

3D Printing/Additive Manufacturing Technologies in Dentistry: A Bibliometric Study

Diş Hekimliğinde 3D Baskı/Katmanlı Üretim Teknolojileri: Bibliyometrik Çalışma

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ABSTRACT

Objective: The aim of this study was to present a bibliometric analysis of scientific articles about the additive manufacturing technologies in dentistry.

Method: The papers published until 24 July 2023, were searched in Web of Science. The top 50 articles with the highest citations and suitable for the study subject were selected among the totally 604 articles.

Results: The United States positioned first in the number of articles with a total of 13 articles. Most included articles were published in Journal of Prosthetic Dentistry (n=8), Dental Materials (n=6), Journal of Prosthodontics-Implant Esthetic and Reconstructive Dentistry (n=5), and Materials (n=4). The most cited article was published in 2019 and the number of citations in Web of Science was 194.

Conclusion: Additive manufacturing research presents a dynamic environment and is estimated to stay presenting high productivity and broad application in the future dentistry.

Keywords: 3D Printing, Additive manufacturing, Bibliometrics, Dentistry

ÖZ

Amaç: Bu çalışmanın amacı, eklemeli imalat teknolojilerinin diş hekimliğinde kullanımı ile ilgili bilimsel makalelerin bibliyometrik analizini sunmaktır.

Yöntem: 24 Temmuz 2023 tarihine kadar Web of Science'ta yayınlanan makaleler taranmıştır. Toplam 604 makale arasından en çok atıf alan ve çalışma konusuna uygun ilk 50 makale seçilmiştir.

Bulgular: Amerika Birleşik Devletleri makale sayısında 13 makale ile ilk sırada yer almıştır. En çok atıf alan makalelerin dergilerinin sıralaması Journal of Prosthetic Dentistry (n=8), Dental Materials (n=6), Journal of Prosthodontics-Implant Esthetic and Reconstructive Dentistry (n=5) ve Materials (n=4) şeklinde olduğu tespit edilmiştir. 194 atıfı en çok atıfı olan makale 2019 yılında yayınlanmıştır.

Sonuçlar: Diş Hekimliğinde eklemeli imalat teknolojileri dinamik bir ortam sunmakta olup, gelecekte diş hekimliğinde yüksek üretkenlik ve geniş uygulama sunmaya devam edeceği tahmin edilmektedir.

Anahtar Kelimeler: Eklemeli imalat, bibliyometrik, 3D Baskı, Diş hekimliği

INTRODUCTION

Computer-aided design/computer-aided manufacturing (CAD/CAM) technology has found the field of use and application in industry for a long time. It has gained popularity in the field of dentistry in recent years.¹⁻³ CAD/CAM systems used in dentistry consist of many stages. First, the data is obtained with scanning, they are processed with the software system and as a result, intended products such as restorations, dental prostheses and orofacial prostheses are manufactured. Clinicians could review data, evaluate treatment plans, and make corrections on the intended product in various stages of scanning. Digital files are uploaded to a cloud-based server and provide a chance to make quick communication with other dental technicians. Also, it has some other advantages such as saving time, eliminating the need for materials required for measurement and delivering the product to the patient on the same day.⁴

Production could be made by either subtractive manufacturing (SM) or additive manufacturing (AM) with the CAD/CAM systems. The first CAD/CAM systems used to be in the form of SM in which products were obtained by cutting prefabricated blocks and removing excesses. Starting from the 1980s, the attraction of additive manufacturing technology has increased with the development of 3D printers and their availability for daily use. 3D printers can print the desired object in 3D using the desired and compatible resins using the STL (Stereolithography, Standard Transformation Language) file format. The object to be produced must be prepared in STL format using a slicing program suitable for a 3D printer. 3D printers can produce the desired object in 3D by layer-by-layer curing with suitable resins. In 3D printers, the layer thickness is generally between 25-100 µm. Lower layer thicknesses can increase the resolution of

the object while increasing production time. The type, size and power of the light source of the 3D printer also affect the production time and resolution. Today, there are many types of printers according to their usage areas and 3D printing technology. With 3D printers, production can be made with suitable resins for many purposes such as crown restorations, model production, surgical guides and occlusal splints⁵⁻⁹

