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# Analysing the Stability of Orthodontic Mini-implants (OMIs) over Time: A Bibliometric and Visualisation Analysis

Kaiyisah Kamaludin[1*], Maryati Md Dasor[1,2], Syed Bazli Alwi Syed Bakhtiar Ariffin[1], Nurul Aida Ngah[3]

[1]*Centre of Paediatric Dentistry and Orthodontic Studies, Faculty of Dentistry, Universiti Teknologi MARA, Sungai Buloh, Selangor, Malaysia*
[2]*School of Dentistry, Management and Science University, Shah Alam, Selangor, Malaysia*
[3]*Centre of Oral & Maxillofacial Surgery Studies, Faculty of Dentistry, Universiti Teknologi MARA, Sungai Buloh, Selangor, Malaysia*

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ABSTRACT

Bibliometric analysis is an effective and informative method for assessing research performance, identifying trends, and informing future directions in a field. It is widely used method for analysing large volumes of scientific data and understanding research trends over time. The study aimed to examine and compare research trends in orthodontic mini implants (OMIs) stability over time. A literature search was conducted in Scopus (Elsevier) and Web of Science, restricted to English-language journal articles and review articles, with no restriction on year of publication. Overall, 741 unique publications that were relevant to the topic were included in the review. Bibliographic metadata, including titles, authors, abstracts, keywords, sources, affiliations, publication years, and citation data, were extracted and analysed using Biblioshiny and VOSviewer for bibliometric analysis and visualisation. It had an average of 18.7 citations per article. The most productive year was 2022, with 56 articles published. Most of these (n=96) were listed in the American Journal of Orthodontics and Dentofacial Orthopedics as one of the important sources of research in this area. The current bibliometric analysis identifies the trends and productivity of research about the stability of OMIs, and different factors that can impact its stability in the long run. Although the volume of available research remains relatively limited, the findings highlight the need for continued investigation and refinement of clinical practice to optimize treatment outcomes. Future research ought to concentrate on strengthening the evidence base as well as scrutinizing the numerous factors that may influence the long-term validity of OMIs.

[1*] Corresponding author. *E-mail address*: kaiyisahkamaludin6008@gmail.com

## 1. INTRODUCTION

The Orthodontic Mini Implants (OMIs) have become prevalent in recent years as a dependable support system in orthodontic treatment (Motoyoshi et al., 2010), and these devices provide the clinician with a dependable and minimally invasive option compared to traditional forms of anchorage. They can be easily placed, require minimal patient compliance, and have a stable skeletal anchorage, greatly increasing the possibilities of orthodontic care (Kharadi, 2021).

The stability of OMI is a process which changes as the treatment advances. First, it depends on the physical interlocking of its threads against the cortical bone to provide resistance to forces and reduce micromotion of the implant. Long-term biological stability gradually replaces this primary stability by means of bone remodelling, developing a hard bone-implant interface (Zainal Abidin & Dasor, 2024).

However, OMIs may lose stability and exhibit mobility during orthodontic treatment, often necessitating removal and potentially compromising treatment outcomes (Tarigan et al., 2024). This clinical dilemma highlights the importance of understanding factors that influence OMI stability over time.

The stability is determined by the geometry of the device (diameter, thread pitch, surface), insertion point and angle, cortical bone thickness, torque values, implant stability quotient (ISQ) values, loading protocols and patient factors. It is noted that the larger the diameter and length of the OMIs, the greater the primary stability. It should be, however, chosen cautiously not to cause harm to other roots (Abdalla & Ali Mahmood, 2023). This is also important in thread design. The tighter the thread pitch, the better the retention, but there is less impact on the thread depth. Tapered or conical implants, as compared to cylindrical ones, tend to be more stable in shape (Abdalla & Ali Mahmood, 2023). It is important to note that surface treatments can enhance the process of osseointegration but have less effect on stability compared to the way the implant is structured (Jedliński et al., 2022). The quality of the bone is also a factor. A cortical bone is thicker and denser and enhances primary stability, which is measured by an increase in insertion torque and resonance frequency (ISQ) values (Möhlhenrich et al., 2021). The most commonly used insertion angles are between 60° and 90°, and occasionally, oblique placement has been shown to enhance results, depending on the quality and thickness of the bone (Möhlhenrich et al., 2021). It is also dependent on anatomical sites. OMIs placed in the maxilla tend to have more success than those deployed in the mandible, and palatal sites have the most favourable stability over time because of favourable bone and reduced interference with the root (de Mattos et al., 2022). Primary stability can be evaluated using an effective method of insertion or removal torque and resonance frequency analysis (ISQ); the higher the value, the greater the fixation and clinical outcome (Möhlhenrich et al., 2021). Immediate loading can be done with reasonable stability, though excessive or too early loads increase the risk of failure (Sarul et al., 2015; Yao et al., 2015). Age and oral hygiene, amongst the patient factors, have smaller effects on outcomes than the mechanical and anatomical factors (Yao et al., 2015).

Although the stability of the OMIs is clinically significant, no bibliometric reviews of this issue have yet been conducted. The existing research is disorganized, and there are differences in design, measurement techniques, anatomical locations and reporting time points. Therefore, these contradictions complicate the process of determining the most persuasive evidence and locating places where consensus or unresolved uncertainty exists.

To address this research gap, this study will conduct a bibliometric analysis of the literature on the stability of OMIs. Applying bibliometric and science-mapping methods, it will identify the evolution of the field, collaboration and citation networks, and choose themes such as torque/ISQ thresholds and loading

protocols. Results will reveal research trends, academic influence, and knowledge gaps, which will inform future researchers and clinical innovations to enhance patient outcomes.

## 2. MATERIALS AND METHODS

The search of digital literature was performed using the Scopus (Elsevier) and Web of Science databases, which are reputed to be wide-ranging in terms of indexation of the scholarly journals in various disciplines (Falagas et al., 2008). The broad search strategy used the following query: ((orthodontic miniimplants OR "mini-screws" OR OMIs) AND (implant stability OR "primary stability" OR "secondary stability") AND (time dependent OR "over-time" OR "follow up")) restricted to the field of Dentistry. This approach ensured that the relevant research on the techniques of examining the stability of OMIs over time was included.

Only English-language journal articles and review articles indexed in Scopus and Web of Science were included in the final bibliometric analysis. The search and screening process was summarized using a flow diagram adapted from the PRISMA 2020 reporting framework. All data were obtained on the same day to minimize the possibility of bias due to constant updating of the database. The titles and summaries of all identified publications were evaluated separately by two evaluators to remove those publications that were not related to the research of OMI stability. To ensure agreement and rigor in the study, in instances where inconsistencies were noticed during the first screening, a second check was made to deliberate and resolve differences.

