Original Research

Bibliometric Analysis of Alveolar Ridge Augmentation Over the Last 20 Years

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ABSTRACT

Objective: This study aims to provide insights into the evolution and trends of academic efforts in the field of alveolar ridge augmentation through a bibliometric analysis. The objective is to assist researchers interested in future work within this domain by identifying potential areas of exploration and contributing to the field's advancement.

Methods: The bibliometric analysis encompasses publications related to alveolar ridge augmentation between 2000 and 2023, sourced from the Web of Science Core Collection database. The analysis involves various metrics and visualization tools, including Citespace, VOSviewer, and Biblioshiny, to evaluate publication patterns, journal analyses, country analyses, reference analyses, and keyword analyses.

Results: The analysis of 3,477 publications revealed a logistic growth pattern with an annual growth rate of 5.52%. Among the most commonly found document types were original articles, reviews, and editorial content. The journal analysis indicated the dominance of specific journals, with a small core journal group identified through Bradford's Law. The United States emerged as a leader in terms of publication and citation counts. Co-citation clustering unveiled evidence-based topics and the progression of research trends.

Conclusion: This bibliometric analysis sheds light on the trajectory of academic contributions in the field of alveolar ridge augmentation. It offers valuable insights for researchers considering future work by identifying potential areas for exploration and contributing to the field's progress.

Keywords: Bibliometric; Alveolar Ridge Augmentation; Grafting

INTRODUCTION

Alveolar ridge augmentation, a significant aspect of modern dental surgical practice, has evolved into a pivotal and continuously advancing field [1–3]. Enlarging the dimension or volume of the alveolar ridge on the jawbone is regarded as a critical step to ensure the successful execution of dental implantation and other dental restorative procedures. This surgical process aims to establish the necessary foundation for the secure integration of implants in cases of inadequate bone volume. Alveolar ridge augmentation not only plays a crucial role in the pre-operative and post-operative stages of the procedure but also forms a cornerstone for long-term success [4, 5].

The progression of modern medical technology and the increasing popularity of dental implants have led to a rapid surge in research dedicated to alveolar ridge augmentation [6] performing alveolar distraction osteogenesis (ADO. Presently, dental implants have become one of the most preferred restorative

options for tooth loss [7]. However, the presence of an adequate amount of bone is imperative for the successful integration of implants. This is precisely where alveolar ridge augmentation emerges as an indispensable step to facilitate proper conditions for dental implantation.

Bibliometric analysis serves as a potent tool for comprehending the quantitative and qualitative aspects of scientific research [8, 9]. The rise in the number of publications in the field of alveolar ridge augmentation has further elevated the significance of bibliometric analysis in this domain. This analytical approach aids not only in assessing the overall growth rate within the field but also in identifying specific subtopics of research, most cited studies, and influential researchers [10, 11]. Moreover, valuable insights such as the extent of leadership assumed by different countries in this field and the prominent journals serving as publication platforms can be derived through this analysis [12].

The objective of this study is to present a comprehensive overview of the literature surrounding alveolar ridge augmentation over the past two decades. Throughout this process, understanding the pace of advancements in the field and determining which areas have garnered greater attention becomes crucial in shaping the direction of future research endeavors. As alveolar ridge augmentation forms a fundamental bridge for successful dental implantation, research in this domain will continue to contribute to the expansion and progression of the discipline. In conclusion, this bibliometric analysis pertaining to alveolar ridge augmentation aims to offer a broad perspective on the strides taken in the realm of dental surgery and implantation. This analysis not only aids in comprehending the current state but also assists in identifying potential areas for future studies, thus guiding the advancement of the field.

Main Points;

- The analysis of 3,477 publications revealed a logistic growth pattern with an annual growth rate of 5.52%.
- Cluster analysis based on co-citations divided the literature into 17 topic headings.
- The largest cluster was "titanium mesh exposure (Cluster #0)" with 110 articles.
- The strongest citation burst was related to the keyword 'alveolar bone grafting'.

