

A Bibliometric Analysis of the Research Trends of Resin Cements in Dentistry

Diş Hekimliğinde Rezin Simanların Araştırma Eğilimlerine Yönelik Bir Bibliyometrik Analiz

Alper ÖZDOĞAN¹

¹ Atatürk University, Faculty of Dentistry, Department of Prosthodontics, Erzurum, Türkiye

Eda GÜLEK¹

¹ Atatürk University, Faculty of Dentistry, Department of Prosthodontics, Erzurum, Türkiye

Ömer ASLAN¹

¹ Atatürk University, Faculty of Dentistry, Department of Prosthodontics, Erzurum, Türkiye



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Sorumlu Yazar/Corresponding author:
Eda Gülek

E-mail: edagulek0@gmail.com

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ABSTRACT

Objective: In this bibliometric analysis, it was aimed to analyze the research trends of the researchers, organizations, countries, and journals that contributed to the research focus of resin cements in dentistry.

Methods: The literature search was carried out on the basis of the Web of Science (WoS) database containing publications on resin cements between 1970 and 2022. 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 VOSviewer software program.

Results: As a result of the bibliometric analysis, 1643 studies published between 1970 and 2022 were found in the searches made in the Web of Science database. While publications on resin cements received a total of 26871 citations, this number corresponded to an average of 20.75 per article. The H index was found to be 71. The document type of these publications was 97.60% in the article type. While the most publications on resin cements are in the Journal of Adhesive Dentistry and Journal of Prosthetic Dentistry, the most references are in the Dental Materials Journal and Journal of Prosthetic Dentistry.

Conclusion: Between 1983 and 2022, research on resin cements was on the rise. With the global increase in resin cement research, extensive collaborations and citations have been noted between authors, institutions, and countries or regions. It is predicted that resin cements will maintain their popularity in future studies.

Keywords: Article, author, bibliometric analysis, resin cement

ÖZ

Amaç : Bu bibliyometrik analizde, diş hekimliğinde kullanılan rezin simanların araştırma odağına katkıda bulunan araştırmacıların, kuruluşların, ülkelerin ve dergilerin araştırma eğilimlerini analiz etmek amaçlandı.

Yöntemler: Literatür taraması, 1970-2022 yılları arasında rezin simanlar alanında yayınların yer aldığı Web of Science (WoS) veri tabanına dayanarak gerçekleştirilmiştir. Başlıklar, özetler, anahtar kelimeler, yazarlar, bağlantılar, ülkeler ve referanslar gibi meta veriler kaydedilmiştir. Elde edilen veriler, WOSviewer yazılım programı aracılığıyla tüm etkileşimler ve işbirlikleri için bibliyometrik göstergeler kullanılarak analiz edildi.

Bulgular: Bibliyometrik analiz sonucunda, Web of Science veri tabanında yapılan aramalarda 1970-2022 yılları arasında yayınlanmış 1643 çalışma bulunmuştur. Rezin simanlar üzerine yayınlar toplam 26871 atıf alırken, bu sayı makale başına ortalama 20,75'e karşılık gelmektedir. H indeksi 71 olarak bulundu. Bu yayınların belge türü makale türünde %97,60'tı. Rezin simanlar üzerine en çok yayın Journal of Adhesive Dentistry ve Journal of Prosthetic Dentistry'de yer alırken, en çok referans Dental Materials Journal ve Journal of Prosthetic Dentistry'de yer almaktadır.

Sonuç: 1983 ile 2022 yılları arasında rezin simanlar üzerine yapılan araştırmalar artıyordu. Rezin siman araştırmalarındaki küresel artışla birlikte yazarlar, kurumlar ve ülkeler veya bölgeler arasında kapsamlı işbirlikleri ve atıflar kaydedildi. Rezin simanlarının gelecekteki çalışmalarda popülerliğini sürdüreceği öngörülmektedir.

Anahtar Kelimeler: Makale, yazar, bibliyometrik analiz, rezin siman

INTRODUCTION

Recent studies in dentistry have led to a gradual decrease in the need for removable partial dentures and an increase in esthetic concerns as a result of patients' increased awareness of oral health, and fixed prosthetic restorations have come to the forefront. One of the most important factors in the success of fixed prosthetic restorations is the cementation process.¹⁻³ Luting cements have the primary function of filling the gap between the prosthetic restoration and the tooth or implant abutment and ensuring retention of the restoration. The shortcomings of conventional cements are high solubility, lack of adhesion and inadequate esthetic properties. In order to avoid these negative aspects, resin cements have emerged.^{2,4} In current clinical applications, resin cements have found more areas of application, leaving behind traditional resin cements with their chemical bonding properties, low microleakage, color options, and their contribution to aesthetics.⁴ Although there are many in vitro and in vivo studies in the literature regarding resin cements,

