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Research Article

Bibliometric Analysis of Articles About the Use of MTA in Endodontics

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Abstract

Aim: The aim of this study was to perform a bibliometric and visualized analysis to identify and critically appraise articles on the use of Mineral Trioxide Aggregate (MTA) in endodontics.
Material and Method: A Web of Science (WoS) search was conducted on November 25, 2024, using the keywords 'root canal treatment' AND 'mineral trioxide aggregate' OR 'MTA' under the 'All Fields' option. Only articles of the 'Article' type were included in the study. The WoS category was limited to 'Dentistry Oral Surgery Medicine,' and the WoS index was filtered using 'Science Citation Index Expanded,' resulting in a total of 415 articles published between 1999 and 2024. The data of the studies were downloaded in 'BibTeX' format from WoS and analyzed using Biblioshiny software.
Results: It was found that 1398 authors contributed to the research in this field, 882 keywords were used, and 45 journal sources were referenced. A total of 415 articles were published with an annual growth rate of 14.09%. The majority of the articles were published in the Journal of Endodontics, with the United States being the leading country in terms of publication volume. The most frequently used keywords by authors in this field included 'mineral trioxide aggregate.'
Conclusion: The positive annual growth rate indicates an increasing interest in the field. The Journal of Endodontics holds a leading position in this domain. The United States ranks first in both publication and citation counts. This study expands the existing literature and offers new research topics to researchers, serving as an important reference for future studies related to MTA use in endodontics, especially in the national context.

Keywords: Bibliometrics, root canal treatment, mineral trioxide aggregate

INTRODUCTION

Mineral Trioxide Aggregate (MTA) was first introduced by Torabinejad in the 1990s and was approved by the U.S. Food and Drug Administration (FDA) for use in the United States in 1997 (1). MTA is a bioactive endodontic cement primarily composed of calcium and silica elements. To date, it has found applications in various treatments, including apexification, regenerative endodontics, perforation repair, vertical and horizontal root fractures, partial pulpotomy for Cvek pulpotomy, root canal treatment of deciduous teeth, and repair of resorptive defects (2). It is also used in the prophylactic partial pulpotomy treatment of dens invaginatus, as well as in sealing the affected junction areas of teeth with fusion and endodontic treatment needs (3). MTA, being a biocompatible material, has low cytotoxicity. When extruded beyond the apex, it causes minimal inflammation. The formation of an odontoblastic layer induces the creation of a dentin bridge. By activating cementoblasts, it promotes tissue regeneration. It also stimulates the release of cytokines from pulpal fibroblasts, which in turn stimulates hard tissue formation and supports the rapid growth of cells. Although MTA is considered an indispensable biomaterial in endodontic procedures, it has certain disadvantages, such as a long setting time and the potential for tooth discoloration (4-6).

In 1969, Alan Pritchard coined the term "bibliometrics", applying arithmetic and applied statistics to the study of journals and books for scientific measurement analysis (7,8). Bibliometric analysis is an evaluation and analysis method that provides data on a publication's field of study, author

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and institution information, country of publication, citation count, inter-publication connections, and collaborations (9). These data networks offer both a visual and a general perspective on the examined topic (10). This evaluation not only highlights the connections between countries, institutions, and publications, but also offers the opportunity to analyze the current developments on a specific topic in a temporal cross-sectional manner (11). Since the discovery of MTA, the number of studies on MTA has increased. A comprehensive review of the current literature suggests that an extensive bibliometric analysis of MTA has not yet been conducted.

The aim of this bibliometric analysis is to identify progress and current trends in MTA from 1999 to November 2024, assessing the importance of publication and citation counts, countries, institutions, authors, journals and keywords. This analysis will provide clinicians and researchers with a comprehensive overview of the research status of MTA in the field of dentistry.

MATERIAL AND METHOD

Data Collection

Since the data used in this research are studies obtained from the Web of Science (WoS) database, it does not require ethics committee approval. On November 25, 2024, a WoS search was conducted using the keywords 'root canal treatment' AND 'mineral trioxide aggregate' OR 'MTA' in the 'All Fields' option.