They were stored in plain text and in the form of *.RIS, with the information about the title, author, keywords, and abstract. The data were analyzed in Biblioshiny and VOSviewer and presented in the form of visual maps illustrating research trends at the country, publication, and journal levels. In turn, the visualizations have been created based on co-citation and keyword analysis findings and presented in the form of network maps, density maps, and overlay visualizations.

The keywords that appeared in the Biblioshiny interface were carefully filtered on the selection parameters of the study that led to the final set of data of 741 unique documents. They were mainly scholarly articles (90.0%), with reviews (9.9%) also present. This comprehensive bibliometric analysis offers insightful information on how OMIs will be stable over time, reveals the current trends in research and what areas require further research in the future.

## 3. RESULTS

### 3.1 Publications Evolution

The first search on the database retrieved 902 records. After a thorough screening and eligibility assessment, 161 records were eliminated, mostly because they were duplicates and did not pertain to the stability of OMIs. As a result, 741 unique articles were retained and bibliometrically analyzed.

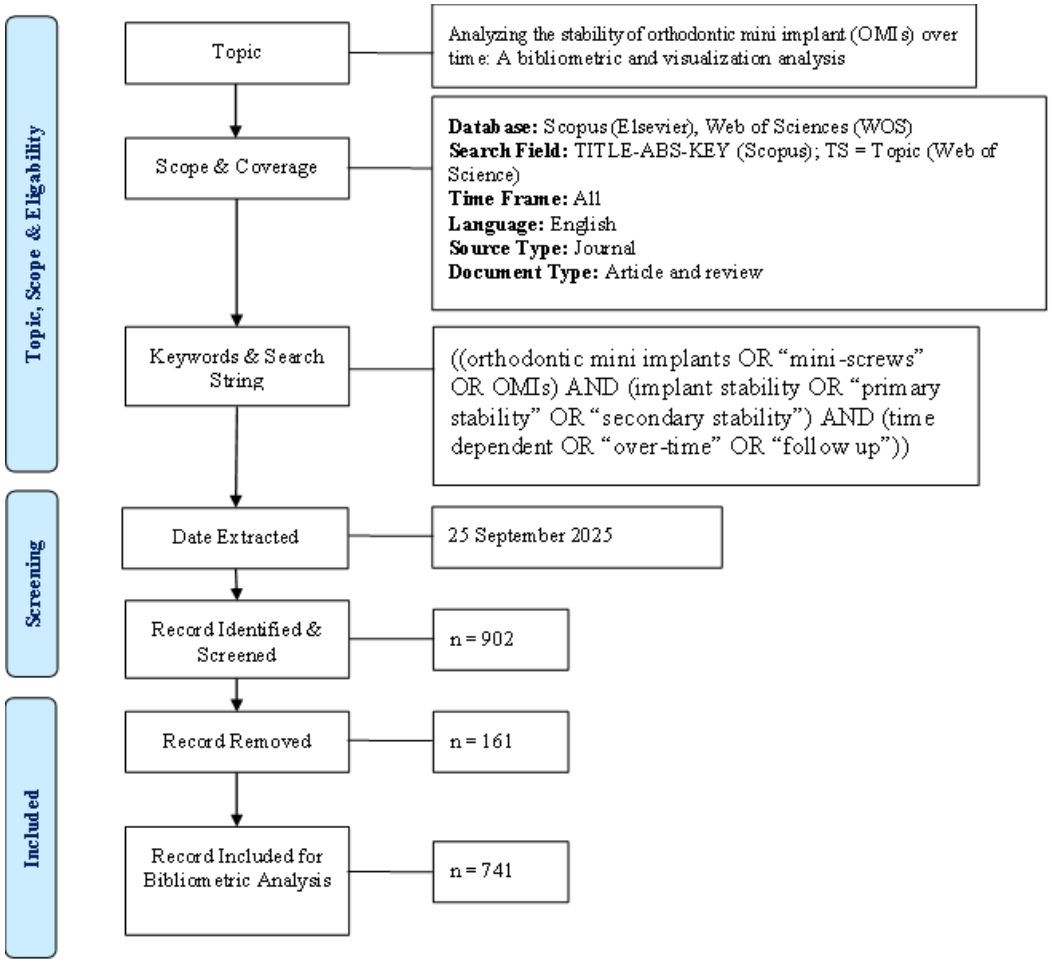



Fig. 1. Flow diagram of the search and screening process, adapted from the PRISMA 2020 reporting framework.

Source: Zakaria el al. (2020).

A review of annual publication trends showed that the first article on the issue of the "stability of OMIs" was published in 2003 in the English language. Between 2003 and August 25, 2025, 741 separate publications on this topic were registered in the Scopus and Web of Science databases. Despite slight fluctuations over the years (Figure 2), the rate at which the number of publications was growing was 16.54% per year. The peak publication rate was in 2022 (56 papers), 2021 (52 papers), and 2015 (48 papers).

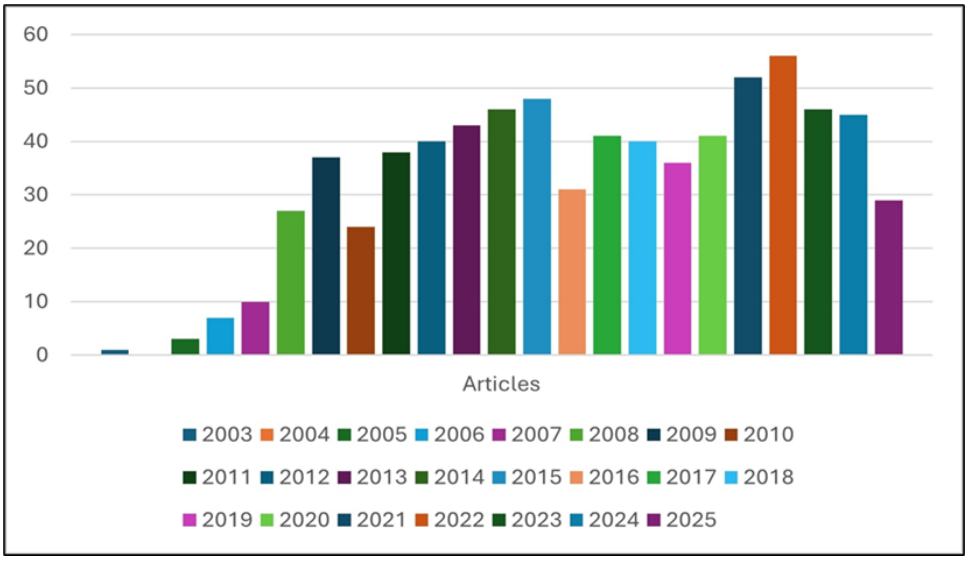



Fig. 2. Number of articles published per year.

