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Research Araştırma

The Research Trends of Post-Core Restorations: A Bibliometric Analysis

Post-Core Restorasyonların Araştırma Eğilimleri: Bibliyometrik Bir Analiz

ABSTRACT

Objective: The post-core restorations are generally used to endodontically treated teeth. Although there are many in vivo and in vitro studies in the literature on such restorations, there is a lack of quantified analysis. In this bibliometric study, it was aimed to examine the studies on post-core restorations in terms of many factors such as author, citation, country, journal, collaborators.

Materials and Method: The literature search was done by typing the word "post-core" in the web of science database. Filtering was done by excluding articles from before 2000. Metadata including titles, abstracts, keywords, authors, links, countries, and references has been recorded. The obtained data were analyzed using bibliometric indicators for all interactions and collaborations via the Vos viewer software program.

Results: As a result of filtering and pyramid narrowing, 121 articles were found between the years 2000-2022. While publications on post-core received a total of 11969 citations, this number corresponded to an average of 96.78 per article. The H index was found to be 72.

Conclusion: It has been observed that there has been a general increase in the publications on post-core since 2000, this increase is not linear and tends to decrease in some years. Although it is predicted that the interest in post-core restorations will decrease with new systems, it is thought that it will maintain its place in the literature systematically.

Key Words: Bibliometric, Core, Dentistry, Post.

ÖZ

Amaç: Post-Core restorasyonlar genellikle endodontik tedavi edilmiş dişler için kullanılır. Literatürde bu tür restorasyonlarla ilgili birçok in vivo ve in vitro çalışma olmasına rağmen, nicel analiz eksikliği vardır. Bu bibliyometrik çalışmada, çekirdek sonrası restorasyonlarla ilgili çalışmaların yazar, atıf, ülke, dergi, işbirlikçiler gibi birçok faktör açısından incelenmesi amaçlanmıştır.

Gereç ve Yöntemler: Literatür araştırması, web of science veritabanına "post-core" kelimesi yazılarak yapıldı. Filtreleme, 2000'den önceki makaleler hariç tutularak yapıldı. Başlıklar, özetler, anahtar kelimeler, yazarlar, bağlantılar, ülkeler ve referanslar dahil olmak üzere meta veriler kaydedildi. Elde edilen veriler, Vosviewer yazılım programı aracılığıyla tüm etkileşimler ve işbirlikleri için bibliyometrik göstergeler kullanılarak analiz edildi.

Bulgular: Filtreleme ve piramit daralması sonucunda 2000-2022 yılları arasında 121 makale bulundu. Çekirdek sonrası yayınlar toplam 11969 atıf alırken, bu sayı makale başına ortalama 96,78'e karşılık geldi. H indeksinin 72 olduğu bulundu.

Sonuç: 2000 yılından bu yana post-core'daki yayınlarda genel bir artış olduğu, bu artışın doğrusal olmadığı ve bazı yıllarda azalma eğiliminde olduğu gözlenmiştir. Çekirdek sonrası restorasyonlara olan ilginin yeni sistemlerle azalacağı tahmin edilse de literatürdeki yerini sistematik olarak koruyacağı düşünülmektedir.

Anahtar Kelimeler: Bibliyometrik, Core, Diş Hekimliği, Post.

