Bibliometric Network Analysis and Visualization of Research Trends in Gingivectomy

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Background: Gingivectomy has been the preferred method since the findings in 1884. It evolved from "blind" subgingival scaling to "the excision of the soft tissue". The use of these techniques is no longer mandatory in clinical situations; therefore, researchers have searched for numerous publications that have been registered regarding gingivectomy. This research aims to fill the niche area by assessing more about gingivectomy and it's trend among the periodontology topic of discussion.

Methods: Descriptive and analytical observation by evaluating the result of the VOS viewer mapping and calculation throughout the bibliographic data from publications obtained from SCOPUS in July 2022.

Results: There are 660 publications from six types of publication. Related keywords are compiled and visualized by network mapping. There is a significant gap among the contributing countries in the number of documents and number of citations per journal. However, a minimal gap is seen in other objectives, such as authors, journals, and institutions on their contribution towards the publication of gingivectomy topics.

Conclusion: A total of 660 of 1914 articles were included in the analysis after the filtering process, and these articles were cited 5910 times, with an average of 9 citations per article.

Keywords: gingivectomy, gingival excision, periodontal surgery, oral surgery, bibliometric analysis, scientific review, performance analysis, dentistry, periodontology

Introduction

Gingivectomy

Gingivectomy is a surgical excision procedure of the unsupported gingival tissue to a stage where it is attached and creates a new gingival margin that is apical to the earlier position.[1] Gingivectomy itself is a technique that is easy to conduct and is usually well accepted by patients, which, referring to the correct indications, can result in satisfactory dental-gingival aesthetics and harmony.[2] According to the earliest journal in the year 1946 about gingivectomy, it was stated that the GV procedure is indicated for a situation where a pocket is so shaped and will not disappear when the gingival tissues shrink after subgingival curettage, GV could be performed.[3] Ten years later, around 1956, it was stated that the indication of doing the GV procedure is to eliminate the supra bony pockets if the pocket wall is fibrous and firm. It is also indicated for gingival enlargement.[4]

Gingivectomy was a frequently performed procedure back in the past. However, with the advancement of technologies, this procedure has lost its significance in periodontitis treatment.[5] In recent times, conventional gingivectomy has been considered one of the most uncomfortable of the two other methods.[6,7] It stated that laser gingivectomy has gained popularity since it may avoid some problems such as surgical trauma, bleeding during surgery, postoperative pain and swelling, and low satisfaction among patients.[6,7]

Bibliometric Analysis

Bibliometric analysis is the attempt to assess the academic quality of journals or authors by statistical methods such as citation rates.[8] Bibliometric analysis is defined as a statistical evaluation of published scientific articles, books, or chapters of a book, and it is an effectual way to measure the influence of publication in the scientific community.[9] The academic impact of a piece of research can be gauged by the number of times others have cited it.[10,11] The study design of a bibliometric analysis or citation classics is a widely used technique to assess the impact of an article.[12,13] Bibliometric analysis has gained immense popularity in all research fields in recent years.[14] The advancement, availability, and accessibility of bibliometric software such as Gephi, Leximancer, VOS viewer, and scientific databases such as Scopus and Web of Science, and the cross-disciplinary pollination of the bibliometric methodology from information science to research on any subjects.[15,16]

Scholars use bibliometric analysis for a mixture of reasons, such as to discover emerging trends in article and journal performance, collaboration designs, and research divisions and to explore the intellectual structure of a specific domain in the surviving literature.[17] A bibliometric analysis represents an understanding that provides a cross-sectional view and the current state of research work on the topic of interest. It is a statistical and quantitative analysis that aims to identify the scholarly impact and characteristics of publications within a specific research field, which could provide useful information to researchers involved in the development of research strategies to address health issues.[18] The methods are straightforward since they are based on simple counting. Many techniques have become especially simple in the digital age because their application can be automated. At first sight, they are objective and unbiased.[19,20] The objective of this study was to examine constituent performance regarding authors, institutions, countries, and journals which discuss gingivectomy in the last two decades.

Materials and Methods

The design of research that is used is the descriptive and analytical observation by evaluating the result of the VOS viewer mapping and calculation throughout the bibliographic data[16] from publications that have been obtained from the SCOPUS online database on the 11th of July 2022. All publications regarding the gingivectomy keyword registered on the SCOPUS online database were included as the research population.

