Revista ARACÊ
ISSN: 2358-2472

THE 50 MOST CITED ARTICLES ON GINGIVAL GRAFTS: A BIBLIOMETRIC ANALYSIS

https://doi.org/10.56238/arev7n2-299

Submitted on: 26/01/2025 **Publication date:** 26/02/2025

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ABSTRACT

Keratinized gum loss is often associated with receding gums, a condition in which gum tissue recedes toward the apex of the tooth root, exposing root surfaces. This combination can compromise periodontal health. Gingival grafts emerge as an effective alternative to treat these conditions, contributing to the regeneration of the keratinized gingival strip. Techniques such as free gum grafting and subepithelial connective tissue grafting are widely used to restore periodontal functionality and health. The objective of this study was to perform a bibliometric review of the 50 most cited articles in the area of gingival grafts. The search strategy was carried out in the Web of Science database of Clarivate Analytics. A search was performed using the terms (Periodontic OR Gingival recession OR Root coverage OR Connective tissue graft OR Plastic periodontal surgery OR Soft tissue grafting OR Coronally advanced flap) in the title and/or abstract. The paired selection of manuscripts was carried out by two researchers, MBM and VJS, independently and previously calibrated. The initial search identified 2033 articles. The most cited article in the top 50 was the one by Cairo et al. in 2008. The oldest manuscript of this bibliometric analysis was published in 1968 by Sullivan in the Journal of Clinical Periodontology and was cited 226 times, while two articles were the most recent, published in 2021 by Tavelli. in the Journal of periodontology, it was cited 127 times and in 2020 by Zucchelli et al. in the

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Journal of periodontology, cited 130 times. The institutions that stood out the most were the University of Zurich, followed by Private Practice. The main country was the United States. Among the main journals are the Journal of Periodontology and the Journal of Clinical Periodontology. In total, 290 keywords were used. The year 2010 was the most productive, with six studies published. More recent works were poorly represented, with the most current dating from 2021. The literature review carried out in this study revealed the growing interest and research around the use of Gingival Grafts as an effective alternative for the recovery of keratinized gums and treatment of gingival recessions.

Keywords: Periodontics. Gingival recession. Root Cover. Connective Tissue Graft. Periodontal Plastic Surgery. Soft Tissue Grafts. Coronally advanced flap.

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ISSN: 2358-2472

INTRODUCTION

The loss of keratinized gums and the development of gingival recession are conditions that can compromise oral health and the aesthetics of the smile. Gum recession occurs when the gingival margin retracts to an apical position in relation to the cement junction, exposing the root of the tooth. This condition is often associated with keratinized gum failure, occlusal trauma, improper brushing, or periodontal disease. Other contributing factors include close insertions of frenulums and bridles, reduced depth of the vestibule, tooth malposition, areas of bone dehiscence and fenestration, as well as physical trauma from inadequate restorative and periodontal procedures (BACKER, 2019). This condition affects both soft and hard tissues, and is more common in older people. The consequences of gingival recession and loss of keratinized gums include increased tooth sensitivity, risk of root caries, and aesthetic impairment (CAZELATO, 2011).

The Miller classification is a system used in periodontics to categorize the degree of gingival recession. Developed by P.D. Miller in 1985, it is widely used to assess the predictability of root coverage procedures and the severity of gingival recession. It divides gum recession into four classes: Class I: Recession limited to the gums without loss of interdental tissue; Class II: Recession beyond the cementary junction and no loss of interdental tissue; Class III: Recession with mild or moderate loss of interdental tissue and gingival recession beyond the cementary junction; Class IV: Recession with severe interdental loss and absence of sufficient bone or gingival tissue for root coverage (NETO, 2022).

Gum grafts are surgical procedures used to treat gum recession, increase the amount of healthy, keratinized gums around the teeth, or correct cosmetic defects. The main objectives of these grafts are to increase the amount of keratinized gums and/or cover the exposed roots of the teeth, preventing tooth sensitivity, root caries and improving the aesthetics of the smile. In addition, they help strengthen the gums around the teeth and can offer protection against inflammation and trauma (FEITOSA *et al.*, 2008).

There are different types of gingival grafts in which tissue is removed from one donor area and transported to another recipient at a distance, such as: Free Gingival Graft, which consists of removing a fragment of gum from the palate, including the epithelium and connective and grafting directly to the area where there is a lack of keratinized gum; Subepithelial Connective Tissue Graft, in which connective tissue is removed from the palate region, without removing the gingival epithelium; Connective Tissue Graft (en bloc),

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which consists of removing a wider area of the palate, containing epithelium and connective, and the portion of epithelial tissue is removed on the bench and only the connective tissue remains for grafting.

There are also Lateral Gum Grafts which involve the use of a healthy gum fragment that is taken or displaced from an area adjacent to the gum recession (DANTAS *et al.*, 2012).

Gum grafts are considered a successful technique for the treatment of gum recession, offering good results both aesthetically and functionally. Studies show that gum grafting procedures can provide significant root coverage, with success rates that vary according to the type of graft and the individual characteristics of the patient (GUIMARÃES, 2016)

One factor that contributes to the success of gingival grafts is the stabilization of the coronarily positioned flap. This technique, combined with grafting, promotes additional stability and helps prevent future gingival recession. Long-term success depends on the patient's adherence to good oral hygiene habits and periodontal maintenance consultations, in addition to the skill of the professional and the patient's anatomical conditions (MESSORA, 2009).

The success rate can also vary depending on the severity of the recession and the amount of gum tissue available. In cases of more extensive recession or in patients with thin gingival biotype, the procedure may be more challenging and require complementary techniques for better results (RODRIGUES, 2010).

Knowing the factors associated with graft prognosis is important for clinical decision-making regarding the choice of technique and the necessary care. Thus, in the present study, a bibliometric research with quantitative analysis of scientific publications on the subject is proposed. This study aims to identify trends and growth in knowledge about gingival grafts, through a literature review. This approach is used to outline a profile that highlights the specific interests of journals, groups of authors, or research centers (SOARES, 2018). In addition, the bibliometric review is a valuable tool to evaluate the process and the level of scientific and technological advancement in the field, contributing to a deeper understanding of the topic addressed (FAGGION *et al.*, 2016).

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METHODOLOGY

A literature review on the topic of gingival grafts in dentistry was carried out in the Web of Science database of Clarivate Analytics. As this is a review, this study does not require approval by the research ethics committee.

A search was performed on January 15, 2024, in the Clarivate Analytics Web of Science database, using the terms (Gingiva OR Gums OR Gum OR Gingival) AND (Grafts OR Graft) AND (Periodontic OR Gingival Recession OR Root Coverage OR Connective Tissue Graft OR Plastic Periodontal Surgery OR Soft Tissue Grafting OR Coronally Advanced Flap) in the title and/or abstract. The results were extracted from a table in Microsoft Excel software and organized in descending order of citation count. The paired selection of manuscripts was carried out by two researchers, MBM and VJS, independently and previously calibrated.

The study sample included publications that mentioned gingival grafts in the title and/or abstract, and publications that did not refer to the topic studied or that were using the topic as a secondary subject were excluded. There was no restriction regarding the study design, year of publication, language, or journal impact factor of the manuscripts.

