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ORIGINAL ARTICLE

Non-Instrumental Pulp Therapy for Deciduous Molars: A Global Bibliometric Analysis of Clinical Studies

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ABSTRACT

Objective: To evaluate the bibliometric characteristics of clinical studies about the non-instrumental technique with antibiotic paste. **Material and Methods:** The Web of Science database 'Core-Collection' was searched by two researchers. The following bibliometric parameters were examined: number of citations, authorship, institution, country, journal title and impact factor, study design, year of publication, and keywords. Scopus and Google Scholar databases were used to compare the number of article citations. The VoSviewer software was used to generate collaboration networks. **Results:** 452 articles were recovered with the search key, and 18 articles were included. The number of citations ranged from 0 to 80, and the number of authors ranged from 2 to 7. Japan had the highest number of citations (n=80). Clinical trials were the most common study design (n= 6). The journals that published the most articles were Pediatric Dentistry (22.2%), Journal of Clinical Pediatric Dentistry (16.6%), Contemporary Clinical Dentistry (11.2%), and International Journal of Pediatric Dentistry (11.2%). Most papers originated from Brazil, the United States of America, and India. **Conclusion:** The study showed increased publications with a clinical focus in the last decade on the LSTR/NIPT technique, with Brazil leading in the number of relevant publications. It also provided clinicians and researchers with articles on an alternative technique for pulp therapy in deciduous teeth with pulp necrosis.

Keywords: Pediatric Dentistry; Dental Pulp Necrosis; Bibliometrics; Tooth, Deciduous.

Introduction

The anatomical complexity of the root canal system and the microbiome diversity associated with some children's negative behavior are challenges for controlling endodontic infection in primary teeth [1]. The microorganisms present in the root canals of teeth with pulp necrosis are organized in a biofilm that matures in crossed layers surrounded by an extracellular polymeric matrix that forms a physical barrier, thus hindering the action of drugs and irrigating solutions [2,3].

Aiming to control endodontic infection in deciduous teeth with pulp necrosis, Cappiello [4] reported clinical success when he used a paste composed of chloramphenicol, tetracycline and zinc oxide and eugenol (CTZ paste) at the non-instrumented root canal entrances. Following the same criteria, a researcher from the Niigata School of Dentistry (Japan) used a paste composed of ciprofloxacin, metronidazole and minocycline manipulated with macrogol and propylene glycol (3MIX-MP paste) associated with non-instrumentation of root canals (Non-Instrumental Pulp Treatment - NIPT), which they called the LSTR technique (Lesion Sterilization and Tissue Repair) [5].

Using antibiotic pastes reduces the microbial load in the root canals of deciduous teeth with pulp necrosis, thus favoring the repair of periodontal tissues [6-9]. Compared to pulpectomy, the LSTR/NIPT technique has a lower cost, a shorter working time, and a low level of technical difficulty, facilitating its acceptance among children and enabling its execution by nonspecialist dentists [8,10,11].

Many authors have studied the LSTR/NIPT technique, and numerous scientific publications have examined it [11-14]. Therefore, it is important to analyze the bibliometric characteristics of published scientific articles to identify research trends and existing gaps in knowledge on this subject. Furthermore, these analyses enable the recognition of institutions, authors, and journals that publish information about the LSTR/NIPT technique [15-17].

Bibliometric analyses have been carried out in several areas of dentistry [18-20]; however, articles on the LSTR/NIPT technique have yet to be identified. Thus, the current study aimed to evaluate the bibliometric characteristics of published studies about the LSTR/NIPT technique.

Material and Methods

The Web of Science electronic database 'Core-Collection' (Wos-CC) was searched for this bibliometric study on February 27, 2023. There was no restriction on the year or language of publication.

Bibliographical research was carried out in the WoS-CC database using the following search strategies: TS=(3MIX OR "3MIX-MP" OR "3MIX paste" OR “antibacterial drugs” OR "triple antibiotic paste" OR "antibiotic paste" OR “CTZ paste" OR CTZ OR "non-instrumentation endodontic" OR “root canal therapy” OR “root canal filling materials” OR "pulpectomy" OR LSTR OR “LSTR therapy” OR "lesion sterilization and tissue repair") AND TS=(child OR children OR child, preschool OR “preschool child*” OR infant* OR toddler* OR preschool* OR childhood OR pediatric* OR pedodontic* OR deciduous OR “deciduous dentition” OR dentition, primary OR “primary dentition” OR “primary tooth” OR “primary teeth” OR tooth, milk OR tooth, primary OR tooth, deciduous OR tooth, baby OR teeth, baby).