Bibliometric studies aim to present the historical process of articles published on a particular subject and a current approach to this subject, and to measure the number of citations of articles on this subject.^{10,11} This study aims to present a bibliometric analysis of scientific articles about the use and fields of AM technologies in dentistry

METHODS

This study aimed to provide a bibliometric analysis of articles on the use of AM in dentistry. The characteristics such as authors, study design, study years and the number of citations of papers in scientific literature on the use and application fields of AM in dentistry were presented in the form of bibliometric analysis. In this bibliometric analysis, the most used keywords were used to determine the articles to be scanned by considering their synonymies. <https://www.ncbi.nlm.nih.gov/mesh> site was used to check the synonymies of the words and their relevance.

It was examined in Web of Science (WOS), covering all databases, for articles published until July 24, 2023 with the formulation 'additive manufacturing, 3D printing, dentistry'. 604 articles were identified in the 'Science Citation Index-Expanded of the WOS' (Clarivate Analytics, Philadelphia, United States of America) web site. Articles written in all languages were examined and the 50 most cited articles were selected.

RESULTS

The top 50 articles published until 24 July 2023 were selected from most to least in order of citation in WOS. The most cited article was the article published in the 'Journal of Prosthodontics-Implant Esthetic and Reconstructive Dentistry' in 2019 with 194 citations. The least cited article on the topic was the article published in the journal 'Materials' with 20 citations in 2022. The top 50 articles with the highest citations which evaluated the field of application of AM in dentistry are presented in Table 1.

'The Journal of Prosthetic Dentistry' was the journal that had the highest publication rate with 8 among the top 50 articles. The journal with the highest JCR® IF2022 rate was 'The Frontiers in Bioengineering and Biotechnology' with a rate of 5.7. The top 50 articles with the highest citations which evaluated the field of application of AM in dentistry and their impact factors are presented in Table 2.

The first author of the article which had the highest citation rate in the field of AM in dentistry was Marta Revilla-León, while the first author of the 50th article was Andrej Thurzo. Among the top 50 articles, Marta Revilla-León had 9, Nawal Alharbi had 4 and other authors had 1 article each. The first authors of these 50 articles with the highest citations which evaluated the field of application of AM in dentistry are presented in Table 3.

When the countries of the first authors on this topic were reviewed, it was found that the US was the first country with 13 authors, and Germany was the second with 7 authors. The number of countries with the first authors is presented in Table 4.

