

## Bibliometric Study on Temporary Anchorage Devices in Orthodontics

Palani Vinodhini<sup>1\*</sup>, Chandrasekharan Deepak<sup>1</sup>, Katepogu Praveen<sup>1</sup>, Nidhi Angrish<sup>1</sup>, Akshay Tandon<sup>1</sup>, Purushothaman Deenadayalan<sup>1</sup>, Victor Samuel<sup>2</sup>

<sup>1</sup>Department of Orthodontics and Dentofacial Orthopaedics, SRM Institute of Science and Technology (SRMIST), Tamil Nadu, India

<sup>2</sup>Department of Paediatric and Preventive dentistry, SRM Institute of Science and Technology (SRMIST), Tamil Nadu, India

### ABSTRACT

**Objective:** Orthodontics is a specialized field of dentistry that focuses on correcting misaligned teeth and jaws. Temporary Anchorage Devices (TADs) have emerged as a revolutionary tool in orthodontic treatment, providing improved control and efficiency. This abstract provides an overview of the key concepts, methods, and applications of TADs using Bibliometric analysis.

**Methodology:** The study involved the systematic retrieval of relevant articles from reputable scientific databases, resulting in a substantial dataset. Bibliometric techniques, including citation analysis, co-authorship analysis, keyword analysis, and visualization, were applied to gain insights into the growth and development of TAD research in orthodontics. The VOS viewer program (Centre for Science and Technology Studies, Leiden University, The Netherlands), the package "bibliometrix," and RStudio 2021.09.0+351 for Windows (RStudio, Boston, MA) were used in the bibliometric research. The website VosViewer.com. The literary data for this study came from Elsevier's Scopus database (www.scopus.com), and they were exported in BibTex format. The following criteria were used to independently classify the articles: (a) annual scholarly output; (b) top nations or regions; (c) top journals; (d) productive authors; (e) citations; (f) study design; and (g) topic distribution.

**Results:** Italy, China, and the United States of America have the most single-country publications, according to a statistical analysis. The h-index and total number of citations were used to rank the top authors.

**Conclusion:** This bibliometric analysis offers a comprehensive overview of the literature published to date. Future research can be guided by the knowledge that already exists.

**Key words:** TADs, orthodontics, Bibliometric analysis, Anchorage, Mini implants.

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**Corresponding author:** Palani Vinodhini  
**e-mail**✉: vinodhinipalani2000@gmail.com

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### INTRODUCTION

A Temporary Anchoring Device (TAD) is an auxiliary appliance used to give orthodontic anchorage. It is also referred to as mini-implants, Miniscrews, micro implants, miniplates, and on plates (Chang & Tseng, 2013). TADs can be further divided into two categories according to its primary feature, which is either a "screw"

or a "plate" (Jambi et al., 2014). TADs used in orthodontics since the beginning of the twenty-first century are constructed of titanium or a titanium alloy (Kalra et al., 2013). Because TADs do not require patient compliance, they are becoming increasingly popular in orthodontic treatment today. This is likely because they deliver superior outcomes in instances requiring greater anchorage (Ashton et al., 2023) [1].

Bibliometric is a multidisciplinary field that applies statistical and mathematical techniques to the analysis of bibliographic data, which includes citations, publication records, and metadata related to scholarly publications. The term "bibliometrics" is derived from two Greek

words: "biblion" (meaning book) and "metron" (meaning measure) (Donthu et al., 2021) [2].

Performing a bibliometric analysis on a specific topic like "TADs in orthodontics" involves evaluating and quantifying the research literature related to Temporary Anchorage Devices (TADs) in the field of orthodontics which would need access to relevant scholarly databases like PubMed, Google Scholar, Scopus, or Web of Science. Insights about the present level of orthodontic research, assistance in identifying knowledge gaps, and direction for future studies in the field may all be gained from bibliometric analyses of TADs (Schechtman, 2007) [3].

### MATERIALS AND METHODS

Bibliometrics is the primary scientific tool for the quantitative analysis of publications, journal article statistics, and citation counts. Almost all scientific disciplines now employ quantitative analysis of publication and citation data to assess a community's development, maturity, leading writers, conceptual and intellectual maps, and trends. The performance analysis and scientific mapping in this work, including metrics related to publications, citations, co-citation, co-wording, and co-authorship on TADs in orthodontics, were found using the Scopus Database (Ashton et al., 2023) [4].