The inclusion criteria were articles with the following study designs: randomized clinical trials (RCT), nonrandomized clinical trials (NRCT), systematic review (SR) with or without meta-analysis, literature review, series, and case report. Laboratory studies, letters to the editor, editorials, and conference abstracts were excluded.

Two researchers (RVSC and CBO) selected the articles. They screened the titles and abstracts. Then, the selected articles were cross-checked, and in cases of doubt, the articles were read and evaluated in full by the

two researchers. In cases of disagreement, a third researcher was consulted (LFADM). The bibliometric parameters analyzed herein were the number and density of citations, authorship, affiliation institution (corresponding authors), country where the study was carried out, journal title and impact factor, study design, year of publication, and keywords.

The list of articles was organized in the Excel® program (Office Professional Plus, version 2016; Microsoft) in descending order according to the number of citations. Subsequently, Scopus and Google Scholar databases were used to compare the number of article citations. Bibliometric data that were not imported through WoS-CC were manually included as several authors, several citations from Scopus (https://www.scopus.com) and Google Scholar (https://scholar.google.com.br), citation density, country of the corresponding author, journal impact factor (IF), and study design. To evaluate a study's relevance over time, citation density is calculated as the ratio of the number of citations to the years since its publication. The Journal Citation Reports (JCR) [20] for the year 2022 were used to identify the IF of each journal.

Visualization of Similarities® software (VoSviewer for Windows, version 1.6.18; Center for Science and Technology Studies, Leiden University, Leiden, The Netherlands) was used to generate collaboration networks, cluster visualization maps, and collaborative density, which facilitates the visualization and understanding of term relationships between keywords and data exported from the WoS-CC database.

Results

Of the 452 scientific articles analyzed, 18 met the eligibility criteria [5,8,10,11,21-34]. The general information of the articles is described in Table 1. The citations ranged from 0 to 80 in the WoS-CC database, 0 to 116 in Scopus, and 1 to 336 in Google Scholar.

Table 1. Analysis of the 18 articles published in the WoS-CC database on LSTR/NIPT.

Author	No. of WoS-CC Citations (Density of Citations)	Study Design	Corresponding Author's Country
Takushige et al. [5]	80 (4,21)	NRCT	Japan
Duarte et al. [8]	5 (1,66)	SRMA	Brazil
Oliveira et al. [10]	2 (1,00)	RCT	Brazil
Moura et al. [11]	0 (0,00)	RCT	Brazil
Nakornchai et al. [21]	50 (3,84)	NRCT	Thailand
Trairatvorakul et al. [22]	25 (2,27)	NRCT	Thailand
Jaya et al. [23]	13 (1,18)	NRCT	India
Coll et al. [24]	12 (4,00)	SRMA	USA
Sijini et al. [25]	1 (0,50)	RCT	Saudi Arabia
Chouchene et al. [26]	0 (0,00)	SRMA	Tunisia
Garrocho-Rangel et al. [27]	0 (0,00)	Scope Review	Mexico
Moura et al. [28]	7 (1,00)	Case Series	Brazil
Burrus et al. [29]	9 (1,00)	Literature review	USA
Raslan et al. [30]	9 (1,50)	NRCT	Syria
Chakraborty et al. [31]	0 (0,00)	Case Report	India
Arangannal et al. [32]	0 (0,00)	NRCT	India
Parakh et al. [33]	3 (0,75)	NRCT	Arab Emirates
Coll et al. [34]	11 (3,66)	SRMA	USA

RCT: Randomized Clinical Trial; NRCT: Non Randomized Clinical Trial; SRMA: Systematic Review and Meta-analysis.

The number of authors per article ranged from 2 to 7, averaging 4.72. Regarding the study design, NRCTs were predominant (n=6; 33.4%), followed by RCTs (n=4; 17.6%) and SRs (n=4; 17.6%). The other study designs included one instance: literature review, scoping review, case report, and case series (n=1; 5.5%).

