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Original Article

Bibliometric Analysis of the 100 Most Cited Articles in the Field of Endodontic Retreatment

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ABSTRACT

Objective: Conservative retreatment of failed endodontic cases plays a significant role in endodontic practice. Bibliometric analysis is an analysis method used to examine the quantitative and qualitative characteristics of published scientific articles. The number of citations a scientific article receives serves as a key indicator of its impact within a given field. The aim of this study is to identify the 100 most cited articles on non-surgical endodontic retreatment and to provide a general perspective on the subject by analyzing their basic features.

Materials and Methods: A search was conducted in the Web of Science (WoS) database in September 2024 to identify relevant publications. For the most frequently cited articles, various parameters were systematically documented and examined: journal title, the names of authors, institutional affiliations, nation of origin, year of publication, citation frequency, collaborations, and key terms. Biblioshiny application along with VOSviewer software (version 1.6.20; Leiden University Center for Science and Technology Studies, Leiden, Netherlands) was used for the analysis and visual depiction of the results.

Results: Among the top 100 most-cited articles, the highest citation count for a single article was 884. The 100 articles included in the analysis were published in seven different journals, with the journal with the largest share (57%) being the *Journal of Endodontics*. The largest proportion of articles was published in 2008 (n=10). The most frequently occurring first authors were José F. Siqueira Jr., Isabela N. Rôças, and Sbimon Friedman. The term 'endodontic retreatment' was the most frequently used keyword.

Conclusion: This study highlights the research trends in the field of non-surgical endodontic retreatment and emphasizes that this topic is one of the fundamental issues in endodontics.

Keywords: Bibliometric analysis, endodontic research, non-surgical retreatment, retreatment

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INTRODUCTION

Endodontic retreatment involves the removal of existing root canal filling materials, followed by thorough cleaning, reshaping, and refilling (obturating) of the root canals [1]. Retreatment of a tooth that has previously undergone root canal therapy is indicated in cases of persistent or secondary endodontic infections, typically characterized by post-treatment apical periodontitis [2]. Post-treatment apical periodontitis is fundamentally a microbiological issue, as infection is present in all cases associated with this condition, even in teeth that seem to have radiographically adequate root canal treatments [3]. Because of the anatomic complexity of root canal systems, pathogenic microbial communities form complex and resilient structures, limitations of chemomechanical shaping and obturation

methods, and leakage of permanent restorations, complete elimination of bacteria from the root canal systems cannot always be achievable [4].

Retreatment is an acceptable treatment option if the cause of failure in the primary root canal treatment can be identified; however, this is not always possible in every case [5]. Retreatment should be considered for teeth in which technical management is feasible, periodontal support is sufficient, and the tooth can be restored to its proper function. Alternative options to retreatment following an unsuccessful initial root canal treatment include apical surgery, intentional replantation, transplantation, tooth extraction with replacement via an implant, extraction with replacement using a fixed dental prosthesis, or extraction without replacement [6]. A study evaluating the outcomes of orthograde retreatment reported a success rate of 81% [7]. This rate also varies between 71% and 77% across different follow-up periods [8].

A substantial body of literature has been published on root canal retreatment, detailing various protocols and methods that have been tried and implemented to establish best applications for this procedure [9,10]. It is essential to analyze these studies and assess their impacts on research and development in the field of root canal retreatment. This evaluation can be made through bibliometric analysis. Bibliometric analysis is a widely used method for evaluating research developments, publication trends, and their scholarly impact on a particular topic or field over time [11]. Citation analysis assesses the impact of research publications by evaluating citation data.

Bibliometric analyses have been conducted on diverse topics in endodontics [12-14]. As the number of publications in the literature increases, bibliometric analyses in specific areas become necessary to guide future research [15]. Endodontic retreatment is a crucial and evolving area within endodontics. To our knowledge, however, a comprehensive bibliometric analysis of the most cited articles in the field of endodontic retreatment has not yet been conducted. The aim of this bibliometric analysis is to identify the most cited articles in the field of non-surgical retreatment and to address this gap in the literature by highlighting the relative importance of journals, authors, countries, and institutions.