Inclusion and Exclusion Criteria

Only publications written in English and classified as 'Articles' were included in the study. Conference proceedings, book chapters, review articles, and publications in languages other than English were excluded. Research articles obtained from the WoS search, after applying the aforementioned exclusion criteria and further limiting by the WoS category 'Dentistry Oral Surgery Medicine' and the WoS index 'Science Citation Index Expanded', resulted in 415 articles published between 1999 and 2024.

Data Analysis

The data from the studies that met the inclusion criteria were downloaded from WoS in 'BibTeX' format with 'Full Record' selected and analyzed using the Biblioshiny software, a part of the Bibliometrix package, on the RStudio platform (v 4.3.2; https://posit.co/products/open-source/rstudio/), which can be installed for free. The data scanning and analysis were performed by two researchers (Ö.K. and M.G.) to ensure the accuracy and reliability of the analysis. The analysis included parameters such as the number of articles, the number of authors, publishing journals, year of publication, citation number, author-country relationships, and keywords used.

RESULTS

A bibliometric analysis was conducted on articles published between 1999 and 2024 in the WoS database regarding the use of MTA in endodontics. The results show that research in this area was conducted by 1,398 authors, with 882 unique keywords used, and the articles were published in a total of 45 different journal sources. A total of 415 articles were published, with an annual growth rate of 14.09%. The highest peak in annual scientific productivity occurred in 2016, as depicted in Figure 1.

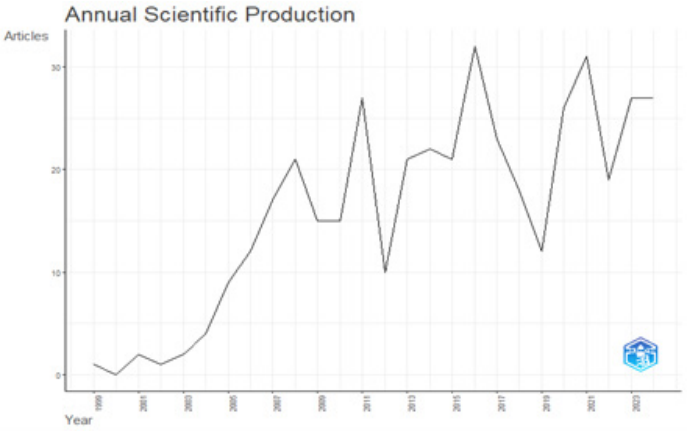

Figure 1. Annual scientific production

The majority of the articles were published in the Journal of Endodontics, followed by the International Endodontic Journal and Dental Traumatology. The ten most frequently used sources are shown in Figure 2.

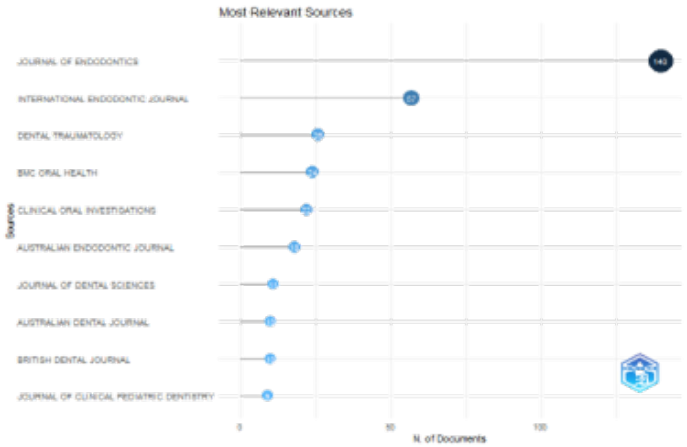

Figure 2. List of journals with the most frequent publications

The author with the most publications in the field of MTA use in endodontics was found to be Simos S., while the most affiliated institution was identified as Hacettepe University in Türkiye, as shown in Figure 3.