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INTRODUCTION

Bibliometric analysis comprehensively defines the relationship between data by creating a knowledge map. It is a very useful method for evaluating the usability and analysis of information. Bibliometric analysis provides the opportunity to evaluate the whole of the literature statistically according to certain criteria (1). The bibliometric analysis method is used in many branches of science. Dentistry is one of these fields, where a summary and precise information can be obtained between researches, authors, and research countries by creating a relationship map between the data in post-core restorations. This study aimed to discuss post-core restoration systems in terms of popularity and frequency of publication by using bibliometric analysis method. Post-core restorations, which are the chosen subject for analysis, are one of the treatment options used in cases where there is damage to the coronal part of the tooth (2). In post-core restorations, the “post” is located in the root canal and extends up to 2/3 of the root canal, and the “core” is prepared to replace the lost dentin tissue and is located in the coronal part (3,4). It is an effective treatment method used to ensure the functional and esthetic integrity of endodontically treated teeth. Endodontic posts are used to provide retention in cases where there is insufficient dental tissue in crown restoration (5-7). Currently, a wide range of post materials is available, including custom-fabricated metal posts (8,9), prefabricated zirconia posts (10), quartz fiber posts (11), prefabricated carbon fiber posts (12,13), composite posts (14), glass fiber posts (15), CAD/CAM-milled glass fiber posts (16), zirconia post-cores (PCs) (17), and CAD/CAM-fabricated composite PCs (18), among others. Beyond material selection, research on post-cores encompasses various critical aspects such as surface treatment of posts, three-dimensional mechanical behavior, bonding effectiveness, flexural resistance of restored teeth, the condition of the remaining tooth structure, and the ferrule effect. The topic of post-cores remains a focal point in prosthodontic research. Notably, in 2019, 11 of the 100 most-cited articles in the field of dental prosthetics focused on post-core systems (19). Restoration of endodontically treated teeth with post-core treatment has been studied and researched in many aspects in the last 20 years (20). The aim of this study is to bibliometrically analyze the publications in the database about post-core restorations.

MATERIAL AND METHODS

The literature search was carried out in the Web of Science database of Clarivate Analytics, which includes comprehensive and high-quality literature resources. The searching was applied in a pyramid-shaped structure that narrowed it down with keywords besides the main topic. The searching was carried out in Dec 2022. Literature before 20 Dec 2022 was searched. Pilot searches were made with many words and the main title and keywords were decided accordingly. While choosing the word group "post core" as the main title, the words "endodont, dent, prosthodont, oral, tooth, teeth OR restoration” were chosen as keywords. A total of 34595 results were obtained in the search made in the Web of Science database with the word group "post core". These results were narrowed down by keywords with a pyramid-like approach from general to specific. As a result of this narrowing with keywords, a total of 2265 literatures were reached. Non-English speakers and literature before 2000 were not included in the search. A total of 2052 literature was obtained after all eliminations. The 200 highest-rated publications from this body of literature were included in the study. However, these literatures were category independent and included literatures from all fields. These 200 pieces of literature were examined one by one and those not related to the post were removed. In this context, a total of 121 literatures were obtained. Analyzes and tables were made within these 121 literatures. Various information was obtained from these literatures by using the "analyze results" and "citation report" interfaces of the Web of Science database for further analysis. The reports created in the "Analyze results" section for use in tables were downloaded in ".txt" format. In the "Citation report" section, detailed reports about the total citations of the literature were obtained and these reports were downloaded in ".txt" format. These reporting results, which were created from the literatures ranked as the highest citing area, were exported in the formats called “tab delimited file” and “.xls”. For bibliometric analysis, the data obtained were analyzed using the software VOS viewer (v1.6.18.; Leiden University, Center for Science and Technology Studies, The Netherlands) (21). This software was the most recent version in the research history and was downloaded from the official website. With the help of this software, data such as titles, abstracts, keywords, countries, authors, and references were analyzed. Reports in “.txt” format created from “Analyze results” section were used to generate tables (21-23). Office Excel and Word (Microsoft Office 365 Excel, Word v16.61; Microsoft Corp, Redmond, Washington, USA) software were used for this situation. Data such as the 20 most cited articles, the 10 most productive authors, the 10 most productive countries, and the number of publications by year were tabulated and added to the literature. The number of collaborations and citations was visualized

by network type or overlay with the help of VOS viewer software. In this created visual map, the size of the bubble reflected the number of broadcasts, the distance between the bubbles reflected the relationship of the 2 items, and the color of each bubble had different meanings in different visual maps. For the co-authors, a network-type visualization was presented where bubbles of the same color form clusters and show close collaborations because of the research.