MATERIALS AND METHODS

Since this study uses bibliometric data from publications available in a specific database, approval from an ethics committee is not required. In September 2024, an advanced search was conducted using Thomson Reuters Web of Science to identify published articles on endodontic retreatment. The investigation encompassed English-language articles from journals classified within the "Dentistry, Oral Surgery and Medicine" domain. The published articles were detected using the words "Orthograde retreatment" OR "Nonsurgical retreatment" OR "Root canal retreatment" OR "Endodontic retreatment" OR "Secondary root canal treatment" and their combinations. Two researchers independently assessed each article to determine its eligibility for inclusion in the list of the top 100 most cited articles. In instances where consensus was unattainable, a tertiary expert adjudicated the contention pertaining to the incorporation or omission of the article. The top 100 most-cited articles were meticulously chosen, and the subsequent parameters were systematically aggregated within a database: article title, first author's name, institute and country of origin (based on the first author's affiliation), number of authors, journal name and impact factor, year of publication, number of citations and keywords.

The articles are listed in descending order based on their citation counts. In cases where multiple articles had the same number of citations, the more recently published article was ranked higher. If the first author had more than one affiliation, only the primary affiliation was recorded. Publications that did not primarily focus on endodontic retreatment were excluded from the analysis. In our study, datasets were obtained from this database in 'Tab delimited file' and 'BibTeX' formats. Data analyses were conducted using Biblioshiny, a web-based interface of Bibliometrix, designed for comprehensive science mapping and quantitative research in bibliometrics [16]. Bibliometric mapping was performed using the VOSviewer software (version 1.6.20; Leiden University Center for Science and Technology Studies, Leiden, Netherlands).

RESULTS

The most cited article among those included in the research was cited 884 times (Fig. 1). A total of 26 articles with 100 or more citations were identified. In the citation analysis, when documents were chosen as the unit of analysis, the 1998 article by Sundqvist et al. [17] had the highest number of citations. This is followed by the articles of Siqueira et al. [18] and Hancock et al. [19] (Fig. 2).

Journals and Year of Publication

The 100 articles included in the research on non-surgical endodontic retreatment were published in 8 different journals. The *Journal of Endodontics* had the largest contribution of articles at 57%, with the *International Endodontic Journal* at 27% and the *Journal of Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontology* at 10%. The three mentioned journals represented 94% of the most-cited scientific articles related to endodontic retreatment. Most articles on this subject were published in 2008 (n=10) (Fig. 3).