whose popularity and area of application are increasing day by day, there is a lack of bibliometric analysis regarding this issue. Many research fields; use bibliometric methods to investigate the impact of a particular article, by researchers, or to identify particularly influential articles in a particular research field. While bibliometric research can identify the most productive researchers in a given field, it can also reveal the dimensions of interaction between them.^{5,6} Using a similar approach, bibliometric studies can also make comparisons between countries, between institutions, or between schools in different fields. The main objectives of such studies were to define the chronological trends of the analyzed subject, to show the number of citations, and to highlight the evidence-based studies.^{7,8} In essence, bibliometric analysis is an analytical method used to gain insight into an academic field.⁹

The aim of this study was to perform a bibliometric analysis of the articles published on resin cements in the literature.

METHODS

The search was conducted in the Web of Science (WoS) database, originally created by the Institute for Scientific Information (ISI) and later maintained by Clarivate Analytics. The literature search was conducted in June 2022. Articles published before June 15, 2022 were included in the search. Filters were applied to improve and limit the search. First, article and compilation were selected as the document type for filtering. A total of 1643 results were obtained by entering "TS=[("resin cement") AND (dent OR prosthodont OR oral OR tooth OR teeth OR crown)]" in the advanced search section. While 1289 of these results were in the "Dentistry Oral Surgery Medicine" category, 189 of them were in the "Materials Science Biomaterials" category. The 189 results in the "Materials Science Biomaterials" category were analyzed individually and 146 publications related to dentistry were included in the study. Papers whose abstracts and keywords were not in English were excluded from the study. 87.34% of 1643 studies, or 1435 studies, were included.

All results from the final screening process were sorted from the most cited to the least cited as "highest cited" publications. The data of the publications obtained for the bibliometric analysis were saved in plain text document format ".txt" and exported. Likewise, the data of the 100 most cited publications and the first 20 of them were exported by saving them in an Excel file in ".xls" format.

For the bibliometric analysis of the obtained data, the bibliometric analysis program VOSviewer (Center for Science and Technology Studies, Leiden University) was used.^{10,11} VOSviewer version 1.6.18, published on January 24, 2022, was downloaded free of charge from the official website of the program.¹⁰ Data in ".txt" and ".xls" formats were transferred to the VOSviewer program and processed.¹¹⁻¹³ Collaborations and citation numbers were visualized by network type or registration with the help of VOSviewer software. In the resulting visual map, the size of the bubble reflected the number of broadcasts, the distance between the bubbles reflected the relationship between the two elements, and the color of each bubble had different meanings in different visual maps.

RESULTS

As a result of the bibliometric analysis, 1643 studies published between 1970 and 2022 were found in the Web of Science database. The number of articles published per year showed an increasing trend, with slight decreases in between. Publications on resin cements received a total of 26871 citations, with an average of 20.75 citations per article.

The H-index was found to be 71. The document type of these publications was mainly articles, 97.60%. Using the information in the database, information on certain topics such as titles, authors, journals, publication dates, total citations, annual average was obtained and tables were created. Spreadsheet of the 20 most cited articles in "resin cement" research using scan targets (Microsoft Office 2020 Excel v16.35; Microsoft Corp) and shown in Table 1. The number of articles published by year between 2000 and 2022 was shown graphically in Figure 1. The distribution of the network structures formed because of the bibliometric analyses according to authors was shown in Figure 2, the distribution according to institutions in Figure 3, and the distribution according to countries in Figure 4. Information on the 10 most productive authors on resin cements was given in Table 2. According to this table, the most productive author was Valandro Luiz Felipe. There were many institutions from different parts of the world doing research on resin cement. The number of articles and citations of these countries and institutions were shown in Tables 3 and 4. Ignoring main search item, resin cement, the most used keywords were 'bond strength', 'shear bond strength', 'adhesion', and 'zirconia' (Figure 5). The distribution of the most productive countries for resin cement is consistent with the distribution of research institutions. The highest number of articles was found in the USA, followed by Brazil and Turkey. While the Journal of Prosthetic Dentistry had the most publications on resin cement, it also had the most citations (Figure 6). The three most cited authors were Ferrari M, Goracci C, and Tay FR (Table 2). Although more than one organization was at the forefront of resin cement, the universities that contributed the most were univ siena, univ sao paulo, and univ estadual paulista.

