, low birth weight and prematurity, ethnicity and sex [23,24]. Moreover, these factors have the potential to modify tooth replacement by accelerating or delaying this process by being harmful, since it unbalances all the functions of teeth.

The Geographical Distribution of Research, Source of Research and Centers of Research

The predominant centers of research in the analysis were located in Europe, with significant contributions also coming from the United Kingdom (England, Scotland, Wales, and Northern Ireland) and American countries (United States and Brazil). The total number of citations was a relevant factor in the classification of countries, the difference from the first-placed (United States of America) to the third (Brazil) is 34% and 26% for the second place (United Kingdom), motivating its prevalence in the theme. The United States and Brazil were the countries with the most publications, with Brazil closely following the United States, albeit with a 28% difference. Brazil's notable position in both citations and publications is attributed to its more recent contributions to the field. Brazil has its importance in the ranking of citations and publications, its position of third place with 557 citations and second place with 49 publications and it is related to a more recent publication. The absence of Asian, African, and Oceanian countries, as well as the limited presence of Latin American countries in this analysis, suggests that researchers from these regions did not significantly contribute to the top country rankings. Possible reasons for this include language barriers, limited professional connections, and restricted access to information. "Archives of Oral Biology," "Oral Diseases," "Journal of Dental Research," "American Journal of Orthodontics and Dentofacial Orthopedics," "Pediatric Dentistry," and "International Journal of Paediatric Dentistry" were the most prominent journals in this field due to their numerous publications. These journals are recognized for their high scientific quality and methodological relevance, contributing to our understanding of various aspects of oral and craniofacial sciences, dental malocclusions, dental development, and aesthetics in dentistry. They strive to publish work of significant scientific importance to society.

Analysis of the Top-Cited Publications and the Most Recent Publications

Among the top-cited publications, a classic literature review by Lunt and Law [5] was mentioned. This review proposed a revision of a table that had remained unchanged since 1939, originally established by Lysell et al. [25,26] in their studies from 1962 and 1964. These revisions highlighted statistically significant differences in the eruption of maxillary teeth and suggested the possibility of true variations among population groups. In contrast, among the most recent publications, none of them had reviewed the literature on the chronology and sequence of current tooth eruption [27-29]. Instead, these recent articles explored various factors that could influence tooth eruption, utilizing different methodologies. These factors included dental anomalies related to syndromes [30-32], genetics related to eruption timing [24], and the association of tooth eruption with nutritional status [23-38].

Regarding dental anomalies related to syndromes, recent studies investigated cleidocranial dysplasia and its combination with patients with cleft lip/cleft lip and palate, as this syndrome often affects tooth eruption due to the presence of numerous supernumerary teeth [30,39]. Another focus of recent research on tooth eruption centered on systemic manifestations and enamel defects in children with congenital Zika Virus Syndrome. A scope review conducted in northeastern Brazil revealed that children infected with the Zika Virus experienced delays in tooth eruption, ranging from 17.8% to 60.7% [30,32,34]. These studies shed light on the impact of various conditions and factors on tooth eruption, expanding our understanding of this critical developmental process.

The association of genetic polymorphisms with changes in the timing of tooth eruption has emerged as a recent and significant topic [24]. Madalena et al. [24] conducted a study investigating the association of late-onset eruption with nucleotide polymorphisms of estrogen receptors. This genetic aspect is increasingly expected to influence the timing of tooth eruption, whether it occurs later or earlier.

Dental abnormalities have long been a classic theme related to tooth eruption. Recent publications, such as Nagayama et al. [40], reported cases in which patients with dental ankylosis of deciduous teeth experienced delays in the timing of tooth eruption according to the eruption sequence. Additionally, recent studies have explored associations between tooth eruption and various factors, including socioeconomic status, traumatic events, and conditions like overweight/obesity and low birth weight [30,32-35].

Regarding the association of tooth eruption with nutritional status, Garn et al. [36] suggested in 1965 that nutritional, maturational, and genetic factors could influence dental development. Their study confirmed that overweight and obese children undergoing sexual maturation and steroid-mediated development tend to experience milder dental evolution. The United States ranks first in the prevalence of overweight and obese children in the general population, and this condition has been found to alter the sequence of tooth eruption [37]. Current findings support past research, indicating that obese and overweight children are more likely to experience earlier eruption of permanent teeth compared to children with normal weight [35,36,38]. This highlights the complex interplay of genetic, nutritional, and developmental factors in tooth eruption.