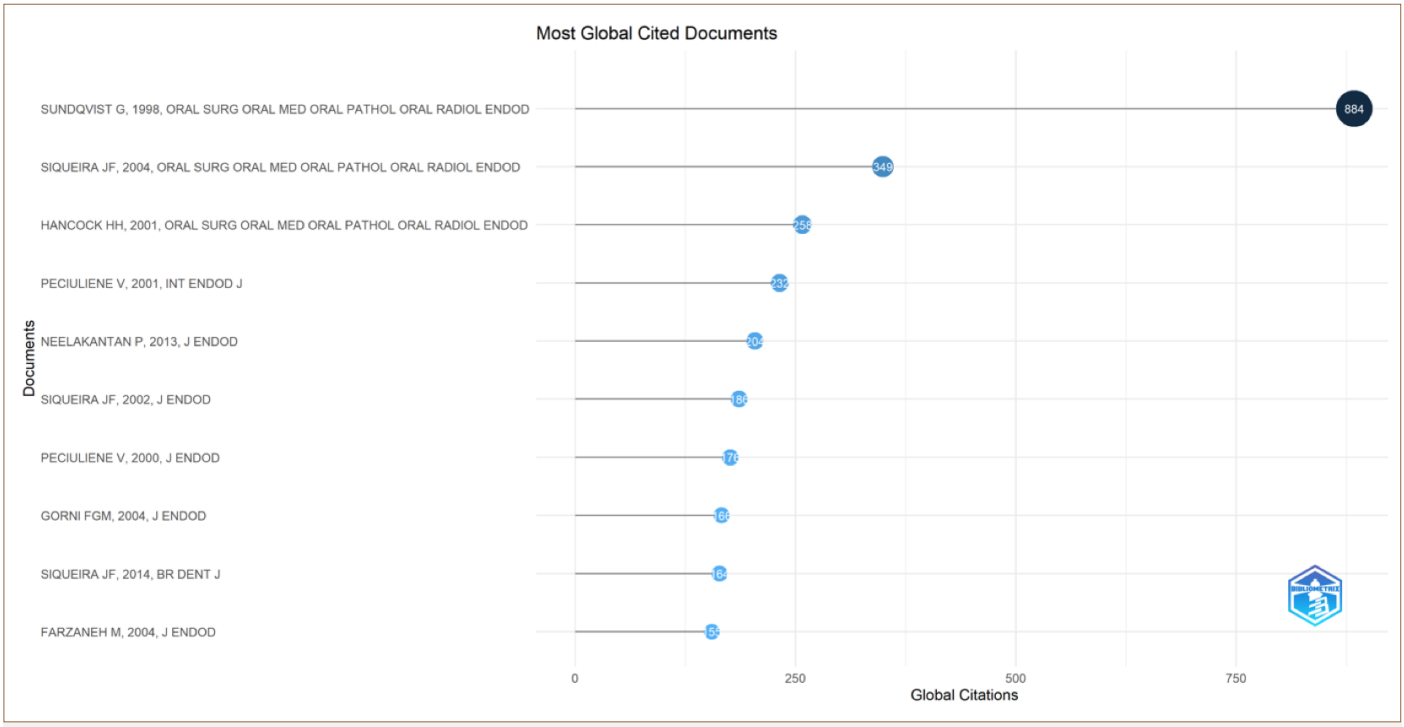

Figure 1. Most global cited documents in non-surgical endodontic retreatment.

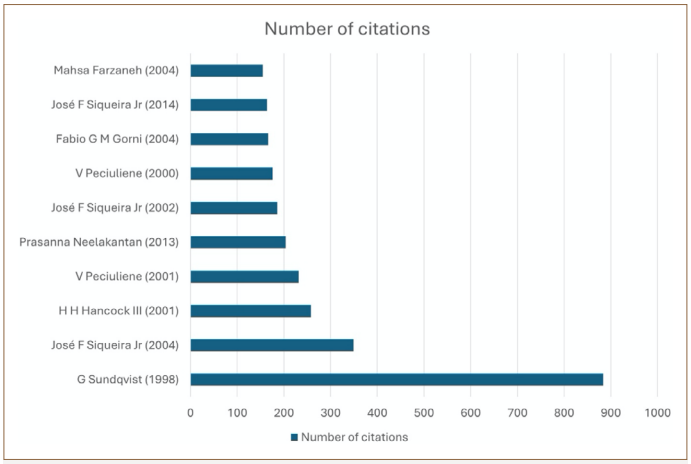

Figure 2. Number of citations for the top 10 most-cited authors.

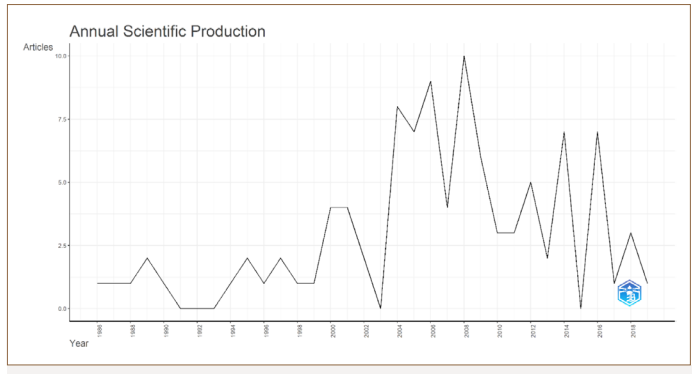

Figure 3. Annual scientific production in the field of non-surgical endodontic retreatment.

Authors

In total, 325 people were included as authors in the most cited articles. The author with the most articles was José F. Siqueira Jr., with 13 articles, followed by Sbimon Friedman and Isabela N. Rôças (Fig. 4). The author with the highest number of citations is José F. Siqueira Jr., who has been cited 1511 times. Further analysis of the top-cited authors revealed that they contributed to other research articles. A collaboration network was established for coauthors who participated in four or more articles from the list of articles (Fig. 5). The size of each node in the figure represents the number of articles published by each author, while the connecting lines indicate the power of collaborations among the authors.