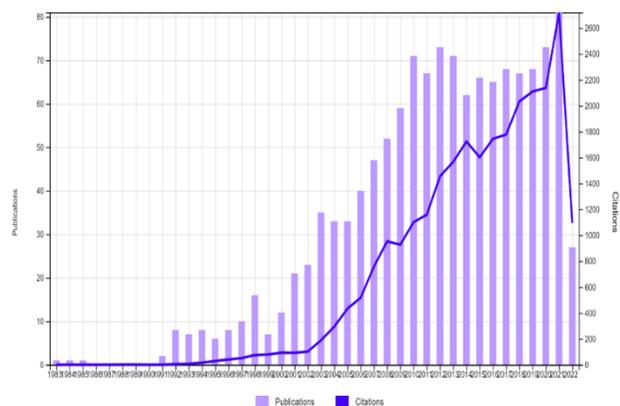


Figure 1. Annual number of published articles from 1983 to 2022 with resin cements

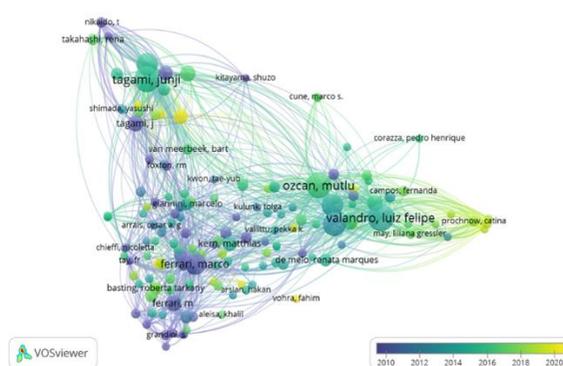


Figure 2. Collaboration networks between authors with more than 5 publications

Table 1. 20 most cited articles in resin cement research

Title	Authors	Source Title	Publication Date	Publication Year	Total Citations	Average per Year
Resistance to fracture of endodontically treated teeth restored with different post systems	Akkayan B, Gulmez T.	Journal of Prosthetic Dentistry	Apr 2002	2002	351	16.71
Monolithic cad/cam lithium disilicate versus veneered yt-zp crowns: comparison of failure modes and reliability after fatigue	Guess Petra C, Zavanelli Ricardo A, Silva Nelson RFA, Bonfante Estevam A, Coelho Paulo G, Thompson Van P.	International Journal of Prosthodontics	Sep-Oct 2010	2010	214	16.46
Clinical behavior of zirconia-based fixed partial dentures made of dc-zircon: 3-year results	Tinschert J, Schulze Karen A, Natt G, Latzke P, Heussen N, Spiekermann H.	International Journal of Prosthodontics	May-Jun 2008	2008	202	13.47
Effects of sodium hypochlorite and rc-prep on bond strengths of resin cement to endodontic surfaces	Morris MD, Lee KW, Agee KA, Bouillaguet S, Pashley DH.	Journal of Endodontics	Dec 2001	2001	199	9.05
Clinical behavior of translucent-fiber posts: a 2-year prospective study	Monticelli F, Grandini S, Goracci, C.	International Journal of Prosthodontics	Nov-Dec 2003	2003	197	9.85
Fracture resistance of endodontically treated teeth restored with composite posts	Newman MP, Yaman P, Dennison J, Rafta M, Billy E.	Journal of Prosthetic Dentistry	Apr 2003	2003	187	9.35
Meta-analysis of bonding effectiveness to zirconia ceramics	Inokoshi M, De Munck J, Minakuchi S, Van Meerbeek B.	Journal of Dental Research	Apr 2014	2014	178	19.78
Bonding to oxide ceramics-laboratory testing versus clinical outcome	Kern M.	Dental Materials	Jan 2015	2015	163	20.38
In vitro retentive strength of zirconium oxide ceramic crowns using different luting agents	Ernst CP, Dose P, Cohnen U, Stender E, Willershausen B.	Journal of Prosthetic Dentistry	Jun 2005	2005	162	9
Influence of surface treatments and resin cement selection on bonding to densely-sintered zirconium-oxide ceramic	de Oyague RC, Monticelli F, Toledano M, Osorio E, Ferrari M, Osorio R.	Dental Materials	Feb 2009	2009	157	11.21
The contribution of friction to the dislocation resistance of bonded fiber posts	Goracci C, Fabianelli A, Sadek FT, Papacchini F, Tay FR.	Journal of Endodontics	Aug 2005	2005	155	8.61
Clinical evaluation of teeth restored with quartz fiber-reinforced epoxy resin posts	Malferri S, Monaco C, Scotti R.	International Journal of Prosthodontics	Jan-Feb 2003	2003	155	7.75
Development of a clinically validated bulk failure test for ceramic crowns	Kelly JR, Rungruanant P, Hunter B, Vailati F.	Journal of Prosthetic Dentistry	Oct 2010	2010	152	11.69
Efficacy of different adhesive techniques on bonding to root canal walls: an sem investigation	Ferrari M, Vichi A, Grandini S.	Dental Materials	Sep 2001	2001	148	6.73
Mechanical and physical properties of contemporary dental luting agents	Attar N, Tam LE, McComb D.	Journal of Prosthetic Dentistry	Feb 2003	2003	146	7.3
Evaluation of the adhesion of fiber posts to intraradicular dentin	Goracci C, Sadek FT, Fabianelli A, Tay FR, Ferrari M.	Operative Dentistry	Sep-Oct 2005	2005	145	8.06
Microtensile bond strength and interfacial properties of self-etching and self-adhesive resin cements used to lute composite onlays under different seating forces	Goracci C, Cury AH, Cantoro A, Papacchini F, Tay FR, Ferrari M.	Journal of Adhesive Dentistry	Oct 2006	2006	139	8.18
The effect of zirconia surface treatment on flexural strength and shear bond strength to a resin cement	Qeblawi DM, Munoz CA, Brewer JD, Monaco EA.	Journal of Prosthetic Dentistry	Apr 2010	2010	133	10.23
Surface debris of canal walls after post space preparation in endodontically treated teeth: a scanning electron microscopic study	Serafino C, Gallina G, Cumbo E, Ferrari M.	Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontologist	Mar 2004	2004	126	6.63
Adhesive permeability affects coupling of resin cements that utilise self-etching primers to dentine	Carvalho RM, Pegoraro FA, Tay FR, Pegoraro LF, Silva NRFA, Pashley DH.	Journal of Dentistry	Jan 2004	2004	124	6.53

