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Original Article

A scientometric study on research trends and characteristics of furcation involvement in periodontal disease

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KEYWORDS

Bibliometrics;
Cone beam computed tomography;
Furcation defects;
Periodontitis;
Treatment strategy**Abstract** *Background/Purpose:* Furcation involvement is a condition characterized by unpleasant odors originating from the oral cavity. The purpose of this study was to analyze the scientometric characteristics and research trends of furcation involvement.*Materials and methods:* All the papers on furcation involvement were comprehensively retrieved from the Scopus database. The years of publication were divided into before 2010 and after 2010 in the analysis of research trends.*Results:* There were 1537 papers on furcation involvement, with total citations of 47,246 and the *h* index of 98. The treatment modalities included guided tissue regeneration (GTR), bone regeneration, artificial membranes, surgical flaps, bone transplantation, dental scaling, and plastic surgery. The trend of diagnostic aspect has highlighted the diagnostic imaging by cone beam computed tomography and micro-computed tomography after 2010. The trend of treatment, plastic surgery, root canal therapy, subgingival curettage, absorbable implants, anti-bacterial agents, and anti-infective agent before 2010, has changed to bone defect, bone graft, platelet-rich fibrin, and local drug delivery after 2010. There have always been common keywords such as furcation defects, periodontitis, alveolar bone loss, GTR, bone regeneration, periodontal pocket, pathology, periodontal attachment loss, randomized controlled trial, and risk factor.

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Conclusion: This scientometric study for the first time elucidated the current scenario and research trends of furcation involvement, particularly the comprehensive identification and recognition of the important research topics concerned.

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Introduction

Furcation involvement refers to a condition in which the progression of the periodontal disease process invades the bi- or tri-furcation area of multirooted teeth.¹ It is characterized by the resorption of bone and loss of attachment, and furcation-involved molars are a common presentation in general dental practice.¹ The furcation is an area of complex anatomic morphology that may be difficult or impossible to debride by means of routine periodontal instrumentation.² Teeth with increasing degrees of furcation involvement are at a higher risk of requiring extraction. With appropriate supportive therapy, these teeth have been shown to have acceptable survival rates.^{3,4} However, the treatment of a multi-rooted tooth with a furcation involvement is still a challenge and a problem that has, to date, not been solved.^{4,5} Therefore, diagnosis and its correct interpretation are essential when establishing an adequate treatment.^{3,4} An improved understanding of how to appropriately manage these teeth can result in improved outcomes for patients.

The assessment and management of furcation-involved teeth may be complicated by difficulties in accessing the furcation for both the clinician and patient.^{3,4} Enhanced efforts are needed to improve detection and management of furcation involvement by general dental practitioners. Scientometrics is a useful tool that utilizes citation and bibliometric data to measure scientific output and research trend of a specific research field.^{6–8} The previous bibliometric analyses of periodontal disease focus on the other aspects, e.g., systemic diseases and immune response,^{9–12} without relevant study on furcation involvement. Such analysis would be important for understanding of diagnosis, prognosis and treatment planning of a disease as well as for the communication between clinicians and researchers. Therefore, the purpose of this study was to analyze the scientometric characteristics and research trends of all the papers on furcation involvement, with emphasis on the analysis of the keywords that can reflect research directions and topics of concern.

Materials and methods

As per the methodology described previously,^{6–8} all the papers on furcation involvement in periodontal disease in the Scopus database were retrieved on 04 April 2025. We used medical subject terms “furcation involvement OR furcation defect” AND “Periodont*” in title, abstract and keywords in literature search, without restriction to paper

type and year of publication. Only English literature was included because it is an international knowledge-exchange language. The scientometric characteristics of all the eligible papers were recorded for the following information: title, keyword, citation count, publication year, journal of publication, authorship, affiliation, and country/region of origin. Data search and extraction were performed independently by two investigators, and any discrepancy of results was resolved in a consensus symposium. The years of publication were divided into before 2010 and after 2010, so that the number of papers can be to some extent compared in the analysis of research trends. Microsoft Office Excel 365 was used for index model building, and the Bibliometrix Biblioshiny R-package software was used for bibliometric statistics. In this descriptive study, variables were presented as numbers and percentages. No comparisons were made, and thus no *P*-values were set.

Results

Citation characteristics

With the search strategy algorithm, a total of 1537 papers on furcation involvement were retrieved in the Scopus database. As presented in Fig. 1A, the most type of papers on furcation involvement was article (*n* = 1307), followed by review (*n* = 189) and book chapter (*n* = 19). The total citation count (after removal of self-citations) was 47,246 (43,320) and the *h* index was 98 (92) for all the papers. To further concretize the trends of scientific output, we assessed the annual number and accumulated citations of the papers during 2005–2024 (Fig. 1B). The annual number of the papers on furcation involvement ranged from 23 to 67 during 2005–2024. The accumulated citations (after removal of self-citations) of the papers increased from 1020 (908) to 3351 (3159) during 2005–2024. Supplementary Table S1 presents the detailed information on publication year, authors, title, abstract, journal of publication, citation count, institutions, and keywords of the 100 most-cited papers.