Table 1. The 50 most cited articles on additive manufacturing in dentistry

Rank	Paper	Number of Citations (WOS)	All databases' citations	Paper type
1	Revilla-León M, Özcan M. Additive Manufacturing Technologies Used for Processing Polymers: Current Status and Potential Application in Prosthetic Dentistry. <i>J Prosthodont.</i> 2019 Feb;28(2):146-158.	194	197	Article
2	Alharbi N, Osman R, Wismeijer D. Effects of build direction on the mechanical properties of 3D-printed complete coverage interim dental restorations. <i>J Prosthet Dent.</i> 2016 Jun;115(6):760-7.	173	175	Article
3	Galante R, Figueiredo-Pina CG, Serro AP. Additive manufacturing of ceramics for dental applications: A review. <i>Dent Mater.</i> 2019 Jun;35(6):825-846.	160	165	Review
4	Barazanchi A, Li KC, Al-Amleh B, Lyons K, Waddell JN. Additive Technology: Update on Current Materials and Applications in Dentistry. <i>J Prosthodont.</i> 2017 Feb;26(2):156-163.	137	145	Article
5	Alharbi N, Osman RB, Wismeijer D. Factors Influencing the Dimensional Accuracy of 3D-Printed Full-Coverage Dental Restorations Using Stereolithography Technology. <i>Int J Prosthodont.</i> 2016 Sep-Oct;29(5):503-10.	122	122	Article
6	Dehurtevent M, Robberecht L, Hornez JC, Thuault A, Deveaux E, Béhin P. Stereolithography: A new method for processing dental ceramics by additive computer-aided manufacturing. <i>Dent Mater.</i> 2017 May;33(5):477-485.	104	109	Article
7	Shim JS, Kim JE, Jeong SH, Choi YJ, Ryu JJ. Printing accuracy, mechanical properties, surface characteristics, and microbial adhesion of 3D-printed resins with various printing orientations. <i>J Prosthet Dent.</i> 2020 Oct;124(4):468-475.	102	102	Article
8	Alharbi N, Wismeijer D, Osman RB. Additive Manufacturing Techniques in Prosthodontics: Where Do We Currently Stand? A Critical Review. <i>Int J Prosthodont.</i> 2017 September/October;30(5):474-484.	89	90	Review
9	Revilla-León M, Meyers MJ, Zandinejad A, Özcan M. A review on chemical composition, mechanical properties, and manufacturing work flow of additively manufactured current polymers for interim dental restorations.	81	82	Review
10	Bhargava A, Sanjairaj V, Rosa V, Feng LW, Fuh YH. Applications of additive manufacturing in dentistry: A review. <i>J Biomed Mater Res B Appl Biomater.</i> 201 Jul;106(5):2058-2064.	77	79	Review
11	Piedra-Cascón W, Krishnamurthy VR, Att W, Revilla-León M. 3D printing parameters, supporting structures, slicing, and post-processing procedures of vat-polymerization additive manufacturing technologies: A narrative review. <i>J Dent.</i> 2021 Jun;109:103630.	70	70	Review
12	Tunchel S, Blay A, Kolerman R, Mijiritsky E, Shibli JA. 3D Printing/Additive Manufacturing Single Titanium Dental Implants: A Prospective Multicenter Study with 3 Years of Follow-Up. <i>Int J Dent.</i> 2016;2016:8590971.	70	71	Article
13	Jang KJ, Kang JH, Fisher JG, Park SW. Effect of the volume fraction of zirconia suspensions on the microstructure and physical properties of products produced by additive manufacturing. <i>Dent Mater.</i> 2019 May;35(5):e97-e106.	66	68	Article
14	Sulaiman TA. Materials in digital dentistry-A review. <i>J Esthet Restor Dent.</i> 2020 Mar;32(2):171-181.	64	64	Review
15	Etamad-Shahidi Y, Qallandar OB, Evenden J, Alifui-Segbaya F, Ahmed KE. Accuracy of 3-Dimensionally Printed Full-Arch Dental Models: A Systematic Review. <i>J Clin Med.</i> 2020 Oct 20;9(10):3357.	62	65	Review
16	Lin CH, Lin YM, Lai YL, Lee SY. Mechanical properties accuracy, and cytotoxicity of UV-polymerized 3D printing resins composed of Bis-EMA, UDMA, and TEGDMA. <i>J Prosthet Dent.</i> 2020 Feb;123(2):349-354.	62	64	Article
17	Reymus M, Lümkmann N, Stawarczyk B. 3D-printed material for temporary restorations: impact of print layer thickness and post-curing method on degree of conversion. <i>Int J Comput Dent.</i> 2019;22(3):231-237.	61	62	Article