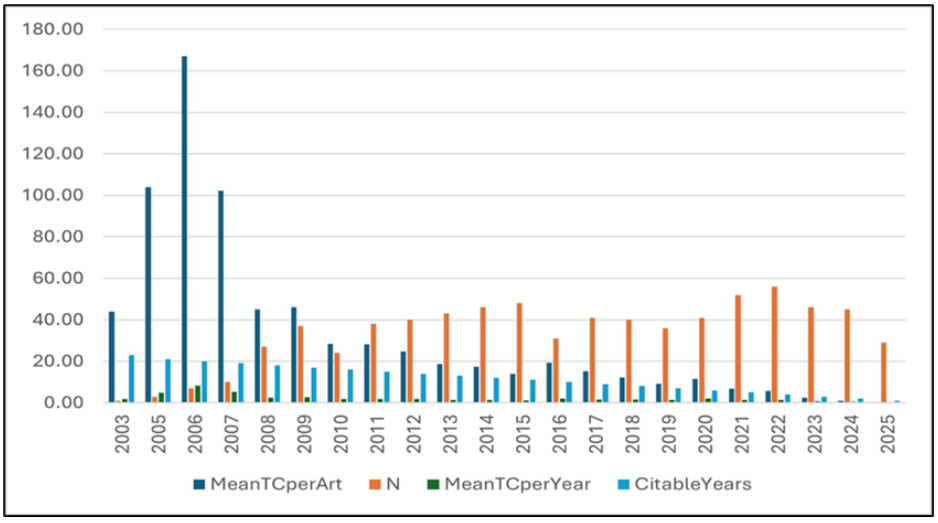



Fig. 3. Number of articles (N), Total citation per article (Mean TC per Art), and Total citation per year (Mean TC per Year).

The proportion of documents published between the years (2003-2025) accounted for 27.4% of the total publications. The graph depicts a rising trend in research outputs concerning the "stability of OMIs," peaking in 2022 with a total of 56 publications, which together accumulated four citations (Mean TC per Art = 4) (Figure 3). This trend indicates that the research on the stability of OMIs has evolved, but the former articles are more favorable for citations. Hence, further good research in this area must be carried out.

In terms of citations analysis, the number of citations per year also exhibits variability. The number of citations varied widely, with some articles receiving little attention and others attracting a lot. The highest

citation rate was in 2003. The citation activity peaked slowly in early 2004, compared with periods of increasing article output.

### 3.2 Country/ International Cooperation Publications

The total number of records acquired was 741, with 55 different nations in total, of which China had the highest number of documents at 478 (17.68%). South Korea comes next with 328 documents (12.14%), and the United States of America (USA) comes in the third position with 241 documents (8.92%). Table 1 provides the top 10 countries according to the number of publications.

Table 1. Top 10 countries with highest publications, and total citation

| Country | Total documents | Total citation | Average citation per document | % International Collaboration |
|---|---|---|---|---|
| China | 478 | 1855 | 18.90 | 8.18 |
| South Korea | 328 | 1894 | 21.00 | 7.30 |
| USA | 241 | 1947 | 36.70 | 7.83 |
| Japan | 205 | 1750 | 28.70 | 8.65 |
| Germany | 198 | 1855 | 29.00 | 4.39 |
| Brazil | 184 | 854 | 13.10 | 0.00 |
| Italy | 142 | 776 | 22.20 | 3.34 |
| India | 130 | 228 | 4.70 | 7.77 |
| Romania | 115 | 102 | 4.20 | 1.86 |
| Iran | 72 | 165 | 9.20 | 1.72 |

Note: Country-level publication counts are based on author affiliation occurences. As one publication may involve authors from more than one country, the cumulative country count may exceed the total number of unique publications included in the analysis.

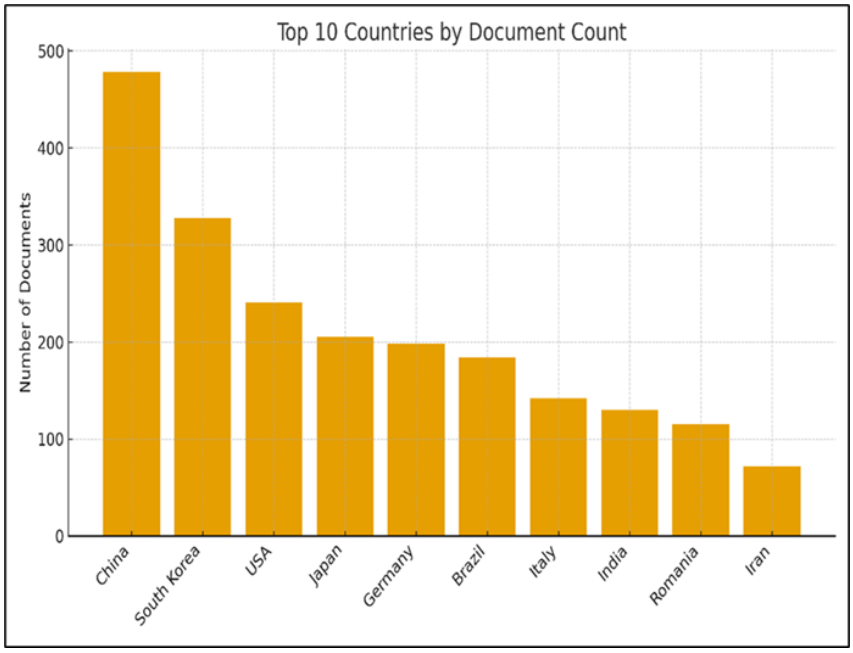



Fig. 4. Top 10 countries with highest publications.