MATERIALS AND METHODS

Due to adhering to the principles of the Leiden Manifesto, this bibliometric analysis study is exempt from ethical approval. The Web of Science Core Collection database was utilized to retrieve publications related to alveolar ridge augmentations within the years 2000 to 2023. The search employed the following terms: "khoury technique (Topic) or urban technique (Topic) or Horizontal Ridge Augmentation (Topic) or Horizontal Bone Augmentation (Topic) or Shell technique (Topic) or Vertical Alveolar Ridge Augmentation (Topic) or umbrella technique (Topic) and Alveolar Ridge Augmentation (Should – Search within topic) and Bone Augmentation (Should – Search within topic) and Ridge Augmentation (Should – Search within topic) and Vertical Ridge Augmentation (Should – Search within topic) and Dentistry Oral Surgery Medicine (Web of Science Categories) and 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2014 or 2015 or 2013 or 2012 or 2011 or 2010 or 2009 or 2008 or 2007 or 2006 or 2005 or 2004 or 2003 or 2002 or 2001 or 2000 (Publication Years)."

Full records and complete reference lists of the accessed publications were downloaded in plain text format and subjected to data cleansing using Excel 2016 software. Subsequently, Citespace, VOSviewer, and Biblioshiny software [13] were employed for bibliometric analyses. In the visual representations of the data, nodes represented objects of interest such as references/authors/countries/keywords, while the lines connecting the nodes depicted relationships between pairs of nodes. The size of a node was indicative of the frequency of that element in the analysis; likewise, the thickness of the line connecting two nodes corresponded to the intensity of the connection between them.

Co-citation is a concept in bibliometrics and information retrieval that refers to the relationship between two documents based on the frequency with which they are cited together by other documents [14]. In other words, if two documents are frequently cited in the same context by other researchers, they are considered to have a co-citation relationship [15]. Co-citation analysis is often used in academic research to identify the intellectual connections between different works and to understand the relationships between authors, topics, or fields of study. Co-citation analysis can provide valuable insights into the intellectual structure of a particular research field, helping researchers identify seminal works, influential authors, and emerging trends. It is a useful tool for mapping the landscape of

academic literature and understanding the connections between different scholarly works. In this study, co-citation relationships were examined using functions of the Citespace software.

While the publication-citation numbers of the journals and their zones according to Bradford's scattering law were evaluated with Biblioshiny software [13], quartile groups were determined using Journal Citation Reports 2022. While metric properties such as keyword frequency and citation burst were obtained from Citespace software, Vosviewer software was used for visualizations.

RESULTS

General Outcomes

There were a total of 3,477 publications between 2000 and 2023. The annual publication count demonstrated logistic growth with an annual growth rate of 5.52% (Figure 1). The year 2019 had the highest number of publications with 238. Among the most common document types were 2,869 original articles, 325 reviews, 34 editorial contents, 14 editorials, and 13 meeting abstracts. The literature involved 9,694 authors, 7,590 institutions, and was published in 199 journals.

Journal Analysis

Out of a total of 199 journals, only 4 were part of the core journal group according to Bradford's Law. With 416 publications, "Clinical Oral Implants Research" held the top position in terms of publication count, followed by "International Journal of Oral & Maxillofacial Implants" with 319 publications and "International Journal of Periodontics & Restorative Dentistry" with 273 publications. The ranking, publication counts, distribution according to Bradford's Law, and quartile values of the top 10 journals with the most publications are shown in Table 1.

Country Analysis

The United States had the highest publication and citation counts, followed by Italy, Germany, Japan, and China. The publication counts, citation counts, and centrality values according to collaboration analysis of the top 10 contributing countries are presented in Table 2.

Reference Analysis

The most cited article, with 731 citations, belonged to Buser et al[16]. The network formed by references aimed to evaluate the evidence-based separation of topic headings within the literature. Co-citation analysis revealed 912 nodes and 2,092 connections. The top 5 most cited and co-cited articles are summarized in Table 3. Cluster analysis based on co-citations divided the literature into 17 topic headings. The largest cluster was "titanium mesh exposure (Cluster #0)" with 110 articles. The clustering analysis map is shown in Figure 2.a., and the timeline view is displayed in Figure 2.b. The overall silhouette value of the clustering analysis was 0.8798, indicating a reasonable level of separation within the literature.