18	Maroulakos M, Kamperos G, Tayebi L, Halazonetis D, Ren Y. Applications of 3D printing on craniofacial bone repair: A systematic review. <i>J Dent.</i> 2019 Jan;80:1-14.	61	63	Review
19	Schweiger J, Edelhoff D, Güth JF. 3D Printing in Digital Prosthetic Dentistry: An Overview of Recent Developments in Additive Manufacturing. <i>J Clin Med.</i> 2021 May 7;10(9):2010.	55	55	Review
20	Alharbi N, Alharbi S, Cuijpers VMJ, Osman RB, Wismeijer D. Three-dimensional evaluation of marginal and internal fit of 3D-printed interim restorations fabricated on different finish line designs. <i>J Prosthodont Res.</i> 2018 Apr;62(2):218-226.	52	53	Article
21	Revilla-León M, Meyer MJ, Özcan M. Metal additive manufacturing technologies: literature review of current status and prosthodontic applications. <i>Int J Comput Dent.</i> 2019;22(1):55-67.	50	51	Review
22	Methani MM, Revilla-León M, Zandinejad A. The potential of additive manufacturing technologies and their processing parameters for the fabrication of all-ceramic crowns: A review. <i>J Esthet Restor Dent.</i> 2020 Mar;32(2):182-192.	49	50	Review
23	Pillai S, Upadhyay A, Khayambashi P, Farooq I, Sabri H, Tarar M, Lee KT, Harb I, Zhou S, Wang Y, Tran SD. Dental 3D-Printing: Transferring Art from the Laboratories to the Clinics. <i>Polymers (Basel).</i> 2021 Jan 4;13(1):157.	47	47	Review
24	Revilla-León M, Sadeghpour M, Özcan M. An update on applications of 3D printing technologies used for processing polymers used in implant dentistry. <i>Odontology.</i> 2020 Jul;108(3):331-338.	46	48	Review
25	Jockusch J, Özcan M. Additive manufacturing of dental polymers: An overview on processes, materials and applications. <i>Dent Mater J.</i> 2020 Jun 5;39(3):345-354.	44	45	Review
26	Revilla-León M, Sadeghpour M, Özcan M. A Review of the Applications of Additive Manufacturing Technologies Used to Fabricate Metals in Implant Dentistry. <i>J Prosthodont.</i> 2020 Aug;29(7):579-593.	43	46	Review
27	Park SM, Park JM, Kim SK, Heo SJ, Koak JY. Flexural Strength of 3D-Printing Resin Materials for Provisional Fixed Dental Prostheses. <i>Materials (Basel).</i> 2020 Sep 8;13(18):3970.	40	41	Article
28	Salah M, Tayebi L, Moharamzadeh K, Naini FB. Three-dimensional bio-printing and bone tissue engineering: technical innovations and potential applications in maxillofacial reconstructive surgery. <i>Maxillofac Plast Reconstr Surg.</i> 2020 Jun 3;42(1):18.	39	40	Review
29	Unkovskiy A, Wahl E, Zander AT, Huettig F, Spintzyk S. Intraoral scanning to fabricate complete dentures with functional borders: a proof-of-concept case report. <i>BMC Oral Health.</i> 2019 Mar 13;19(1):46.	39	44	Article
30	Revilla-León M, Gonzalez-Martín Ó, Pérez López J, Sánchez-Rubio JL, Özcan M. Position Accuracy of Implant Analogs on 3D Printed Polymer versus Conventional Dental Stone Casts Measured Using a Coordinate Measuring Machine. <i>J Prosthodont.</i> 201 Jul;27(6):560-567.	36	36	Article
31	Chen J, Ahmad R, Suenaga H, Li W, Sasaki K, Swain M, Li Q. Shape Optimization for Additive Manufacturing of Removable Partial Dentures--A New Paradigm for Prosthetic CAD/CAM. <i>PLoS One.</i> 2015 Jul 10;10(7):e0132552.	36	36	Article
32	Gruber S, Kamnoedboon P, Özcan M, Srinivasan M. CAD/CAM Complete Denture Resins: An In Vitro Evaluation of Color Stability. <i>J Prosthodont.</i> 2021 Jun;30(5):430-439.	34	35	Article
33	Bayarsaikhan E, Lim JH, Shin SH, Park KH, Park YB, Lee JH, Kim JE. Effects of Postcuring Temperature on the Mechanical Properties and Biocompatibility of Three-Dimensional Printed Dental Resin Material. <i>Polymers (Basel).</i> 2021 Apr 7;13(8):1180.	32	32	Article
34	Cristache CM, Totu EE, Iorgulescu G, Pantazi A, Dorobantu D, Nechifor AC, Isildak I, Burlibasa M, Nechifor G, Enachescu M. Eighteen Months Follow-Up with Patient-Centered Outcomes Assessment of Complete Dentures Manufactured Using a Hybrid Nanocomposite and Additive CAD/CAM Protocol. <i>J Clin Med.</i> 2020 Jan 23;9(2):324.	32	32	Article