The sampling methods used in this research are by using Similar keywords for publications; in this case, "gingivectomies" is the plural form of gingivectomy and the synonym: "gingival excision" or "gingiva excision".[16] Data ranging from 1946 until 2022 is filtered into the last 21 years, starting from 2001 until 2021, and was also included as the data samples. After the filtering process is done, eligible samples to be used in this research are 660 publications out of 1914 publications available.

The keyword formula used in this research is: "gingivectomy" OR "gingivectomies" OR "gingival excision" OR "gingiva excision". The included criteria for this research were given as follows: Publications registered on SCOPUS from the year 2001 to 2021, All types of open access, All subject areas, All source types, and English-written publications. Excluded Criteria were also enabled for Review Articles, In vitro and in vivo studies, and Books / Books Series.

This research aims to assess several main components: Most used related keywords, Annual Trend, Publication with the most citations, Countries with the most published articles and Journals with the most published articles. These components help to determine the objective of this research which is assessing more about the bibliometric analysis of gingivectomy and calculating the trend of registered global publications discussing gingivectomy.

The bibliometric analysis was done in several steps.[20] After the arrangement of the research proposal, the publications were compiled from SCOPUS (filtered using the inclusion and exclusion criteria). Followed by word refinement using OpenRefine Version 3.5.2 (Metaweb Inc, Berkeley, CA, USA). The collected data were visualised using VOS viewer Version 1.6.18 (Centre for Science and Technology Studies (CWTS) of Leiden University, Netherlands). The compiled results were presented using Tableau Public Version 2022.1.1 (Salesforce, Seattle, Washington, USA) and are available to be analysed.

Collected data will be filtered with OpenRefine; then, it will be analysed in VOS viewer for keyword mapping and bibliometric distribution analysis.[20] Data collected include countries, institutions, journals, authors, and the number of citations. The analysis result will be served in the form of a table, graphic, and smart chart, followed by an explanation of each analysis result.

Results

Most Used Keywords Related to the Gingivectomy Publications

There are 3713 keywords associated with gingivectomy publications; the lowest occurrence is once, and the highest occurrence is 555 times. The 50 most used keywords are shown in the Network Visualization figure, which shows the keywords that are used most often and their correlation between each keyword. They are divided into three clusters, which are determined by their colour differentiation. Each nodule represents each keyword, which, when they are placed more in the middle, indicates that it is the keyword with the most occurrence rate and most connections to the other nodes. Underneath the network visualization, there are tables of summary regarding the keyword and their occurrence in each publication. It ranges from 37 to 555 occurrences. It has shown the variety of keywords used to help acknowledge each journal and help the researcher determine the best category for their research topics, as shown in Figure 1 and Table 1.
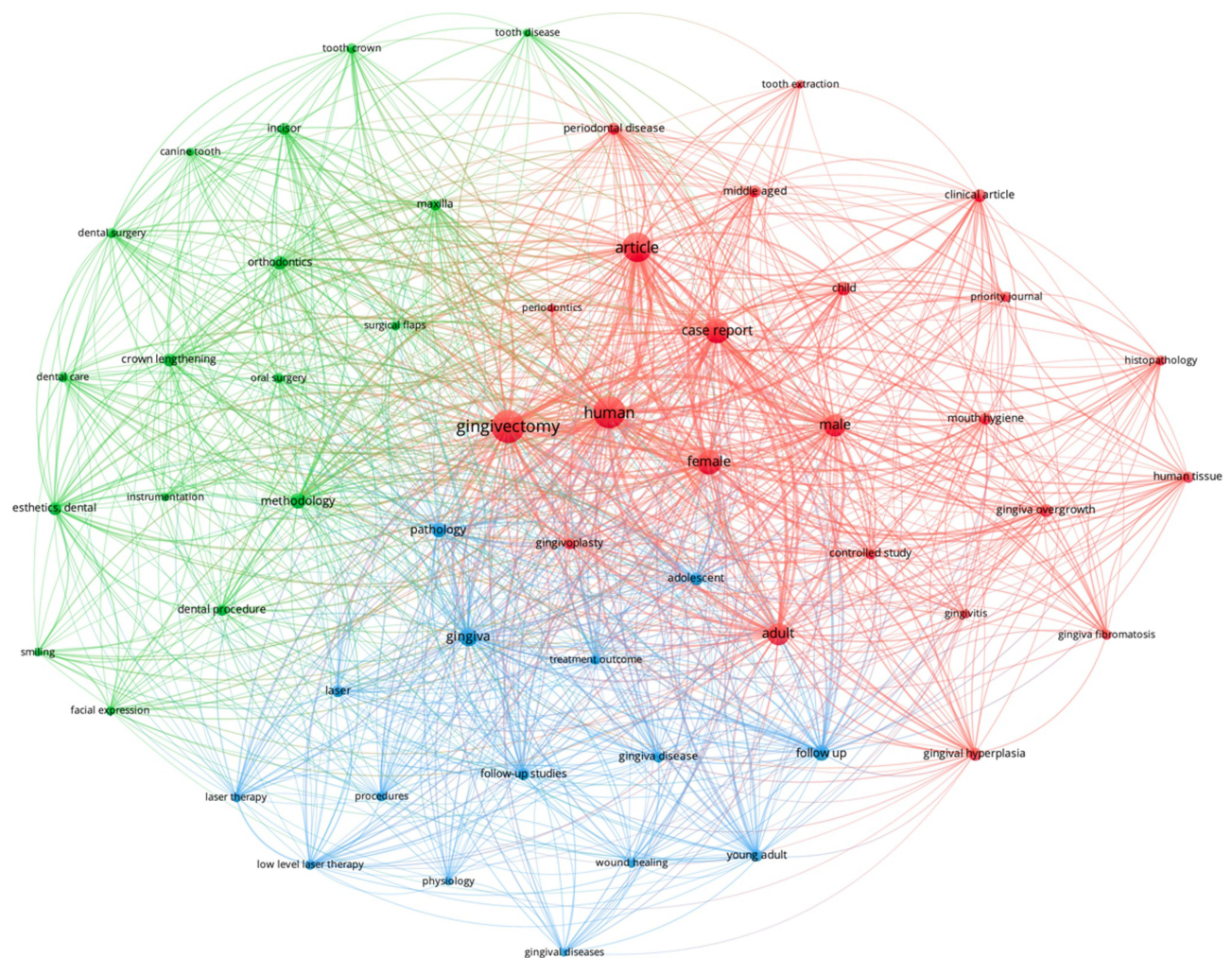

