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A Bibliometric Analysis of 3D Printing in Orthodontics: A Cross-Sectional Research

Ortodontide 3D Baskının Bibliyometrik Analizi: Kesitsel Araştırma

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ABSTRACT Objective: This bibliometric analysis aims to provide a general assessment of advancements in and the current state of 3 dimensional (3D) printing technologies as well as to review the literature on the clinical applications of such technologies in orthodontics. **Material and Methods:** On July 7, 2024, a detailed electronic search was conducted in the Web of Science Core Collection (WoSCC) and Scopus databases for terms related to 3D printing in orthodontics. This search yielded 467 publications in WoSCC and 676 in Scopus, which were exported, merged, and processed to remove duplicates (410) and irrelevant publications, resulting in 595 publications for analysis. The bibliometric analysis was performed using VOSviewer and the Bibliometrix Biblioshiny R package. Adjustments were made to the dataset to correct errors in author names, countries, journals, and institutions. **Results:** A total of 595 articles were included in this study. The top 5 most productive countries in terms of published articles were the United States of America, China, Italy, Germany, and India. The most prolific journal has been The American Journal of Orthodontics and Dentofacial Orthopedics. The main themes highlighted in the articles include "digital workflow," "bone regeneration" and "3D imaging". The most frequently used keywords were "3D printing", "orthodontics", and "additive manufacturing". The most influential author was Kasper F. Kurtis, who accounted for 16 articles and 406 citations. **Conclusion:** This bibliometric analysis has revealed the current state of 3D printing technology in orthodontics, the increasing number of publications, the main research themes, and its impact through leading countries, journals, and authors.

Keywords: Bibliometrics; citation analysis; data visualization; orthodontics; 3D printing

ÖZET Amaç: Bu bibliyometrik analiz, 3 boyutlu [3 dimensional (3D)] baskı teknolojilerindeki gelişmeleri ve mevcut durumu genel olarak değerlendirmeyi, ayrıca bu teknolojilerin ortodontideki klinik uygulamalarına ilişkin literatürü gözden geçirmeyi amaçlamaktadır. **Gereç ve Yöntemler:** 7 Temmuz 2024 tarihinde, Web of Science Core Collection (WoSCC) ve Scopus veri tabanlarında ortodontide 3D baskı ile ilgili terimler için ayrıntılı bir elektronik arama yapılmıştır. Bu arama sonucunda WoSCC'de 467 ve Scopus'ta 676 yayın elde edilmiş, bunlar dışa aktarılmış, birleştirilmiş ve mükerrer (410) ve ilgisiz yayınların çıkarılması için işlenerek analiz için 595 yayın elde edilmiştir. Bibliyometrik analiz, VOSviewer ve Bibliometrix Biblioshiny R paketi kullanılarak gerçekleştirilmiştir. Yazar adları, ülkeler, dergiler ve kurumlardaki hataları düzeltmek için veri setinde ayarlamalar yapılmıştır. **Bulgular:** Bu çalışmaya toplam 595 makale dâhil edilmiştir. Yayınlanan makaleler açısından en üretken ilk 5 ülke Amerika Birleşik Devletleri, Çin, İtalya, Almanya ve Hindistan olmuştur. En üretken dergi The American Journal of Orthodontics and Dentofacial Orthopedics olmuştur. Makalelerde öne çıkan başlıca temalar arasında "dijital iş akışı", "kemik rejenerasyonu" ve "3 boyutlu görüntüleme" yer almaktadır. En sık kullanılan anahtar kelimeler "3D baskı", "ortodonti" ve "eklemeli üretim" olmuştur. En etkili yazar ise 16 makale ve 406 atıfla Kasper F. Kurtis olmuştur. **Sonuç:** Bu bibliyometrik analiz, 3D baskı teknolojisinin ortodontideki durumunu, artan makale sayısını, ana araştırma temalarını ve önde gelen ülkeler, dergiler ve yazarlar üzerinden etkisini ortaya koymuştur.

Anahtar Kelimeler: Bibliyometri; atıf analizi; veri görselleştirme; ortodonti; 3 boyutlu baskı

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Advancements in digital applications have facilitated significant developments in various professions, including orthodontics. Although the fundamental principles and practices of orthodontic treatment have remained the same, the use of digital systems and technologies has led to significant changes and transformations in the operation of orthodontic clinics. One of the most recent developments in this process is the use of 3 dimensional (3D) printing technologies to produce physical objects from digital files.[1] In recent years, interest in 3D prints produced by 3D printers among researchers has increased. Due to the advent of 3D printers, it has become possible to create 3D objects that exhibit various structures and complex geometries directly from digital models. The production of 3D parts involves 3 main processes: shaping, subtractive manufacturing, and additive manufacturing. Shaping involves reshaping a workpiece without adding or removing material, as in the case of vacuum forming.[2] Subtractive manufacturing involves removing material from a block through milling or cutting until the desired shape is achieved.[3] Additive manufacturing refers to a process in which a raw material is added layer by layer in a specific shape with the goal of producing an object.[3,4] Other terms that have been used to discuss 3D printing in the literature include additive manufacturing and rapid prototyping.[5] This process facilitates the production of complex structural configurations to address specific needs under the guidance of digital data pertaining to the geometry of the object to be printed. The fundamental steps involved in layered manufacturing include conceptualization, computer-aided design, the conversion of data to stereolithographic format, additive processing, structure fabrication, postprocessing modifications, and final delivery.[6] Since the emergence of this process, additive manufacturing has expanded significantly from the aerospace industry to specialized fields of dentistry, such as orthodontics and oral, dental, and maxillofacial surgery. This technology has revolutionized dental practices worldwide. Various specialties in the field of oral and dental health greatly benefit from the use of 3D printing technology. Dentists are able to offer patients more accurate, faster, and personalized treatment options, thus significantly improving their treatment processes.[7]