This bibliometric analysis has greatly benefited from computerized data processing, and which has become increasingly common in recent years, as supported by some papers [42,43]. The utilization of computerized data processing enhances the efficiency and accuracy of bibliometric analyses. Added to it, the Scopus database was selected for this study because it covers more titles and research papers than other popular biomedical databases. Scopus database is the largest database of peer-reviewed abstracts and citations of literature, with bibliometric tools to track, analyze and visualize the years there has been a large increase in the number of publications. The use of only one database research. Scopus contains more than 22,000 titles from

more than 5,000 publishers worldwide, covering the fields of science, technology, medicine, social sciences and arts and humanities [41]. In addition, bibliometric analysis does not only rely on computerization in its processing but must enter certain volumes of data sequentially to be statistically reliable [17].

This paper provides valuable insights into global trends in tooth eruption in deciduous and permanent dentition among children and adolescents. It offers a straightforward presentation of countries, researchers, themes, and representative articles in this field. Furthermore, it offers the potential to predict and highlight future perspectives in this significant area of study. However, it's important to acknowledge certain limitations of this research. These include the inclusion of older studies, the absence of an evaluation of the quality of the included studies, and a limited basis for promoting the theme in the most cited articles. he strength of this bibliometric analysis lies in its utilization of computerized data processing, which has become increasingly prevalent in recent years. Additionally, there has been a significant increase in the number of publications in this field. The use of a single database for conducting the bibliometric analysis is supported by relevant papers in the field [42,43]. Overall, this study provides a valuable overview of the current state of research on tooth eruption and offers insights into its past and potential future directions.

In the context provided, there are several future directions that can be speculated in the field of tooth eruption research. These potential areas of study may include: i) Pathophysiology of Chronology and Sequence: Future research may delve deeper into the pathophysiology of the chronology and sequence of tooth eruption, aiming to uncover the underlying mechanisms and factors that influence this process; ii) Repercussions on Malocclusion: Understanding how tooth eruption affects malocclusion and the development of orthodontic issues could be a key focus. This research could help orthodontists and pediatric dentists develop more effective treatment plans. iii) Association with Congenital Malformations and Pathology: Investigating the associations between tooth eruption and congenital malformations or dental pathologies could provide valuable insights into diagnosis and treatment.

Looking forward, the future scenario in tooth eruption research appears to be closely tied to investigations into the eruption of deciduous and permanent teeth, with a focus on themes such as genetics, tooth development, timing of eruption, and syndromic conditions. These areas of research will likely continue to evolve and contribute to our understanding of tooth eruption and its clinical implications.

Conclusion

Based on the quantitative analyses conducted in this study, the future scenario in tooth eruption research appears to be closely tied to investigations of both deciduous and permanent teeth, with an emphasis on themes such as genetics, tooth development, the timing of tooth eruption, and syndromic conditions. These areas of study are likely to gain prominence and continue to attract research interest in the coming years.

Tooth eruption is a subject of significant importance, given its implications for clinical practice and the well-being of patients. It plays a crucial role in helping pediatric dentists, orthodontists, and clinicians plan individualized treatments. This bibliometric analysis has highlighted that tooth eruption research is particularly active in the Americas, with the United States and Brazil leading in terms of publications and citations. American journals have also contributed significantly to this area of study. Furthermore, it's notable that many of the largest research centers in this field are located in Europe.

Furthermore, despite tooth eruption being a well-accepted topic in the fields of Pediatric Dentistry and Orthodontics, it's noteworthy that there is emerging interest in this subject within journals that focus on oral biology and oral pathologies. This suggests that researchers from a variety of disciplines are recognizing the

importance of tooth eruption in understanding oral health and related pathologies, which may lead to more interdisciplinary collaborations and a deeper exploration of this critical area of study.

Authors' Contributions

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LSA	https://orcid.org/0000-0002-2115-6958	Validation, Writing - Review and Editing, Visualization and Supervision.
LAAA	https://orcid.org/0000-0002-8432-0815	Conceptualization, Methodology, Formal Analysis, Resources, Writing - Review and Editing, Supervision, Project Administration and Funding Acquisition.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study (Supplementary Material) are openly available in Open Science Framework at https://osf.io/5zfsp/.

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