Short Communication

A scientometric study on research trends and characteristics of ameloblastoma

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Abstract *Background/purpose:* Ameloblastoma is a benign tumor derived from odontogenic epithelium in the jaws. The purpose of this study was to analyze the scientometric characteristics and research trends of ameloblastoma.
Materials and methods: All the papers on ameloblastoma were comprehensively retrieved from the Scopus database. The years of publication were divided into before 2014 and 2014—2024 in the analysis of research trends.
Results: There were 2507 papers on ameloblastoma, with total citations of 34,691 and the *h* index of 70. The related disorders of the diagnosis of ameloblastoma were mandibular neoplasms, maxillary neoplasms, ameloblastic carcinoma, odontogenic cyst, lung neoplasms, and teratoma. Before 2014, bone graft/transplantation, osteotomy, reconstructive surgical procedures, surgical flaps, cell differentiation, and cytology were more frequent keywords. After 2014, biology research on BRAF protein, gene mutation, cytokeratin 19, biomarkers, epithelial mesenchymal transition, signal transduction, tumor microenvironment, and carcinogenesis were more frequent keywords. Clinical studies on cohort analysis, cone beam computed tomography, quality of life, fine needle aspiration biopsy, incisional biopsy, surgical margin, and hemi-mandibulectomy were more common. Experiment methods such as dog, tumor cell line, cell migration, gene expression, real time polymerase chain reaction, and western blotting were also more frequent keywords after 2014.

Conclusion: This scientometric study elucidated the current scenario and research trends of ameloblastoma, and would help in improving in reciprocal collaboration and communication for investigations on this tumor.

Introduction

Ameloblastoma is a benign tumor derived from odontogenic epithelium in the jaws, with locally aggressive behavior and high recurrence rate when treated conservatively.[1] It usually presents as a slow-growing and asymptomatic swelling neoplasm that causes expansive bone destruction, tooth mobility and displacement, or even cortical bone perforation.[1] According to the 2022 World Health Organization classification of head and neck tumors,[2] ameloblastoma is categorized into five types: conventional, unicystic, extra-osseous (peripheral), adenoid, and metastasizing ameloblastoma. Conventional ameloblastoma was recognized as the most common type and more aggressive behavior with high recurrence even though following radical surgery.[3,4] Metastasizing ameloblastoma is that has metastasized to other organs usually the lung and cervical lymph nodes, and it presents identical histopathological features to conventional ameloblastoma. Ameloblastic carcinoma is malignant counterpart of ameloblastoma, and it is a primary odontogenic carcinoma resembling ameloblastoma.[4–6]

Despite progress in understanding the clinical behavior and management approaches of ameloblastoma, gaps remain in its pathogenesis and treatment challenge clinical practice.[7] Since it is a complex tumor associated with an increased risk of morbidity, there have been thousands of the papers regarding the field of ameloblastoma. Scientometrics is a useful tool that utilizes citation and bibliometric data to measure scientific output and research trend of a specific research field.[8–10] The bibliometric analyses on some jaw conditions have previously reported, but there is little relevant analysis on ameloblastoma.[11–13] Although an analysis of only top-100 most-cited articles on ameloblastoma has been reported, there was lack of a comprehensive overview of the publications on this tumor.[14] Therefore, the purpose of this study was to analyze the scientometric characteristics and research trends of all the papers on ameloblastoma, 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,[9,10] all the papers on ameloblastoma in the Scopus database were retrieved on 31 Oct 2024. We used medical subject terms "ameloblastoma" OR "ameloblastic carcinoma" in the Title 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 2014 and 2014—2024, 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 of the papers on ameloblastoma

With the search strategy algorithm, a total of 2507 papers on ameloblastoma were retrieved in the Scopus database. As presented in Fig. 1A, the most type of papers on ameloblastoma was article (n = 2199), followed by review (n = 148) and letter (n = 89). The total citation count (after removal of self-citations) was 34,691 (33,144) and the h index was 70 (68) for all the papers. To further concretize the trends of scientific output, we assessed the annual number and accumulated citations of the papers during 2004—2023 (Fig. 1B). The annual number of the papers on ameloblastoma stably raised from 33 to 121 during 2004—2023. The accumulated citations (after removal of self-citations) of the papers increased from 451 (428) to 2195 (2095) during 2008—2023. The detailed information on publication year, authors, title, abstract, journal of publication, citation count, institutions, and keywords of the 100 most-cited papers are presented in supplementary Tables S1.