3D printing technology can be used to produce various orthodontic appliances, such as removable orthodontic appliances, expansion appliances, indirect bonding trays, orthodontic models, and clear aligners.[8,9] During the process of planning for the production of orthodontic appliances, it is necessary to develop a physical model of the patient's dental structure. 3D printing eliminates certain traditional steps in this process, such as the needs to take measurements and cast models, by allowing the digital model of the patient's teeth to be converted into a physical model. Additionally, 3D printing technology facilitates the production of multiple identical copies of a digital model and eliminates the risk of distortion or deformation in this context.[10]

Bibliometric analysis is a mathematical technique that facilitates the quantitative assessment of information, the identification of important research areas, and the exploration of contemporary concepts within a specific field.[11] Bibliometric studies can contribute to the development of a field by providing scholars with an overview of the area, identifying knowledge gaps, and facilitating the generation of new research ideas.[12]

Many studies have investigated the use of 3D printers in orthodontics in recent years. However, to our knowledge, this bibliometric study is the first to explore the use of 3D printers in the field of orthodontics. This study fills a significant gap in the literature as the first bibliometric analysis exploring the use of 3D printing in the field of orthodontics. By incorporating both Web of Science Core Collection (WoSCC; Clarivate, United Kingdom) and Scopus (Elsevier, Netherlands) databases, it provides a more comprehensive literature review, while the utilization of VOSviewer (Center for Science and Technology Studies, Leiden University, Netherlands) and the Bibliometrix Biblioshiny R package (University of Naples Federico II, Italy) enhances the presentation of findings through effective visualizations. The study sheds light on global trends by offering visual outputs such as collaboration networks, citation analyses, and keyword density maps. Furthermore, it adopts an interdisciplinary approach, providing novel insights into the academic and clinical impacts of 3D printing technology in orthodontics.

The aim of this bibliometric analysis is to provide insights into the development and current state of 3D printing technologies and to review the literature on the application of 3D printing in clinical orthodontics. Additionally, the data obtained through this research should be useful with respect to the identification of future research directions and collaboration relationships.

MATERIAL AND METHODS

On July 7, 2024, a comprehensive electronic search was conducted in the WoSCC and Scopus databases. In the WoSCC, a topic search for "3D print*" or "3 dimension* print*" or "three dimension* print*" (Topic) and "orthodon*" OR "nasoalveolar mo*" (Topic) yielded 467 publications. In Scopus, a search for [TITLE-ABS-KEY ("3D print*" OR "3 dimension* print*" OR "three dimension* print*") AND TITLE-ABS-KEY ("orthodon*" OR "nasoalveolar mo*")] led to the identification of 676 publications. These publications were exported in bib format. The exported datasets were merged via R software (ver. 4.3.3; R Foundation for Statistical Computing, Vienna, Austria). Based on this set of 1,143 publications, duplicates were eliminated with the assistance of both R Studio and Microsoft Excel (Microsoft Corp., USA) software. This process led to the exclusion of 410 publications. A total of 38 articles were excluded because they were published in languages other than English. Additionally, 92 publications were excluded because they were neither articles nor reviews. Eight publications were excluded because they were unrelated to the topic under investigation. This process resulted in a total of 595 remaining publications. A flowchart related to this study is presented in Figure 1.

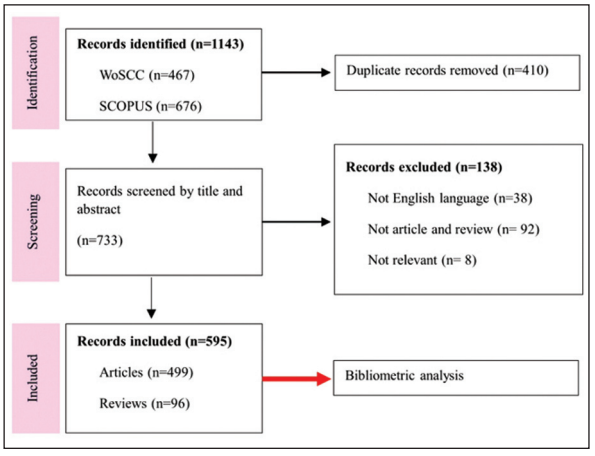

FIGURE 1: Flowchart of the study

Citation counts were based primarily on Scopus data. When the dataset thus obtained was input into bibliometric analysis programs, it was found to produce erroneous results. Therefore, adjustments were made to the dataset to ensure better processing by the bibliometric analysis programs. Errors pertaining to author names, countries, journals, institutions, etc., were manually corrected.

The bibliometric analysis and visualization of the data were performed via VOSviewer software and the Bibliometrix Biblioshiny R package.

