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Short Communication

A scientometric study on research trends and characteristics of randomized controlled trials in orthodontics

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Abstract *Background/purpose:* In evidence-based approaches to orthodontic research, randomized controlled trials (RCTs) are recognized as the highest level of original evidence. The purpose of this study was to analyze the scientometric characteristics and research trends of RCTs in orthodontics, with emphasis on chronological comparison and regional characteristic of the keywords.
Materials and methods: All the reports on RCTs in orthodontics were comprehensively retrieved from the Scopus database. The years of publication were divided into before 2020 and Jan 2020–Jul 2025 in the analysis of research trends.
Results: There were 1343 reports on RCTs in orthodontics, with total citations of 27,314 and the *h* index of 74. The most keyword of condition or related disease was malocclusion, followed by pain, mouth hygiene, tooth disease, dental caries, gingivitis, periodontal disease, and root resorption. The research trend of has changed to accelerated orthodontics,

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photobiomodulation, platelet-rich fibrin, overbite, oral health, mouthwash, chlorhexidine, fluoride varnish, biofilm, streptococcus mutans, low-level laser therapy, and pain management after 2020. Compared with Western countries, the investigators from the representative developing countries more concerned with accelerated orthodontics, diode laser, low-level laser therapy, micro-osteoperforation, microbiology, streptococcus mutans, open bite, pain management, ibuprofen, fluoride varnish, saliva, biofilm, and white spot lesions.
Conclusion: This scientometric study elucidated the comprehensive schema and research trends in the field of RCTs in orthodontics, and would help in improving in reciprocal collaboration and provide helpful guidance for further research.

Introduction

In clinical practice of orthodontics, professional knowledge of different orthodontists is of subjectivity and patients' preferences often vary.[1,2] Evidence-based orthodontics proposes using the best evidence when making clinical decisions. Although the significant contribution of the research to the practice of evidence-based dentistry, it can pose a significant challenge for clinicians and researchers to keep up with the evidence in the rapidly evolving field of orthodontics.[3] The level of evidence is critical in determining the true nature of findings, and randomized controlled trials (RCTs) are recognized as the highest level of original evidence.[4] Despite time-consuming and costly to conduct, RCTs offer valuable clinical evidence and represent authoritative evidence to identify rational decisions and achieve improved treatment outcomes.

Scientometrics is a useful tool that utilizes citation and bibliometric data to measure scientific output and research trend of a specific research field.[5,6] Bibliometrics has been applied in some aspects of orthodontics, such as artificial intelligence, molar distalization, and accelerated orthodontics.[7–9] It is imperative to conduct the analysis of the foundational structure and emerging hotspots within the field of orthodontic RCTs. The previous bibliometric studies analyzed the RCTs in orthodontics retrieved from Web of Science database limited a period of time and the 100 most-cited studies.[10,11] To develop a better comprehensive understanding of this field, this study aimed to analyze the scientometric characteristics and research trends of RCTs in orthodontics with emphasis on chronological comparison and regional characteristic of the keywords, so as to provide helpful guidance for further research.

Materials and methods

As per the methodology described previously,[5,6] all the reports on RCTs in orthodontics in the Scopus database were retrieved on 23 Jul 2025. We used medical subject terms "random*" in the title AND "orthodontic*" AND NOT "non-random*" in the title/abstract/keyword in literature search, without restriction to paper type and year of publication. The asterisk indicates a wildcard used to search for all endings including fifth or more root words. Only English literature was included because it is an international knowledge-exchange language. The scientometric characteristics of all the eligible articles 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 2020 and Jan 2020—Jul 2025, so that the number of articles 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 1343 English reports on RCTs in orthodontics were retrieved in the Scopus database. The total citation count (after removal of self-citations) was 27,314 (25,038) and the *h* index was 74 (70) for all the reports. To further concretize the trends of scientific output, we assessed the annual number and accumulated citations of the articles during 2005—2024 (Fig. 1A). The annual number of RCT reports in orthodontics stably increased from 8 to 143 during 2005—2024. The accumulated citations (after removal of self-citations) of these reports steadily increased from 181 (166) to 3471 (3249) during 2005—2024. The detailed information on publication year, authors, title, journal of publication, citation count, institution and country of origin, abstract, and keywords of the 100 most-cited articles are presented in supplementary Table S1.