Bibliometric characteristics

Fig. 1C displays cloud graphs of journals of publications, contributing authors, institutions, and countries/regions of origin of the papers on furcation involvement, which were divided into before 2010 (782 papers) and after 2010 (755 papers), so that the number of papers can be to some extent compared in the analysis. Before 2010, the journal

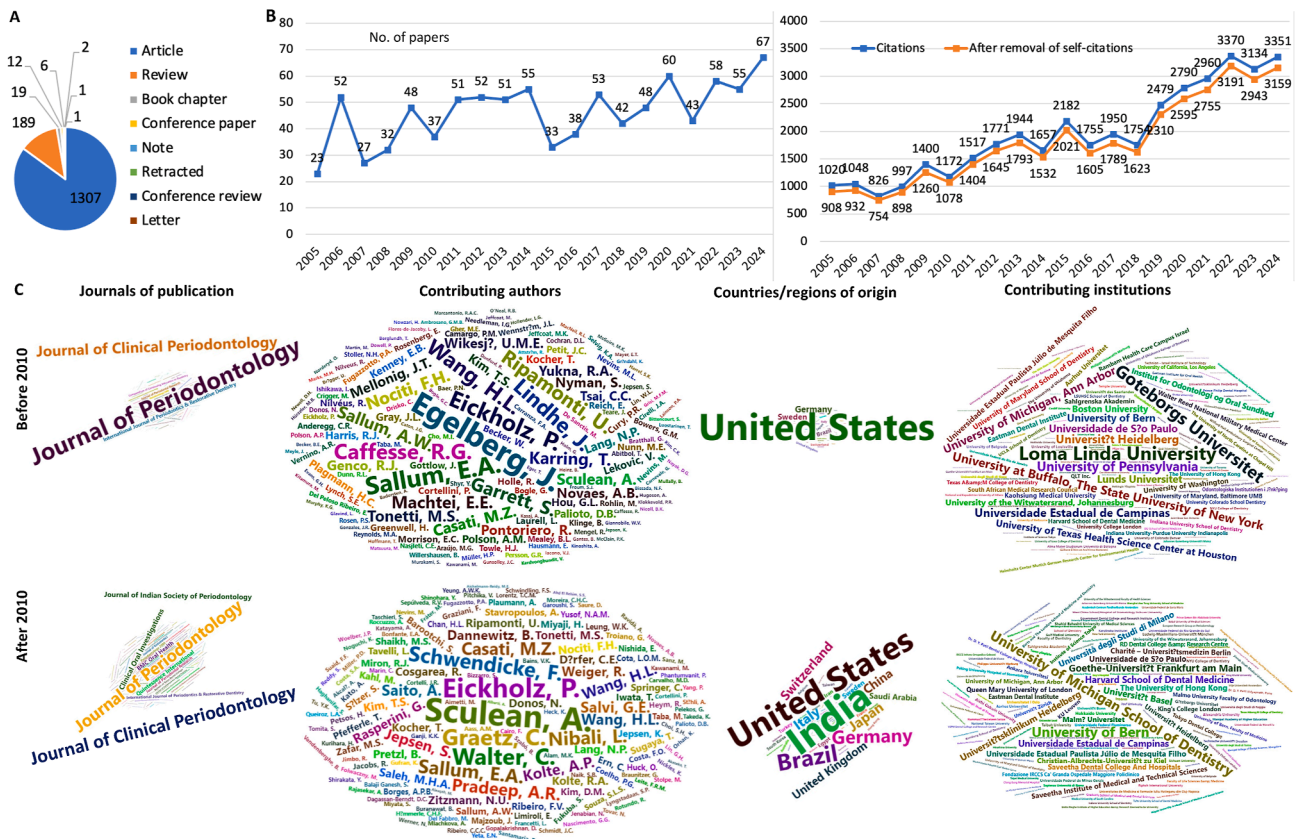


Figure 1 Bibliometric characteristics of the papers on furcation involvement. (A) The numbers of different paper types. (B) The annual number and accumulated citations of the papers during 2005–2024. (C) Cloud graphs of journal of publication, contributing authors, countries and institutions of origin regarding furcation involvement publications before 2010 and after 2010. The font size indicates the number of papers; a larger size means more papers in the cloud graphs.

of publication, contributing author, institution and country of origin with largest number of papers was *Journal of Periodontology* (216 papers), Egelberg, J (20 papers), Loma Linda University (29 papers) and United States (308 papers), respectively. After 2010, the journal of publication, contributing author, institution and country of origin with maximum number was *Journal of Clinical Periodontology* (69 papers), Sculean, A (17 papers), University of Michigan School of Dentistry and University of Bern (both 23 papers) and India (142 papers), respectively. [Supplementary Table S2](#) presents the journals, contributing authors, institutions, and countries/regions with largest number of papers (rank, 1–10).