The Biblioshiny R package is an innovative open-source tool to support comprehensive analysis in the context of scientific mapping. This software supports a recommended workflow for bibliometric analyses. The proposed tool, which is programmed in the R language, is flexible, easily upgradeable, and integrable with other statistical R packages. Therefore, this tool is useful in a continuously evolving field such as bibliometrics.[13] The data were prepared in ".xlsx" file format and processed via this program; furthermore, visuals were created to illustrate coauthorship networks among authors, countries, and institutions; word clouds; cocitation networks; thematic maps; authors' production over time; and annual scientific production.

VOSviewer facilitates the creation of maps of authors or journals on the basis of cocitation data as well as maps of keywords on the basis of co-occurrence data. The program provides a viewer that enables researchers to conduct a comprehensive examination of bibliometric maps.[14] The data, which were originally in the ".xlsx" format, were converted to the ".txt" format to import them into VOSviewer, following which they were processed and used to develop a co-occurrence visualization of the distribution of keywords over the years.

The size of the nodes is proportional to the number of authors, countries, institutions and keywords. The width of the links represents the strength of the cooperative relationship, with a greater width indicating a stronger relationship.

This study does not require ethical approval as it does not involve human participants or animal experiments. This study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

GENERAL INFORMATION

This study examined articles published in the literature on the use of 3D printing technologies in orthodontics from 2011 to 2024. A general increase in the number of published articles each year was observed, and the annual growth rate was 39.39%. A total of 595 publications were reviewed, which were drawn from 221 different sources (journals, books, etc.). Among these publications, 499 (83.86%) were research articles, and 96 were review articles. The average number of citations per article was 14.85. A total of 2,218 authors contributed to the published articles, and the international coauthorship rate was 13.28% (Table 1). The 10 most frequently cited articles on the use of 3D printers in orthodontics, as determined based on the search targets, are presented in Table 2. The number of published articles by year from 2011 to the present is illustrated in Figure 2.

TABLE 1: Main information of the study

Description	Results
Main information about data	
Timespan	2011:2024
Sources (Journals, Books, etc)	221
Documents	595
Annual growth rate %	39.39
Document average age	2.92
Average citations per doc	14.85
References	11.150
Document contents	
Keywords plus (ID)	2.371
Author's keywords (DE)	1.380
Authors	
Authors	2.218
Authors of single-authored docs	16
Authors collaboration	
Single-authored docs	22
Co-authors per doc	5
International co-authorships %	13.28
Document types	
Article	499
Review	96

COUNTRIES & INSTITUTIONS AND AUTHORS

The results of the bibliometric analyses of interinstitutional collaborations are presented in Figure 3a. Among institutions, the University of Zurich made the most contributions to this field (21 articles, 348 citations) (Figure 3b). Collaborations among countries are illustrated in Figure 4a. The top 5 most productive countries are illustrated in Figure 4b, which reveals that the USA made the most contributions (214 articles, 1,314 citations). Author collaborations are illustrated in Figure 5a, and the leading 4 authors are identified in Figure 5b. The most influential author on the topic of 3D printing technologies in orthodontics is Kasper F. Kurtis (16 articles, 406 citations).

KEYWORDS

A total of 1,380 keywords were identified in the works produced by these authors. The most prominent keywords were "3D printing", "orthodontics" and "additive manufacturing". The network map, which illustrates the connections among and distributions of the authors' keywords over the years (Figure 6a), includes a colour-coded timescale in the lower right corner, thus revealing how specific keywords have evolved over time. The use of terms such as "artificial intelligence" and "augmented reality" in addition to "3D printing" and "orthodontics" has increased (Figure 6b).

JOURNALS

The journal associated with the most publications on this topic was the American Journal of Orthodontics and Dentofacial Orthopedics (32 articles, 1,114 citations) (Figure 7).

THEMES

The themes are visualized in 4 quadrants, in which context "digital workflow", "computer-aided design", "bone regeneration" and "guided tissue regeneration" represent the main themes in the upper right quadrant. The niche themes include "orthodontic digital models", "direct printed aligners", and "dental materials." Fundamental themes such as "3D printing orthodontics," "biomechanics," and "finite ele-