The most cited articles were manually stratified according to information retrieved from the Clarivate Analytics Web of Science database, such as: year of publication, authors, number of citations, journals, keywords, contributing institution, country, among others. The address provided to the first author was used to define the country of origin and the contributing institution of the article.

The relationship between the authors is determined based on the number of times they cite each other, using a network visualization made with the VOSviewer software (Leiden University, Netherlands).

RESULTS

The initial search identified 2,033 articles in the Web of Science database. After comparing titles and abstracts, the 50 most cited gingival graft manuscripts are listed in order of classification based on the number of citations in Table 1. The study selection process, including the search strategy used in the database, is summarized in a flowchart as shown in Figure 1.

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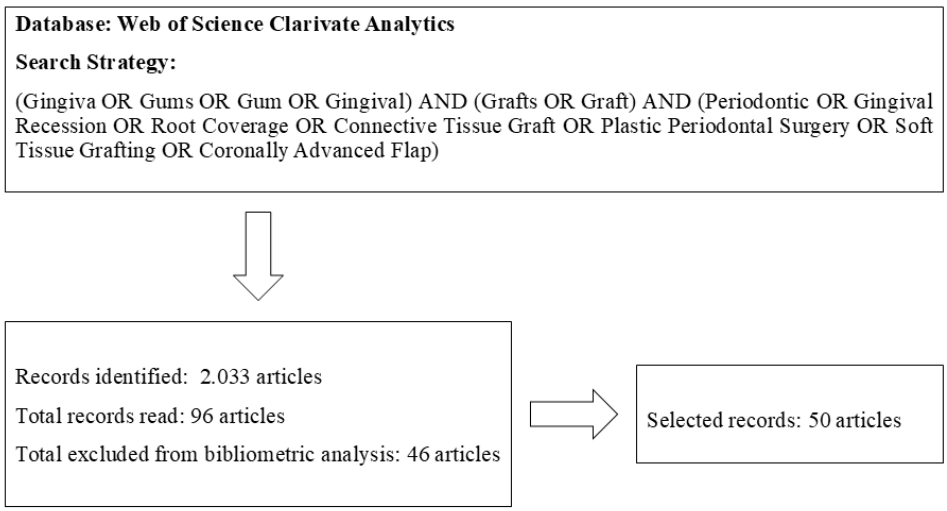
Figure 1 - Flowchart of the study selection process and search strategy of the 50 most cited articles on gingival grafts in dentistry.



Source: Authorship

Table 1 - Ranking of the most cited articles on gingival grafts in dentistry.

RANKING	AUTHORS	ARTICLE TITLE	PUBLICATION YEAR	JOURNAL	INSTITUTION	CITATIONS	AVERAGE CITATION RATE	TYPE OF STUDY
1	Cairo, F; Pagliaro, U; Nieri, M	Treatment of gingival recession with coronally advanced flap procedures: a systematic review	2008	JCP	University of Florence	325	20,31	Systematic review
2	Roccuzzo, M *et al.*	Periodontal plastic surgery for treatment of localized gingival recessions: a systematic review	2002	JCP	University of Turin	312	14,18	Systematic review
3	Chambrone, L; Tatakis, DN	Periodontal Soft Tissue Root Coverage Procedures: A Systematic Review From the AAP Regeneration Workshop	2015	JP	El Bosque University	282	31,33	Systematic review
4	Griffin, T. J . *et al.*	Postoperative complications following gingival augmentation procedures	2006	JP	Tufts University School of Dental Medicine	260	14,44	Clinical study
5	Zucchelli, G *et al.*	Patient morbidity and root coverage outcome after subepithelial connective tissue and de-epithelialized	2010	JCP	Bologna University	257	18,36	Randomized clinical trial

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		grafts: a comparative randomized-controlled clinical trial						
6	Cairo, F; Nieri, M; Pagliaro, U	Efficacy of periodontal plastic surgery procedures in the treatment of localized facial gingival recessions. A systematic review	2014	JCP	University Complutense of Madrid	238	23,80	Randomized clinical trial
7	Sanz, M *et al.*	Clinical evaluation of a new collagen matrix (Mucograft® prototype) to enhance the width of keratinized tissue in patients with fixed prosthetic restorations: a randomized prospective clinical trial	2009	JCP	University of Florence	238	15,87	Systematic review
8	PRATO, GP *et al.*	GUIDED TISSUE REGENERATION VERSUS MUCOGINGIVAL SURGERY IN THE TREATMENT OF HUMAN BUCCAL GINGIVAL RECESSION	1992	JP	Emory University	226	7,06	Article not found
9	SULLIVAN, HC; ATKINS, JH	FREE AUTOGENOUS GINGIVAL GRAFTS .3. UTILIZATION OF GRAFTS IN TREATMENT OF GINGIVAL RECESSION	1968	PS	University of Siena	226	4,04	Clinical study
10	Thoma, D. S . *et al.*	Effects of soft tissue augmentation procedures on peri-implant health or disease: A systematic review and meta-analysis	2018	COIR	University of Zurich	223	37,17	Systematic review and meta-analysis
11	Chambrone, L *et al.*	Root-Coverage Procedures for the Treatment of Localized Recession-Type Defects: A Cochrane Systematic Review	2010	JP	University of São Paulo	218	15,57	Systematic review
12	Thoma, D. S . *et al.*	Efficacy of soft tissue augmentation around dental implants and in	2014	JCP	University of Zurich	200	20,00	Systematic review

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		partially edentulous areas: a systematic review						
13	Hürzeler, MB; Weng, D	A single-incision technique to harvest subepithelial connective tissue grafts from the palate	1999	IJPR	Albert Ludwigs University of Freiburg	197	7,88	Case Report
14	Wennstrom, J.L.; Zucchelli, G	Increased gingival dimensions. A significant factor for successful outcome of root coverage procedures? A 2-year prospective clinical study	1996	JCP	Göteborg University	196	7,00	Clinical study
15	Thoma, D. S *. et al.*	A systematic review assessing soft tissue augmentation techniques	2009	COIR	University of Zurich	190	12,67	Systematic review
16	Zuhr, O; Bäumer, D; Hürzeler, M	The addition of soft tissue replacement grafts in plastic periodontal and implant surgery: critical elements in design and execution	2014	JCP	Johann Wolfgang Goethe-University Frankfurt	170	17,00	Literature review
17	McGuire, MK; Scheyer, ET	Xenogeneic Collagen Matrix With Coronally Advanced Flap Compared to Connective Tissue With Coronally Advanced Flap for the Treatment of Dehiscence-Type Recession Defects	2010	JP	Private Practice	157	11,21	Randomized clinical trial
18	Aichelmann-Reidy, ME *et al.*	Clinical evaluation of acellular allograft dermis for the treatment of human gingival recession	2001	JP	Louisiana State University School of Dentistry	157	6,83	Clinical study
19	Zucchelli, G; Mounssif, I	Periodontal plastic surgery	2015	P2000	University of Bologna	155	17,22	Literature review
20	Aroca, S *et al.*	Treatment of class III multiple gingival recessions: a randomized-clinical trial	2010	JCP	Private practice	145	10,36	Clinical study
21	HARRIS, RJ	THE CONNECTIVE-TISSUE WITH PARTIAL THICKNESS DOUBLE PEDICLE GRAFT - THE	1994	JP	University of Szeged	145	4,83	Randomized clinical trial