#### Data Extraction

The Scopus database from Elsevier is where the data were taken from. The terms "Temporary Anchorage Devices (TADS)," "orthodontics," "mini-implant," "mini-screw," "micro-implants," "mini-implant success rate," "mini-implant failure rate," and "skeletal anchorage" were used to search the data (Baxi et al., 2023). All required fields were selected, the search was conducted under documents, and the data was produced in BibTex format (Ashton et al., 2023) [5].

#### Data Analysis

The "bibliometrix" program in RStudio (R Foundation for Statistical Computing, Vienna, Austria) for Windows was used to analyze the data. Using the R software and the procedures in the installed bibliometrix package, the retrieved data were processed (Aria & Cuccurullo, 2017) (C et al., 2023). The document type, author cooperation, author keywords, annual scientific

production on the topic, most prolific authors, citations, author nation, published sources, author dominance factor, h-index, g-index, and m-index were among the significant features that were examined (Mahuli et al., 2023). Biblioshiny R-package software, Scimago Graphica, VOSviewer, Microsoft Office spreadsheet, and other scientometric mapping tools were utilized to examine research trends, high-impact keywords, prominent producers, and fundamental bibliometric factors (C et al., 2023) [6-8].

### RESULTS

In the results, the years 2005–2023 were taken into account together with other sources (books, journals, etc.). The topic had an average of 8.93% citations per document and a 15.79% yearly growth rate. The search turned up 631 distinct authors in all. There were 27 papers with a single author, 4.06 with a co-author, and 15.64% with international co-authors [9].

#### Annual Scientific Production

On analyzing the data over time, the highest numbers of articles published in a particular year are shown in [Figure 1a]. With 33 publications on TADs, the Annual Scientific Production of the literature peaked in 2020.

#### Top 10 journals with publications

Temporary Anchorage Devices In Clinical Orthodontics(13), followed by Progress In Orthodontics(9) and Angle Orthodontist(8) were the top 3 journals published on the topic TADs shown in [table 1] [10].

Angle Orthodontist has highest impact measure: H of 7 and Apos Trends in Orthodontics and Australasian Orthodontic Journal has lowest impact measure: H of 2 which is shown in [Figure 1b].

#### Journals Production over Time

The top six journals that published TADs research over time are listed in [Figure 1c]. On close examination of the analyzed data, the journal "Temporary Anchorage Devices in Clinical Orthodontics" had zero publications from 2005 to 2019 but there was a sudden cumulative occurrence from 2018 to 2023 of 13 publications on TADs which was the highest of all the journals [11].

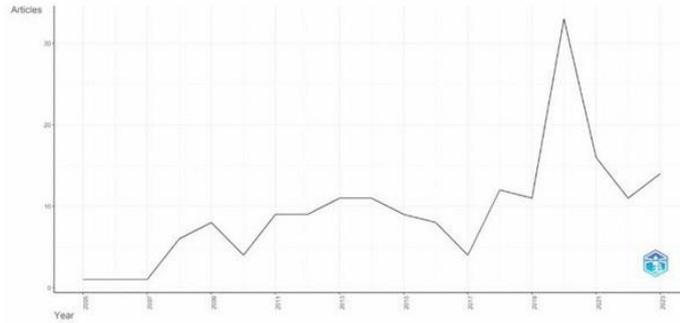


Figure 1a: Annual Scientific Production.

Table 1: Top 10 Journals with publications on TADs.

SOURCES	ARTICLES
Temporary Anchorage Devices in Clinical Orthodontics	13
Progress in Orthodontics	9
Angle Orthodontist	8
Journal of Orthodontics	8
American Journal of Orthodontics and Dentofacial Orthopedics	7
Seminars in Orthodontics	7
Temporary Anchorage Devices in Orthodontics	6
APOS Trends in Orthodontics	5
Applied Sciences (Switzerland)	5
Dental Press Journal of Orthodontics	5