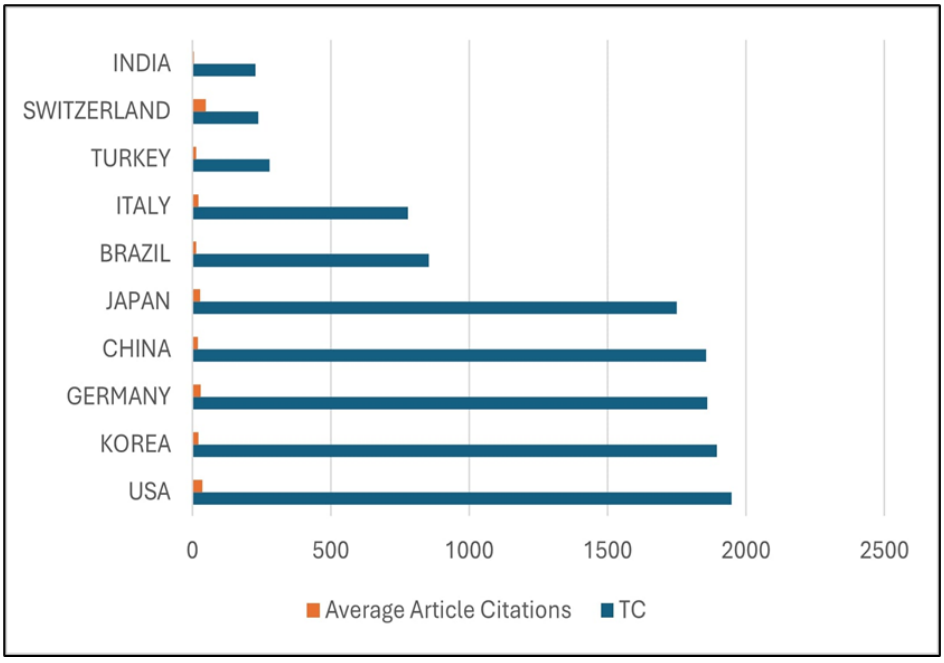



Fig. 5. Top 10 most cited countries.

The comparison shows significant differences across countries in research productivity, citation impact, and international collaboration. The greatest number of publications was in China (478), followed

by South Korea (328) and the USA (241). Although the USA had the least output, it had the highest citation performance, with the total number of citations being 1,947 citations and the mean of the citations per article being 36.7, which is the largest scholarly impact. Germany and Japan were also highly influenced, with 29.0 and 28.7 averages of citations per paper, respectively, with large numbers of citations. Conversely, the other countries (India, Romania, and Iran) showed relatively low citation performance, with an average of fewer than 10 citations per document.

In terms of collaboration, Japan (8.65%), China (8.18%), and the USA (7.83%) had the highest level of international collaboration, with India (7.77%) showing a high level of collaboration as well, whereas Brazil did not show any international collaboration. On the whole, the results indicate that the states that have effective international relations, i.e., Japan, the USA, and China, are likely to obtain higher visibility and a higher impact of citation, which supports the significance of international research.

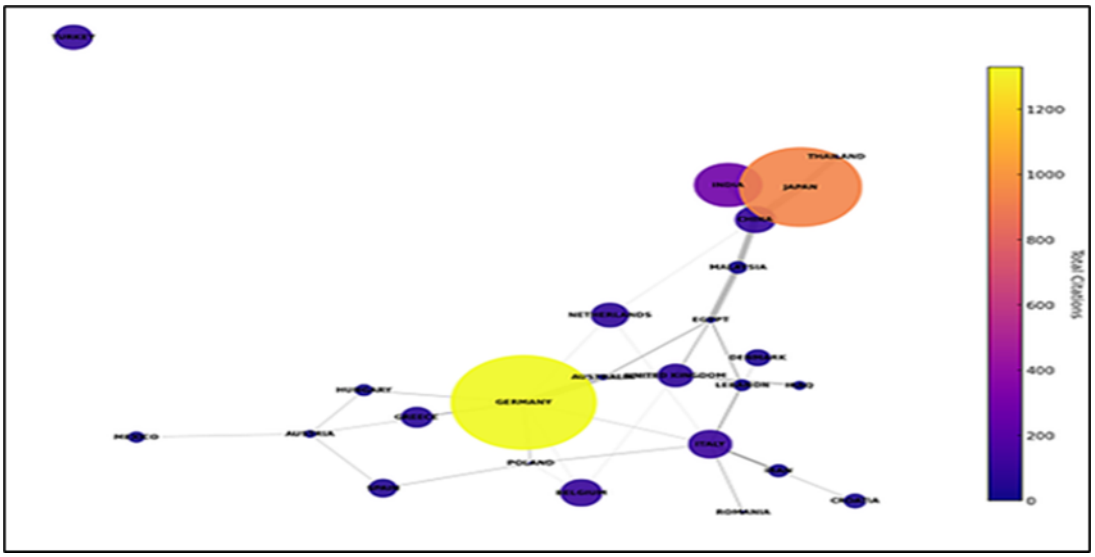



Fig. 6. International cooperation network of the highly cited paper.

The global network among the countries that have the greatest impact on citation in the field of OMI stability is represented by Figure 6. The nodes represent countries, and their size is proportional to the number of citations. Lines (edges) represent collaborative relationships among nations, where more co-authorship relationships are represented by a thicker line. Visualization contains only the 40 countries that are rated highest in terms of their number of citations, and this represents the largest contributors and the collaborative relationships among them.

Only 80% (44 countries) of the 55 countries engaged in cross-border cooperation. This statistic highlights huge international collaborations in this field of study. The countries involved in the research have a close connection with several other countries and have established a powerful network of collaborative research activities. The main node of Germany, which is the biggest one, can be discussed as being a key hub of cooperation and has connections with different countries and is the key to the development of global comprehension of the stability of OMIs.

### 3.3 Journal Distribution / Authorship

Table 2 and Figure 7 demonstrate the ten most popular journals in which the works on the stability of OMIs are published. The analysis of publications shows a strong focus on a limited number of sources, namely the leading journals. The most influential one is the American Journal of Orthodontics and Dentofacial Orthopedics contributing 96 publications and receiving 3,558 citations. The Angle Orthodontist followed with 51 publications with 1,480 citations, whereas the European Journal of Orthodontics publishes 35 articles that have been referred to 935 times; both are major platforms in the sector. There are also significant roles for journals such as the Korean Journal of Orthodontics (34 articles, 384 citations) and the Journal of Orofacial Orthopedics-Fortschritte der Kieferorthopadie (21 articles, 467 citations). Journals related to implants also make significant contributions, such as Clinical Oral Implants Research (18 articles, 1,378 citations), International Journal of Oral and Maxillofacial Implants (20 articles, 445 citations), and International Journal of Oral and Maxillofacial Surgery (17 articles, 816 citations). In the meantime, Implant Dentistry and Orthodontics and Craniofacial Research provide additional coverage, but 15 articles each with moderate citation numbers.

In general, the results indicate that research on orthodontics and implants has been mostly represented by a small number of highly specialized orthodontic and implant journals. This underscores their critical aspect in knowledge transfer and in defining the course of the academic discourse.