Figure 1 Network Visualization of Related Keywords Regarding gingivectomy.

Table 1 Top 50 Keywords Related to Gingivectomy

Rank	Keywords	Frequency	Rank	Keywords	Frequency
1	Gingivectomy	555	26	Laser	72
2	Human	524	27	Periodontal Disease	71
3	Case Report	321	28	Controlled Study	71
4	Female	297	29	Gingivoplasty	71
5	Male	264	30	Maxilla	70
6	Adult	247	31	Dental Procedure	67
7	Gingiva	174	32	Human Tissue	64
8	Gingival Overgrowth	156	33	Low-Level Laser Therapy	61
9	Methodology	137	34	Histopathology	60
10	Follow Up	127	35	Tooth Crown	60
11	Pathology	119	36	Dental Surgery	59
12	Gingiva Fibromatosis	108	37	Priority Journal	59
13	Gingival Disease	107	38	Procedures	58
14	Orthodontics	102	39	Treatment Outcome	58
15	Child	96	40	Oral Surgery	56
16	Adolescent	95	41	Dental Care	53
17	Crown Lengthening	90	42	Laser Therapy	50
18	Gingival Hyperplasia	87	43	Wound Healing	50
19	Esthetics, Dental	86	44	Gingivitis	46
20	Clinical Article	84	45	Surgical Flaps	46
21	Middle Aged	83	46	Facial Expression	45
22	Mouth Hygiene	78	47	Tooth Disease	41
23	Follow-up Studies	76	48	Periodontics	40
24	Young Adult	75	49	Instrumentation	38
25	Incisor	74	50	Tooth Extraction	37

Annual Interest Taken on the Gingivectomy Publication Topic

The annual trend of gingivectomy publications fluctuates over the years, with notable highs and lows (seen in Figure 2). From 2001 to 2005, there was a gradual increase, followed by a sudden 50% drop in 2006. The peak occurred in 2008 with a 45-publication increase, marking the highest in the first decade, but it sharply decreased by 50% in 2009. The numbers gradually rose from 2010 to 2012, maintaining relative stability until 2015. In 2016, there was a drastic decline to the lowest number in the second decade, with 17 publications. Subsequently, there is an upward trend from 2017 to 2021, reaching the highest in 2020 with 51 publications, while 2001 records the lowest with 16 publications.