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		RESULTS OF 100 CONSECUTIVELY-TREATED DEFECTS						
22	Zucchelli, G *et al.*	Bilaminar techniques for the treatment of recession-type defects. A comparative clinical study	2003	JCP	Bologna University	144	6,86	Clinical study
23	Zabalegui, I *et al.*	Treatment of multiple adjacent gingival recessions with the tunnel subepithelial connective tissue graft: A clinical report	1999	IJPR	University of Oviedo	143	5,72	Case Report
24	Aroca, S *et al.*	Treatment of multiple adjacent Miller class I and II gingival recessions with a Modified Coronally Advanced Tunnel (MCAT) technique and a collagen matrix or palatal connective tissue graft: a randomized, controlled clinical trial	2013	JCP	University of Bern	140	12,73	Randomized clinical trial
25	Del Pizzo, M *et al.*	The connective tissue graft: a comparative clinical evaluation of wound healing at the palatal donor site - A preliminary study	2002	JCP	University of Turin	137	6,23	Clinical study
26	BOUCHARD, P *et al.*	SUBEPITHELIAL CONNECTIVE-TISSUE GRAFTS IN THE TREATMENT OF GINGIVAL RECESSIONS - A COMPARATIVE-STUDY OF 2 PROCEDURES	1994	JP	Paris University	136	4,53	Clinical study
27	Bouchard, P; Malet, J; Borghetti, A	Decision-making in aesthetics: root coverage revisited	2001	P2000	Denis Diderot University	133	5,78	Literature review
28	Pini-Prato, GP *et al.*	Coronally advanced flap versus connective tissue graft in the treatment of multiple gingival recessions: a split-	2010	JCP	University of Florence	132	9,43	Clinical study

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		mouth study with a 5-year follow-up						
29	Zucchelli, G *et al.*	Autogenous soft tissue grafting for periodontal and peri-implant plastic surgical reconstruction	2020	JP	University of Michigan School of Dentistry	130	32,50	Literature review
30	Tonetti, MS; Jepsen, S	Clinical efficacy of periodontal plastic surgery procedures: Consensus Report of Group 2 of the 10th European Workshop on Periodontology	2014	JCP	European Research Group on Periodontology	130	13,00	Consensus report
31	Burkhardt, R; Lang, NP	Coverage of localized gingival recessions: comparison of micro- and macrosurgical techniques	2005	JCP	University of Berne	129	6,79	Clinical study
32	Avelli, L *et al.*	Peri-implant soft tissue phenotype modification and its impact on peri-implant health: A systematic review and network meta-analysis	2021	JP	University of Michigan School of Dentistry	127	42,33	Systematic review and network meta-analysis
33	Studer, S. P . *et al.*	The thickness of masticatory mucosa in the human hard palate and tuberosity as potential donor sites for ridge augmentation procedures	1997	JP	University of Zurich	127	4,70	Clinical study
34	Wessel, JR; Tatakis, DN	Patient outcomes following subepithelial connective tissue graft and free gingival graft procedures	2008	JP	Ohio State University	126	7,88	Cross-sectional study
35	Zucchelli, G *et al.*	A novel surgical-prosthetic approach for soft tissue dehiscence coverage around single implant	2013	COIR	University of Campinas	121	11,00	Randomized clinical trial
36	da Silva, R. C . *et al.*	Root coverage using the coronally positioned flap with or without a subepithelial	2004	JP	Bologna University	121	6,05	Clinical study

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		connective tissue graft						
37	Clauser, C *et al.*	Evidence-based mucogingival therapy. Part 2: Ordinary and individual patient data meta-analyses of surgical treatment of recession using complete root coverage as the outcome variable	2003	JP	Accademia Toscana Ricerca Odontostomatologica	120	5,71	Systematic review and meta-analysis
38	Kim, DM; Neiva, R	Periodontal Soft Tissue Non-Root Coverage Procedures: A Systematic Review From the AAP Regeneration Workshop	2015	JP	Harvard School of Dental Medicine	119	13,22	Systematic review
39	Huang, LH; Neiva, REF; Wang, HL	Factors affecting the outcomes of coronally advanced flap coverage procedure	2005	JP	Niversity of Michigan School of Dentistry	118	6,21	Clinical study
40	Cummings, L.C.; Kaldahl, WB; Allen, EP	Histologic evaluation of autogenous connective tissue and acellular dermal matrix grafts in humans	2005	JP	University of Nebraska	118	6,21	Clinical study
41	Harris, RJ	A comparative study of root coverage obtained with an acellular dermal matrix versus a connective tissue graft: Results of 107 recession defects in 50 consecutively treated patients	2000	IJPR	Private Practice	118	4,92	Clinical study
42	McGuire, MK; Nunn, M	Evaluation of human recession defects treated with coronally advanced flaps and either enamel matrix derivative or connective tissue. Part 1: Comparison of clinical parameters	2003	JP	University of Texas	117	5,57	Clinical study
43	JAHNKE, PV *et al.*	THICK FREE GINGIVAL AND CONNECTIVE-TISSUE	1993	JP	Private Practice	116	3,74	Clinical study

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		AUTOGRAFTS FOR ROOT COVERAGE						
44	Paolantonio, M *et al.*	Subpedicle acellular dermal matrix graft and autogenous connective tissue graft in the treatment of gingival recessions: A comparative 1-year clinical study	2002	JP	University G. D'Annunzio	113	5,14	Clinical study
45	Kan, JYK *et al.*	Facial Gingival Tissue Stability After Connective Tissue Graft With Single Immediate Tooth Replacement in the Esthetic Zone: Consecutive Case Report	2009	JOMS	Loma Linda University School of Dentistry	112	7,47	Case Report
46	MILLER, PD	ROOT COVERAGE WITH THE FREE GINGIVAL GRAFT - FACTORS ASSOCIATED WITH INCOMPLETE COVERAGE	1987	JP	University of Tennessee	112	3,03	Literature review
47	Chambrone, L *et al.*	Evidence-Based Periodontal Plastic Surgery. II. An Individual Data Meta-Analysis for Evaluating Factors in Achieving Complete Root Coverage	2012	JP	Guarulhos University	111	9,25	Systematic review and meta-analysis
48	Tatakis, DN *et al.*	Periodontal Soft Tissue Root Coverage Procedures: A Consensus Report From the AAP Regeneration Workshop	2015	JP	Ohio State University	110	12,22	Consensus report
49	Harris, RJ	A comparative study of root coverage obtained with guided tissue regeneration using a bioabsorbable membrane versus the connective tissue with partial-thickness double pedicle graft	1997	JP	Private Practice	108	4,00	Clinical study
50	Thoma, D. S . *et al.*	Soft tissue volume augmentation by the use of collagen-based matrices: a volumetric analysis	2010	JCP	University of Zurich	107	7,64	Clinical study