RESULTS

Searches in the Web of Science database identified 121 literatures from 2000 to 2022 and after other relevant eliminations. The number of articles published by years (Figure 1 to 2) showed an increasing trend, especially after 2015. Of the 121 literatures, 119 (98.3%) were in the "Dentistry Oral Surgery Medicine" category. 16 literatures (13.2%) were included in the category "Materials Science Biomaterials", others in the fields of engineering, mechanics and mathematics. The reason why the sum of the percentage values given at this point was not 100% was that some literatures were classified in more than one category and reflected in the analysis in this way. While the Web of Science database divided the categories into percentiles, they organized it to be the intersection of the literatures and calculated percentiles accordingly. Among the selected literature, the most publications on post-core restorations were in 2006 and these publications constituted 14.8% of the total. A total of 11969 citations were received for post-core restorations. The H index was 73, with an average of 98.92 citations per publication. The 20 most cited literatures, most of which are articles, are presented in Table 1.

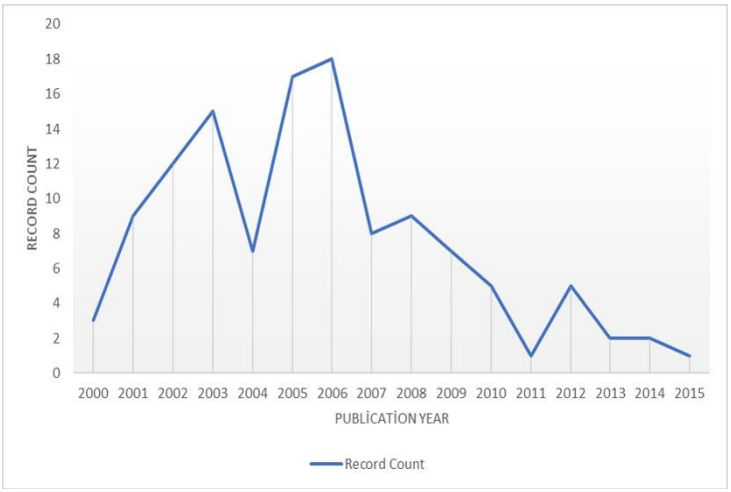

Figure 1. Distribution of 121 articles used in the current study by years.

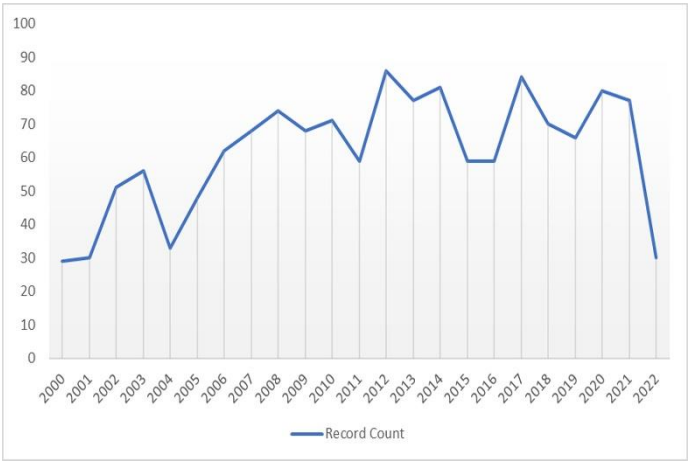

Figure 2. Annual number of published articles from 2000 to 2022 with post-core restorations.

The most cited topics were on fracture strength, clinical success, complications, and biomechanics.
A total of 341 authors contributed to the included articles, with an average of 0.3 authors per article. The 10 most prolific authors and the 10 most cited authors are reported in Table 2. Visual mapping of the most prolific authors is presented in Fig. 3. The most prolific and also the most cited author was Marco Ferrari. A total of seven academics was included in both lists (Ferrari M, Goracci C, Monticelli F, Naumann M, Grandini S, Radovic I, Heydecke G), indicating that they are the most prolific and influential writers. In this study on post-core, a total of 139 universities from 29 countries and regions were included in the study. The 10 universities that produce the most publications are presented in Table 3. According to this table, the university that produced the most publications was the University of Siena with 24 publications and constituted 19.8% of the total publications. The literature reviewed in this study was included in a total of 24 journals. The International Endodontic Journal is in the top 5 among all journals with a rate of 10.7%. The distribution of the most productive countries or regions was largely consistent with the distribution of universities. The country producing the most publications was Italy with 28 publications and constituted 23.12% of the total publications. This country was followed by the United States (26, 21.4%), Germany (24, 19.8%), and Brazil (15, 12.3%). These 4 countries received more than 1000 citations (Italy, 3056 citations; United States, 2651 citations; Germany, 2025; Brazil, 1064 citations) and significantly more than other countries (Table 4). The visual mapping made is presented in Figure 3 to 5. 3 different mappings were generated. The size of each balloon on the map represents the relative magnitude or significance of the title it corresponds to items.