The most significant increase was observed from 2007 to 2008, with a rise of 22 publications (96% increase), and the most substantial decrease occurred from 2015 to 2016, with a drop of 26 publications (60% decrease). Turning to the least significant changes, the minimal increase happened in 2014–2015, with only one additional publication (2.4% increase). The least significant decrease is noted in 2018–2019, with a decline of three publications (8.3% decrease).

Countries That Contributed the Most to the Publication of Gingivectomy

The geographic map (Figure 3) illustrates the global distribution of gingivectomy publications, with only about one-third of the world's countries showing interest in the topic. The map uses colours to signify publication frequency, ranging from light for lower numbers to dark blue for the highest (153 publications). The top ten contributing countries, led by India with 153 publications, are detailed in Table 2, showcasing regional dominance by Asia (4 countries), followed by Europe (3), North America (2), and South America (1).

However, a contradiction arises when comparing publication frequency with citation frequency in Table 3. For example, India, the leader in publications, ranks fourth in citation frequency. The most cited publications are from the United States (1352), Brazil (728), and Turkey (575).
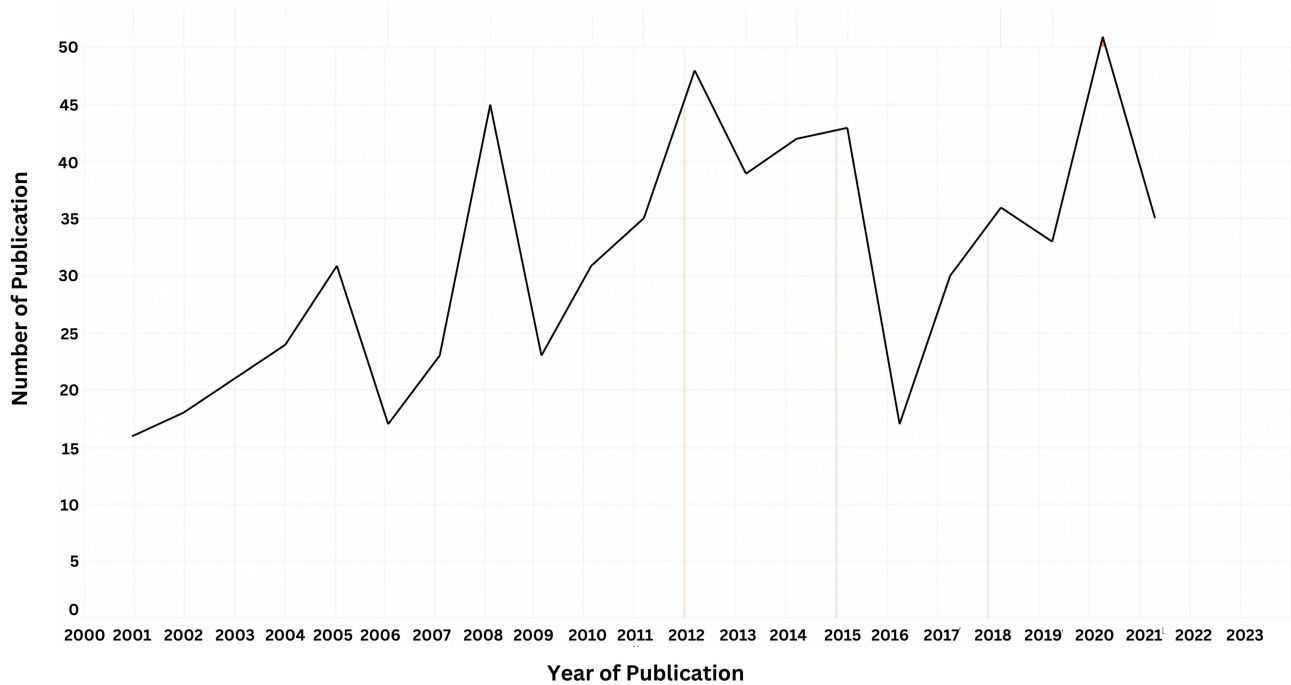
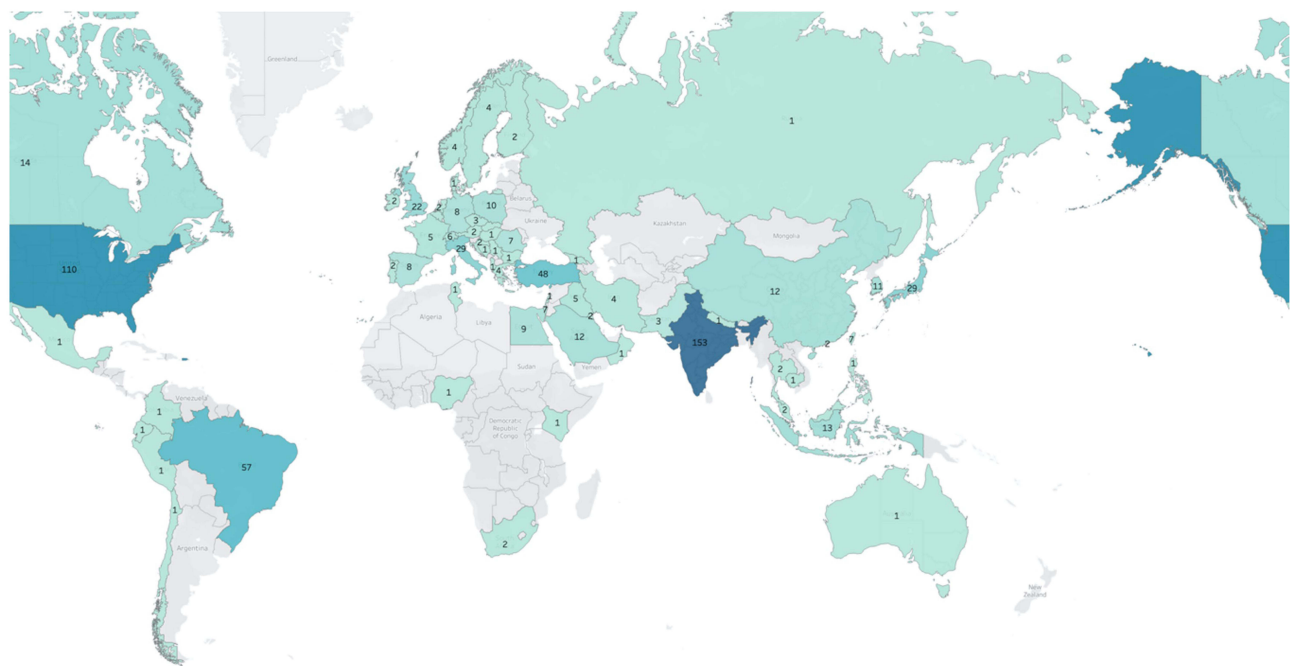**Figure 2** Line Graphic of The Annual Interest Taken on The Gingivectomy Publication Topic.