Institute and Country of Origin

The 100 articles reviewed originate from 26 different countries. In this context, the research institution and country of origin were determined based on the first author's affiliation. Most of the publications originated from Brazil (n=31), followed by the USA (n=19) and Germany (n=15) (Fig. 6). The institutions

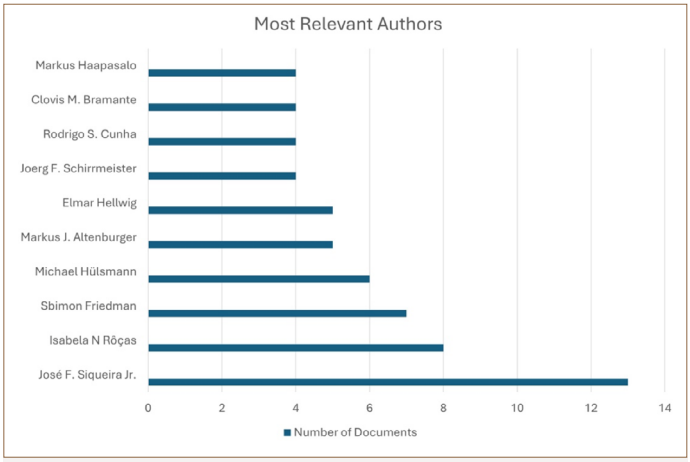

Figure 4. Authors who published the most articles in the field of non-surgical endodontic retreatment.

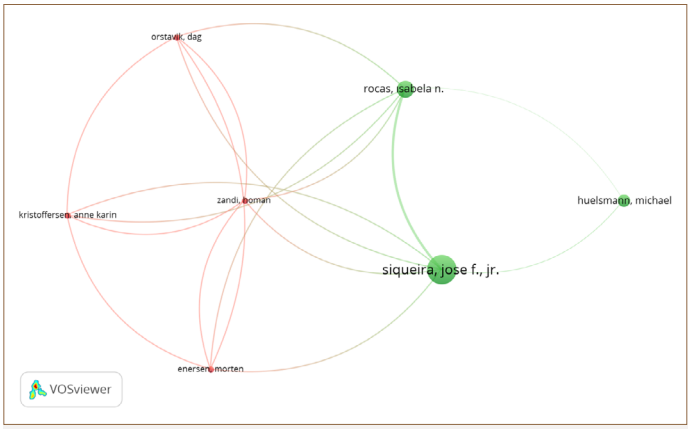

Figure 5. Coauthorship network visualization map based on VOSviewer (min. number of documents of an author: 4). The size of the nodes indicates the large number of normalized citations. The thickness of the line represents the strength of cooperation between authors.

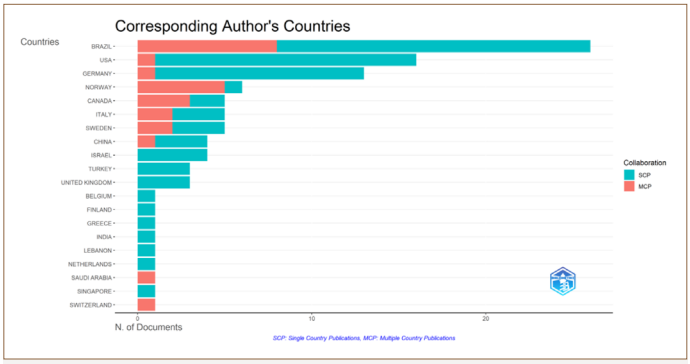

Figure 6. Corresponding author countries of top 100 cited articles.

that produced the 100 most cited articles are shown in Figure 7. The University of Oslo, Oslo, Norway, produced the highest number of publications (n=19), followed by the University of Freiburg, Baden-Württemberg, Germany (n=14).

Key Words

A cumulative total of 180 author keywords were extracted from the 100 most-cited scholarly articles. The ten most prevalent keywords, along with the corresponding network map illustrating their presence in the selected articles, are presented in Figure 8.

DISCUSSION

This study aimed to analyze and evaluate the 100 most cited articles on 'non-surgical endodontic retreatment' within the field of endodontics. In this context, the first 100 most cited articles were published between 1986 and 2019. According to this electronic literature review, the number of articles on 'endodontic retreatment' in dentistry and endodontics fluctuates over time, while the number of citations continues to increase. The research found that 2008 was the year with the highest number of published articles. It is also observed that the research focus of articles in this field has gradually shifted towards root canal irrigants over time [20,21].