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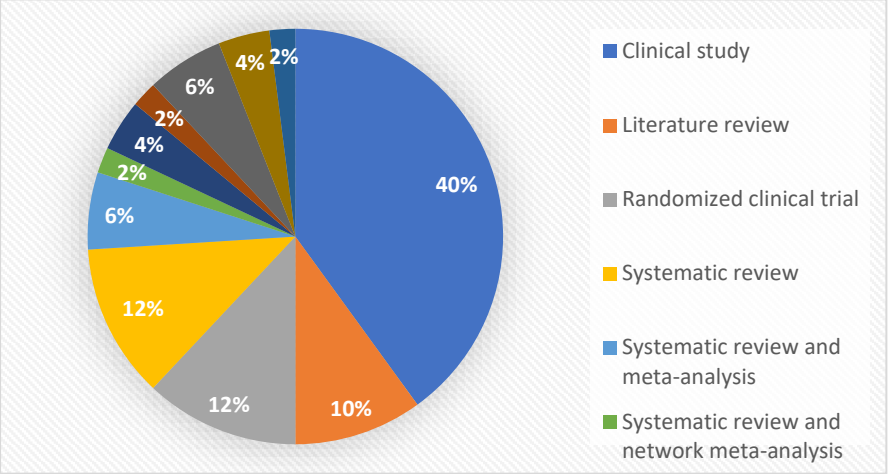
Source: Authorship
Legend: COIR: Clinical Oral Implants Research; **IJPR:** International Journal of Periodontics and Restorative Dentistry; **JCP**: Journal of Clinical Periodontology; **JP:** Journal of Periodontology; **JOMS**: Journal of Oral and Maxillofacial Surgery; **PS**: Periodontics; **P2000:** Periodontology 2000.

TYPES OF STUDY, PUBLICATIONS, AND AUTHOR CITATIONS

Of the types of studies found in the 50 most cited articles on gingival grafts, 40% of them were clinical studies, 12% randomized clinical studies, and 12% systematic reviews, in addition to other types of studies that can be seen in Figure 2.

Figure 2 - Type of studies of the 50 most cited articles in the area of gingival grafts in dentistry.



Source: Authorship

The number of authors and co-authors in the articles ranged from 1 to 10 (mean 4.14±2.11), and these authors may be repeated in more manuscripts. In total, 167 authors and co-authors were found in the 50 most cited articles on gingival grafts in dentistry. The authors and co-authors with the highest number of publications, followed by their respective scores, Jung, Ronald E. (4 articles), Thoma, Daniel S. (4 articles), Zucchelli, Giovanni (4 articles), Chambrone, Leandro (4 articles). About 140 authors and co-authors appeared in only one article and 27 in two or more articles. Figure 3 shows a graphic representation of the network between the authors and co-authors in the articles, showing few lines connecting them, showing little relationship between them.

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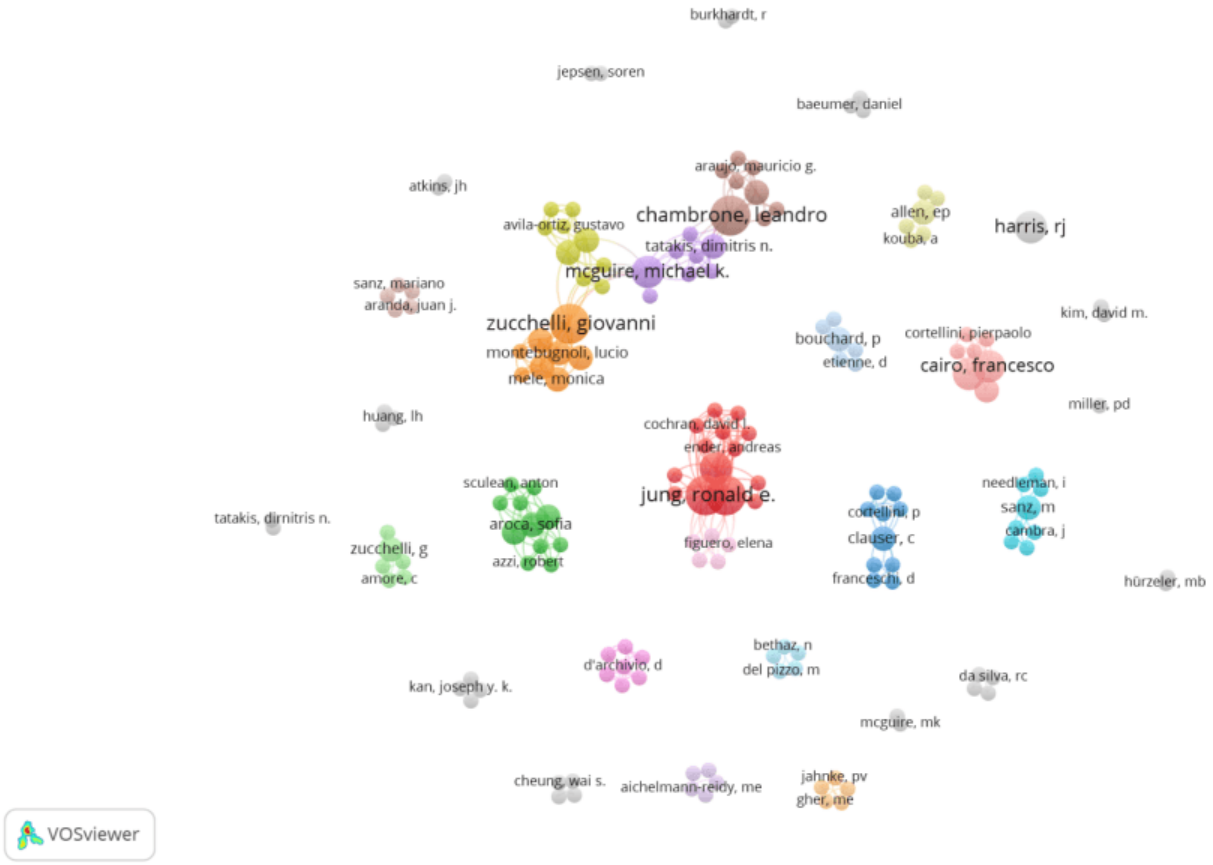
Figure 2 - Network of authors and co-authors.



Source: Authorship

The most cited articles were in first position Cairo F, Pagliaro U, Nieri M in 2008 with a total of 325 citations, followed by Roccuzzo M et al. in 2002 with 312 citations, Chambrone L, Tatakis DN in 2015 with 282 citations. The number of citations ranged from 107 to 325 (mean 161.84±57.26). Around 12 articles reached 200 or more citations, in addition, all articles had more than 100 citations (Table 1). One manuscript was the oldest in this bibliometric analysis, published in 1968 by Sullivan HC, Atkins JH in Periodontics (PS) and was cited 226 times. While the most recent was published by Avelli L and collaborators in 2021 in the Journal of Periodontology and has been cited 127 times. Figure 4 shows the correlation between the number of citations and the year of publication of the studies of the 50 most cited articles on gingival grafts in dentistry.

The citation distribution line shows high peaks in the years 2010, 2014, 2018 with 1016, 738 and 666 citations respectively.