Keyword Analysis

Among 4,074 keywords, 422 keywords appeared at least 5 times. The network of these keywords is illustrated in Figure 3.a., and the graffiti representation of these keywords is depicted in Figure 3.b. When examining keywords associated with citation bursts visualized in Figure 3.c., the strongest citation burst was related to the keyword 'alveolar bone grafting,' which occurred between 2020 and 2023. The second most significant citation burst was associated with the keyword 'tissue engineering,' which occurred between 2010 and 2013.

Table 1. The metric properties of the top 10 journals with the most publications.

| Rank	Journal Title	Number of Publications	Bradford Zone	Quarterly
1	Clinical Oral Implants Research	416	Zone 0	Q1
2	International Journal of Oral & Maxillofacial Implants	319	Zone 0	Q1
3	International Journal of Periodontics & Restorative Dentistry	273	Zone 0	Q2
4	Clinical Implant Dentıstry and Related Research	212	Zone 0	Q1
5	Journal of Periodontology	164	Zone 1	Q1
6	Journal of Oral and Maxillofacial Surgery	128	Zone 1	Q3
7	Journal of Oral Implantology	124	Zone 1	Q2
8	Implant Dentistry	120	Zone 1	Q2
9	International Journal of Oral and Maxillofacial Surgery	120	Zone 1	Q1
10	Journal of Clinical Periodontology	119	Zone 1	Q1
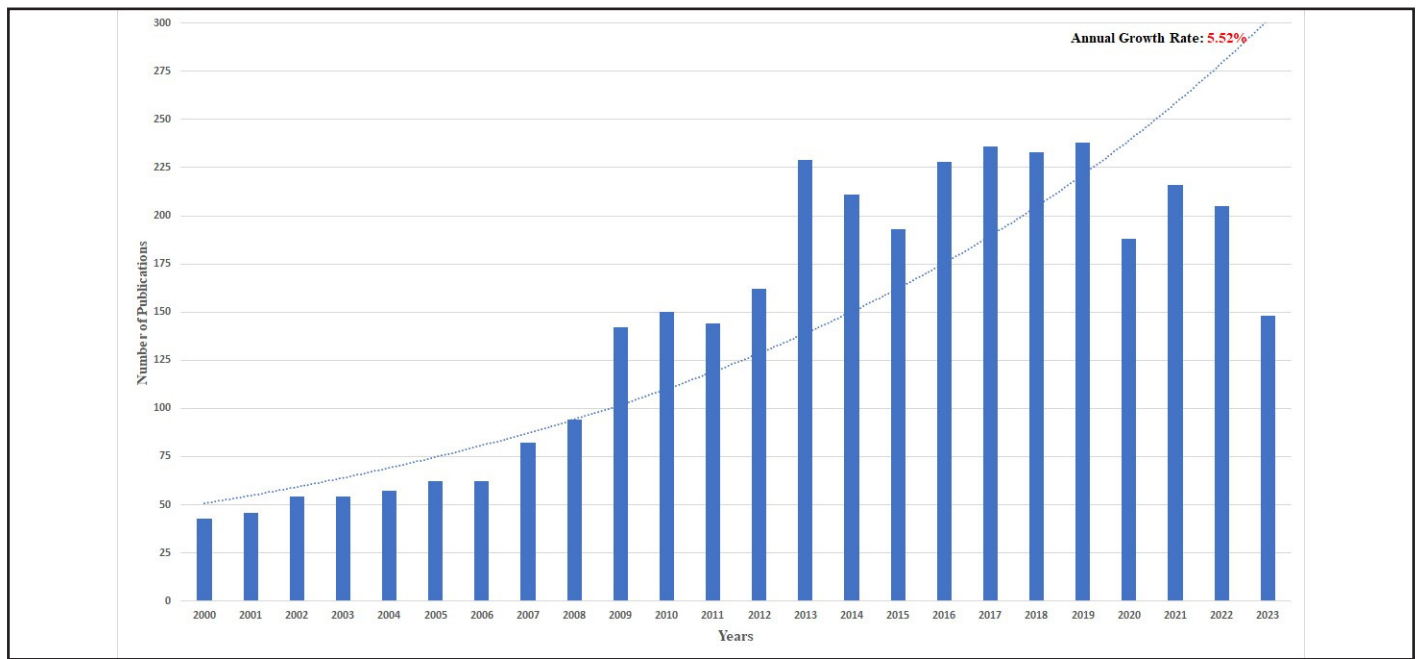
Figure 1. Number of publications by year and annual growth rate."