Bibliometric characteristics of papers on ameloblastoma

Fig. 1C displays cloud graphs of journals of publications, contributing authors, institutions, and countries/regions of origin of the papers on ameloblastoma, which were divided into before 2014 (1375 papers) and after 2014 (1132 papers), so that the number of papers can be to some extent compared in the analysis. Before 2014, the journal of
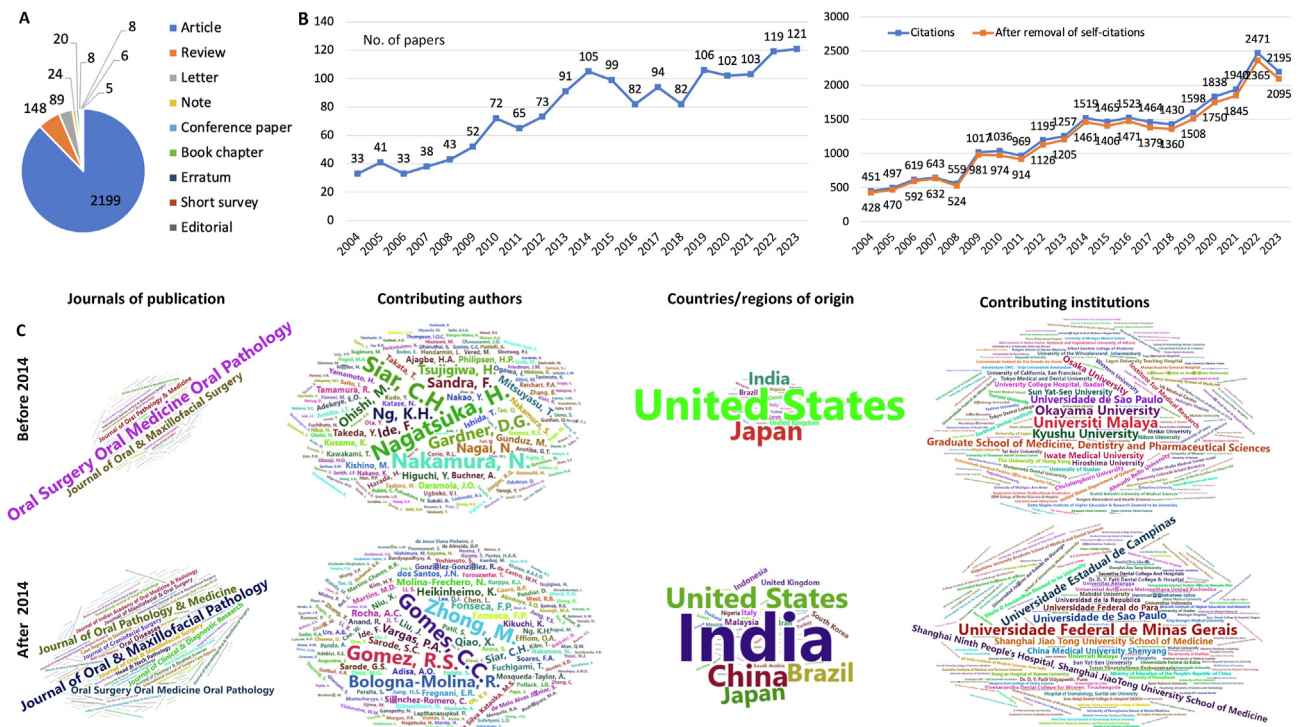
Figure 1 Bibliometric characteristics of the papers on ameloblastoma. (**A**) The numbers of different paper types. (**B**) The annual number and accumulated citations of the papers during 2004–2023. (**C**) Cloud graphs of journal of publication, contributing authors, countries and institutions of origin regarding ameloblastoma publications before 2004 and after 2004. The font size indicates the number of papers; a larger size means more papers in the cloud graphs.