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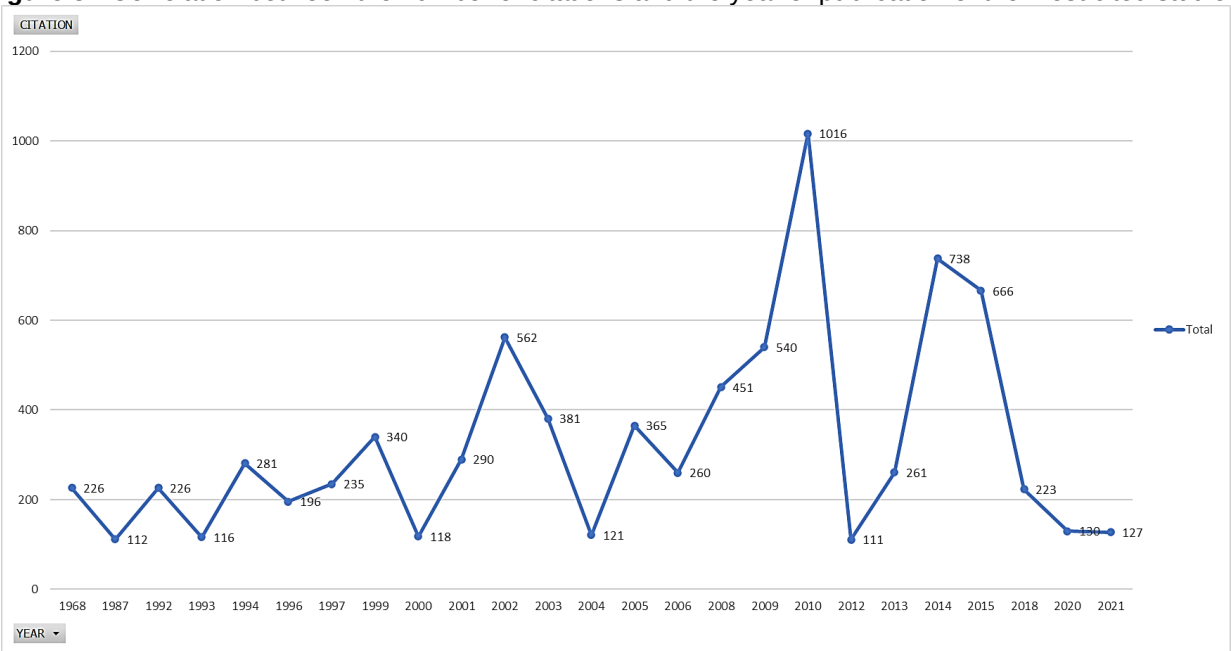
Figure 3 - Correlation between the number of citations and the year of publication of the most cited studies.



Source: Authorship

INSTITUTIONS AND COUNTRIES

A total of 36 different institutions are related to this work when observing only the institutions of the first author, as can be seen in Table 2. University of Zurich (847 citations) and Private Practice (644 citations) lead the list with 5 published manuscripts among the 50 most cited.

Table 2 - Correlation between the institutions of the first author, number of publications and citations, in the top 50 most cited articles on gingival grafting.

First Author's Institutions	Number of articles	Total Citations
University of Zurich	5	847
Private Practice	5	644
University of Florence	3	695
Bologna University	3	522
University of Michigan School of Dentistry	2	257
Ohio State University	2	236
University of Berne	1	129
El Bosque University	1	282
University of Oviedo	1	143
Guarulhos University	1	111
University G. D'Annunzio	1	113
Harvard School of Dental Medicine	1	119
University of Campinas	1	121
Johann Wolfgang Goethe-University Frankfurt	1	170
University of Siena	1	226
Loma Linda University School of Dentistry	1	112
University Complutense of Madrid	1	238

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Louisiana State University School of Dentistry	1	157
University of Bern	1	140
Niversity of Michigan School of Dentistry	1	118
University of Bologna	1	155
Denis Diderot University	1	133
Göteborg University	1	196
European Research Group on Periodontology	1	130
University of Nebraska	1	118
Paris University	1	136
University of São Paulo	1	218
University of Texas	1	117
University of Szeged	1	145
University of Tennessee	1	112
Albert Ludwigs University of Freiburg	1	197
University of Turin	1	312
University of Turin	1	137
Tufts University School of Dental Medicine	1	260
Accademia Toscana Ricerca Odontostomatologica	1	120
Emory University	1	226
Grand Total	**50**	**8092**

Source: Authorship

The studies originated in 10 different countries when looking only at the location of the first author, the total number of citations from all countries was 8,092 citations, only the United States had 2,476 citations, as shown in Table 3. The top countries were the United States with 18 articles, Italy with 13 articles, Switzerland with 7 articles, and Brazil with 3 articles among the 50 articles on gum grafts. Figure 5 shows the map of the world with the countries of the first authors highlighted in blue. When looking at the country of all authors and co-authors, the number of countries of origin increases to 12, so the United States remains in first place, with 17 manuscripts and Italy 14 manuscripts in second. Of these, only 10 are linked to at least one other country, as shown in figure 6.

Table 3 - Number of articles published and number of citations from each country of origin of the 50 most cited articles on gum grafts.

Country Of the First Author	Number of Articles	Number of Citations
United States	18	2476
Italy	13	2410
Switzerland	7	1116
Brazil	3	450
Spain	2	381
Germany	2	367
France	2	269
Colombia	1	282
Hungary	1	145
Sweden	1	196

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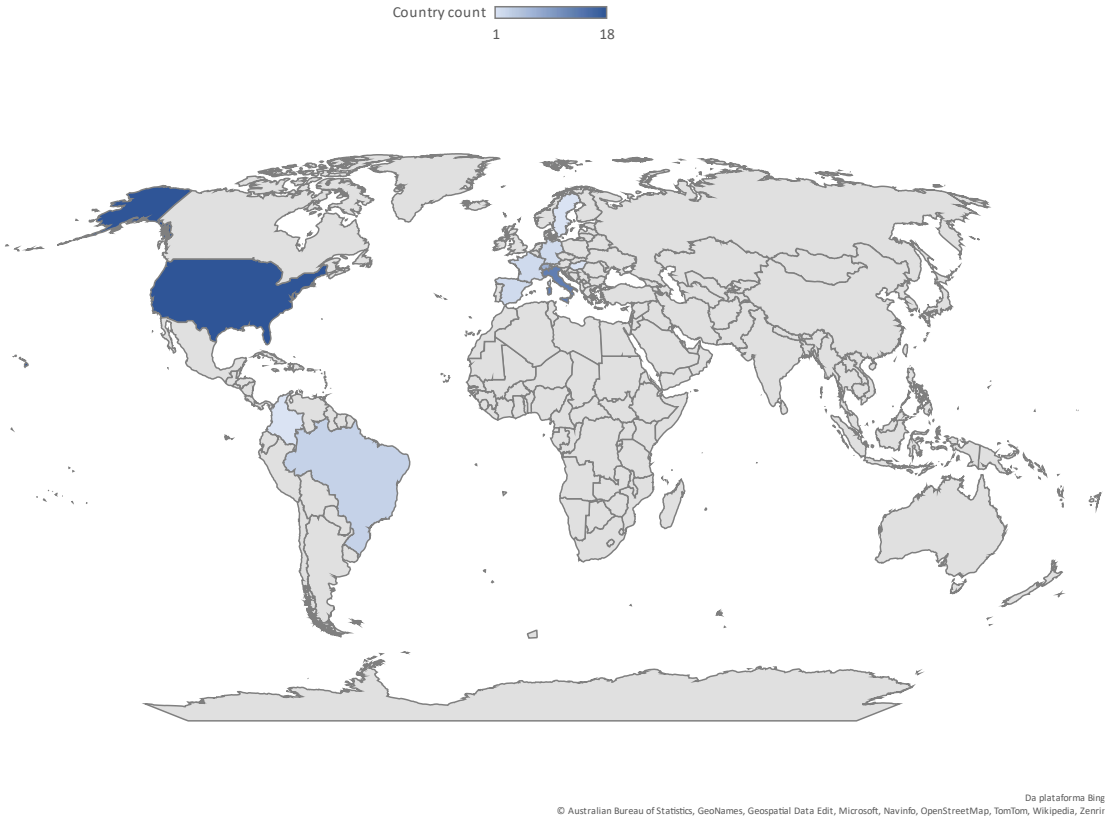
Grand Total	50	8092

Source: Authorship

Figure 4 - World Map, showing the countries of origin of the 50 most cited articles on gingival grafts. The greater the number of publications in that country, the bluer it becomes.