Table 2. Number of publications, number of citations, and centrality values of the top 10 countries with the most publications.

Country	Number of Publications	Number of Citations	Centrality Value
USA	612	15684	0.38
Italy	436	14829	0.14
Germany	345	6562	0.15
Japan	203	3821	0.09
China	180	1935	0.06
South Korea	162	2035	0.03
Brazil	160	2983	0.10
Spain	148	3291	0.11
Switzerland	146	6763	0.16
Israel	103	2832	0.02

Table 3. Top 5 articles with the highest metric values.

Top 5 Most Cited Articles		Top 5 Co-cited Articles	
Count	References	Count	References
731	Optimizing esthetics for implant restorations in the anterior maxilla: Anatomic and surgical considerations	76	Bone augmentation procedures in implant dentistry
629	A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation - Part I: Lateral approach	70	Are there specific indications for the different alveolar bone augmentation procedures for implant placement? A systematic review
622	Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement?	62	Bone augmentation procedures in localized defects in the alveolar ridge: clinical results with different bone grafts and bone-substitute materials
506	Bone Augmentation Procedures in Implant Dentistry	61	Effectiveness of vertical ridge augmentation interventions: A systematic review and meta-analysis
491	Bone augmentation techniques	61	Effectiveness of lateral bone augmentation on the alveolar crest dimension: a systematic review and meta-analysis
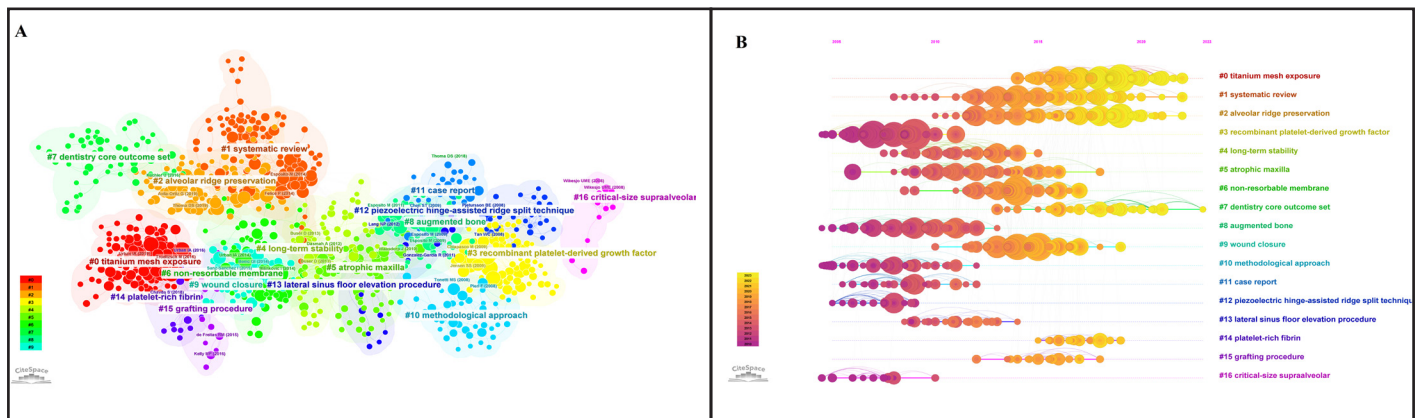
Figure 2. Co-citation analysis. A represents the Cluster analysis view, while B represents the Timeline view.
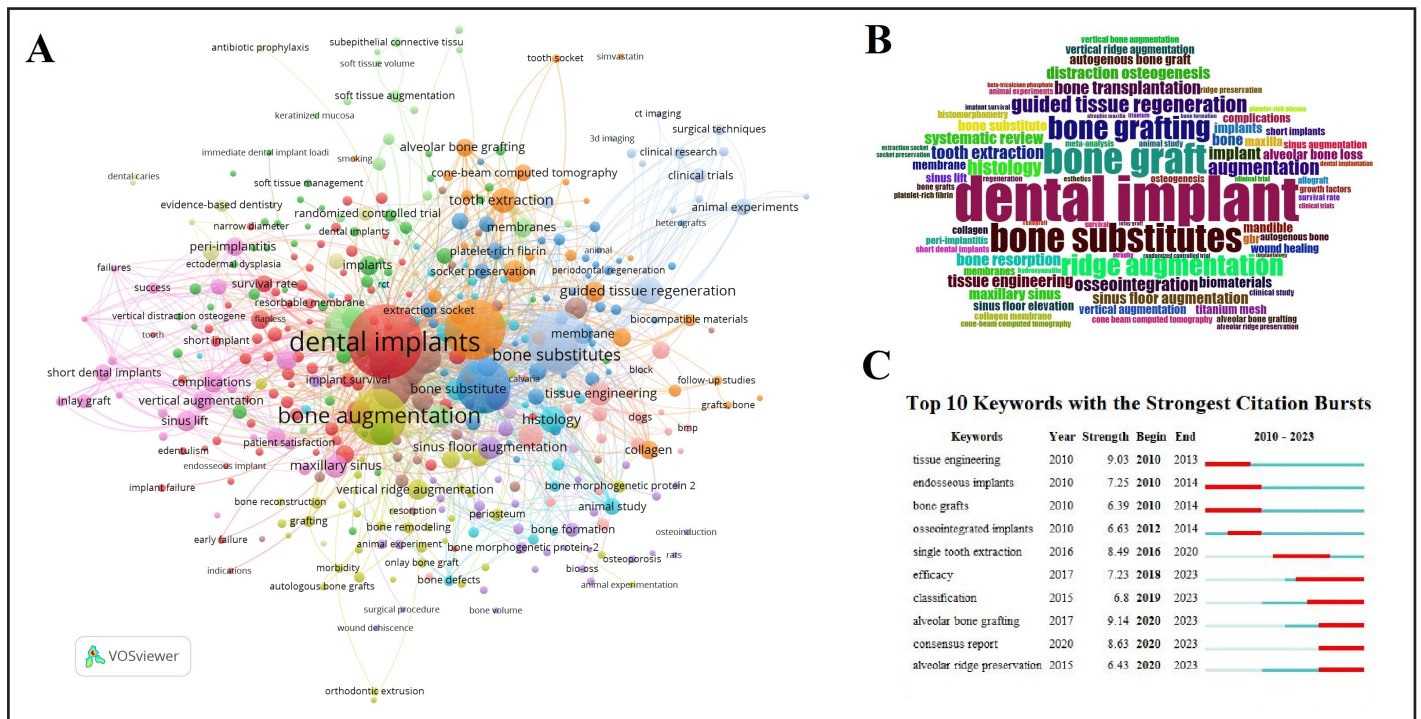
Figure 3. Keyword Analysis. A Co-occurrence network, B Graphite look and C Represents the top 10 keywords with the strongest citation brusts.