Table 1. List of 20 most cited articles.

Title	Author	Journals	Publication Year	Total Citations	Average per Year	Type of Study
Clinical behavior of translucent-fiber posts: A 2-year prospective study	Monticelli F, Grandini S Goracci C, Ferrari M	International Journal of Prosthodontics	2003	197	9.85	article
Finite element analysis of stresses in endodontically treated, dowel-restored teeth	Asmussen E, Peutzfeldt A, Sahafi A	Journal of Prosthetic Dentistry	2005	197	10.94	article
Current perspectives on post systems: a literature review	Goracci C, Ferrari M	Australian Dental Journal	2011	192	16	review
Fracture resistance of endodontically treated teeth restored with composite posts	Newman MP, Yaman P, Dennison J, Rafter M, Billy E	Journal of Prosthetic Dentistry	2003	189	9.45	article
A structured analysis of in vitro failure loads and failure modes of fiber, metal, and ceramic post-and-core systems	Fokkinga WA, Kreulen CM, Vallittu PK, Creugers NHJ	International Journal of Prosthodontics	2004	176	9.26	article
Three-year clinical comparison of survival of endodontically treated teeth restored with either full cast coverage or with direct composite restoration	Mannocci F, Bertelli E, Sheriff M, Watson TF, Ford TRP	Journal of Prosthetic Dentistry	2002	174	8.29	article
Fracture strength and survival rate of endodontically treated maxillary incisors with approximal cavities after restoration with different post and core systems: an in-vitro study	Heydecke G, Butz F, Strub JR	Journal of Dentistry	2001	170	7.73	article
Factors affecting the fracture resistance of post-core reconstructed teeth: A review	Fernandes AS, Dessai GS	International Journal of Prosthodontics	2001	165	7.5	article
Clinical evaluation of teeth restored with quartz fiber-reinforced epoxy resin posts	Malferrari S, Monaco C, Scotti R	International Journal of Prosthodontics	2003	159	7.95	article
Effects of luting agent and thermocycling on bond strengths to root canal dentine	Bitter K, Meyer-Lueckel H, Priehn K, Kanjuparambil JP, Neumann K, Kielbassa AM	International Endodontic Journal	2006	152	8.94	article
Long-term retrospective study of the clinical performance of fiber posts	Ferrari M, Cagidiaco MC, Goracci C, Vichi A, Mason PN, Radovic I, Thai F	American Journal of Dentistry	2007	149	9.31	article
Corona-radicular reconstruction of pulpless teeth: A mechanical study using finite element analysis	Pierrisnard L, Bohin F, Renault P, Barquins M	Journal of Prosthetic Dentistry	2002	149	7.1	article
A review of the management of endodontically treated teeth - Post, core, and the final restoration	Cheung W	Journal of the American Dental Association	2005	142	7.89	review
The adhesion between prefabricated FRC posts and composite resin cores: microtensile bond strength with and without post-silanization	Goracci C, Raffaelli O, Monticelli F, Balleri B, Bertilli E, Ferrari M	Dental Materials	2005	135	7.5	article
Evaluation of the biomechanical behavior of maxillary central incisors restored by means of endocrowns compared to a natural tooth: A 3D static linear finite elements analysis	Zarone F, Sorrentino R, Apicella D, Valentino B, Ferrari M, Aversa R, Apicella A	Dental Materials	2006	133	7.82	article
Ferrule Effect: A Literature Review	Juloski J, Radovic I, Goracci C, Vulicevic ZR, Ferrari M	Journal of Endodontics	2012	133	12.09	article