Table 2. Top 10 Journals in terms of number of publications

| Sources | Articles | Total citation |
|---|---|---|
| American journal of orthodontics and dentofacial orthopedics | 96 | 3558 |
| Angle orthodontist | 51 | 1480 |
| European journal of orthodontics | 35 | 935 |
| Korean journal of orthodontics | 34 | 384 |
| Journal of orofacial orthopedics-fortschritte der kieferorthopadie | 21 | 467 |
| International journal of oral \& maxillofacial implants | 20 | 445 |
| Clinical oral implants research | 18 | 1378 |
| International journal of oral and maxillofacial surgery | 17 | 816 |
| Implant dentistry | 15 | 151 |
| Orthodontics\& craniofacial research | 15 | 278 |

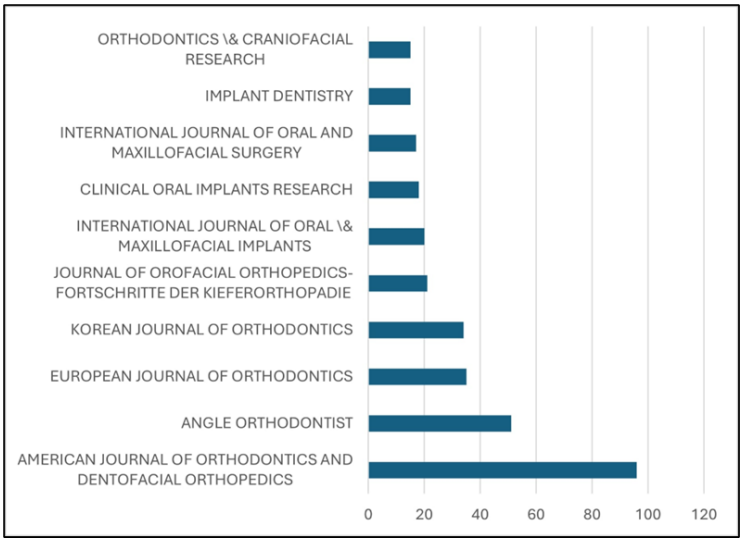



Fig. 7. Top 10 Journals in terms of number of publications.

Table 3. Most influential authors based on citations

| Number | Author | Document | Citation | Link | TLS |
|---|---|---|---|---|---|
| **Based on citation** | | | | | |
| 1 | Park Hyo-Sang, Jeong Seong-Hwa, Kwon Oh-Won | 1 | 390 | 0 | 0 |
| 2 | Motoyoshi M, Hirabayashi M, Uemura M, Shimizu N | 1 | 299 | 0 | 0 |
| 3 | Wilmes B | 1 | 266 | 0 | 0 |
| 4 | Noriyoshi | 1 | 256 | 3 | 3 |
| 5 | Motoyoshi Mitsuru, Yoshida Tohru, Ono Akiko, Shimuzu | 1 | 219 | 1 | 1 |
| 6 | Niklaus P | 1 | 190 | 1 | 1 |
| 7 | Baumgaertel S | 1 | 160 | 0 | 0 |
| 8 | Buchter A | 1 | 155 | 0 | 0 |
| 9 | Motoyoshi M, Inaba M, Ono A, Ueno S, Shimizu N | 1 | 146 | 0 | 0 |
| 10 | Chen Yi-Jane, Chang Hao-Hueng, Huang Chi-Yin, Hung | 1 | 142 | 1 | 1 |

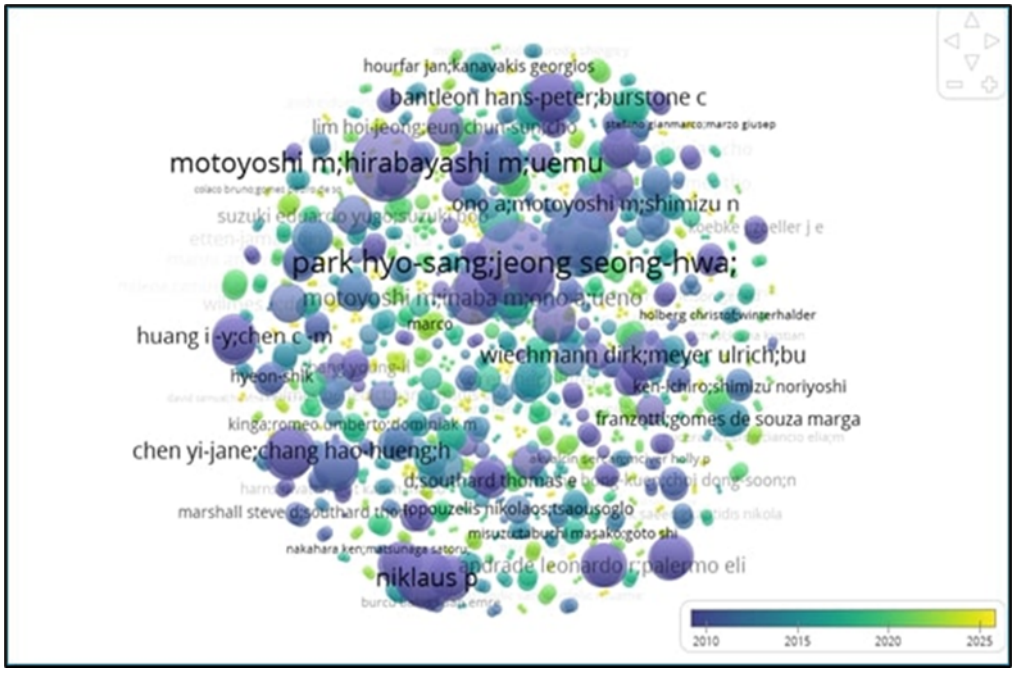



Fig. 8 Co-authorship network visualization.

Despite network analysis showing that the number of authors whose networks constitute 592 links and the difference between international and local co-authorships was very low (19.57%), some of the authors have an impressive citation influence, nonetheless. As an example, Park Hyo-Sang and colleagues were the most cited (390), next were Motoyoshi M (299) and Wilmes B (266). Nevertheless, they have low or even no Total Link Strength (TLS) values, which implies that, although they created impactful work, they did not build far-reaching collaborative relationships with other writers. It can be referred to as a disjointed network in which influential research is generated, although cooperation amongst prominent authors is minimal. Therefore, by reinforcing these networks, they can be beneficial in the exchange of knowledge and integration across the globe.

### 3.4 Most Influential Institutions/Organizations

The number of organizations or institutions that published papers in the field of research on the stability of OMIs between 2003 and 2025 was 845. Table 4 is the representation of the 10 most productive organizations, each of which has 32 to 79 articles published. The differences among the entities are based on the scale of influence, which is presented in the number of citations and the mean number of citations per publication.