TABLE 2: Most cited 10 articles

Title	Authors	Journals	Publication year	WoSCC total citations	WoSCC citations average per year	Scopus total citations	Scopus citations average per year	Type of study
3D Printing in Dentistry	Dawood A, Marti B, Sauret-Jackson V, Darwood A	British Dental Journal	2015	598	59.8	692	69.2	Article
Accuracy and Reproducibility of Dental Replica Models Reconstructed by Different Rapid Prototyping Techniques	Hazeveld A, Slater J, Ren Y	American Journal of Orthodontics and Dentofacial Orthopedics	2014	215	19.54	242	22	Article
3D and 4D Printing in Dentistry and Maxillofacial Surgery: Printing Techniques, Materials, and Applications	Khorsandi D, Fahimipour A, Abasian P, Saber S, Seyedi M, Ghanavati S, Ahmad A, De SA, Taghavinezhaddilami F, Leonova A, Mohammadinejad R, Shabani M, Mazzolai B, Mattoli V, Tay F, Makvandi P	Acta Biomaterialia	2021	153	38.25	191	47.75	Review
Current Status and Applications of Additive Manufacturing in Dentistry: A Literature-Based Review	Javaid M, Haleem A	Journal of Oral Biology and Craniofacial Research	2019	-	-	186	31	Review
A Review of 3D Printing in Dentistry: Technologies, Affecting Factors, and Applications	Tian Y, Chen C, Xu X, Wang J, Hou X, Li K, Lu X, Shi H, Lee E, Jiang H	Scanning	2021	136	34	174	43.5	Review
Influence of the Three-Dimensional Printing Technique and Printing Layer Thickness on Model Accuracy	Zhang Z, Li P, Chu F, Shen G	Journal of Orofacial Orthopedics	2019	133	22.16	152	25.33	Article
Three-Dimensional Printing Technology	Groth C, Kravitz N, Jones P, Graham J, Redmond W	Journal of Clinical Orthodontics	2014	-	-	143	13	Article
3D Printing-Encompassing the Facets of Dentistry	Oberoi G, Nitsch S, Edelmayer M, Janjic K, Muller A, Agis H	Frontiers in Bioengineering and Biotechnology	2018	108	15.43	134	19.14	Review
Effect of Print Layer Height and Printer Type on the Accuracy of 3-Dimensional Printed Orthodontic Models	Favero C, English J, Cozad B, Wirthlin J, Short M, Kasper F	American Journal of Orthodontics and Dentofacial Orthopedics	2017	108	13.5	130	16.25	Article
A Review on Additive Manufacturing of Shape-Memory Materials for Biomedical Applications	Sabahi N, Chen W, Wang C, Kruzic J, Li X	Jom	2020	-	-	119	23.8	Review

WoSCC: Web of Science Core Collection

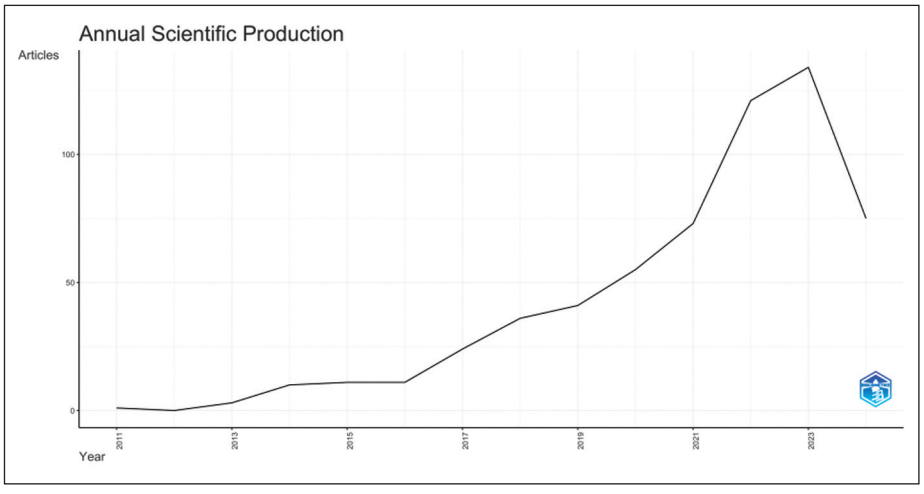

FIGURE 2: Number of articles published by year

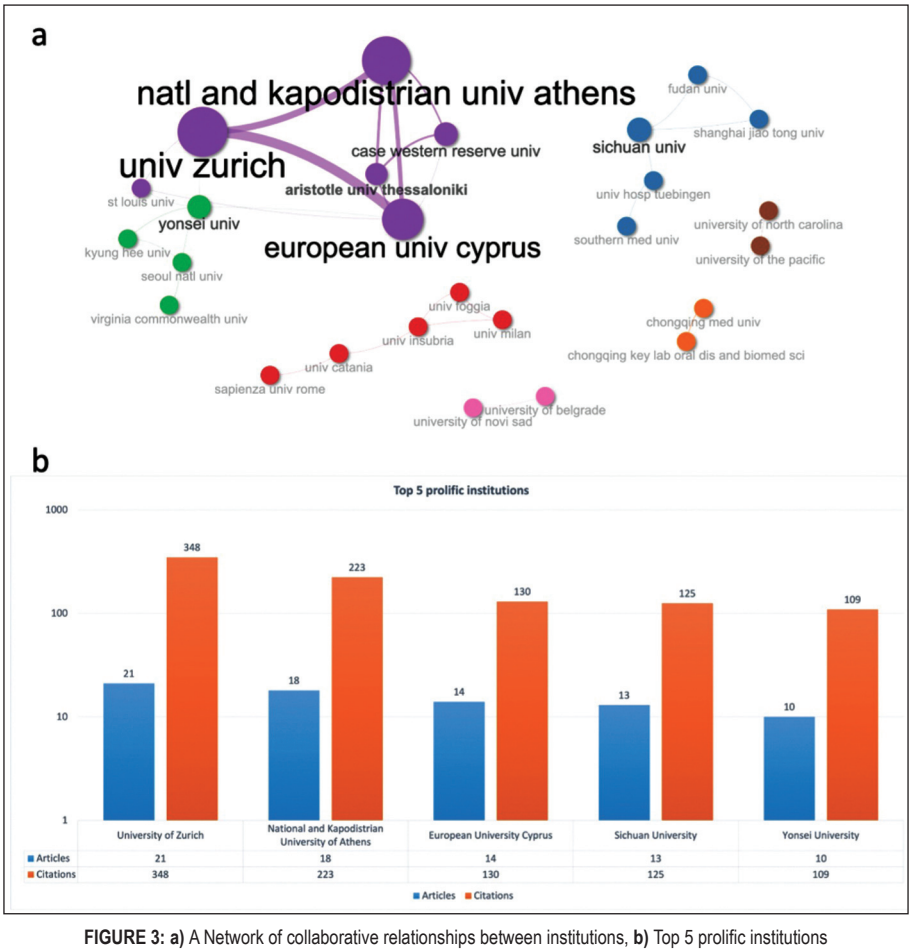

FIGURE 3: a) A Network of collaborative relationships between institutions, **b)** Top 5 prolific institutions

ment analysis" are located in the lower right quadrant. In the lower left quadrant, emerging or declining themes such as "implants", "optical impressions", and "mechanical testing" are illustrated (Figure 8).