Source: Authorship

Figure 5 - Analysis of the network of countries based on the bibliometric research carried out.

Source: Authorship

DIARIES

The 50 most cited articles involving gum grafts were published in 7 different journals. Among the main ones are the Journal of Periodontology (JP) leading the ranking with 24 articles published, followed by the Journal of Clinical Periodontology (JCP) with 16 articles published as shown in Figure 7.

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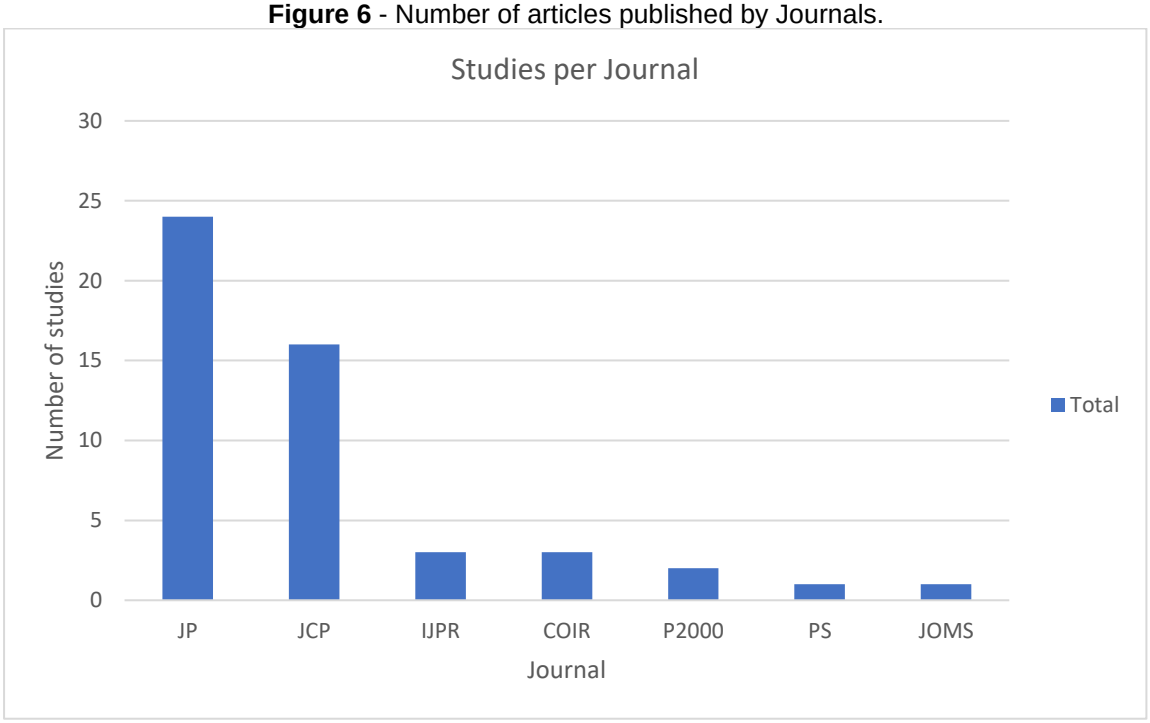
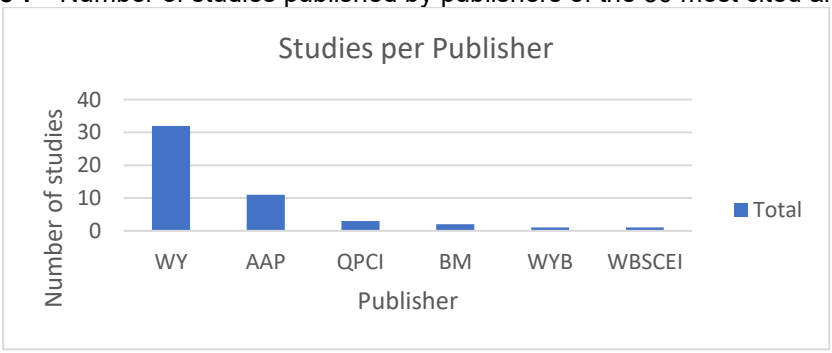
Figure 6 - Number of articles published by Journals.



Source: Authorship
Legend: COIR: Clinical Oral Implants Research; **IJPR:** International Journal of Periodontics and Restorative Dentistry; **JCP**: Journal of Clinical Periodontology; **JP:** Journal of Periodontology; **JOMS**: Journal of Oral and Maxillofacial Surgery; **PS**: Periodontics; **P2000:** Periodontology 2000.

The most present editors of the 50 articles were Wiley (WY) with 32 articles, followed by the American Academy of Periodontology (AAP) with 11 articles published as shown in Figure 8.

Figure 7 - Number of studies published by publishers of the 50 most cited articles.



Source: Authorship. **Legend: AAP**: American Academy of Periodontology; **BM:** Blackwell Munksgaard; **QPCI:** Quintessence Publishing Co., Inc.; **WY:** Wiley; WYB: Wiley-Blackwell; **WBSCEI:** W.B. Saunders Co. Elsevier, Inc.

KEYWORDS

In total, 290 keywords were used in the 50 most cited articles. The most commonly used keywords in this list of articles were: Root coverage (22 times), acellular dermal