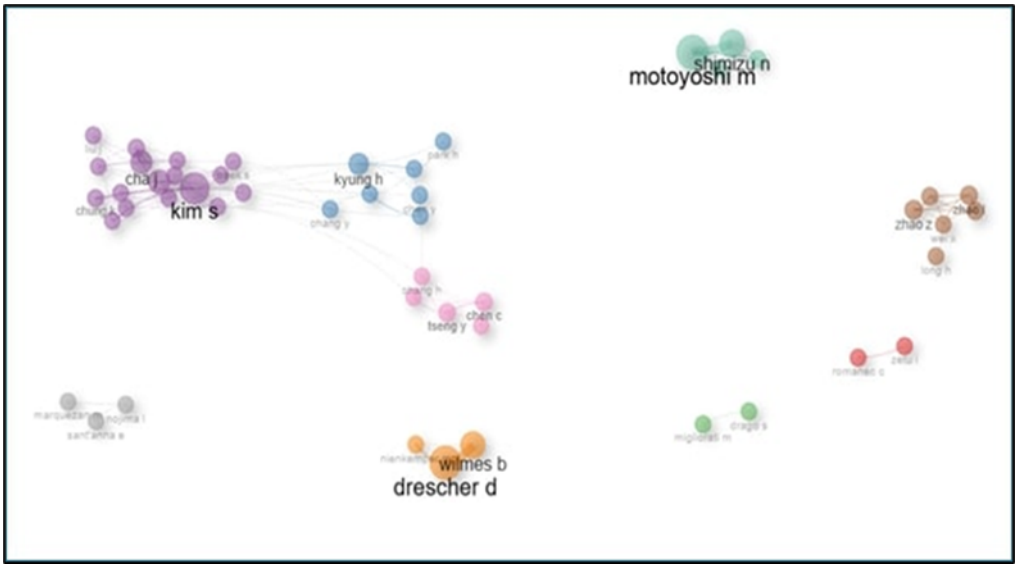



Fig. 9. Co-authorship cluster map.

Table 4. Most influential affiliations based on articles produced

| Affiliation | Country | Articles | Number of citations | Citation per article |
|---|---|---|---|---|
| Seoul National University | South Korea | 79 | 1314 | 16.6 |
| Nihon University | Japan | 73 | 3112 | 42.6 |
| Sichuan University | China | 67 | 770 | 11.5 |
| Yonsei University | South Korea | 63 | 1210 | 19.2 |
| Kaohsiung Medical University Hospital | Taiwan | 43 | 394 | 9.16 |
| Kyung Hee University | South Korea | 42 | 430 | 10.2 |
| Düsseldorf University | Germany | 41 | 1587 | 38.7 |
| Kaohsiung Medical University | Taiwan | 36 | 766 | 21.3 |
| Kyungpook National University | South Korea | 32 | 1221 | 38.2 |
| Fed Rio De Janeiro University | Brazil | 32 | 659 | 20.6 |

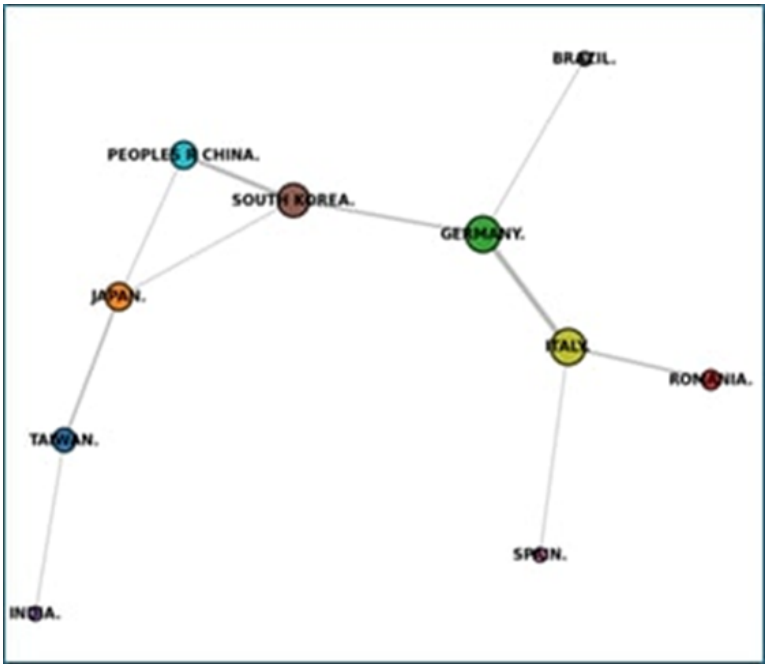



Fig. 10. Author's collaboration within countries.

### 3.5 Keywords Co-occurrence Trends Analysis

The joint presence of keywords is quite important to analyze the relations between leading ideas in the stability studies of OMI. This strategy emphasizes leading trends and gives an idea of existing scientific priorities. Given that keywords in publications represent core knowledge concepts, they can be used as a useful tool for revealing the knowledge structure underlying the field of research (Su & Lee, 2010).

The total number of keywords that were explored in the course of this research is 1,980, which represents a high level of thematic coverage. Out of these, 132 keywords were used over 10 times, and they constitute a core set of common subjects. In the visualization, there were nodes with different colours, which depicted different clusters; the size of the nodes reflected the frequency of the presence of a keyword, and the thicker lines connecting them denoted a stronger correlation of the items. In total, there were four clusters (Figure 11) that were created depending on the similarity of related keywords (Waltman et al., 2010). "Stability" (343 times) and "anchorage" (266 times) were the most common words, followed by device-specific keywords as "mini-implants" (238 times), "orthodontic anchorage" (134 times), and "mini-screws" (128 times).