Figure 3 Geographic Visualization of Countries and The Number of Their Gingivectomy Publications.

Journals That Produce the Largest Publications Regarding Gingivectomy

In our dataset of 660 publications across 241 journals, the publication counts per journal range from 1 to 36. The summary Table 4 presents the top ten journals with their respective publication numbers. Topping the list is the Journal of Periodontology, with 36 publications, followed by the Journal of the Indian Society of Periodontology (28) and Dentistry Today (22). The list concludes with the Journal of Oral and Maxillofacial Surgery and Contemporary Clinical Dentistry, each contributing 12

Table 2 Top 10 Countries with the Highest Publications in the Gingivectomy Topics

Rank	Country	Publications Frequency
1	India	153
2	United States of America	110
3	Brazil	57
4	Turkey	48
5	Italy	29
6	Japan	29
7	United Kingdom	22
8	Canada	14
9	Indonesia	13
10	China & Saudi Arabia	12

Table 3 Top 10 Countries with the Most Cited Publications in the Gingivectomy Topics

Rank	Country	Citations Frequency
1	United States of America	1352
2	Brazil	728
3	Turkey	575
4	India	562
5	Italy	301
6	United Kingdom	271
7	Canada	197
8	Israel	166
9	Japan	155
10	China	154

Table 4 Top 10 Journals with the Most Published Gingivectomy Articles

Rank	Journals	Frequency	SJR	H-index
1	Journal of Periodontology	36	1.95	164
2	Journal of Indian Society of Periodontology	28	0.33	31
3	Dentistry Today	22	0.1	26
4	Quintessence International	15	0.58	74
5	Journal of Clinical Periodontology	14	2.7	159
6	BMJ Case Reports	13	0.23	31
7	International Journal of Periodontics and Restorative Dentistry	13	0.82	86
8	Contemporary Clinical Dentistry	12	0.27	29
9	Journal of Oral and Maxillofacial Surgery	12	0.73	126
10	Journal of Clinical and Diagnostic Research	11	0	56

publications. In comparison, the Journal of Clinical and Diagnostic Research ranks lowest among the top 10 with 11 publications. This concise presentation provides a clear overview of the significant contributors in gingivectomy research journals.

Discussion
Related Keywords
A total of 3713 keywords were filtered to the top 50 for visualization, with "gingivectomy" standing out. Correlated with "humans" (524 occurrences), keywords branch into age groups but lack representation for babies and seniors. "Human tissue" logically follows.

"Case Report" (321 occurrences) emerges, revealing various article types, including methodology, clinical articles, and follow-up studies. Despite original articles dominating, diverse subcategories exist. "Gingiva" (174) relates to diseases, with terms like gingival overgrowth and gingival fibromatosis, indicating discussions on gingival enlargement. Keywords associated with oral conditions include incisor, maxilla, and tooth crown.

Unexpectedly, medical and dental science divisions (Pathology, Orthodontics, Histopathology, and Periodontics) surpass periodontology in keyword frequency. Exploring gingivectomy procedures, related keywords cover pre-treatment (mouth hygiene), treatment methods (crown lengthening, gingivoplasty), and post-treatment considerations. Keywords like dental esthetics, wound healing, and facial expression assess treatment outcomes, with follow-up studies (127 occurrences) indicating successful treatments.

Annual Trend

The 21-year publication trend on gingivectomy is visually summarized, showing a gradual increase from 16 publications in 2001 to 35 in 2021. The average growth rate is 0.95 publications per year or 31.4 on average annually. Over half of the years (52.4%) fall below this average. The data is divided into two decades, with the second (2011–2020) contributing significantly more publications (374) than the first (249), marking a 1.5x increase.

The first decade's publication numbers range from 16 to 45, while the second decade ranges from 17 to 51. The overall trend suggests a growing interest in gingivectomy research, contrasting with its decline in the clinical field. This may signal a shift in research focus, indicating a need for the exploration of new methods or modifications in the gingivectomy procedure.

Annual Trend

The geographical analysis and table depict the global distribution of gingivectomy publications, highlighting India and the United States as dominant contributors with over a hundred publications each. India leads with 153 publications, constituting 23% of the total, while the United States follows closely with 110 publications, making up 16%. The top 10 countries collectively contribute 73.8% of all publications, averaging 48.7 publications per country. In contrast, the other 53 countries contribute 26.2%, with an average of 3.3 publications per country.

Examining citations, the top 10 countries range from 154 to 1352 citations, accumulating a total of 5910 citations. The United States leads with 1352 citations, comprising 22.9% of the total. The top 10 countries contribute 70.3% of all citations, averaging 446.1 citations per country. The remaining countries contribute 29.7%, averaging 27.3 citations per country.

With 660 publications generating 5910 citations, each publication receives an average of 9 citations. The table of countries with the highest average frequency of citations per publication ranges from 11.3 to 23.7 citations. Israel leads with 23.7 citations per publication, almost 2.5 times higher than the average, while Switzerland closes the list with 11.3 citations, leading by 2.3 points from the average.

The Most Contributing Journals

The author highlights the crucial role of journals in assessing publication standards, presenting a compilation of the top 10 journals on gingivectomy. The table showcases publication ranges from 11 to 36, with a notable threefold difference between the top and bottom-ranked journals.

Leading with over 30 publications, the Journal of Periodontology stands out, followed by the Journal of The Indian Society of Periodontology (28) and Dentistry Today (22). The analysis transitions from quantity to quality, evaluating journals using Scimago Journal & Country Rank (SJR) incorporating factors like Quartile, H-Index, SJR, and citation frequency. The Publications ranking is compiled and shown in Table 4.