Ten countries contributed to the publication of the 18 included articles (Figure 1). The countries that published the most articles were Brazil (4 articles; 14 citations), the United States of America (USA) (3 articles; 32 citations) and India (3 articles; 13 citations). Among the 12 institutions, the University System of Maryland (USA) (2 articles; 23 citations) and the Federal University of Piauí (Brazil) (2 articles; 9 citations) were the ones that collaborated the most, and the other institutions presented one article each. Three corresponding authors were not affiliated with educational or research institutions.

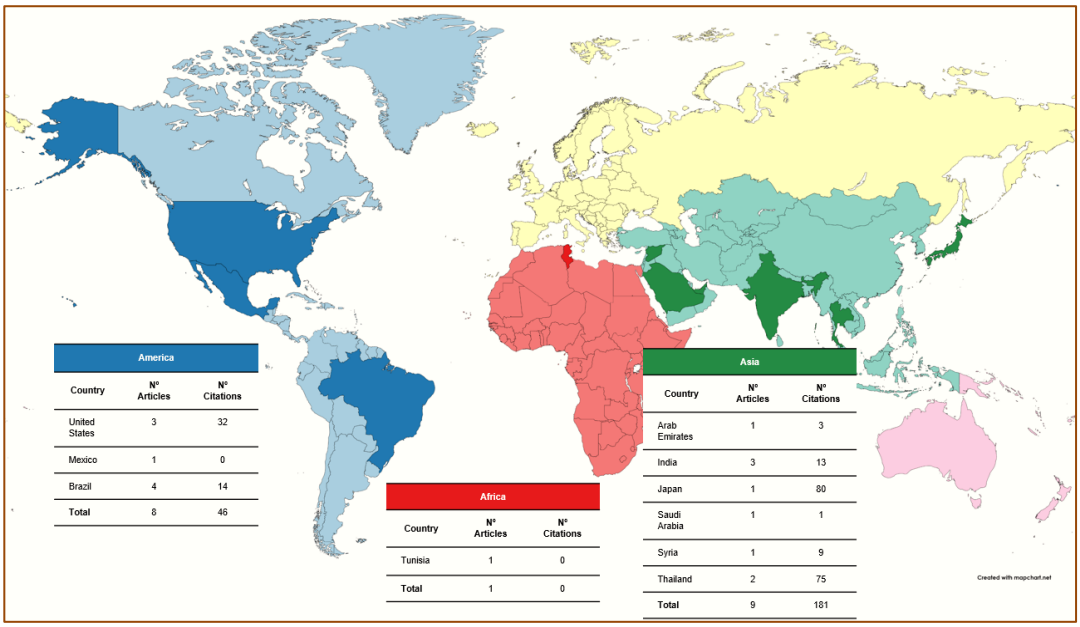

Figure 1. Countries that published about the LSTR/NIPT technique.

The list of journals, journal impact factor, and number of citations in the WoS-CC, Scopus, and Google Scholar databases are described in Table 2.

Table 2. Journals published about the LSTR/NIPT technique from 2004 to 2021.

Journal	Impact Factor (2022)	No. of Publications	Year of Publications	Citations		
				WoS	Scopus	Google Scholar
International Endodontic Journal	5,165	01	2004	80	116	336
Clinical Oral Investigations	3,607	01	2020	05	05	18
International Journal of Paediatric Dentistry	3,264	02	2021	50	63	169
International Journal of Paediatric Dentistry	3,264		2012	25	30	94
Brazilian Oral Research	2,674	01	2021	02	03	04
Pediatric Dentistry	2,378	04	2014	09	14	34
Pediatric Dentistry	2,378		2020	12	13	28
Pediatric Dentistry	2,378		2020	11	11	30
Pediatric Dentistry	2,378		2021	01	04	06
European Journal of Paediatric Dentistry	2,327	01	2017	09	07	23
Journal of Clinical Pediatric Dentistry	1,338	03	2012	13	15	3
Journal of Clinical Pediatric Dentistry	1,338		2016	07	07	30
Journal of Clinical Pediatric Dentistry	1,338		2021	00	00	02
Contemporary Clinical Dentistry	*	02	2018	00	01	06
Contemporary Clinical Dentistry	*		2019	00	01	02
Chinese Journal of Dental Research	*	01	2019	03	00	04
Clinical and Experimental Dental Research	*	01	2021	01	01	03
International Journal of Dentistry	*	01	2021	00	00	03

*No Impact Factor.

Approximately 95 keywords were identified, with metronidazole (n=7) being the most cited, followed by "ciprofloxacin" and "primary teeth" (n=6) and "pulpectomy" and "endodontic treatment" (n=5) (Figure 2).