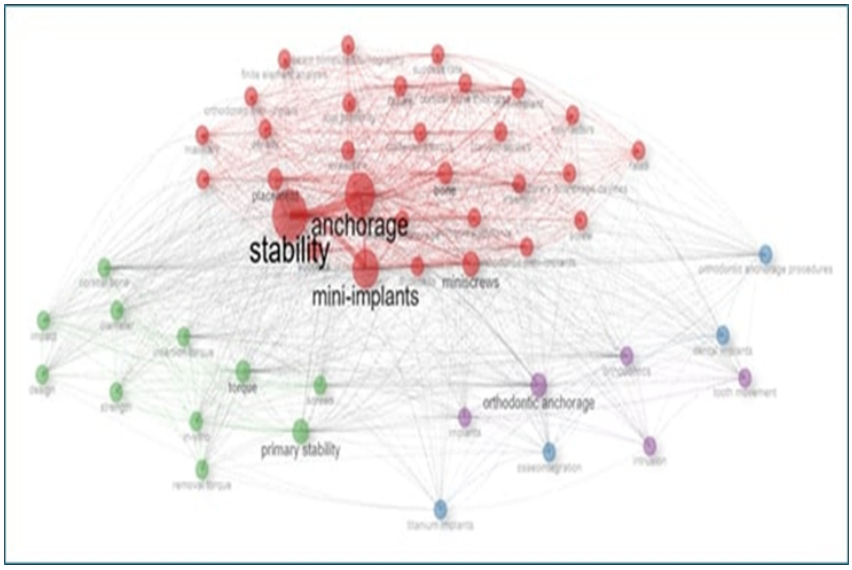



Fig. 11. Keyword co-occurrence network mapping.

In Figure 11, the co-occurrence maps of keywords are presented that demonstrate the key themes of research in orthodontic mini implants. Stability, anchorage, mini-implants, and mini-screws are the largest nodes, which imply the most commonly researched issues and are the core subject of the sphere. These core clusters are surrounded by specific clusters that define subfields of research: the green cluster is associated with biomechanical measures, including torque, primary stability, cortical bone, and removal torque. The purple cluster represents clinical uses like orthodontic anchorage, movement of teeth and intrusion. The blue cluster, in the meantime, focuses on the themes of material science, such as titanium implants, osseointegration, and dental implants. The interrelations between these clusters are strong, which implies that biomechanical knowledge and materials studies are highly interconnected with clinical practices, which again supports the multidisciplinary character of OMIS research.

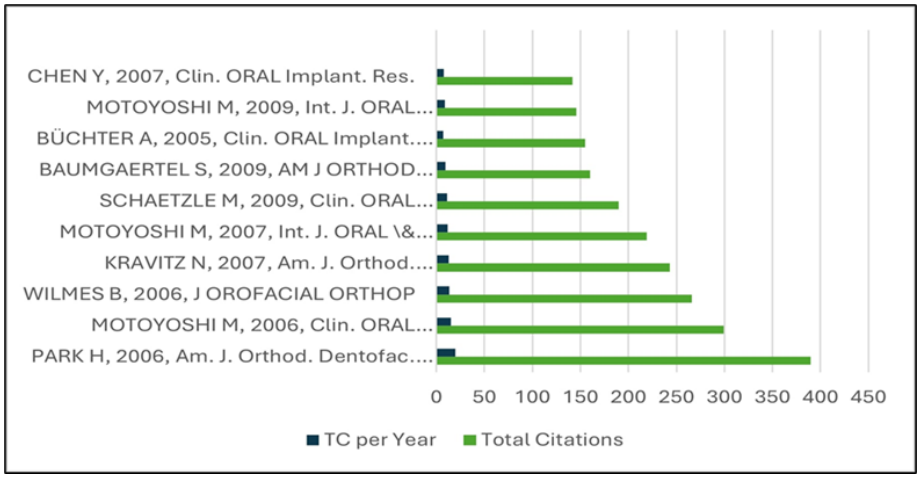



Fig. 12. The top 10 most cited documents by citation count

Figure 12 presents the top 10 most cited documents based on citation count. These highly cited studies mainly focused on clinically important topics, including factors affecting mini implant success, recommended placement torque, primary stability, and orthodontic anchorage outcomes.

| Author | Document Title | Year | Journal Title | Citation |
|---|---|---|---|---|
| Hyo-Sang Park, Seong-Hwa Jeong, Oh-Won Kwon | Factors affecting the clinical success of screw implants used as orthodontic anchorage | 2006 | American Journal of Orthodontics and Dentofacial Orthopedics | 390 |
| Mitsuru Motoyoshi, Masayuki Hirabayashi, Miwa Uemura, Noriyoshi Shimuzu | Recommeded placement torque when tightening an orthodontic mini-implant | 2006 | Clinical Oral Implants Research | 299 |
| Benedict Wilmes, Carsten Rademacher, Gudrun Olthoff, Dieter Drescher | Parameters affecting primary stability of orthodontic mini-implants | 2006 | Journal of Orofacial Orthopedics-Fortschritte Der Kieferorthopadie | 266 |
| Neal D. Kravitz, Budi Kusnoto | Risks and complications of orthodontic miniscrews | 2007 | American Journal of Orthodontics and Dentofacial Orthopedics | 243 |
| Mitsuru Motoyoshi, Tohru Yoshida, Akiko Ono, Noriyoshi Shimizu | Effect of cortical bone thickness and implant placement torque on stability of orthodontic mini-implant | 2007 | International Journal of Oral/&Maxillofacial Implants | 219 |
| Marc Schatzle, Roland Mannchen, Marcel Zwahlen, Niklaus P. Lang | Survival and failure rates of orthodontic temporary anchorage devices: a systematic review | 2009 | Clinical Oral Implants Research | 190 |
| Sebastian Baumgaertel, Mark G. Hans | Buccal cortical bone thickness for min-implant placement | 2009 | American Journal of Orthodontics and Dentofacial Orthopedics | 160 |
| Andre Bucheter, Dirk Wiechmann, Stefan Koerdt, Hans Peter Wiesmann, Josef Piffko, Ulrich Meyer | Load-related implant reaction of mini-implants used for orthodontic anchorage | 2005 | Clinical Oral Implants Research | 155 |
| M.Motoyoshi, M.Inaba, A.Ono, N.Shimizu | The effect of cortical bone thickness on the stability of orthodontic mini-implants and on the stress distribution in surrounding bone | 2009 | International Journal of Oral and Maxillofacial Surgery | 146 |
| Yi-Jane Chen, Hao-Hueng Chang, Chi-Yin Huang, Hsin-Chia Huang, Eddie Hsiang-Hua Lai, Chung-Chen Jane Yao | A retrospective analysis of the failure rate of three different orthodontic skeletal anchorage systems | 2007 | Clinical Oral Implants Research | 142 |

Fig. 13. Representative visualization of highly cited documents

The most influential publication in the category is the article by Hyo-Sang Park, Seong-Hwa Jeong, and Oh-Won Kwon 'Factors affecting the clinical success of screw implants used as orthodontic anchorage,' which has received 390 citations. This was followed by 'Recommended placement torque when tightening an orthodontic mini-implant' by Mitsuru Motoyoshi, Masayuki Hirabayashi, Miwa Uemura, Noriyoshi Shimizu, which received 299 citations (Figure 13).