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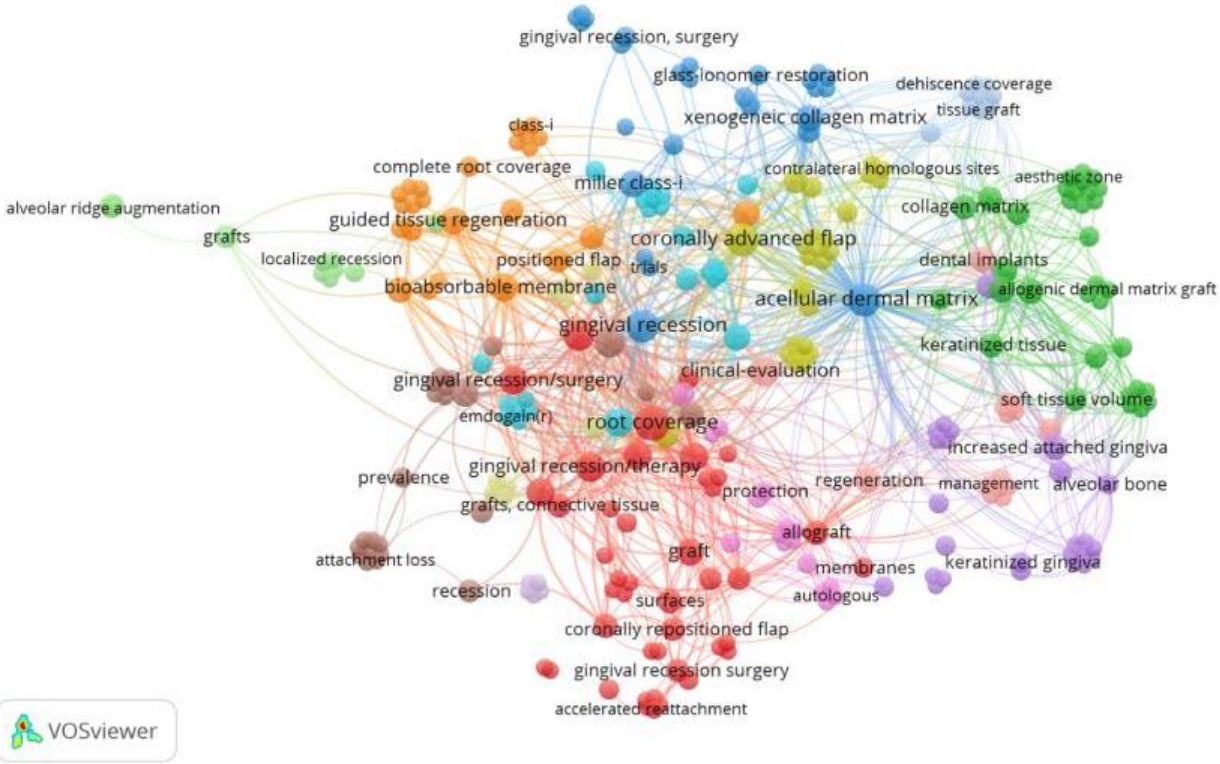
matrix (15 times), coronally advanced flap (15 times), gingival recession (14 times), double pedicle graft (12 times), connective-tissue graft (11 times), gingival recession/therapy (10 times), clinical-evaluation (10 times), gingival recession/surgery (9 times). The most commonly used keyword was repeated in 22 studies, and the frequency of use of the keywords ranged from 1 to 22 repetitions. Figure 9 shows a graphical representation in the form of a map of the keywords.

Figure 8 - Network analysis of keywords from the bibliometric search on gingival grafts. The sizes of the circles are related to the frequency of each keyword used.



Source: Authorship

TIME PATTERN OF PUBLICATIONS

Based on the distribution of the 50 most cited articles and the year of their publications, the period of 2010, 2014 and 2015 were the years with the highest concentration of publications and the most productive, with 6 articles and the last two with 4 studies, respectively, as shown in Figure 10.

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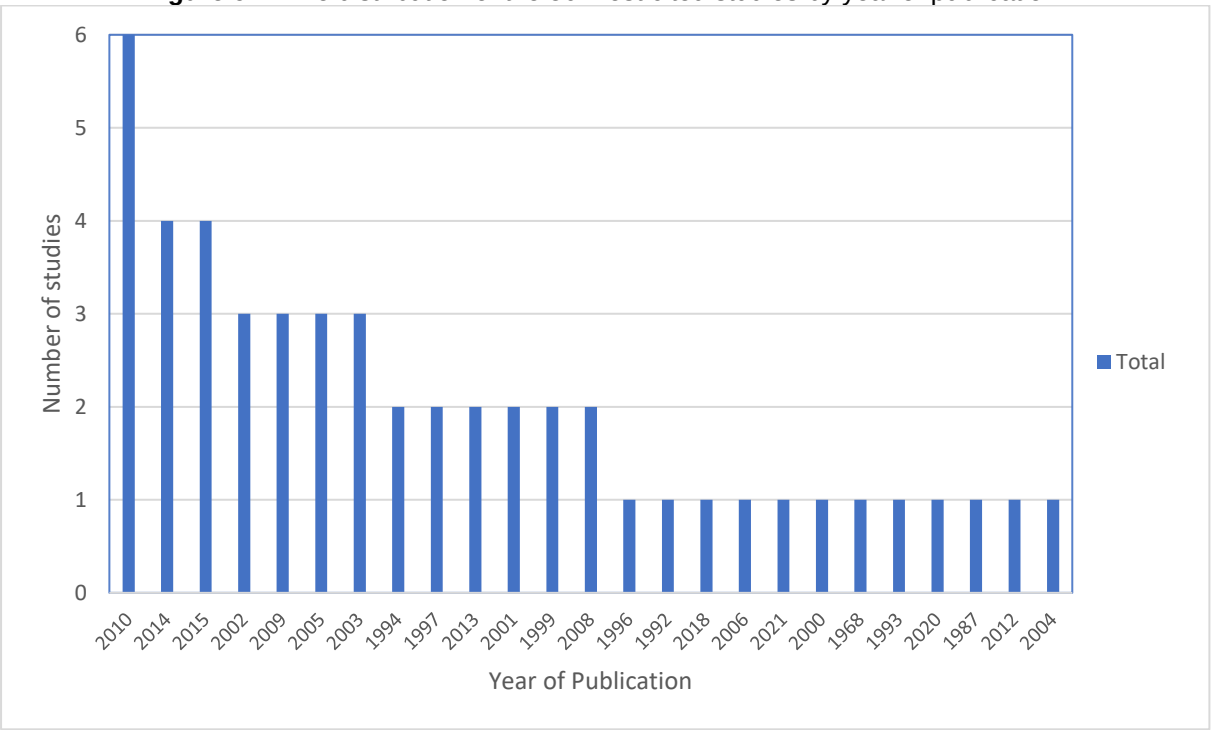
Figure 9 - Time distribution of the 50 most cited studies by year of publication.



Source: Authorship

DISCUSSION

Despite the great efficiency and contribution of gingival graft procedures in their various applicable contexts, it is important to highlight their results, the factors associated with prognosis in a global view and to give more prominence to a theme that is evolving and presents itself as the center of several studies still in progress. The present bibliometric analysis provided a broad verification of the production and dissemination of scientific knowledge on the subject.

With the initial search, it was possible to identify 2033 articles related to gum grafts. The bibliometric analysis in relation to the publication and the number of authors cited reveals the importance of these works for the scientific community. Of the top 50, 100% of the articles reached 100 or more citations and can be considered as classic articles related to the "Gingival Grafts" material, because according to Feijoo et al. (2014), articles that have more than 100 citations are classified as classic studies.

The average number of citations per year is also an important metric, as more recent articles may have the same ranking parameter as older articles. In this review, twenty-two articles had more than 10 citations per year.

The first was the thirty-second most cited article with 42.33 citations per year. This article deals with the modification of the peri-implant soft tissue phenotype and its impact

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on peri-implant health, concluding that approaches involving connective tissue grafts resulted in a significant increase in mucosal thickness compared to non-enlarged sites and the increase in keratinized mucosal width via the apically positioned flap technique was associated with a significant reduction in probing depth, soft tissue dehiscence and plaque index (TAVELLI *et al.*, 2021).