In this study, articles published in English and indexed in SCI-Expanded journals within the WoS database were analyzed. In the literature, the WoS database is most frequently used in citation-based bibliometric analyses [22,23]. This choice was influenced by the fact that Web of Science provides access to a larger number of articles in the health sciences compared to similar databases. However, a study has indicated that the number of citations may vary across different databases and that Google Scholar may lack technical precision, as it also includes graduate theses and conference papers [24,25]. The index in which a journal is scanned and impact factor are important parameters that provide information about the quality of the journal [26]. For this reason, our study analyzed publications from high-impact SCI-Expanded journals. This may have led to the omission of highly cited publications that were not included in this index. Similarly, this study analyzed publications in English, the predominant language in the literature, which may have led to the omission of highly cited articles published in other languages. This represents the limitations of our study.

Highly productive journals publish a significant proportion of articles in a particular field and are subsequently widely cited by newly published studies [27]. According to the results of this study, the Journal of Endodontics and the International Endodontic Journal made the highest contribution to the topic of retreatment. These two journals also have the

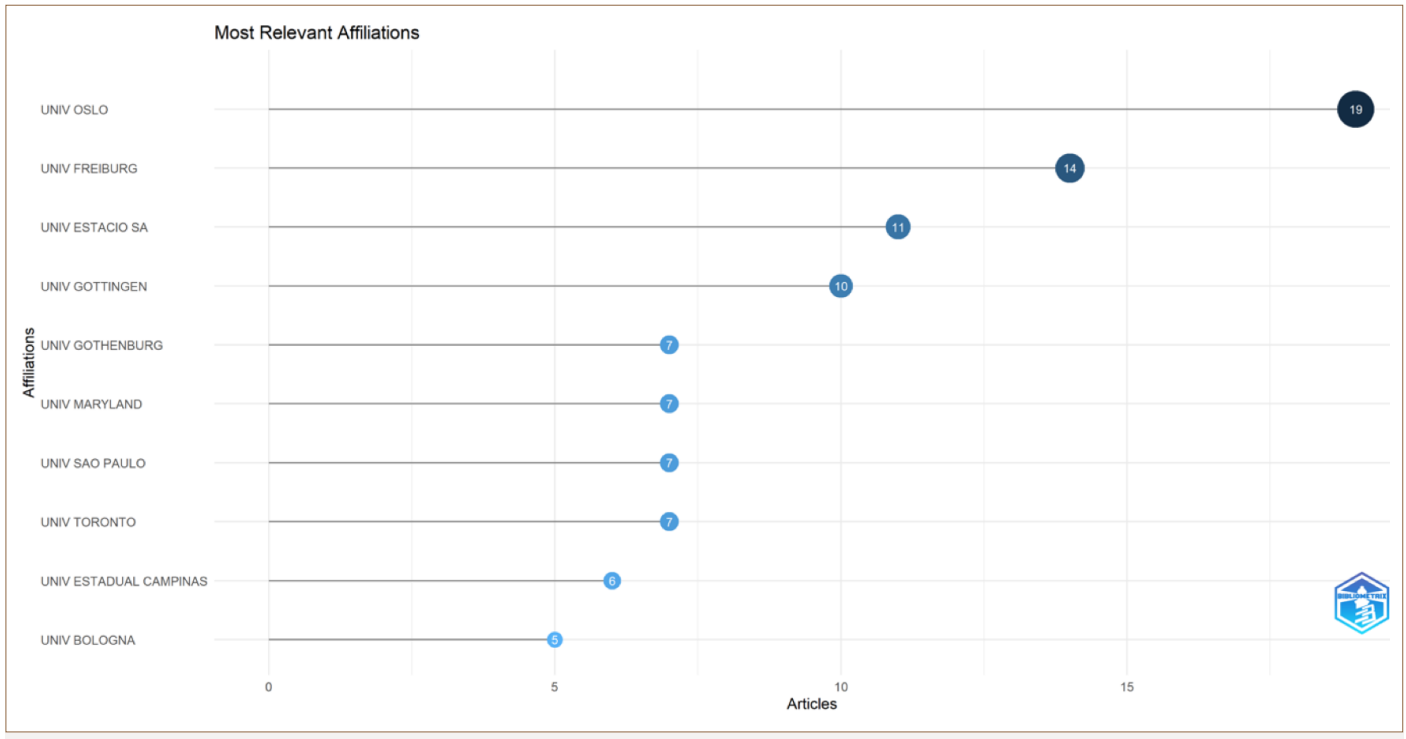

Figure 7. Most prolific affiliations by the number of retreatment publications.