DISCUSSION

This study aims to present a bibliometric analysis of publications in the field of alveolar ridge augmentation, providing an overview of scientific production and development in this domain. Towards this purpose, publications related to Alveolar Ridge Augmentation from 2000 to 2023 were obtained from the Web of Science Core Collection, and they were analyzed using specially prepared programs for bibliometric analysis.

Bibliometric analysis aids in understanding trends and emphases within the literature, helping to identify priorities and potential research directions for the future [14, 17]. This article offers a panorama of academic effort and progress in the field of alveolar ridge augmentation. The obtained findings indicated that this field is a dynamic structure that is progressively growing, evolving, and diversifying into various topic areas.

Alveolar ridge augmentation is a commonly used procedure aimed at creating the appropriate bone volume required for dental implants or other restorative dental surgeries [18, 19]. Among the topics that have particularly garnered attention in current literature in this field are the selection of augmentation materials, the refinement of surgical techniques, and the long-term monitoring of outcomes [20, 21]. Factors such as the biocompatibility of augmentation materials, their impact on implant stability, and complication rates are especially important in the decision-making process for surgeons [22, 23]. Additionally, changes and advancements in surgical techniques have been a subject of discussion, particularly with the increasing use of minimally invasive approaches and digital Technologies [24]. Bibliometric analysis methods can be valuable in assessing new developments and clinical applications in the field of alveolar ridge augmentation. The results obtained through bibliometric analysis methods have the potential to provide more enlightening information for future research endeavors, aiming to enhance success rates of augmentation procedures and achieve better outcomes for patients.