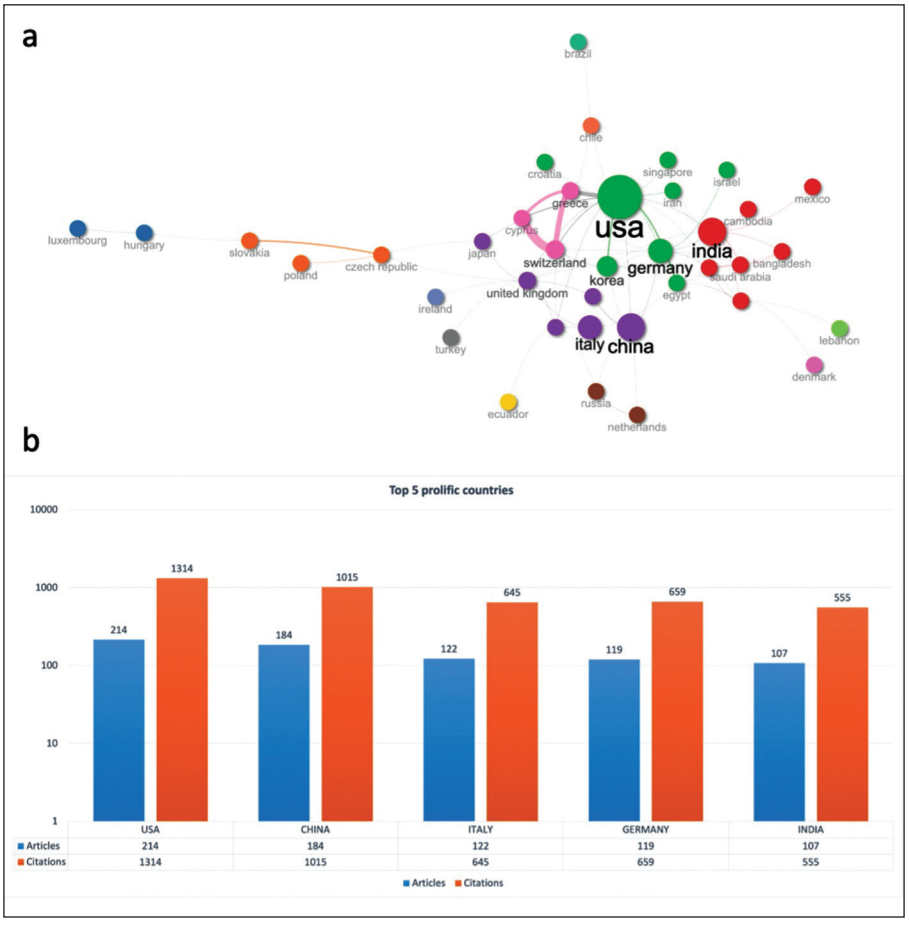

FIGURE 4: a) A network of collaborative relationships between countries, **b)** Top 5 prolific countries

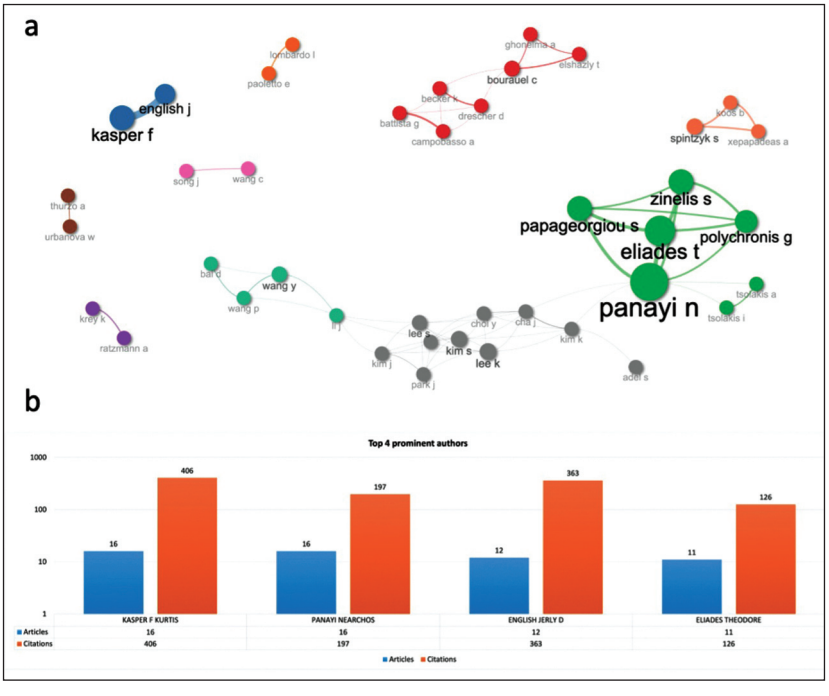

FIGURE 5: a) A network of collaborative relationships among authors, **b)** Top 4 prominent authors