publication, contributing author, institution and country of origin with largest number of papers was *Oral Surgery Oral Medicine Oral Pathology Oral Radiology* (n = 149), Nagatsuka, H. and Siar, C.H. (both n = 19), Universiti Malaya (n = 23) and United States (n = 327), respectively. After 2014, the journal of publication, contributing author, institution and country of origin with maximum number was *Journal of Oral & Maxillofacial Pathology* (n = 45), Gomes, C.C. (n = 18), Universidade Federal de Minas Gerais (n = 34) and India (n = 284), respectively. Table S2 presents the journals, contributing authors, institutions, and countries/regions with largest number of papers (rank, 1–10).
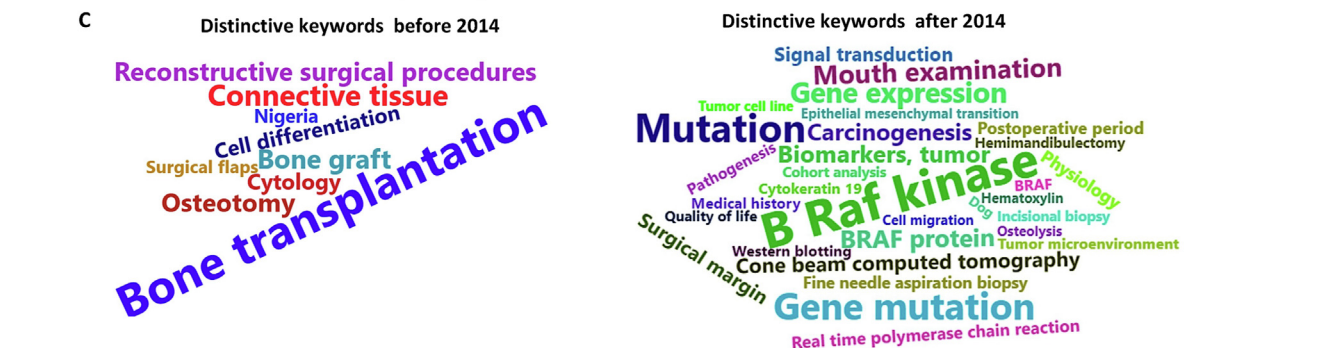
Research trends of papers on ameloblastoma

There have always been the same common keywords such as pathology, histopathology, protein expression, mandible, maxilla, computer assisted tomography, panoramic radiography, metabolism, genetics, neoplasm/tumor recurrence, differential diagnosis. The related keywords of the diagnosis of ameloblastoma were mandibular neoplasms, maxillary neoplasms, ameloblastic carcinoma, odontogenic tumor, odontogenic cyst, odontogenic keratocyst, unicystic ameloblastoma, peripheral ameloblastoma, desmoplastic ameloblastoma, lung neoplasms, and teratoma (Fig. 2A). Based on the keywords of papers on ameloblastoma (Fig. 2B), the more common keywords in different years can basically reflect research trends (Fig. 2C). Before 2014, bone graft/transplantation, osteotomy, reconstructive

surgical procedures, surgical flaps, cell differentiation, connective tissue, and cytology were more frequent keywords. After 2014, biology research on BRAF protein, gene mutation, cytokeratin 19, biomarkers, epithelial mesenchymal transition, pathogenesis, physiology, signal transduction, tumor microenvironment, and carcinogenesis were more frequent keywords. Clinical studies on cohort analysis, cone beam computed tomography, medical history, quality of life, fine needle aspiration biopsy, incisional biopsy, surgical margin, and hemi-mandibulectomy were more common. Experiment methods such as dog, tumor cell line, cell migration, gene expression, real time polymerase chain reaction, and western blotting were also more frequent keywords after 2014.