The analysis results illustrate how the publication count in the field of alveolar ridge augmentation has changed over time and which topics have garnered more attention. Additionally, they reveal the countries and institutions leading in this area, as well as the authors contributing the most. Such data can provide insights into the formation of global collaborations and research networks in alveolar ridge augmentation. Identifying potential areas for future research is another important contribution of this study. The analysis results also highlight needs for further research in specific topics or methods and how these studies could impact the field. Furthermore, the results could provide hints on how multidisciplinary approaches or new technologies can be integrated into the realm of alveolar ridge augmentation.

Based on our findings, the United States had the highest publication and citation counts, and also the highest centrality value. This suggests that the United States is leading the efforts in this field and likely assisting other countries in finding new research topics. Additionally, countries like Japan, China, and South Korea had high publication counts but low centrality values, indicating that their studies had more localized impacts and were cited less by authors from other countries. To improve this situation, authors from countries with low centrality values are encouraged to engage in international collaborations and publish multi-national studies.

The most cited article belonged to Buser et al [16], and its main topic was to define key points to consider in dental implant treatment in the anterior maxilla. This study, published in 2004, has continued to remain relevant as the key points identified in this research are still applicable today. The second most cited article was a systematic review by Pjetursson et al [25], which examined sinus floor elevation using the lateral window approach. The study concluded that the procedure utilizing rough-surfaced implants covered by a membrane through the lateral window method achieved the highest success rate with a 98.3% implant survival rate three years later. Among the top 5 most cited articles, the other 3 articles did not focus on any specific topic but were related to bone augmentations.

Co-citation clustering analysis allowed us to identify evidence-based topics that the literature is divided into [10]. The more two different articles are co-cited, the more likely those publications are on the same topic. When performing co-citation clustering analysis, the frequencies of words used in the titles of these co-cited articles were evaluated to determine the cluster heading. Accordingly, the literature on alveolar ridge augmentation was divided into 17 subclusters. The largest and youngest cluster was Cluster #0, the 'titanium mesh exposure' cluster. The publications in this cluster were related to the use of titanium mesh in alveolar ridge augmentation. The recent decrease in the cost and increase in the popularity of titanium mesh is likely contributing to the rise in the number of publications. The significant advantages of titanium mesh, such as high biocompatibility, mechanical strength, flexibility, ease of shaping, promotion of cellular reactions, long-term durability, transparency, visibility, and minimal infection risk, have led to its increased use in alveolar ridge augmentation [26–30].

Certain topics have gained more importance over time, while others have lost significance. Notably, the use of PRF (platelet-rich fibrin) and alveolar crest split are among those that have decreased in importance. This decline could be due to other techniques proving more advantageous, and also the challenge of finding new aspects to explore regarding these two techniques.

Keywords play a crucial role in summarizing a paper's content and highlighting specific subjects or concepts [31, 32]. These keywords enable easier discovery of papers in databases or search engines [33]. Furthermore, topic selection is a critical component of papers, as focusing on a specific subject allows for in-depth knowledge production and expertise leadership

[32]. Keyword analysis can provide essential insights into the literature. The fact that 'Dental Implants' is the most frequent keyword indicates that alveolar ridge augmentation is strongly related to dental implants. Figure 3.c, which displays the changing popularity of keywords over time, is important for showing trends.

Limitations

This study had several limitations. First, the evaluated studies were limited to those published in English. Second, only a single database was utilized. The main issue here was the inability to combine data from multiple databases for analysis in Citespace. Consequently, only one database was used.

CONCLUSION

In conclusion, this study contributes to understanding the evolution and directions of academic efforts in the field of alveolar ridge augmentation. Researchers contemplating future work in this area can benefit from the insights provided by this analysis to identify potential areas of exploration and contribute to the advancement of the field. Monitoring significant developments and pioneering innovations should remain a primary objective for researchers in this domain, as they play a vital role in shaping the landscape and progress of the field.

Conflict of Interest: The author has no conflicts of interest to disclose.

Funding: None.

Ethical Statement: Ethical standards were adhered to in this study. Ethical approval was not required the bibliometric study.