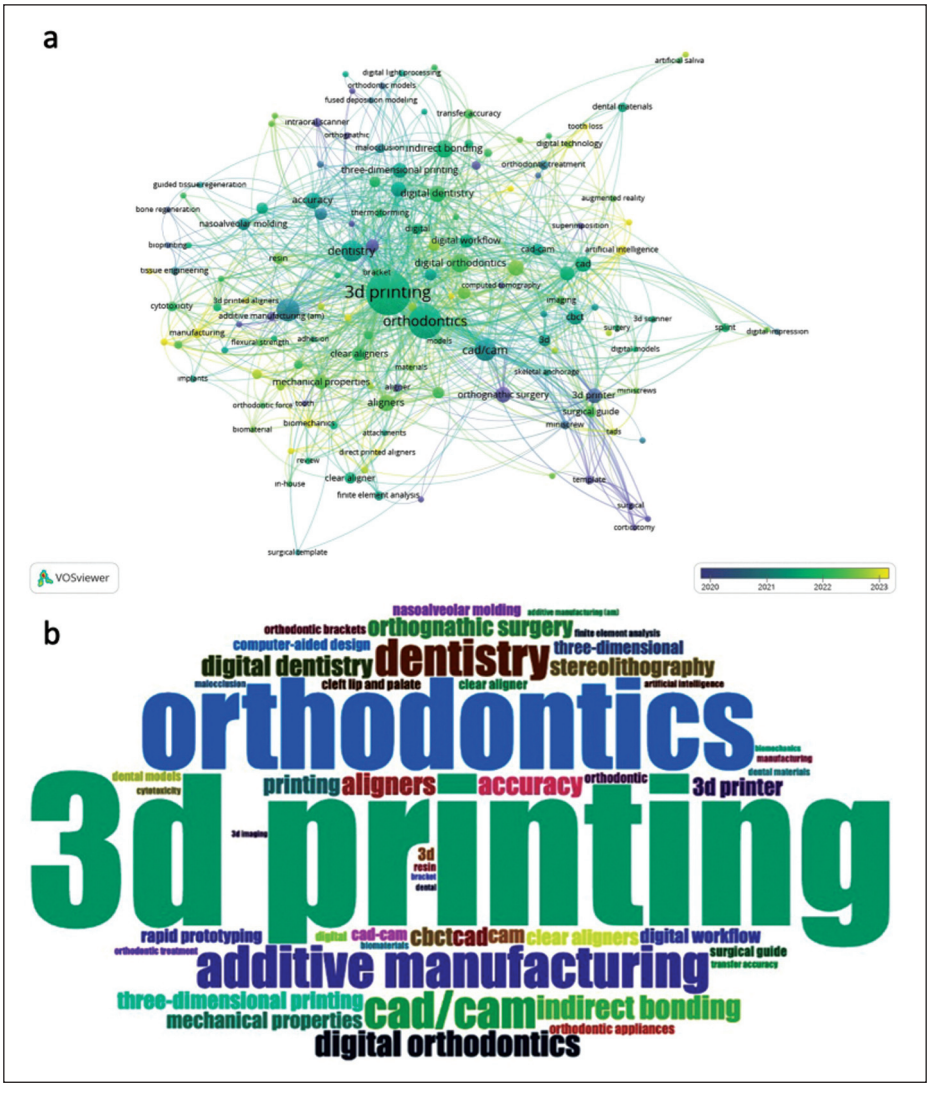

FIGURE 6: a) Network of author keywords by year, **b)** Word cloud of authors keywords