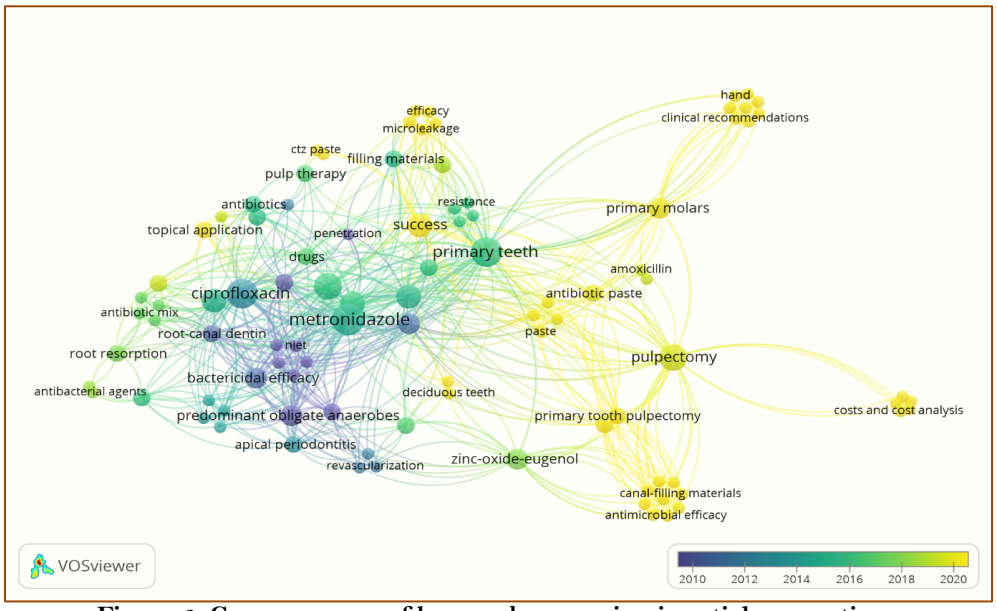

Figure 2. Co-occurrence of keywords appearing in articles over time.

Discussion

To the best of our knowledge, this is the first bibliometric study to evaluate articles about the LSTR/NIPT technique for deciduous teeth. The first article using the term LSTR was the most cited article examined herein, and the acronym was used as a reference to the association of non-instrumentation of root canals in deciduous teeth with antibiotic paste [5]. Between 2010 and 2012, three articles were published that together totaled 85 citations [21-23]. Since 2014, articles on the LSTR/NIPT technique have been published more frequently [8,11,24-34].

The absolute number of citations for a scientific article is a quantitative bibliometric parameter; however, it depends on the databases, the perspective of understanding, and the authors' preferences. Therefore, this parameter is somewhat biased and subjective [35]. The high number of citations of an article is important because it reflects its influence; however, it is also influenced by the time at which the article was published [35], thus leading to temporal bias [10,25-27,31,32,35], which was observed in the present study, in which articles that have been published for a long time accumulate a more significant number of citations (Table 2). To minimize the influence of the year of publication on the frequency of citations, citation density is a safer parameter that corresponds to the ratio between the number of citations and the number of years since publication [35]. Furthermore, critics can cite articles that weaken this bibliometric parameter.

The number of citations in Google Scholar was higher than in other databases, perhaps because it publishes "gray literature," which is non-peer-reviewed and open-access [36]. The Scopus database is more comprehensive with regard to the number of journals, but it only retrieves articles published since 1996, while the WoS-CC retrieves high-quality articles published since 1945 [36].

Although there has been an increase in the number of publications about the LSTR/NIPT technique in the past decade, most of the articles were published in journals outside the area of pediatric dentistry [5,25,26,31-33], perhaps due to the possibility of being performed by nonspecialist clinicians. Nevertheless, articles published in journals with a high IF are expected to be cited as they attract more attention from researchers.

In a previous bibliometric analysis [37], the authors evaluated the 100 most cited articles about pulp therapy in deciduous teeth, which included the three highest-cited articles in the present study [5,21,22], corresponding to the seventh, forty, and eighty-second positions. We consider these three articles on the LSTR/NIPT technique relevant, performed on primary teeth with and without pulp vitality. However, they indicated the technique only for teeth with irreversible pulpitis or pulp necrosis. The World Health Organization decreed the COVID-19 pandemic in March 2020, and the peak of the health crisis lasted until mid-2021 [38]. This unexpected situation had effects on the types of study designs that were used. However, during that period, three RCTs on the LSTR/NIPT technique were published [10,11,25].