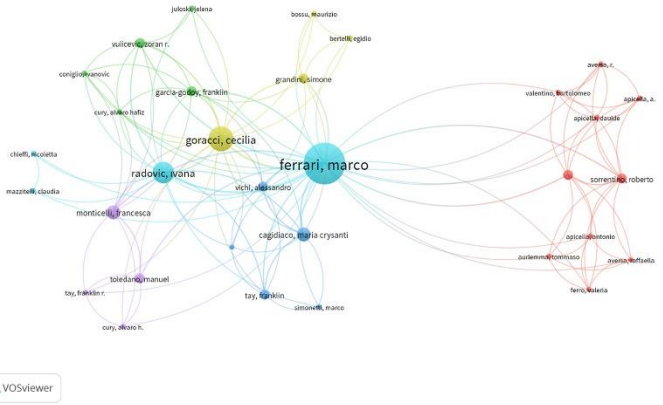

Figure 3. Collaboration networks between authors.

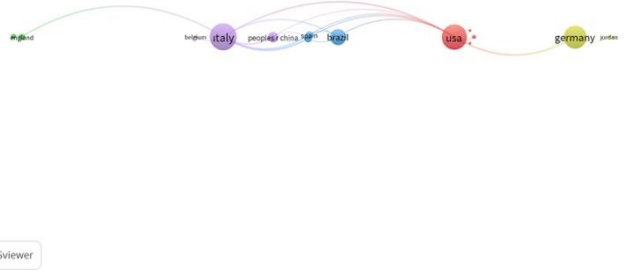

Figure 4. Collaboration networks between countries.

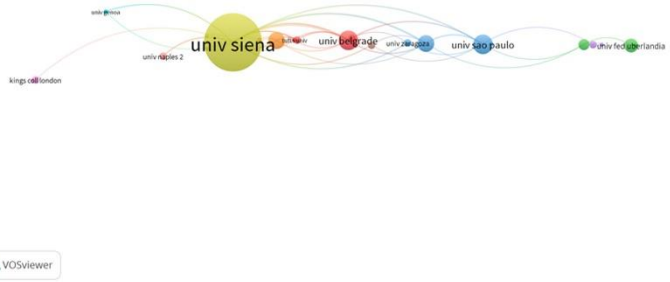

Figure 5. Collaboration networks between institutions.

Table 2. List of most producing and cited 10 authors.

Author	Institution	Country or Region	Number of Articles	Author	Institution	Country or Region	Number of Citations
Ferrari, Marco	University of Leeds	Italy	20	Ferrari, Marco	University of Leeds	Italy	2150
Goracci, Cecilia	University of Siena	Italy	12	Goracci, Cecilia	University of Siena	Italy	1432
Naumann, Michael	Otto von Guericke University	Germany	10	Monticelli, Francesca	University of Zaragoza	Spain	810
Monticelli, Francesca	University of Zaragoza	Spain	9	Naumann, Michael	Otto von Guericke University	Germany	923
Grandini, Simone	University of Siena	Italy	7	Grandini, Simone	University of Siena	Italy	742
Radovic, Ivana	University of Belgrade	Serbia	6	Radovic, Ivana	University of Belgrade	Serbia	555
Heydecke, Guido	University Medical Center Hamburg	Germany	4	Heydecke, Guido	University Medical Center Hamburg	Germany	488
Bitter, Kerstin	Charite Universitatsmedizin	Germany	4	Strub, Joerg	University of Freiburg	Germany	411
Creugers, NHJ	Radboud University Nijmegen Medical Center	Netherlands	4	Butz, Frank	University of Freiburg	Germany	451
Fokkinga, Wietske	Radboud University Nijmegen Medical Center	Netherlands	4	Asmussen, Erik	University of Copenhagen	Denmark	451

Table 3. 10 most contributing institutions.