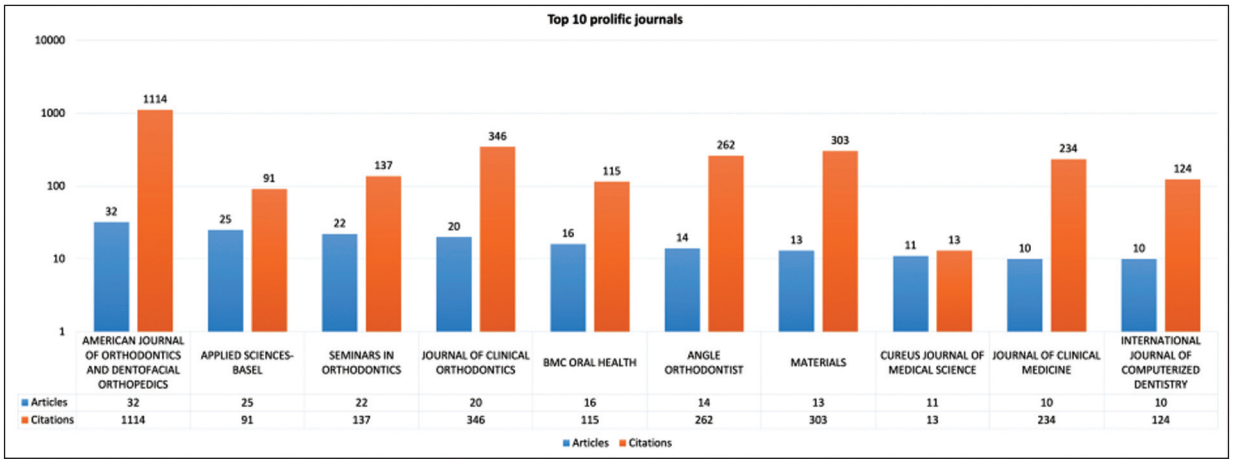

FIGURE 7: Top 10 prolific journals

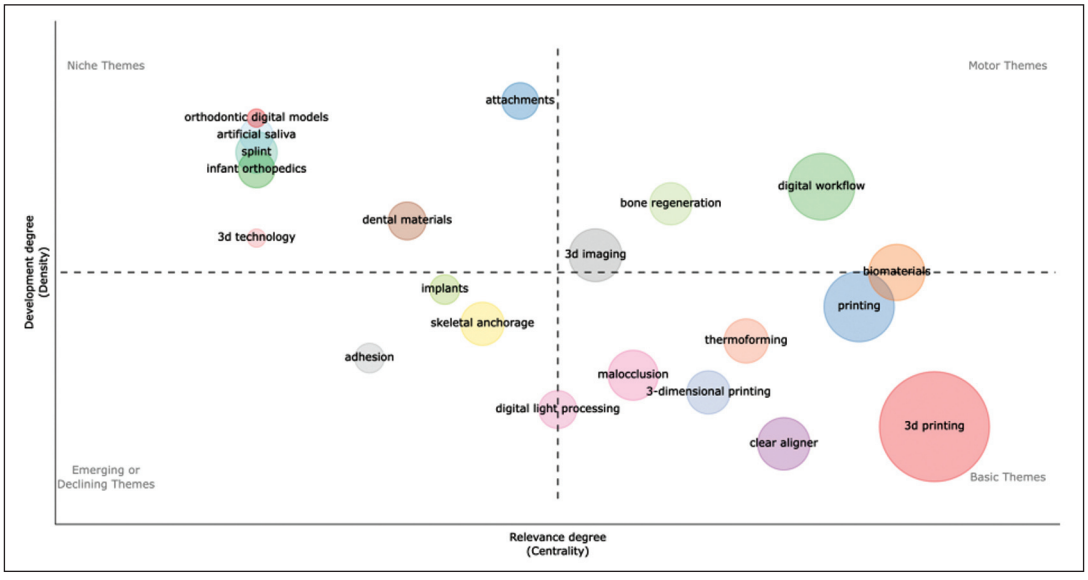

FIGURE 8: Thematic map

DISCUSSION

The aim of this study is to perform a bibliometric analysis of articles published in WoSCC and Scopus regarding the use of 3D printing technologies in orthodontics. In our study, we utilized both the WoSCC and the Scopus database to provide a comprehensive and robust analysis of the literature. The reason for using both the WoSCC and Scopus databases together in our study is that each offers different advantages, providing a more comprehensive and reliable bibliometric analysis. WoSCC and Scopus are important resources for research evaluation and bibliometric analyses, with broad data coverage and effective impact indicators. However, both databases also have specific biases and limitations.[15] Therefore, the combination of both databases balances the shortcomings of each, enabling us to obtain more balanced and reliable results by providing a broader data range for our research. WoSCC provides access to important publications in specific fields, while Scopus offers a broader content scope and a more user-friendly interface for practical use. Both databases play a significant role in evaluating research publications and metrics across various disciplines. Given that similar methodologies have been used in previous studies, this dual approach emphasizes the importance of minimizing potential biases and enhancing the validity of bibliometric analyses.[16,17] The study analyzed all publications from the 1st paper published on this topic in 2011 to 2024, with the aim of evaluating the development of 3D printing technologies.

Due to recent technological advancements, various innovations have emerged in the field of orthodontics. Advanced technologies such as 3D imaging and digital scanning help orthodontists make more accurate diagnoses and develop treatment plans. As a result, patients can be treated more quickly and effectively, and outcomes become more predictable. This relationship between orthodontics and evolving technology enhances the comfort and efficiency of treatment processes for patients and increases access to orthodontic care.[18]

3D printers represent a significant technological advancement in the field of orthodontics. These printers allow orthodontists to produce custom-designed prosthetics, brackets, and other orthodontic devices for patients.[19] While these devices can also be produced via traditional methods, these methods are often time-consuming, whereas the production of such devices via 3D printers is faster and more precise.[20] Specifically, 3D printers play a major role in the development of more aesthetically acceptable and

comfortable treatment methods, such as clear aligners. These devices can produce each aligner to the patient's specific dental structure by using digital models of the patient's mouth, thus providing a more comfortable and effective treatment experience. Additionally, the production of orthodontic devices becomes more predictable when 3D printers are used. Dentists can scan patients' mouths and digitally model them, thus facilitating better planning at every stage of the treatment process. This approach not only increases the success of the treatment but also enhances patient satisfaction and the comfort of the treatment process.[21]

Theoretically, the quality of a paper is reflected by the degree of recognition that it receives within the scientific community and the impact that it has on clinical practice, whether by instigating changes and discussions or highlighting new directions for future research.[22] A significant majority of the total citations of the 595 publications on which this research focuses pertain to the American Journal of Orthodontics and Dentofacial Orthopedics. The most frequently cited journal is the American Journal of Orthodontics, which specializes in orthodontics. This journal has been consistently ranked 1st in many bibliometric studies.[23,24] According to Bradford's law, these results reveal that a substantial number of studies are contained within a limited core of journals.[25,26] Under the influence of the increased visibility of the desired outcomes, authors tend to submit their works to the most prestigious journals to increase their probability of receiving citations.[27] On the other hand, with regard to the number of publications, the journal Applied Sciences-Basel, which publishes in the field of engineering, is the leading publication source. This finding reflects the increasingly multidisciplinary nature of orthodontic science.