Discussion

This scientometric study attempted to analyze the bibliometric characteristics and research trends of all the publications on ameloblastoma retrieved from the Scopus database. The increasing annual number and citations of the papers on ameloblastoma suggest that this tumor has governed increasing attention and investigation. Bibliometric characteristics including journals of publications, contributing authors, institutions and countries of origin, and keywords were identified in sequence. For instance, the journal of publication with largest number of papers before 2014 and after 2014 was *Oral Surgery Oral Medicine Oral Pathology Oral Radiology* and *Journal of Oral & Maxillofacial Pathology*, respectively. The institution of

A Keywords of ameloblastoma diagnosis

Keyword	Count
Ameloblastoma	2180
Mandibular neoplasms	637
Odontogenic tumor	418
Maxillary neoplasms	200
Ameloblastic carcinoma	166
Odontogenic cyst	118
Unicystic ameloblastoma	111
Teratoma	110
Odontogenic keratocyst	81
Lung neoplasms	63
Desmoplastic ameloblastoma	51
Peripheral ameloblastoma	50

B All the keywords

C Distinctive keywords before 2014

Distinctive keywords after 2014

Figure 2 Research characteristics of the papers on ameloblastoma. (**A**) The related keywords of differential diagnosis of ameloblastoma. Cloud graphs of (**B**) all the keywords and (**C**) distinctive keywords of papers published before 2014 and after 2014. The font size indicates the number of papers; a larger size means more papers in the cloud graphs.

origin with maximum number of papers before 2014 and after 2014 was Universiti Malaya and Universidade Federal de Minas Gerais, respectively. These would aid clinicians and researchers in choosing target journals, finding potential collaborators or partner institutions, as well as promoting mutual understanding and more reciprocal cooperation regarding ameloblastoma research.

We observed that there were some related keywords of the diagnosis of ameloblastoma (Fig. 2A). The frequency (637) of mandibular neoplasms was more than three times than that (200) of maxillary neoplasms, in agreement with ameloblastoma more frequently occurring in mandible than maxilla in clinical practice. As an odontogenic tumor, ameloblastoma should be performed the differential diagnosis of odontogenic cyst, especially odontogenic keratocyst.[15] Unicystic ameloblastoma and peripheral ameloblastoma are two types of ameloblastoma,[16,17] and desmoplastic ameloblastoma is one of subtypes of conventional ameloblastoma. The presence of lung neoplasms as a keyword is because lung is the more common metastatic site suffering from metastasizing ameloblastoma, compared with other organs. Neoplasm/tumor recurrence as a keyword is because ameloblastoma has a high reported recurrence rate (up to 38 %) after surgical intervention (reviewed in Ref. 1). Moreover, ameloblastic carcinoma as the malignant counterpart of ameloblastoma is a primary odontogenic carcinoma histologically resembling ameloblastoma (reviewed in Ref. 6). We newly reported that the overall incidence of recurrence and ameloblastic carcinoma among 1626 cases of ameloblastoma was 17.2 % and 3.4 %, respectively.[4]

The strength of this scientometric study was to perform the chronological comparison (before 2014 versus after 2014) based on all the papers on ameloblastoma. The more common keywords in different years can basically reflect research trends. According to the frequency of the keywords in the papers on ameloblastoma, the trend of biology research has changed to research mainly on BRAF protein, gene mutation, gene expression, biomarkers, and epithelial mesenchymal transition after 2014. Currently, BRAF p.V600E mutation and the mutations of mitogen-activated protein kinases (MAPK) pathway-related genes such as RAS family genes (NRAS, KRAS, and HRAS) have been demonstrated as key molecular events in the pathogenesis of ameloblastoma.[18−20] The BRAF p.V600E mutation has a frequency that ranges from 46 % to 80 % in ameloblastoma, and 20%−50 % of ameloblastoma cases are BRAF wild type (reviewed in Ref. 7). Moreover, Zhang et al. recently identified the key biomarkers related to epithelial−mesenchymal transition and some hub genes involved in the progression and development of ameloblastoma.[21] Besides, bone graft/transplantation, reconstructive surgery, surgical flaps, and mandibulectomy as keywords suggest that radical operation procedures of ameloblastoma remain the jaw osteotomy and reconstruction.[22]

In summary, this scientometric study on ameloblastoma elucidated the current scenario and research trends in the field of this tumor. 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 this neoplasm.

Declaration of competing interest

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

Acknowledgments

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jds.2024.11.030.

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