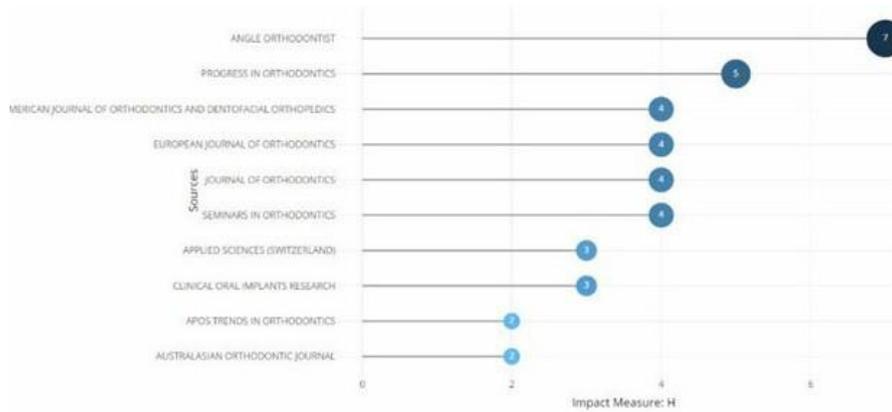


Figure 1b: Top 5 Impact Measures of the Journals on TADs.

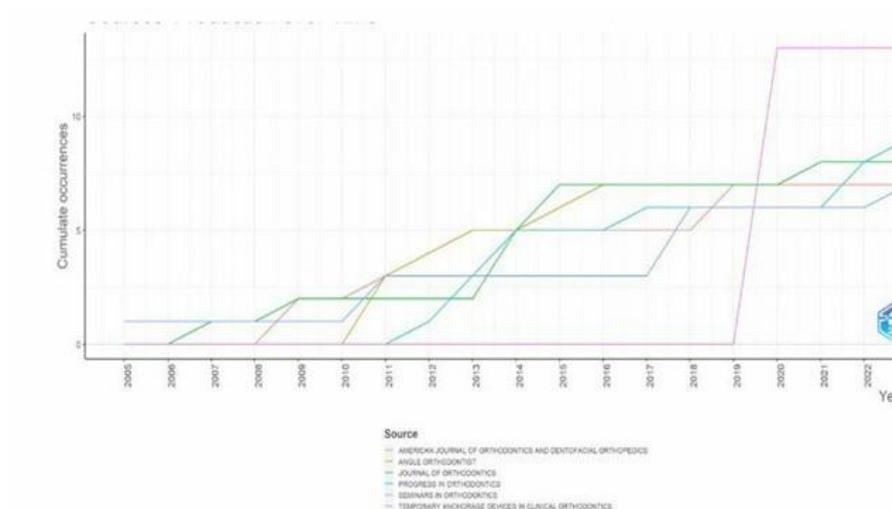


Figure 1c: Journals Production over Time.

**Top 10 Authors in the Field of TADs**

The top ten most productive authors in TADs are shown in [Table 2]. Moon W has published the most articles on TADs with five, followed by Hong C and Cousley RRJ [12].

**H-Index**

The Hirsch index, sometimes known as the h-index, gauges a scientist's influence more so than a journal's. The greatest number of a scientist's articles that have h or more citations each, while the other papers have fewer than h citations each, is known as the h-index. [Figure 2a] lists the top 10 writers based on the h-index [13].

**Institutions with the Most Relevant Articles**

Based on the bibliometric analysis, the top 10 universities with the most relevant articles on TADs were listed (Ahmad et al., 2019). The Sichuan University published the highest number of articles on TADs (a total of 24 articles), followed by the Sapienza University of Rome in the second position with 23 articles and University of California in the third position with 14 articles [Figure 2b] [14].

**Most productive countries that published on Temporary Anchorage Devices**

An analysis of the data clearly shows that the research on TADs was mainly led by the Italy (24), China (14), and USA (12) [Figure 3a] [15].

**Top Cited Countries**

The top cited articles were analyzed using Biblioshiny based on the countries affiliated with the published studies. [Figure 3b] shows that Italy received the most citations (366), followed by China (208), and Iran (32), which came in the tenth place [16].