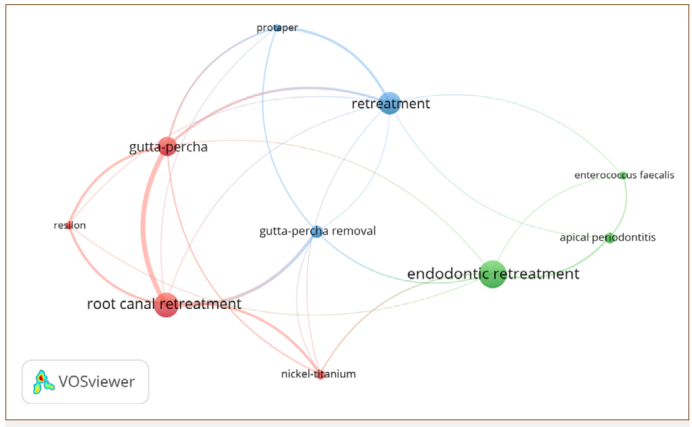

Figure 8. Co-occurrence network of keywords in the endodontic retreatment literature. Larger nodes represent a larger number of co-occurrence linkages with other terms in the overall network. The thickness of the line represents the strength of co-occurrence between author keywords.

highest impact factors in the field of endodontics. The aforementioned journals have played a more prominent role than others in publishing research on retreatment. Bradford's law states that influential journals in a given field have a high proportion of articles related to that field [28]. Therefore, articles published in these high-impact journals are more likely to be cited. For this reason, these two journals can be considered the most important in the field of endodontic retreatment, as they have published the majority of the most cited articles in this area.

The number of citations is a time-dependent parameter; therefore, older publications are expected to accumulate more citations than newer ones [29]. The number of citations for a published study can increase by reaching a wider audience through open-access journals or journals offering optional open-access options. This can also be facilitated in a stable economic environment. Accordingly, our study observed that countries with lower socioeconomic status or limited research opportunities generally contributed less to published studies on non-surgical endodontic retreatment. When examining the three most cited articles in this study, it is observed that they focus on the following topics: the identification of microbial flora associated with unsuccessful endodontic treatments, the outcomes of non-surgical endodontic retreatment, and the distribution of bacteria in different populations that play a role in unsuccessful endodontic treatment. Given that the number of citations is a time-dependent factor, it appears that the topic of endodontic retreatment initially gained prominence through microbiological research [17,18].