Research characteristics

Based on the frequency of the keywords in all the papers on furcation involvement ([Fig. 2A](#)), a list of the common keywords is automatically recognized by the database. The most common study design was controlled/comparative study, followed by follow-up study, randomized controlled trial, clinical trial, retrospective study, prospective study, and longitudinal study. The most common keyword of treatment on furcation involvement was periodontal guided tissue regeneration (GTR), followed by bone regeneration, artificial membranes, surgical flaps, bone transplantation, dental scaling, plastic surgery, periodontal regeneration,

root planning, and so on ([Fig. 2B](#)). Before 2010 and after 2010, there have always been the same common keywords such as furcation defects, periodontitis, alveolar bone loss, GTR, bone regeneration, periodontal pocket, pathology, periodontal attachment loss, randomized controlled trial, animal, dog, and risk factor.

Based on the keywords of papers on furcation involvement published in different years ([Fig. 2C](#)), the more common keywords can basically reflect research trends. before 2010, the investigations on pathophysiology, microbiology, connective tissue, denture, permanent dental restoration, time factors, observer variation, and reproducibility of results were more common. The keywords of treatment aspect including plastic surgery, root canal therapy, subgingival curettage, absorbable implants, biodegradable implant, bioremediation, politef, polytetrafluoroethylene, polymer, anti-bacterial agents, anti-infective agent, citrates, citric acid, lactic acid, polylactic acid, equipment design, instrumentation, and patient care planning were more frequent. After 2010, the investigations on prevalence, outcome assessment, dental caries, diabetes mellitus, enamel matrix proteins, and cementogenesis were more common. The keywords of treatment aspect including bone defect, bone graft, platelet-rich fibrin, complication, aluminum compounds, calcium compounds, calcium derivative, calcium phosphate, silicates, hydroxyapatite, mineral trioxide



| Intervention | Number of Publications |
|--|------------------------|
| Guided tissue regeneration | 365 |
| Bone regeneration | 231 |
| Membranes, artificial | 221 |
| Surgical flaps | 165 |
| Bone transplantation | 128 |
| Dental scaling | 126 |
| Plastic surgery | 125 |
| Periodontal regeneration | 122 |
| Root planing | 108 |
| Hydroxyapatite/polytetrafluoroethylene | 99 |
| Collagen | 90 |
| Biocompatible materials | 86 |
| Tooth extraction | 83 |
| Debridement | 82 |
| Tissue regeneration | 81 |
| Root canal therapy | 54 |
| Bone graft | 47 |

Distinctive keywords after 2010



aggregate, and drug combinations were more frequent. Moreover, the keywords of diagnostic aspect including diagnostic imaging, cone beam computed tomography, micro-computed tomography, clinical attachment level, bleeding on probing, and plaque index were also more common after 2010. Besides, there were more cohort analysis, cross-sectional study, prospective study, systematic review, and Meta analysis.

Furcation-involved teeth, commonly seen in dental practice, have a higher likelihood of needing extraction as the severity of periodontal disease increases.¹ This scientometric study attempted to analyze the bibliometric characteristics and research trends of all the publications on furcation involvement retrieved from the Scopus database. The increasing citations of the papers on furcation involvement suggest that this condition has governed increasing attention and investigation. Bibliometric characteristics including journals of publications, contributing

The strength of this scientometric study was to perform the chronological comparison (before 2010 versus after 2010) based on all the papers on furcation involvement. According to the frequency of the keywords in the papers on furcation involvement, the trend of diagnostic aspect has highlighted the diagnostic imaging by cone beam computed tomography and micro-computed tomography after 2010.^{13–16} The trend of treatment, plastic surgery, root canal therapy, subgingival curettage, absorbable implants, anti-bacterial agents, and antinfecitive agent before 2010, has changed to bone defect, bone graft,

platelet-rich fibrin, and local drug delivery after 2010.^{17–20} Moreover, the trend of investigations on pathophysiology, microbiology, connective tissue, denture, and permanent dental restoration, before 2010, has changed to outcome assessment, diabetes mellitus, enamel matrix proteins, and cementogenesis after 2010. Regarding the limitations of the current study, we only searched all the English papers from the Scopus database and thus may overlook important research published in other languages and other databases. Moreover, the more recent papers could not accumulate a large number of citations at the time of this study.

In summary, this scientometric study for the first time elucidated the current scenario and research trends in the field of furcation involvement. Overall, finding the scientometrics would elucidate the comprehensive identification and recognition of the important research topics concerned, and help in improving in reciprocal collaboration and communication for investigations on furcation involvement.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jds.2025.05.026>.

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