**Most Relevant Key Words**

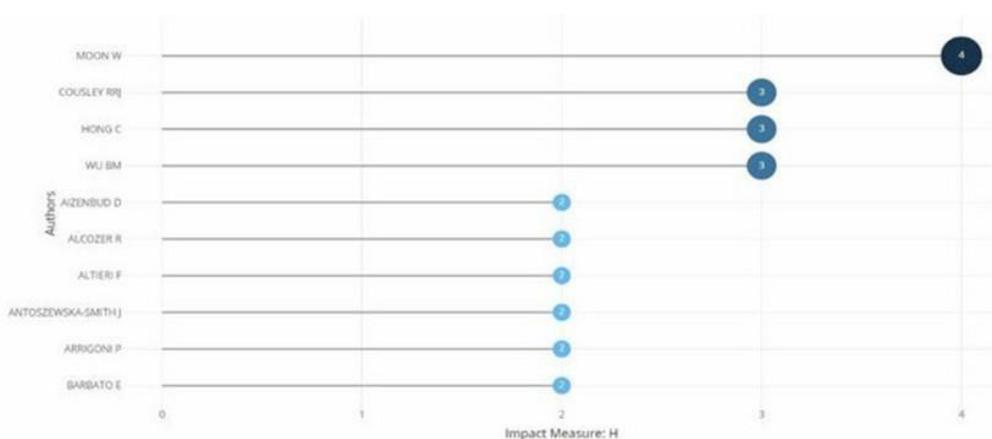
The top 10 most relevant keywords were evaluated [Figure 4a]. The most frequently used keyword was "Human" with an occurrence of 106. Other frequently mentioned keywords included "Orthodontics" with 99 occurrences. The other most relevant keywords are listed in it [17].

**Trending Topics over Time**

From the research on the TADs in orthodontics, "Instrumentation" was the most trending topic in 2009 (Johnston & Littlewood, 2015). In 2023, the top trending topic was "workflow". All the trending topics are listed in [Figure 4b] [18].

**Table 2: Top 10 Productive Authors on TADs.**

Element	h-index	g-index	m-index	TC	NP	PY-start
MOON W	4	5	0.308	65	5	2011
COUSLEY RRJ	3	3	0.3	23	3	2014
HONG C	3	3	0.231	56	3	2011
WUBM	3	3	0.231	56	3	2011
AIZENBUD D	2	2	0.167	34	2	2012
ALCOZER R	2	2	0.333	52	2	2018
ALTIERI F	2	4	0.333	45	4	2018
ANTOSZEWSKA-SMITH J	2	2	0.222	29	2	2015
ARRIGONI P	2	2	0.143	18	2	2010
BARBATO E	2	5	0.333	45	5	2018



**Figure 2a: Top 10 Authors Based On H-index.**

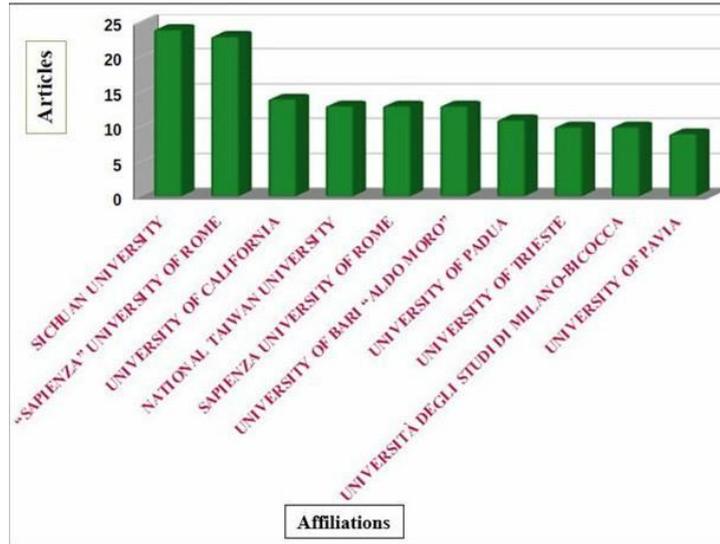


Figure 2b: Institutions with the Most Relevant Articles.