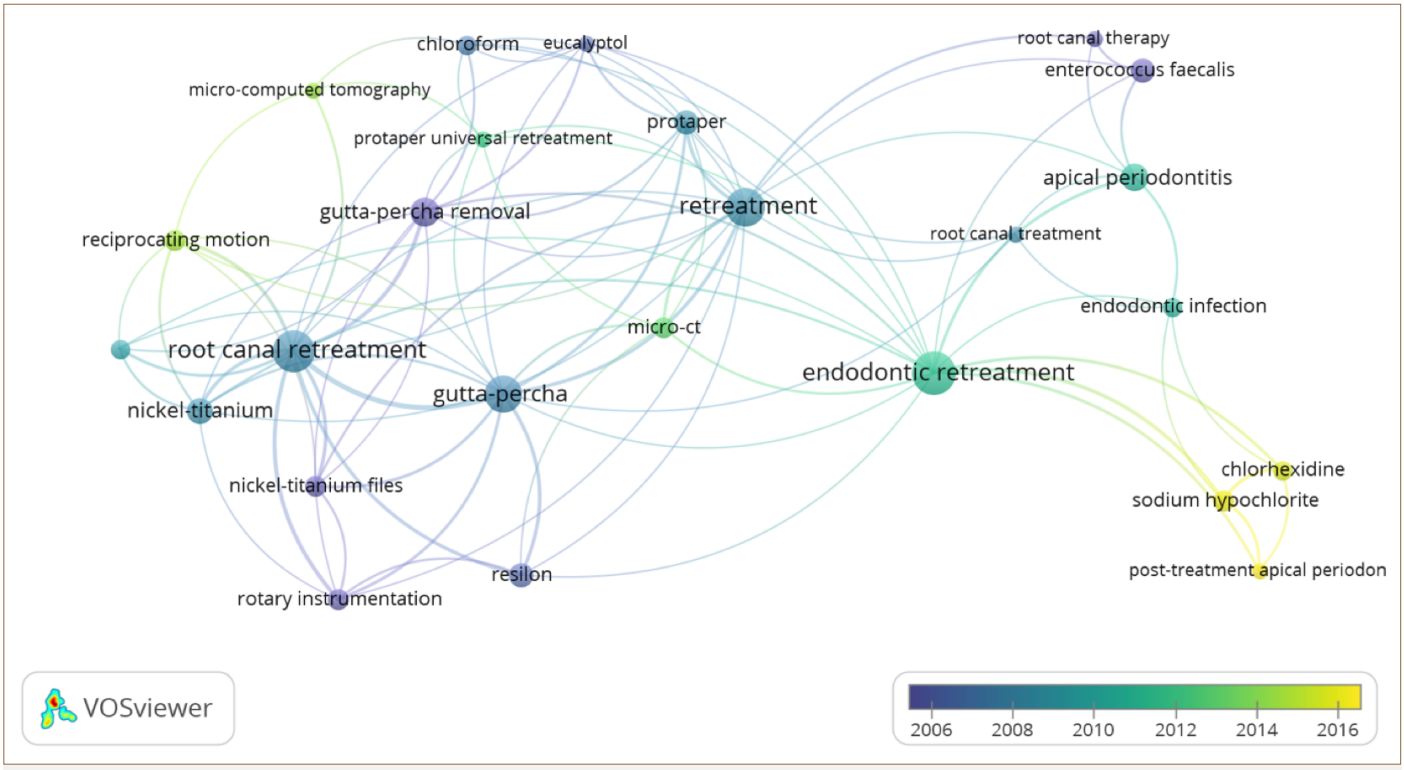

Figure 9. Keyword density network analysis.

An examination of the 'author keyword analysis' showed that 'gutta-percha' was the most frequently used root canal filling material. Another notable observation in the keyword analysis of the top 100 cited articles was the increasing importance of irrigation solutions over time in non-surgical endodontic retreatment, compared to methods aimed at removing root canal filling materials (Fig. 9). This can be attributed to the growing interest in developing antimicrobial protocols effective against apical periodontitis, a microbiological condition, in non-surgical endodontic retreatment, which serves as a conservative solution for unsuccessful endodontic treatments. One of the limitations of this study is the potential omission of articles that do not include the selected keywords and use different subject titles and keywords.

An examination of the citation analysis reveals that the most cited authors are José F. Siqueira Jr. (1511 citations) and Isabela N. Rôças (993 citations), respectively. An analysis of the corresponding authors' countries revealed that most publications originated from Brazil, followed by the USA and Germany. It can be concluded that the official language does not pose a barrier to publishing in the field of endodontics and that funding institutions in these countries provide adequate support for conducting research projects [30]. In addition, the most prolific author contributed 13 articles on this topic, while other researchers had similar publication numbers. This indicates that interest in the current topic is not limited to a specific group but is shared among various authors.

CONCLUSION

Bibliometric analysis studies in the field of endodontics are becoming increasingly prevalent in the literature. This study, which analyzed the 100 most cited articles in the field of endodontics, found that the majority focused on methods and instruments used for the removal of gutta-percha. The results of this study indicate that endodontic retreatment is a well-established and comprehensive topic that continues to attract the attention of researchers.

DECLARATIONS

Ethics Committee Approval: Not applicable.

Author Contributions: Concept – CF, OK; Design – CF, OK; Supervision – CF, OK; Resource – CF, OK; Materials – CF, OK; Data collection and/or processing – CF, OK; Analysis and/or interpretation – CF, OK; Literature review – CF, OK; Writing – CF, OK; Critical Review – CF, OK.

Conflict of Interest: The authors denied any conflicts of interest related to this study.

Use of AI for Writing Assistance: The authors declared that artificial intelligence-based technologies were not utilized in this study.

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