Institution	Country or Region	Number of Articles	Number of Citations	Citations per Article
University of Siena	Italy	24	2470	102.92
Humboldt University of Berlin	Germany	13	1141	87.77
Charite Universitatsmedizin Berlin	Germany	11	924	84
Free University of Berlin	Germany	11	924	84
Universidade De Sao Paulo	Brasil	6	450	75
University of Belgrade	Serbia	6	538	89.67
University Of Michigan	USA	5	620	124
University of Freiburg	Germany	5	530	106
University of Granada	Spain	5	413	82.6
University of Hong Kong	Hong Kong	5	519	103.8

Table 4. 10 most contributing country or region.

Country or Region	Number of Articles	Proportion of Articles (%)	Number of Citations
Italy	28	23.14	3122
United States	26	21.48	2702
Germany	24	19.83	2175
Brazil	15	12.39	1100
Peoples R China	9	7.43	881
Serbia	6	4.95	555
Spain	6	4.95	508
Turkey	6	4.95	830
England	5	4.13	517
Netherlands	5	4.13	501

DISCUSSION

Throughout the history of dentistry, tooth extraction treatment is applied due to caries or periodontal problems. The loss of function, phonation and esthetics, as the missing teeth remain empty, has led to the emergence of new treatment methods. Prosthetic treatment of a lost tissue with post-core provides esthetics as well as function and phonation. Since post-core treatment is a frequently used treatment method today, it has created the need for scientific evaluation by taking the prevalence of clinical applicability as a reference. Apart from this purpose, the applicability of both the new cementation systems and the materials developed today in the post-core system has been a source of inspiration for our study. When the distribution of studies on post-core restorations according to years is examined, an increase is seen between 2000 and 2012, reaching the highest number of publications in 2012. The studies, which were stable and fluctuating between 2012 and 2020, decreased dramatically after 2020 (Table 1). This table covers all of the published literature on post core. In the situation that emerged as a result of our eliminations, a regular increase is observed between the years 2000-2003 and the number of literatures published in 2006 reaches its peak. In addition, the number of regularly published literature has been decreasing since 2008 until May 2015, when we prepared our study (Table 2). We think that the reason for this decrease may be due to the fact that the treatment of teeth with excessive crown destruction and the development of adhesive dentistry, as an alternative to traditional post-core crown restorations, can be performed with endo-crown restorations. In addition, the risk of root perforation and fracture during post treatment has led to the search for alternative methods to the traditional system (24-26).

The country that produced the most post-core publications was Italy with 28 publications, accounting for 23.12% of total publications. Italy was followed by the United States (26, 21.4%), Germany (24, 19.8%), and Brazil (15, 12.3%). Nowadays, it is more accessible in developed countries that rapidly advancing technology and the superior materials it brings into the field of dentistry. The number of articles produced in excess can be attributed to the level of development of these countries. These 4 countries received more than 1000 citations (Italy, 3056 citations; United States, 2651 citations; Germany, 2025 citations; Brazil, 1064 citations), significantly more than any other country. It can be thought that the high number of published articles may be effective in the high number of citations in these 4 countries. In addition, when the number of articles produced and the number of citations received are compared, the highest productivity has emerged in the People's Republic of China. It is seen that the top 3 contributors are Ferrari M, Goracci C, and Naumann M. There is usually a parallelism between the number of publications of the authors and the highest citation (Table 2). Authors such as Grandi S, Heydecke G, and Bitter K, although the number of publications is small, discussed influential articles with relatively high citations (Table 2).

CONCLUSION

Based on the findings obtained from the bibliometric analysis of the studies in the literature on post-core, the following conclusions were reached:

1. As a result of the development of esthetic prosthetic materials, there is a global decrease in research on traditional post-core. As a result of this development, esthetic post-core materials have become more popular and the collaboration in research has increased and the number of citations has remained at a high level.

2. As a result of the rapidly advancing technology in recent years and the introduction of superior materials brought by it into the field of dentistry, there has been a decrease in the publications related to post-core applications.

3. Popular research topics include current post-core material types, cementation techniques, esthetic, and mechanical comparison of different post-core systems.

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