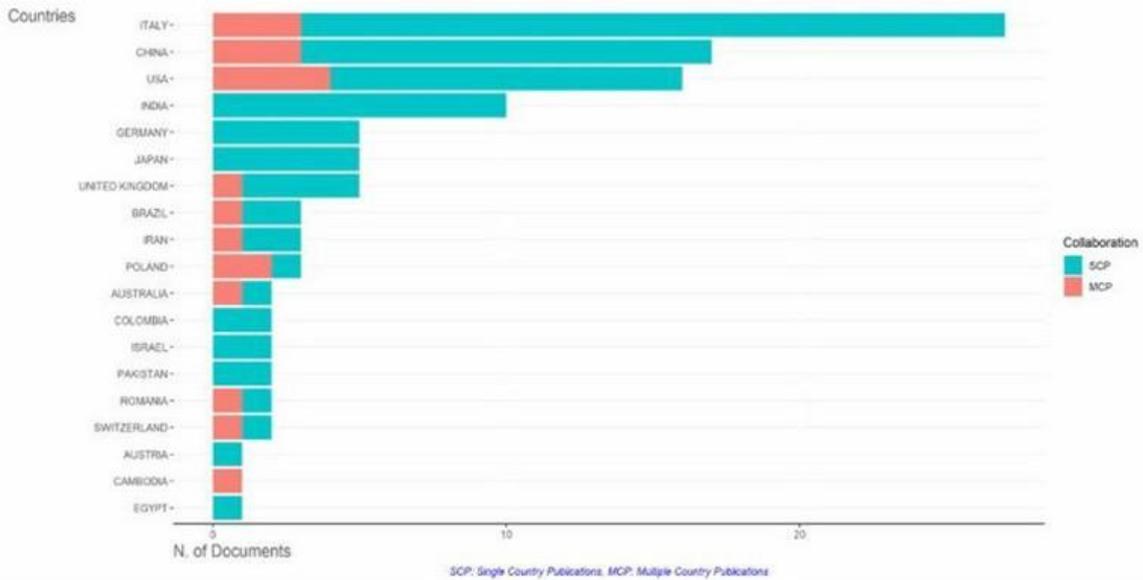


Figure 3a: Most Productive Countries and their Affiliations.

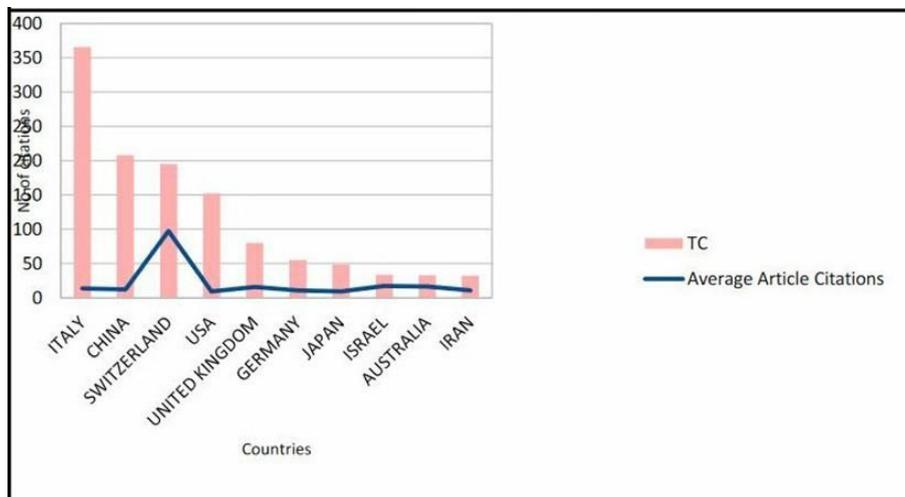


Figure 3b: Top Cited Countries.

**Keywords with the most co-occurrence**

Our findings determined that the keywords, “orthodontics”, “human”, “humans”, and “orthodontic anchorage procedures” had the highest co-occurrence and other keywords co-occurrences are shown in [Figure 4c]. The VOS viewer 1.6.18 program was used to examine the co-occurrences.

**Most Global Cited Documents**

Based on the global citation criteria, the identified articles were analyzed to determine the top 10 global cited articles. The result highlighted that SCHÄTZLE M (2009) published in Clin Oral Implants Res, has the highest number of citations, with approximately 183 citations [Figure 5].