REFERENCES

[1] Mahardawi B, Kyaw TT, Mattheos N, Pimkhaokham A (2023) The clinical efficacy of autogenous dentin blocks prepared chairside for alveolar ridge augmentation: A systematic review and meta-analysis. Clin Oral Implants Res. 0(0):1-13. https://doi.org/10.1111/clr.14131

[2] Kämmerer PW, Tunkel J, Götz W, et al (2022) The allogeneic shell technique for alveolar ridge augmentation: a multicenter case series and experiences of more than 300 cases. Int J Implant Dent. 8(1):1-15. https://doi.org/10.1186/s40729-022-00446-y

[3] Urban IA, Tattan M, Ravida A, et al (2022) Simultaneous alveolar ridge augmentation and periodontal regenerative therapy leveraging recombinant human platelet-derived growth factor-BB (rhPDGF-BB): A case report. Int J Periodontics Restorative Dent. 42(5):1-5. https://doi.org/10.11607/prd.6055

[4] Kim J-W, Cho M-H, Kim S-J, Kim M-R (2013) Alveolar distraction osteogenesis versus autogenous onlay bone graft for vertical augmentation of severely atrophied alveolar ridges after 12 years of long-term follow-up. Oral Surg Oral Med Oral Pathol Oral Radiol. 116(5):540-549. https://doi.org/10.1016/j.oooo.2013.06.037

[5] Sbordone C, Toti P, Guidetti F, et al (2012) Volume changes of iliac crest autogenous bone grafts after vertical and horizontal alveolar ridge augmentation of atrophic maxillas and mandibles: a 6-year computerized tomographic follow-up. J Oral Maxillofac Surg. 70(11):2559-2565. https://doi.org/10.1016/j.joms.2012.07.040

[6] Rachmiel A, Emodi O, Aizenbud D, et al (2018) Two-stage reconstruction of the severely deficient alveolar ridge: bone graft followed by alveolar distraction osteogenesis. Int J Oral Maxillofac Surg. 47(1):117-124. https://doi.org/10.1016/j.ijom.2017.07.007

[7] Pjetursson BE, Heimisdottir K (2018) Dental implants–are they better than natural teeth? Eur J Oral Sci. 126(1):81-87. https://doi.org/10.1111/eos.12543

[8] Ge Y, Chao T, Sun J, et al (2022) Frontiers and hotspots evolution in psycho-cardiology: A bibliometric analysis from 2004 to 2022. Curr Probl Cardiol. 47(12):101361. https://doi.org/10.1016/j.cpcardiol.2022.101361

[9] Akmal M, Hasnain N, Rehan A, et al (2020) Glioblastome multiforme: A bibliometric analysis. World Neurosurg. 136(1):270-282. https://doi.org/10.1016/j.wneu.2020.01.027

[10] Sun H-L, Bai W, Li X-H, et al (2022) Schizophrenia and Inflammation Research: A Bibliometric Analysis. Front Immunol. 13(1):907851. https://doi.org/10.3389/fimmu.2022.907851

[11] Liu J, Liu S, Shi Q, Wang M (2021) Bibliometric Analysis of Nursing Informatics Research. Stud Health Technol Inform. 284(2):47-49. https://doi.org/10.3233/SHTI210661

[12] Wilson M, Sampson M, Barrowman N, Doja A (2021) Bibliometric analysis of neurology articles published in general medicine journals. JAMA Netw open. 4(1):e215840. https://doi.org/10.1001/jamanetworkopen.2021.5840

[13] Aria M, Cuccurullo C (2017) Bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetr. 11(4):959-975. https://doi.org/10.1016/j.joi.2017.08.007

[14] Trujillo CM, Long TM (2018) Document co-citation analysis to enhance transdisciplinary research. Sci Adv. 4(1):e1701130. https://doi.org/10.1126/sciadv.1701130

[15] Boyack KW, Klavans R (2010) Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately? J Am Soc Inf Sci Technol. 61(12):2389-2404. https://doi.org/10.1002/asi.21419

[16] Buser D, Martin W, Belser UC (2004) Optimizing esthetics for implant restorations in the anterior maxilla: Anatomic and surgical considerations. Int J Oral Maxillofac Implants. 19(1):43-61.