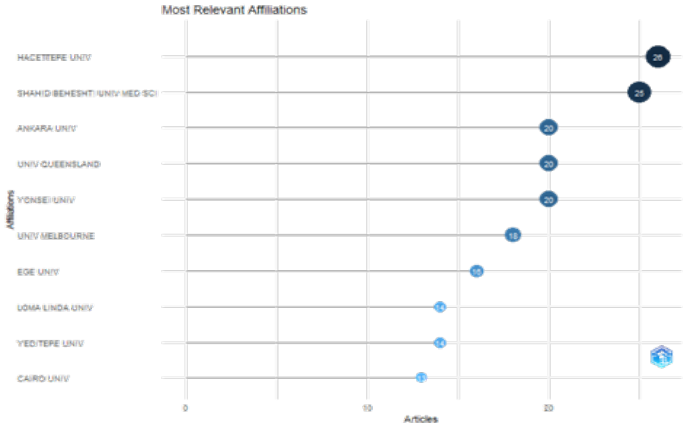

Figure 3. List of most affiliated institutions

The countries with the highest number of publications in this field, in order, are the United States, Brazil, Türkiye, China, and Iran. Our country ranks third globally in terms of the number of publications and citations related to the use of MTA in endodontics (Table 1). Figure 4 shows the collaboration between countries.

Table 1. Number of publications and citations by country

	Number of publications	Number of citations
USA	191	3,677
Brazil	174	1,506
Türkiye	162	984
China	118	744
Iran	87	718

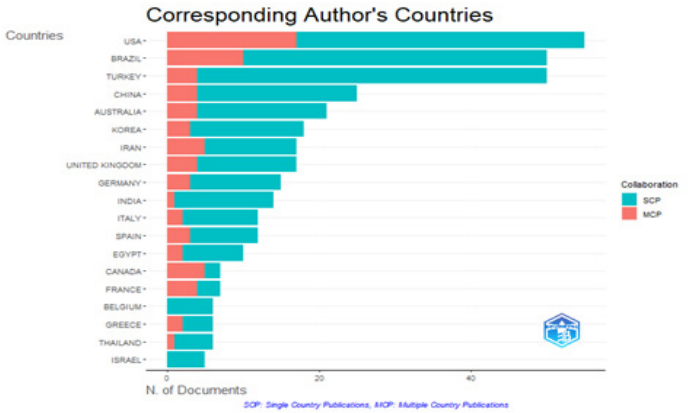

Figure 4. Inter-country collaborations (MCP: multi-country publications, SCP: single-country publications)

When examining the most frequently used keywords by authors in this field, "mineral trioxide aggregate" is followed by "tooth" and "teeth," with "calcium hydroxide" ranking third, as shown in Figure 5.

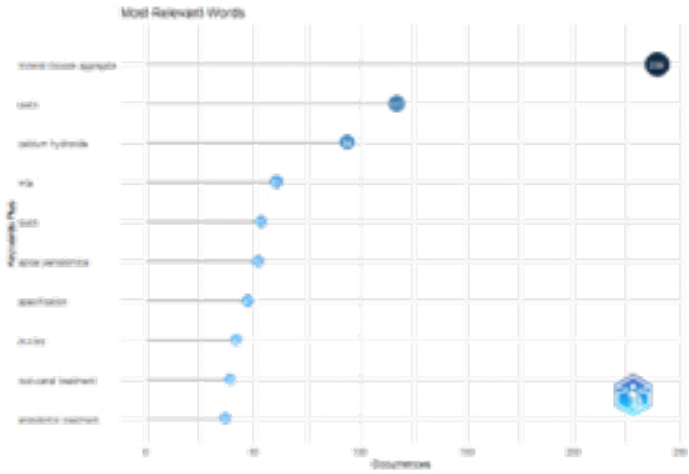

Figure 5. Most frequently used keywords by authors

DISCUSSION

This study presents a bibliometric analysis of research on the use of MTA in endodontics, based on an electronic literature review. The positive annual growth rate observed indicates a steadily increasing interest from researchers in this area.