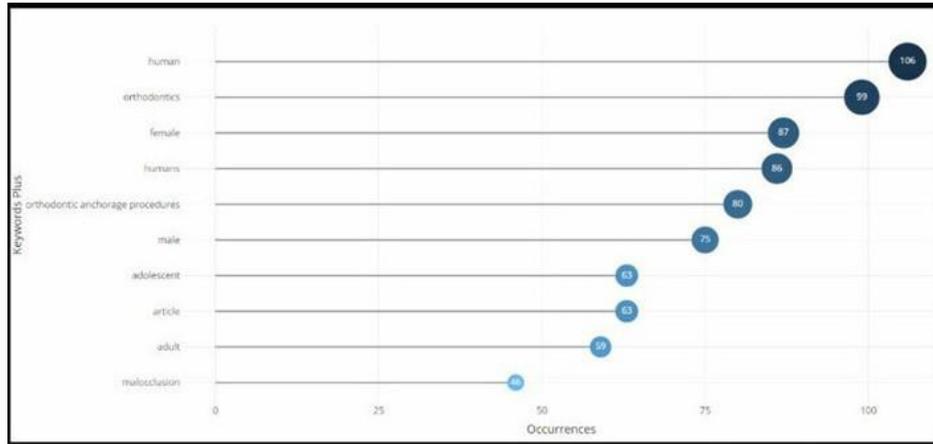


Figure 4a: Top Ten Key Words.

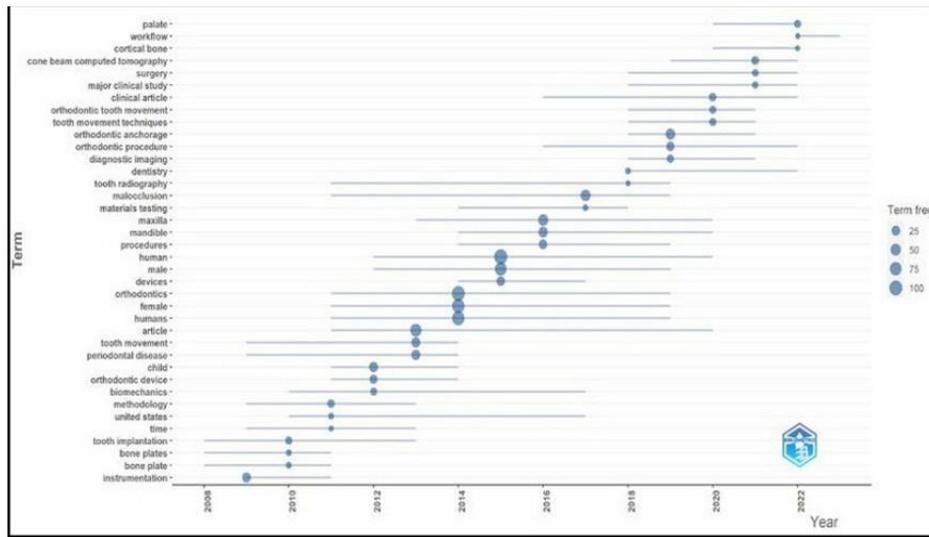


Figure 4b: Trending Topics over Time.

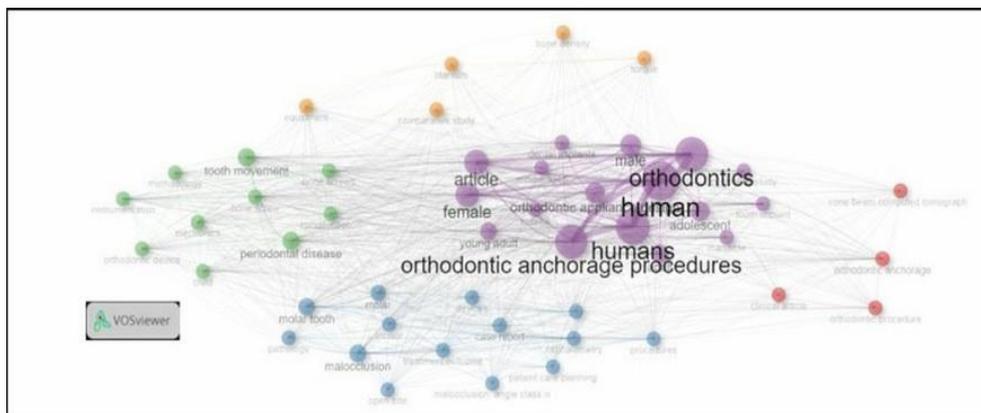


Figure 4c: Keywords with the most co-occurrence.