The United States has been identified as the most productive country in terms of article production, which is consistent with the findings of other bibliometric studies.[28-30] Unsurprisingly, these publications are produced in developed countries such as the USA, Germany and Italy. Traditionally, scientific research and publications have been concentrated in developed countries because these countries have more resources and better infrastructure. However, the high number of articles produced in developing countries such as China and India is quite impressive and noteworthy. China and India are also notable in terms of research on the use of artificial intelligence in orthodontics.[31] The significant number of publications in innovative fields such as 3D printing technologies in orthodontics produced in China and India highlights the degree to which these countries emphasize scientific research and innovation, thus indicating their potential in this area. Researchers in these countries can enhance their knowledge base by collaborating with colleagues from developed countries or by conducting intensive research programmes within their own regions. This diversity and expansion with regard to the global production and sharing of scientific knowledge can lead to the emergence of a richer and more inclusive scientific community. The increasing number of scientific publications from these countries represents an important step towards the achievement of the common goals of the global scientific community.

The period from 2011 to 2016 can be viewed as a time during which 3D printing technologies in orthodontics had not yet been widely researched or when awareness of this topic was low. Research on the use of 3D technologies in orthodontics began to exhibit a significant upwards trend in 2017, peaked in 2021 and 2022, and experienced a slight decline in 2023. This trend indicates that 3D printing technologies have become an increasingly important and mature research topic in the field of orthodontics. This information can help researchers identify trends and potential research areas on which they can focus in future studies.

A significant majority of the articles contained in the WoSCC and Scopus (n=499) databases were research papers. This finding indicates that innovative studies are being conducted in this area.

Kasper F. Kurtis, who published 16 works, is the most prolific author in this context. However, with regard to the citation counts for each paper, another author, Dawood A, is notable, receiving 598 citations in the WoSCC database and 692 in the Scopus database.[18] Citation rates vary across disciplines. Generally, a publication that is cited more than 400 times is considered to be a classic.[32] In medical fields,

where research activity is limited, the criterion for classifying a paper as a classic is 100 citations.[23] The fact that all of the top 10 most frequently cited papers exceed 100 citations indicates the intensity of research activity in this area.

Total citation counts alone are insufficient to assess the impact of a study. The value of recently published, high-quality, meaningful, and original articles can be overlooked in such a context, as works typically receive more citations the longer they are available.[33,34] The highest scientific impact of articles often occurs within a 10-20 year chronological range.[23,29] Therefore, the potential impact of recently published articles is often underestimated. The annual average citation count is an indicator of the potential high impact of articles that have been recently published, which have not yet had sufficient time to accumulate a large number of total citations.[23,35] Consequently, in our study, annual citation counts are also considered. The study published by Dawood et al. exhibits a notably high annual citation count.[18] The fact that Dawood et al.'s work has received the highest number of citations both annually and in total indicates its high scientific value and impact. The thematic map analysis offers us insights into research trends and emerging themes pertaining to the use of 3D printing technologies in orthodontics. In the map, the upper right region highlights motor themes such as "digital workflow", "3D imaging" and "bone regeneration". These findings indicate that the clinical applications of 3D printing technologies in orthodontics are important and well-developed topics. Fundamental themes represent core and broad areas in this field. In this area of the map, topics such as "3D printing", "thermoforming" and "clear aligner" are present. These findings suggest that 3D printing technologies represent a fundamental and widely studied topic in orthodontics. Niche themes are characterized by low centrality but high density. In this part of the map, topics such as "orthodontic digital models", "attachments" and "dental materials" are found. These findings indicate that 3D printing technologies are intensively studied in specific areas of specialization. Emerging or declining themes represent new or waning areas of interest. In this region of the map, topics such as "implants", "skeletal anchorage" and "adhesion" are present. These findings suggest that these topics are either emerging or received decreased interest from researchers.

LIMITATIONS

The main advantage of this study lies in the fact that the literature review is based on 2 major databases (WoSCC and Scopus). This approach indicates that the study is grounded in a comprehensive and broad literature base. Additionally, the investigation combines both manual and automated software reviews, thus facilitating a thorough analysis. However, like other bibliometric analyses, this study has several limitations. First, although 2 major databases were consulted, some studies that were not included in these databases may have been overlooked. Second, while the analyses were conducted with the assistance of relevant software, the possibility of bias in the interpretation should be noted.

CONCLUSION

The following results were obtained in our study:

- The annual growth rate of published articles utilizing 3D printing technologies is 39.39%.
- The highest contribution in this field has been made by the University of Zurich.
- The USA has emerged as the most productive country contributing to this area.
- The most prominent keywords include "3D printing", "orthodontics" and "additive manufacturing."

These results indicate that 3D printing technology is a rapidly growing focus of interest in the field of orthodontics, and further research is needed to understand its potential impacts on clinical applications.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members

of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

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