The second article with the highest average citation rate per year was published in 2018 and is a systematic review and network meta-analysis that aimed to review the dental literature also in terms of soft tissue augmentation procedures and their influence on peri-implant health or disease and concluded that soft tissue grafting procedures result in more favorable peri-implant health (THOMA *et al.*, 2018). This review had an average of 37.17 citations per year.

The third article evaluated by the number of citations per year was the twenty-ninth article with 32.50 citations per year. This is a review that presents the latest evidence and current status of autogenous soft tissue grafting for soft tissue augmentation and recession coverage at teeth and dental implant sites. The indications and predictability of free gingival grafting and connective tissue grafting (CTG) techniques are highlighted, along with their expected clinical and aesthetic results (ZUCCHELLI *et al.*,2020). This leads us to infer that the health of peri-implant tissues has been a topic of wide discussion for researchers in the area.

The leading ranking of the most cited was the review article by Cairo *et al.* in 2008, entitled "Treatment of gingival recession with coronally advanced flap procedures: a systematic review" published in the Journal of Clinical Periodontology with a total of 325 citations. The objective of this study was to conduct a systematic review of the literature on the use of the coronarily positioned flap, alone or in combination with other approaches, such as connective tissue grafts, barrier membranes, enamel matrix derivatives, or other materials for the treatment of Miller class I and II gingival recessions. The aim was to evaluate the efficacy of these combinations in the management of this condition, identifying the best available therapeutic strategies. It was concluded that connective tissue grafting or enamel matrix derivatives increased the probability of obtaining complete root coverage in Miller Class I and II gingival recessions (CAIRO *et al.*, 2008).

There was a great variation in the number of citations, which ranged from 107 to 325, which points to the diversity of themes and approaches present in the most cited articles.

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Representing 82% of the 50 most cited articles, the most studied theme was related to gingival connective tissue grafts. As it is an autologous material, connective tissue grafting represents a viable alternative with good predictability in the treatment of root covering and aesthetics, being considered the gold standard in the treatment of marginal tissue recessions (SILVA, DE OLIVEIRA NETO, 2023). However, there was a diversity of sub-themes and studies, and other types of grafts, such as the Free Gingival Graft, were presented as the object of research. Individual and comparative studies between specific types of grafts were also carried out to analyze harmful effects, beneficial factors and obtain more effective results among them. It can be seen then that the theme in question is vast and covers a diversity of subtopics.

The identification of the oldest manuscript among the articles selected in the bibliometric review was the study developed by Sullivan in 1968, entitled "FREE AUTOGENOUS GINGIVAL GRAFTS .3. UTILIZATION OF GRAFTS IN TREATMENT OF GINGIVAL RECESSION". The article entered the search because it contained the theme in the title, but because it is a very old article, no more information about it was found in the analyzed database.

Two papers have been published more recently. The first, most recent, was published in 2021 by Tavelli et al., which is a systematic review and network meta-analysis with a total of 127 citations, occupying the 32nd position in the ranking. The second most recent article was that of Zucchelli et al., a literature review with a total of 130 citations and occupying the 29th position in the ranking of the 50 most cited articles. More recent citations of systematic reviews detected in this bibliometric review show how emerging Gingival Grafts are, justifying their constant evolution and continuity of research over time. The two studies address the impact of soft tissue grafts for periodontal and peri-implant plastic surgical reconstruction. Robust evidence highlights the efficacy of autogenous soft tissue grafting for periodontal and peri-implant plastic reconstruction, promoting tissue health and aesthetics. The free gingival graft technique remains the preferred approach to increase the thickness and width of keratinized tissue in teeth and implants. On the other hand, techniques using connective tissue grafting demonstrate greater predictability to achieve complete root coverage or coverage of areas with soft tissue dehiscence, in addition to offering excellent aesthetic results (ZUCCHELLI *et al.*, 2020).

The analysis carried out on institutions and countries revealed that studies on the subject are distributed in several locations and organizations. The University of Zurich

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stood out, which presented the largest number of published manuscripts, followed by Private Practice. These data indicate that both the University of Zurich and dentists in private practice show great interest in the topic, contributing significantly to new discoveries in the area.

It is interesting to observe the relevant role of private practice, which not only helps in ongoing studies, but also expands the scope of discussions. This contribution influences other institutions to invest in research related to the theme, promoting its global expansion, greater visibility and enriching the databases with relevant information for future studies.

The distribution of studies by country highlights a wide variety of contributions, with the United States leading in the number of published manuscripts, followed by Italy, Switzerland, and Brazil. These data show the diversity of academic and cultural contexts involved in the research. Thus, the topic in question has a truly global reach, reinforcing the importance of incorporating different perspectives and contexts into your approach.

The analysis of the most frequent journals and publishers in the 50 most cited articles on gingival grafts reveals a significant diversity in the publications and publishers involved. The Journal of Periodontology, established in 1930, leads the ranking with an impact factor of 4.2 in 2023, followed by the Journal of Clinical Periodontology, founded in 1974, with an impact factor of 5.8 in 2023. These data indicate a concentration of studies in specific journals, characterized by high impact factors.

As for the publishers, six different ones stand out among the articles analyzed. Wiley is the most present, followed by the American Academy of Periodontology, evidencing the broad participation of different agents in the dissemination of knowledge. This variety of publishers reflects the wealth of approaches and perspectives on the subject.

The analysis of the most frequent keywords in studies on gingival grafts in dentistry revealed the main focuses of interest. The most used keyword was "root coverage", indicating that root cover is a central and widely explored theme. Other recurring terms include "acellular dermal matrix", "coronally advanced flap", "gingival recession", "double pedicle graft" and "connective-tissue graft", highlighting the most relevant aspects of this area. The graphical representation in the form of a map (Figure 9) facilitates the visualization of the connections between themes and subthemes, identifying patterns, trends and relationships that help in understanding the literature and guiding future research.

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When investigating the temporal distribution of the 50 main articles, it was identified that the year 2010 was the most productive, with six studies published. On the other hand, more recent works were poorly represented, with the most current dating from 2021. These results may indicate a decline in interest or research activities on the topic, or that recent studies have not had enough time to achieve the same level of impact and citation as older ones. This observation suggests possible gaps and opportunities for further investigations in the field.

Finally, the analysis of the most cited articles provides valuable insights into the trends and impact of research on gingival grafts. This data is essential for researchers, practitioners, and academic institutions, as it helps to identify promising areas for future investigations, assess the relevance of existing contributions, and guide scientific collaborations that promote significant advances in knowledge.

CONCLUSION

Gum grafts are highly effective procedures with a significant impact on improving oral health. They help treat and solve various conditions, such as gingival recessions around teeth and implants, in addition to promoting the increase of keratinized mucosa. The literature review carried out in this study highlighted the growing worldwide interest in these procedures as an alternative in the treatment of mucogingival problems.

The techniques analyzed showed great potential, evidencing the relevance and the need for continuous advances through studies, research and discussions in the area. With progress in this field, gum grafts are expected to not only solve specific oral health problems but also contribute to the overall improvement of quality of life.

However, it is essential to carry out new research that expands the reach and application of these techniques, both in practical and biological aspects, aiming at a global and sustainable evolution over time.

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