When analyzed by institutions, the most productive institutions were shown in Table 3. The top 3 most productive institutions were Univ estadual paulista, Univ sao paulo, Uni siena. The fact that the first 2 of the 3 most productive institutions and the first 10 of the 5 most

productive institutions were in Brazil, as well as Brazil's second place in the publication ranking of the countries, suggested an excess of interest in esthetic restorations in Brazil and an increased in this regard. According to the number of articles, the 3 most influential institutions were the University of Augusta, the University System of Georgia and the University of Siena. Based on the data, it could be said that the number of studies conducted in institutions and the rate of influence did not increase linearly (Table 3).

Table 2. Top 10 most cited authors

Author	Citations	Documents	Average per Article
Ferrari M	2607	58	44.95
Goracci C	1282	27	47.48
Thai FR	1130	17	66.47
Bottina MA	860	37	23.24
Valandro LF	859	37	23.22
Tagami J	704	31	22.71
Nikaido T	574	19	30.21
Kern M	567	18	31.5
Ozcan M	518	33	15.7
Soares CJ	346	17	20.35

Table 3. 10 most contributing institutions

Organizations	Documents	Citations	Average per article
Univ estadual paulista	74	1452	19.62
Uni sao paulo	65	1528	23.51
Uni siena	63	2702	42.89
Univ estadual de campinas	50	1112	22.24
Univ federal de santa maria ufsm	45	1048	23.29
Tokyo med dent	43	1206	28.05
Univ zurich	40	686	17.15
Egyptian Knowledge Bank EKB	37	575	15.54
Augusta Uni	27	1237	45.81
Unisystem of Georgia	27	1237	45.81

Table 4. 10 most contributing countries or regions

Country	Documents	Citations	Average per Article
USA	300	8285	27.62
Brazil	298	5460	18.32
Turkey	135	2512	18.61
Germany	126	4233	33.6
Japan	112	2219	19.81
Italy	106	3687	34.78
Switzerland	64	1269	19.83
England	59	1199	20.32
Saudi Arabia	52	373	7.17
Peoples R China	45	1226	27.24

CONCLUSIONS

Based on the findings obtained from the bibliometric analysis of the studies in the literature on resin cements, the following conclusions were reached:

1. As a result of the development of esthetic prosthetic materials, there was an increase in research on resin cement on a global scale. As a result of this development, the material had become more popular, and the cooperation in research had increased, the number of citations had remained at a high level.

2. In line with the publications in recent years, the bond strength of resin cement and esthetic concerns have become popular research topics.

3. It is predicted that resin cement will maintain their popularity in future studies.

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