The citations analysis provides an emphasis on the significant role of the key works in shaping contemporary knowledge and contributing to the research on the stability of OMIs. Their position and wide acknowledgment in the scientific community are reflected in highly cited works. Besides, the variety of topics of the most quoted articles demonstrates the comprehensive efforts of researchers to examine various aspects of the correlation between OMIs and stability.

## 4. DISCUSSION

OMIs has been widely used in dental practice as dependable anchorage devices and treatment adjunts for moderate to severe malocclusions. In this study, Biblioshiny and VOSviewer were used to conduct a bibliometric analysis of OMI stability research from 2003 to 2025, providing an overview of approximately 22 years of scientific development. The analysis traced publication trends and identified emerging hotspots that may help evaluate the existing body of knowledge and guide future research (Bhattacharjee et al., 2022).

The trend analysis of publications indicates that the development of OMIs research is characterized by distinctive development stages. At the initial stages (2007-2011), research was mainly exploratory, capitalizing on basic concepts in the form of osseointegrated implants, tooth implantation systems and titanium implants, which represented the extension of the concept of implantology to orthodontics. In 2011-2016, the research expanded into mini implants, mini screws, placement methods, torque values, and stability, and the shift of biomechanical research and applicability to clinical practice. Between 2017 and 2023, clinical complications and the success of the treatment became more and more an issue in the literature that discusses primary stability, bone integration, fracture and failure rates, and long-term outcomes. In the latest period (2023-2025), the focus has moved to risk assessment, optimization of anchorage devices, and their incorporation in overall orthodontic protocols. The field has moved on a path of research as a groundbreaking experimental area to a developed clinical outcome-driven field.

The trend analysis of publications indicated that there was a steady increase in the number of studies conducted on OMIs, and the growth rate of the field was 16.54% per year, a growing but still active field. South Korea, China, and Japan have provided the largest number of publications, followed by the USA, Germany, and Japan, with better citation efficiency, with the highest number of publications per paper. International cooperation was rather small; however, the best results were achieved by institutions such as Seoul National University, Nihon University, and the University of Düsseldorf.

The citation analysis revealed that the USA recorded the highest number of total citations (1,947) and the highest average citations per article (36.7), indicating strong scholarly impact. Although China and South Korea generated high publication volumes, their average citation rates were lower than those of the USA, Germany, and Japan. This pattern may reflect differences in publication timing, journal visibility, international collaboration, and the extent to which early studies addressed clinically important topics such as placement torque, primary stability, success factors, and anchorage reliability. Countries with lower average citation values, such as India, Romania, and Iran may represent emerging contributors whose research visibility could increase through broader collaboration and publication in high-impact journals.

The journal and the authorship analysis revealed the most influential and leading works in the discipline. Scholars such as Hyo-Sang Park and Mitsuru Motoyoshi, along with universities like Seoul National University and Nihon University, became prominent players. Articles with high citations, such as “Factors affecting the clinical success of screw implants used as orthodontic anchorage” and “Recommended placement torque when tightening an orthodontic mini implant,” have been fundamental in defining the research environment.

As a result, the key themes of research and the possible hotspots in the future were identified through keyword cluster analysis. The terms “stability,” “anchorage,” “mini implant,” “orthodontic anchorage,” and “mini-screws” became the key spheres in need of more profound research. The density map highlighted

terms that occurred frequently and showed well established areas of study, while the smaller groupings indicated emergent subjects that might be more important in the future.

In this research, the Scopus and Web of Science databases have been used, both of which have a high quality of content and deep analytical opportunities, and thus form a strong foundation of bibliometric analysis (Falagas et al., 2008). The comparison of Scopus with Web of Science shows that the former has significant benefits, including extended coverage and an absence of self-citations (Joshi, 2016). However, some limitations cannot be omitted, such as non-English publications and studies that are not covered and are not indexed by other databases like Google Scholar (Ahmad et al., 2019).

There are a number of limitations to this study. First, it reviewed the most relevant documents published between 2003 and 2025, representing approximately 25 years of research activity. Although Scopus focuses solely on citation of peer-reviewed journal articles, Google Scholar encompasses a wider scope of materials, such as thesis, books, open-access journals, and dissertations, even non-scholarly ones (Ahmad et al., 2020). On the same note, using the Web of Science database is limited, as it is relatively small since it covers high-impact journals but omits several regional or upcoming journals that appear on the Google Scholar index. Thus, the number of citations in Web of Science is usually smaller, which may minimize the impact of some works. In addition, its access through subscription and slower updates also restricts inclusivity compared to the free and more inclusive Google Scholar. Lastly, evaluating the scholarly trends over a longer period, say a century, can provide a more accurate and extensive insight into the development of the scholarly trends (Ahmad et al., 2019).

The study produced robust results due to the use of large volumes of data from the Scopus and Web of Science databases, both known for their broad array of authoritative journals across a variety of fields, and to the exclusion of self-citation. It has been done through the use of VOSviewer to enable the advanced visualization and mapping of data, along with Biblioshiny to provide an in-depth analysis of data and, therefore, provide more insight into the organization and dynamics of the research area.

This study was in a position to establish the trends in the publication output, citation behavior, and the trend in science investigation over a long period of time, providing a comprehensive picture of the development of the field. Keywords and thematic cluster analysis showed an increase in research interest, but network mapping provided a picture of international collaboration, showing the extent and importance of international collaboration. Using the aggregate functions of Scopus and Web of Science, along with their sophisticated analytic tools, introduces a well-balanced and comprehensive perspective of the academic environment. Simultaneously, it will be possible to obtain a clear understanding of the extent and context of the findings through honest recognition of constraints, such as the exclusion of non-English publications.

## 5. CONCLUSION

The stability of OMIs in orthodontics is a relatively recent research field but has been growing steadily over the last several years. Despite the thorough information provided by Scopus and Web of Science, the two databases are limited by the lack of non-English articles and by the large number of local or new sources recorded in Google Scholar. On the whole, the presented bibliometric analysis can help understand the nature of research on the stability of OMIs, including existing trends, the most active authors, and possible future directions. The findings highlight the dynamic evolution of the field in question, in which increased

international collaboration and exploration of new research directions are essential to further develop the knowledge and eventually improve patient outcomes.

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## CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

## AUTHORS' CONTRIBUTIONS

Kaiyisah Kamaludin led the study, carried out the literature search, data collection and analysis, and drafted the manuscript. Maryati MD Dasor and Syed Bazli Alwi Syed Bakhtiar Ariffin contributed to the study design, supervised the work, and provided critical revisions. Nurul Aida Ngah assisted with article screening, data verification, and interpretation of the results. All authors reviewed and approved the final version of the manuscript.

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