35	Presotto AGC, Barão VAR, Bhering CLB, Mesquita MF. Dimensional precision of implant-supported frameworks fabricated by 3D printing. <i>J Prosthet Dent.</i> 2019 Jul;122(1):38-45.	31	34	Article
36	Alifui-Segbaya F, Williams RJ, George R. Additive Manufacturing: A Novel Method for Fabricating Cobalt-Chromium Removable Partial Denture Frameworks. <i>Eur J Prosthodont Restor Dent.</i> 2017 Jun;25(2):73-78.	31	31	Article
37	Revilla-León M, Besné-Torre A, Sánchez-Rubio JL, Fábrega JJ, Özcan M. Digital tools and 3D printing technologies integrated into the workflow of restorative treatment: A clinical report. <i>J Prosthet Dent.</i> 2019 Jan;121(1):3-8.	30	30	Article
38	Revilla-León M, Ceballos L, Martínez-Klemm I, Özcan M. Discrepancy of complete-arch titanium frameworks manufactured using selective laser melting and electron beam melting additive manufacturing technologies. <i>J Prosthet Dent.</i> 2018 Dec;120(6):942-947.	30	33	Article
39	Homsy FR, Özcan M, Khoury M, Majzoub ZAK. Marginal and internal fit of pressed lithium disilicate inlays fabricated with milling, 3D printing, and conventional technologies. <i>J Prosthet Dent.</i> 2018 May;119(5):783-790.	30	29	Article
40	Kessler A, Reymus M, Hickel R, Kunzelmann KH. Three-body wear of 3D printed temporary materials. <i>Dent Mater.</i> 2019 Dec;35(12):1805-1812.	29	29	Article
41	Pituru SM, Greabu M, Totan A, Imre M, Pantea M, Spinu T, Tancu AMC, Popoviciu NO, Stanescu II, Ionescu E. A Review on the Biocompatibility of PMMA-Based Dental Materials for Interim Prosthetic Restorations with a Glimpse into their Modern Manufacturing Techniques. <i>Materials (Basel).</i> 2020 Jun 28;13(13):2894.	28	28	Review
42	Prechtel A, Reymus M, Edelhoff D, Hickel R, Stawarczyk B. Comparison of various 3D printed and milled PAEK materials: Effect of printing direction and artificial aging on Martens parameters. <i>Dent Mater.</i> 2020 Feb;36(2):197-209.	25	27	Article
43	Braim M, Jönsson D, Kevci M, Wennerberg A. Geometrical accuracy of metallic objects produced with additive or subtractive manufacturing: A comparative in vitro study. <i>Dent Mater.</i> 2018 Jul;34(7):978-993.	25	27	Article
44	Revilla-León M, Sánchez-Rubio JL, Besné-Torre A, Özcan M. A report on a diagnostic digital workflow for esthetic dental rehabilitation using additive manufacturing technologies. <i>Int J Esthet Dent.</i> 2018;13(2):184-196.	24	25	Article
45	Kraemer Fernandez P, Unkovskiy A, Benkendorff V, Klink A, Spintzyk S. Surface Characteristics of Milled and 3D Printed Denture Base Materials Following Polishing and Coating: An In-Vitro Study. <i>Materials (Basel).</i> 2020 Jul 24;13(15):3305.	22	22	Article
46	Jin SJ, Jeong ID, Kim JH, Kim WC. Accuracy (trueness and precision) of dental models fabricated using additive manufacturing methods. <i>Int J Comput Dent.</i> 2018;21(2):107-113.	22	24	Article
47	Revilla León M, Klemm IM, García-Arranz J, Özcan M. 3D Metal Printing - Additive Manufacturing Technologies for Frameworks of Implant-Borne Fixed Dental Prosthesis. <i>Eur J Prosthodont Restor Dent.</i> 2017 Sep;25(3):143-147.	22	23	Article
48	Latimer JM, Maekawa S, Yao Y, Wu DT, Chen M, Giannobile WV. Regenerative Medicine Technologies to Treat Dental, Oral, and Craniofacial Defects. <i>Front Bioeng Biotechnol.</i> 2021 Aug 6;9:704048.	21	22	Review
49	Cha HS, Park JM, Kim TH, Lee JH. Wear resistance of 3D-printed denture tooth resin opposing zirconia and metal antagonists. <i>J Prosthet Dent.</i> 2020 Sep;124(3):387-394.	21	21	Article
50	Thurzo A, Urbanová W, Novák B, Waculiková I, Varga I. Utilization of a 3D Printed Orthodontic Distalizer for Tooth-Borne Hybrid Treatment in Class II Unilateral Malocclusions. <i>Materials (Basel).</i> 2022 Feb 25;15(5):1740.	20	20	Article