In this study, the WoS database was chosen as the source for research data. Due to its extensive publication range, which includes articles dating back to 1945, WoS is a widely used database for citation analysis and provides more access to articles than other similar databases in the field of health sciences (12). One study has highlighted that citation counts may vary based on years and journals when searching across different databases, and databases that include theses and conference proceedings may lack sufficient technical precision. A journal's impact factor and indexing are critical parameters that reflect its quality (13). Therefore, only articles published in high-impact SCI-Expanded journals and written in English, the most valid language in the literature, were analyzed in this study.

MTA is a widely used material in endodontic procedures due to its biocompatibility and favourable physico-chemical characteristics (1,14). It has been used in dental treatments for over two decades, and reports suggest that it is playing an increasing role in root canal treatment (6). Research on the use of MTA in endodontics began in 1999, with a significant increase in the number of publications over time. As a result, 1,398 authors have contributed to this area, and 415 articles have been published with an annual growth rate of 14.09%. Furthermore, the increase in systematic analyses of MTA suggests growing interest from researchers in this discipline (15,16).

According to the results of our study, the United States is the country with the most publications and citations in this field. These findings are consistent with other bibliometric analyses, where the United States, with its vast financial resources, funding opportunities, and research facilities, tends to publish higher-impact journals more frequently (17,18). Moreover, the increasing number of scientific publications each year has led to a higher tendency for authors from other countries to cite U.S.-based articles (19,20).

Hacettepe University in Türkiye was identified as the institution with the most publications on MTA (21). Similar results have been reported in previous bibliometric analyses. This increase in publications may be attributed to the launch of the "TÜBİTAK International Scientific Publication Incentive Program" in 1993, which aimed to motivate researchers and improve the quality of publications (22). However, the effects of this incentive program became more evident in the early 2000s. In Iran, Shahid Beheshti University ranked second, receiving the highest citations for its published papers. Although MTA have a significant impact on clinical outcomes, the contributions of other renowned institutions in this field still appear to be lacking.

The total of citations to published articles is clearly related to the year of publication. The full impact of an article is usually recognized at least 20 years after publication (23,24). Accordingly, older research articles tend to be cited more than more recently published ones, regardless of their affect (25). The current study project an increasing citation tendency, consistent with previous studies. The most cited author is Dr. Simos S. from Newcastle University, UK.

Several bibliometric analyses have found that leading journals in a specific discipline account for a significant portion of all publications in that field (26,27). This bibliometric analysis reveals that a few leading journals contribute a large share of publications in the discipline of endodontics (28). The Journal of Endodontics and International Endodontic Journal were the leading journals with the highest publication numbers (140 and 57, respectively) and citation numbers (5083 and 1991, respectively).

Keywords are a crucial part of scientific papers. They not only assist in literature searches but also provide easy access to relevant research articles (29). Therefore, selecting appropriate keywords is essential to facilitate and define relevant searches (30). In this bibliometric analysis, the most frequently used keywords were Mineral Trioxide Aggregate (239 occurrences), Teeth (117 occurrences), Calcium Hydroxide (94 occurrences), and MTA (61 occurrences).

This study provides valuable insights into the distribution and emergence of knowledge related to MTA over time. It is worth noting that MTA research is well represented in the leading journals. These findings can be advantageous for future academics in identifying the best journals, areas of focus, and leading authors in the field has been well represented in the top journals.

CONCLUSION

In this study, a bibliometric analysis was conducted to examine the performance and trends of research articles on the use of MTA in endodontics. The positive annual growth rate indicates an increasing interest in this topic. The Journal of Endodontics is the leading journal in this field. The United States ranks first both in terms of publication volume and citation count. The most frequently used keyword is Mineral Trioxide Aggregate.

This study expands the current literature and provides a significant reference for future studies on the use of MTA in endodontics, particularly within the national context. It offers researchers new avenues for future research topics.

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Ethical approval: *Since the data used in this research are studies obtained from the Web of Science (WoS) database, it does not require ethics committee approval.*

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