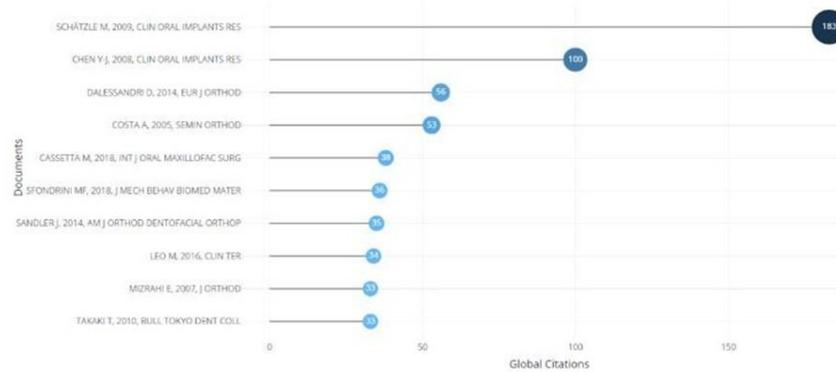


Figure 5: Most Global Cited Documents.

**DISCUSSION**

This is the first bibliometric analysis that has been done. Its objective was to locate and assess scientific research publications on temporary anchorage devices in orthodontics statistically. To the best of the authors' knowledge, this is the first bibliographic analysis using the Scopus database without publication constraints to examine the evolving trends in Temporary Anchorage Devices in orthodontics. This Scopus has the best peer-reviewed books, journals, and conference proceedings among other works. Every year, journals listed in the Scopus database are examined to make sure they live up to our high criteria. This Scopus provides further information on the author in the form of a list of publications that includes author affiliations, citations, references, and the number of times each published work has been cited. As a result, the current study's data retrieval process is employed this Scopus database. This study used a keyword search on the Scopus database to determine the amount of research that has been done globally on TADs in orthodontics. The journals in the Scopus database are reviewed annually to make sure they adhere to strict guidelines. For this reason, data on Temporary Anchorage Devices was retrieved for the current inquiry using the Scopus database [19].

TADs often referred to as mini-implants or mini-screws, have transformed the field of orthodontics in recent year. They are small, biocompatible devices made of titanium that are temporarily placed into the bone to serve as an anchor for orthodontic tooth movement.

Till 2015, the usage of TADs was gradually increasing over time. This suggests that TADs were gaining popularity as orthodontic tools

for providing additional anchorage and support during various dental procedures. A sudden downfall in TAD usage during 2015 to 2017 indicates that something disrupted the increasing trend; this was because of the emergence of the Aligners. The introduction and adoption of Aligners as an alternative or complementary orthodontic treatment method led to a decreased reliance on TADs during this period. The subsequent peak in TAD usage from 2018 to 2020 may suggest a rebound or resurgence in the utilization of TADs. This could be attributed to the incorporation of TADs with Aligners. This combination might have offered orthodontists and patients a more effective and versatile treatment approach. TADs can be used with Aligners to achieve specific tooth movements and address complex cases more efficiently. The incorporation of TADs with Aligners had a great impact on patients. This is likely because the combined use of these orthodontic tools allowed for more customized and effective treatment plans, potentially leading to improved outcomes and patient satisfaction.

Following a preliminary search, one hundred and seventy-nine articles were included for bibliometric analysis. A word frequency analysis of the top 10 keywords revealed that "human," "orthodontics," "female," and "humans" were included in the majority of the publications (McGuinness et al., 1992). This demonstrates how well all relevant articles are retrieved using the keyword-based search strategy. A number of the TADs research's components may be clarified by using keywords [20].

**CONCLUSION**

The study identifies the nations that are actively pursuing these areas and facilitates the formation

of new collaborations aimed at enhancing the quality of the data and supporting the scientific community. Scholars can gain insights from the most published and frequently quoted writers. The nations may aim to repair financing shortages for research by looking back at the literature created and citations generated over time, which will raise the caliber of research. TADs are anticipated to become more and more important in offering patients effective and aesthetically beautiful orthodontic treatment choices as orthodontic technology advances, and bibliometric analysis can assist close these research gaps (Blatz et al., 2019).

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