Table 2. Journals with the top 50 most cited articles on the use of additive manufacturing in dentistry

	Paper Numbers	JCR® IF2022	Quartile Category
Journal of Prosthetic Dentistry	8	4.6	Q1
Dental Materials	6	5	Q1
Journal of Prosthodontics-Implant Esthetic and Reconstructive Dentistry	5	4	Q1
Materials	4	3.4	Q3
Journal of Esthetic and Restorative Dentistry	3	3.2	Q2
Journal of Clinical Medicine	3	3.9	Q2
International Journal of Computerized Dentistry	3	1.7	Q4
International Journal of Prosthodontics	2	2.3	Q3
Journal of Dentistry	2	4.4	Q1
Polymers	2	5	Q1
European Journal of Prosthodontics and Restorative Dentistry	2	1.3	*
Journal Of Periodontal and Implant Science	1	3.4	Q3
International Journal of Dentistry	1	2.1	*
Journal Of Prosthodontic Research	1	3.6	Q1
Odontology	1	2.5	Q3
Dental Materials Journal	1	2.5	Q3
Maxillofacial Plastic and Reconstructive Surgery	1	2.3	*
BMC Oral Health	1	2.9	Q2
PLoS One	1	3.7	Q2
International Journal of Esthetic Dentistry	1	1.4	*
Frontiers In Bioengineering and Biotechnology	1	5.7	Q1

*: These journals do not have Q classification in the relevant category.

Table 3. Authors of the top 50 most cited articles on the use of additive manufacturing in dentistry

First Author	Institution	Country	Number of citations
Marta Revilla-León*	University of Washington (UW)	USA	194
Nawal Alharbi**	King Saud University, University of Amsterdam, Vrije Universiteit Amsterdam	Netherlands	173
Raquel S.C. Galante	University of Lisbon	Portugal	160
Barazanchi, Abdullah	University of Otago	New Zealand	137
Dehurtevent, Marion Ji Suk Shim	University of Lille	France	104
Bhargav, Aishwarya	Korea University	South Korea	102
Bhargav, Aishwarya	National University of Singapore	Singapore	77
Piedra-Cascon, Wenceslao	University of Santiago de Compostela	Spain	70
Tunchel, Samy	University of Santo Amaro (UNISA)	Brazil	70
Jong, Kyoung-Jun	Chonnam National University	South Korea	66
Taiseer Sulaiman	University of North Carolina	USA	64
Etamad-Shahidi, Yasaman	Griffith University	Australia	62
Lin, Chih-Hsin	Taipei Medical University	Taiwan	62
Marcel Reymus	University of Munich	Germany	61
Maroulakos, Michael P.	National & Kapodistrian University of Athens	Greece	61
Schweiger, Josef	University of Munich	Germany	55
Mohammad Mujtaba Methani	University of Minnesota Twin Cities	USA	49
Sangeeth Pillai	McGill University	Canada	47
Jockusch, Julia	Leipzig University	Germany	44
Park, Sang-Mo	Seoul National University (SNU)	South Korea	40
Salah, Muhja	University of Nottingham	England	39
Unkovskiy, Alexey	Humboldt University of Berlin	Germany	39
Junning Chen	University of Exeter	England	36
Gruber, Simon	University of Zurich	Switzerland	34
Bayarsaikhan, Enkhjargal	Yonsei University	South Korea	32