Brazil had the most published articles with a clinical focus on the LSTR/NIPT technique. This country also showed an annual increase in publications [8,10,11,28], which aligns with studies in other areas of pediatric dentistry [17,37,39]. Asia was the continent with the highest number of publications and citations [5,21-23,25,30-32].

Four systematic reviews were included in this study. One systematic review and meta-analysis was published in 2020 and used radiographic criteria to determine that pulpectomy with ZOE and Vitapex pastes was more favorable than the LSTR/NIPT technique using 3MIX paste; however, the meta-analysis showed no difference between the two treatments [8]. A systematic review and meta-analysis by Coll et al. [24] evaluated the overall success of treating teeth with pulp necrosis. One of the study's conclusions indicated that the LSTR/NIPT technique is indicated for nonvital deciduous teeth with root resorption whose permanence in the dental arch is equal to or less than twelve months [24].

The third systematic review and meta-analysis [34] established a recommendation guide for pulpal therapy in deciduous teeth. The authors concluded that for teeth without root resorption, the success of the LSTR/NIPT technique was lower than that of pulpectomy. Although the meta-analysis favored pulpectomy, the difference was not significant. The fourth systematic review and meta-analysis compared the effectiveness of antibiotic pastes in the LSTR/NIPT technique in primary teeth [26]. The article concluded that the technique is effective for teeth with advanced root resorption and when conventional endodontic treatment is contraindicated, regardless of the antibiotic paste used.

Keywords are important instruments used in scientific research because they allow the retrieval of sentences or phrases that can locate articles of interest to research [40]. In the present study, 95 keywords were included. In Figure 2, the keywords are arranged such that the size of the circles represents the frequency of citations of each keyword, the lines that interconnect the terms refer to the strength of correlation between the terms, the lines between the conglomerates indicate a relationship and thicker lines indicate a stronger relationship between the Keywords [17,37]. Metronidazole was the most common keyword (7.34%), as it was used in seven articles and is part of the 3MIX paste, which is currently the most cited in the LSTR/NIPT technique [5,21,29,30,32,33].

The present study had two self-citations – a case series [28] and an RCT [11]. They were still included herein because the authors researched and published a study about the LSTR/NIPT technique, and the articles are listed in the WOS-CC database. The inclusion of the two articles showed no change in the citation order, considering that the first article received seven citations in the WOS-CC, and the RCT received no citations. These facts did not change the citation order in Table 1.

This bibliographic analysis is also important to draw the attention of journal editors to learn about the LSTR/NIPT technique and the impact that published articles can have on health policies. Furthermore, when a study is published, it becomes more accessible to the dental community, attracting readers' attention and

clarifying doubts about the LSTR/NIPT technique. Knowledge about the technique can influence new research or stimulate changes in clinical practice. However, it is essential to carry out innovative studies on simplified pulp therapy techniques in primary teeth that can positively impact the quality of life of individuals. There needs to be more standardization in the literature about the terminology of the technique of non-instrumentation of root canals and the use of pastes containing antibiotics. In the present study, the acronym LSTR/NIPT was adopted to clarify the association of non-instrumentation with antibiotic pastes.

Conclusion

This bibliometric analysis presented information on the total number of clinical articles published on the LSTR/NIPT technique. An increase in the number of publications with a clinical focus was observed in the last decade. Brazil was the country that contributed the most significant number of articles, and Pediatric Dentistry was the leading journal in publications on the topic. The study provided bibliometric information on the state-of-the-art concerning the LSTR/NIPT technique. Studies with a clinical approach to the LSTR/NIPT technique have increased in the past decade, with Brazil being the country with the leading number of relevant publications.

Authors' Contributions

RVSC	https://orcid.org/0000-0003-2665-3176	Conceptualization, Methodology, Formal Analysis, Investigation, Resources and Writing - Original Draft.
MDML	https://orcid.org/0000-0002-7641-6331	Methodology, Formal Analysis, and Writing - Review and Editing.
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LFADM	https://orcid.org/0000-0002-4112-1533	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing, Supervision and Project Administration.

All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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