Among the top 10, four journals (40%) fall into the Q1 (Best Quartile), exemplified by high H-Index and SJR values. Notably, the Journal of Periodontology, Journal of Clinical Periodontology, International Journal of Periodontics and Restorative Dentistry, and Journal of Oral and Maxillofacial Surgery exhibit superior quality. Quintessence International is the sole Q2 journal (10%), while Q3 includes the Journal of the Indian Society of Periodontology and Contemporary Clinical Dentistry (20% each). Q4 comprises Dentistry Today and BMJ Case Reports (20% each). The average H-Index

for the top 10 journals is 78.2, and the average SJR is 0.86, placing them at an overall Q2,2 quartile level. The dominance of U.S.-based journals is noteworthy, with 4, followed by India (3), the United Kingdom (2), and Denmark (1).

The Most Cited Publications

The highest citation count for an individual publication on gingivectomy stands at 125 citations, constituting 2.1% of the total citations. The collective citations from the top 10 most cited journals amount to 874, contributing approximately 14.8% to the total citations. With an average of 87.4 citations per publication within this top-tier list, a notable contrast emerges when compared to the remaining 650 publications, which collectively gather 5036 citations. The latter group, on average, accumulates 7.7 citations per publication. This discerns a substantial difference in citation numbers between the top 10 journals and others. Despite this, other journals maintain citation rates akin to the initial average of 9 citations per publication, with only a marginal deficit of 1.3 citations per publication on average.

Research Limitations

The bibliometric analysis discussed in this research is not without its limitations. The primary constraint lies in its quantitative approach, which lacks the integration of qualitative elements found in a meta-analysis. Additionally, the method's suitability is confined to specific types of research, limiting its applicability compared to other review methods. The broad scope of the analysis, while providing a comprehensive overview, may fall short of delivering specific insights for certain cases.

Furthermore, the limitations extend to the specific topic of gingivectomy chosen for analysis. Despite expectations, the research reveals a lesser number of journals, offering a narrower scope. However, in the context of bibliometric analysis, a larger dataset could provide diverse and intriguing bibliographic data. Lastly, the author acknowledges the challenge of conducting bibliometric analysis in the field of dentistry due to its novelty. This research not only highlights these limitations but also presents an opportunity for future authors and researchers to explore and enhance bibliometric analysis in dentistry, contributing to the development of new review methods in the field.

Further Work

The novel review method presented in this research offers a unique perspective that could benefit future research endeavours. Given the novelty of this approach, there is considerable room for improvement. First and foremost, future studies could enhance the bibliometric analysis by incorporating elements from science mapping and power analysis for a more comprehensive evaluation. Second, there is an opportunity to delve deeper into network analysis, exploring its applications beyond connection and link strength calculations. Third, Additionally, it should be considered that other recently introduced compounds have been demonstrated to have a significant influence on the oral environment. The use of postbiotics,[21] lysates[22] and Paraprobiotics[23] can modify Clinical Parameters in periodontal patients, so also these products should be considered in future research, as adjuvants, for gingivectomy procedures. Therefore, future reports are needed to consider these emerging compounds in combination with this well-known surgical technique. Finally, researchers can consider leveraging additional sources and applications to broaden the scope and gain access to new datasets and tools, facilitating more robust and diverse future investigations.

Conclusions

In the analysis encompassing 660 articles out of 1914 after filtering, gingivectomy publications were cited 5910 times, averaging nine citations per article. Original articles constituted about 95% of the publications (629 articles). The prominent keywords correlated with gingivectomy were associated with humans, periodontal structures, publication types, medical and dental sciences, gingivectomy procedures, and follow-up treatment. Gingivectomy was the most frequently occurring keyword (555 times). Over the years (2001–2021), there was a gradual increase in publications, with the lowest being 16 in the first year and the highest being 51 in the last year of the second decade. The timeline, divided into two decades, revealed a significant 1.5-fold increase in numbers from the first to the second decade. Publications on gingivectomy originated from diverse institutions, primarily universities, hospitals, and private practices. Individual and group authors contributed similarly, with a maximum of 4 publications by a single author. The top journals with the

highest gingivectomy publications were largely from the United States, India, and the United Kingdom, with a maximum of 36 publications from a single journal. Only 40% of the top 10 contributing journals qualified as Q1 (best quality) journals, according to Scimago Ranking. The highest number of citations for a single publication was 125.

Data Sharing Statement

Data are available upon request to the corresponding author.

Acknowledgments

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest.

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