*There are 9 articles of the related author for the top 38 first-time authors whose article is most cited.

** There are 4 articles of the related author for the top 38 first-time authors whose article is most cited.

Table 4. Countries where the top 50 most cited articles on the use of additive manufacturing in dentistry were published

Country	Number
United States America	13
Germany	7
South Korea	6
Netherlands	4
Brazil	2
Australia	2
England	2
Romania	2
Portugal	1
New Zealand	1
France	1
Singapore	1
Spain	1
Taiwan	1
Greece	1
Canada	1
Switzerland	1
Lebanon	1
Sweden	1
Slovakia	1

DISCUSSION

It is thought to be a benchmark in the advancement and development of dentistry, when any article appears in the field of dentistry among the list of 50 most cited articles. The quality of an article is measured by its recognition by scientific communities, how it contributes to clinical applications, whether it leads to different opinions and views or how it influences new directions in the study.¹²

When the 50 most cited articles on the topic of AM in dentistry were reviewed, it was found that not enough bibliometric studies have been conducted until now or they have not included all the most cited articles on the topic. Since there has been no bibliometric study in the literature on the application and use of AM in dentistry and to fill the gap in this field, this study aimed to evaluate scientific studies conducted until 24 July 2023. A methodology was adopted by searching keywords 'additive manufacturing, 3D printing, dentistry' and then classifying the articles according to their number of citations.^{13,14}

In recent years, the use of AM in the field of dentistry has gained popularity. Its use has become widespread after the 2000s with the development of technology and 3D printers. The number of most cited 50 articles on the topic has been increasing in the recent years. 2020 is the year with the most cited publications with 14 publications. In addition, the most cited article was published in 2019. It may be considered normal for previously published articles to receive more citations. As we found in our study, the increase in the number of cited articles over the years and the fact that the year with the most citations is after the year with the most cited articles may indicate that the number of studies on the subject has increased recently and the information has changed rapidly.

When the country of the author was evaluated, it was seen that the US dominates the field. The top three most cited articles were from the USA, Germany, and South Korea, respectively.

While there were 4 journals unable to enter Category Quartile classification, 50% of articles were published in journals at Q1 status. Most of the articles were published in the 'Journal of Prosthetic Dentistry'. The reason why the articles were mostly published in the journal probably is that it is the most popular and respected journal in the field of dentistry with the highest impact factor.¹⁵ Another important

factor is that Prosthodontics science is interested in subtractive manufacturing and has increased its transition to additive manufacturing and research. 64% of papers were research, and 36% were review articles. It is a natural course that as the time of publication prolongs the number of citations increases but in this literature review, it was seen that the most cited article was published in 2019 with 194 citations and it was not the oldest among 50 articles is contrary to the explanation of the citation rate. The number of the most cited articles was 14 in 2020, and 12 in 2019 indicating the increasing interest to the topic in recent years. Many factors such as the type and method of the article affect citation rates.

This study has some limitations like other bibliometric studies; the most prominent limitation is that the WOS Citation Reference search tool cannot prevent automatic self-citation and preference of authors to make citations to the journal that intended their articles to be published.^{16,17} In this bibliometric study, data was created by searching from a single source with certain English words over a certain period of time.

Ethics Committee Approval: This study was conducted within a scope that does not require ethics committee approval.

Informed Consent: Informed consent was not required.

Peer-review: Externally peer-reviewed.

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