[17] Garfield E (2006) The history and meaning of the journal impact factor. JAMA. 295(1):90-93. https://doi.org/10.1001/jama.295.1.90

[18] Chavda S, Levin L (2018) Human studies of vertical and horizontal alveolar ridge augmentation comparing different types of bone graft materials: a systematic review. J Oral Implantol. 44:74-84. https://doi.org/10.1563/aaid-joi-D-17-00053

[19] Yu S-H, Wang H-L (2022) An updated decision tree for horizontal ridge augmentation: A narrative review. Int J Periodontics Restorative Dent. 42(1):341-349. https://doi.org/10.11607/prd.5031

[20] Haggerty CJ, Vogel CT, Fisher GR (2015) Simple bone augmentation for alveolar ridge defects. Oral Maxillofac Surg Clin North Am. 27(2):203-226. https://doi.org/10.1016/j.coms.2015.01.011

[21] Rutkowski JL (2016) Vertical alveolar ridge augmentation in implant dentistry: A surgical manual and horizontal alveolar ridge augmentation in implant dentistry: A surgical manual. J Oral Implantol. 42(6):518. https://doi.org/10.1563/aaid-joi-D-Review.4206

[22] Kelly MP, Vaughn OLA, Anderson PA (2016) Systematic review and meta-analysis of recombinant human bone morphogenetic protein-2 in localized alveolar ridge and maxillary sinus augmentation. J oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg. 74(5):928-939. https://doi.org/10.1016/j.joms.2015.11.027

[23] Korsch M, Peichl M, Bartols A (2022) Lateral alveolar ridge augmentation with autologous dentin of periodontally compromised teeth: A retrospective study. Int J Environ Res Public Health.19(8):4560. https://doi.org/10.3390/ijerph19084560

[24] Urban I, Montero E, Sanz-Sánchez I, et al (2023) Minimal invasiveness in vertical ridge augmentation. Periodontol. 2000 91(1):126-144. https://doi.org/10.1111/prd.12479

[25] Pjetursson BE, Tan WC, Zwahlen M, Lang NP (2008) A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation: part I: lateral approach. J Clin Periodontol. 35(8):216-240. https://doi.org/10.1111/j.1600-051X.2008.01272.x

[26] dal Polo MR, Poli PP, Rancitelli D, et al (2014) Alveolar ridge reconstruction with titanium meshes: a systematic review of the literature. Med Oral Patol Oral Cir Bucal. 19(6):639-646. https://doi.org/10.4317/medoral.19998

[27] Roccuzzo M, Ramieri G, Spada MC, et al (2004) Vertical alveolar ridge augmentation by means of a titanium mesh and autogenous bone grafts. Clin Oral Implants Res. 15:73-81

[28] Xie Y, Li S, Zhang T, et al (2020) Titanium mesh for bone augmentation in oral implantology: current application and progress. Int J Oral Sci. 12(1):37. https://doi.org/10.1038/s41368-020-00107-z.

[29] Roccuzzo M, Ramieri G, Bunino M, Berrone S (2007) Autogenous bone graft alone or associated with titanium mesh for vertical alveolar ridge augmentation: a controlled clinical trial. Clin Oral Implants Res. 18(3):286-294. https://doi.org/10.1111/j.1600-0501.2006.01301.x

[30] Torres J, Tamimi F, Alkhraisat MH, et al (2010) Platelet-rich plasma may prevent titanium-mesh exposure in alveolar ridge augmentation with anorganic bovine bone. J Clin Periodontol. 37(10):943-951. https://doi.org/10.1111/j.1600-

051X.2010.01615.x

[31] Shah PK, Perez-Iratxeta C, Bork P, Andrade MA (2003) Information extraction from full text scientific articles: where are the keywords? BMC Bioinformatics. 4(1):1-9. https://doi.org/10.1186/1471-2105-4-20

[32] Li H, An H, Wang Y, et al (2016) Evolutionary features of academic articles co-keyword network and keywords co-occurrence network: Based on two-mode affiliation network. Phys A Stat Mech its Appl. 450(1):657-669. https://doi.org/10.1016/j.physa.2016.01.017

[33] Gil-Leiva I, Alonso-Arroyo A (2007) Keywords given by authors of scientific articles in database descriptors. J Am Soc Inf Sci Technol. 58(8):1175-1187. https://doi.org/10.1002/asi.20595

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