Bibliometric characteristics

Fig. 1B displays cloud graphs of journals of publications, contributing authors, institutions, and countries/regions of origin of the reports on RCTs in orthodontics, which were divided into before 2020 (604 reports) and Jan 2020—Jul

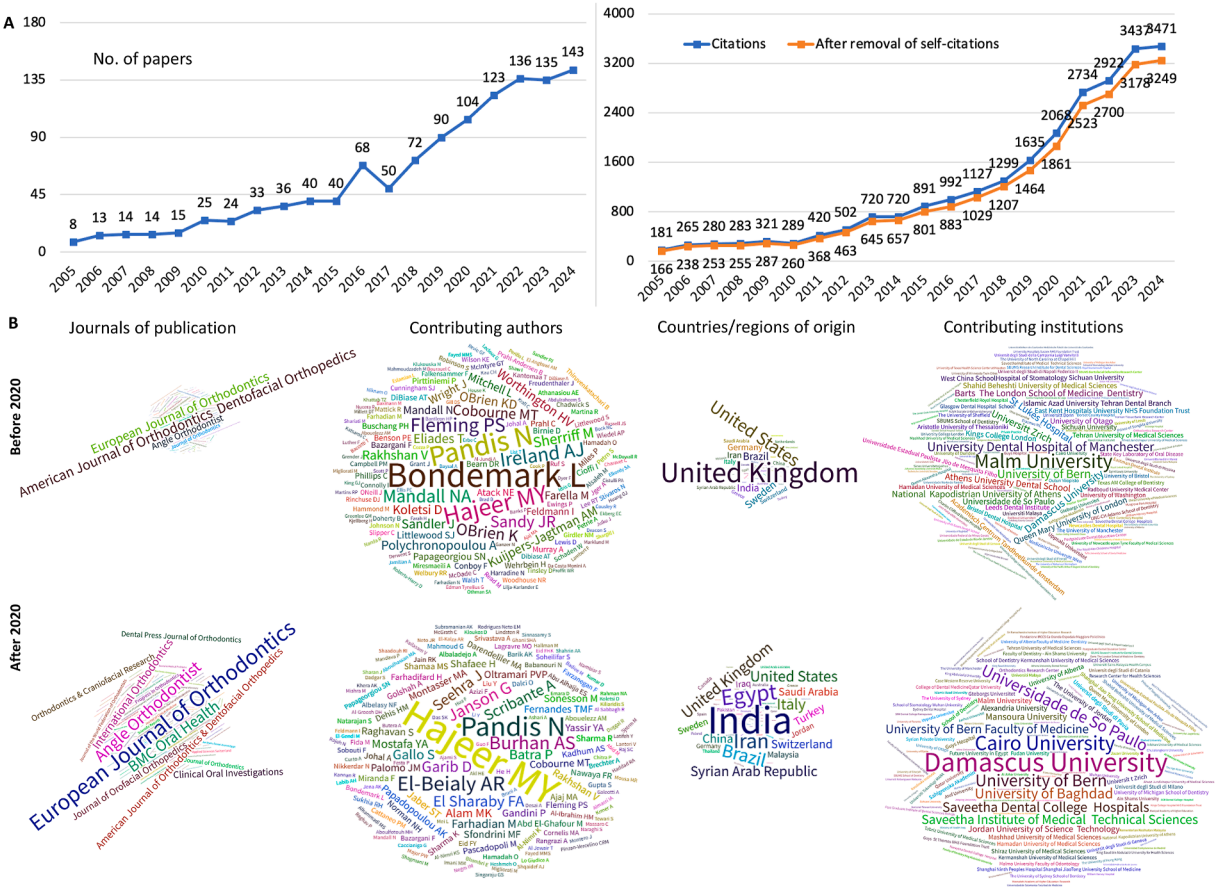

Figure 1 Bibliometric characteristics of the reports on RCTs in orthodontics. (**A**) The annual number and accumulated citations of the articles during 2005–2024. (**B**) Cloud graphs of journal of publication, contributing authors, countries and institutions of origin before 2020 and Jan 2020–Jul 2025. The font size indicates the number of articles; a larger size means more articles in the cloud graphs.

2025 (739 reports). Before 2020, the journal of publication, contributing author, institution and country of origin with largest number of articles was *American Journal of Orthodontics & Dentofacial Orthopedics* (n = 93), Bondemark, L. (n = 21), Malmö Universitet (n = 26) and United Kingdom (n = 130), respectively. After 2020, the journal of publication, contributing author, institution and country of origin with maximum number of articles was *European Journal of Orthodontics* (n = 65), Hajeer M.Y. (n = 23), Damascus University (n = 41) and India (n = 120), respectively. Table S2 presents the journals, contributing authors, institutions, and countries/regions with largest number of articles (rank, 1–10). Of the top-10 countries of origin with maximum number of articles, 5 developed Western countries (United Kingdom, United States, Italy, Sweden, and Switzerland) published 478 articles with the citations of 14,622 and *h* index of 63, and 5 developing countries (India, Brazil, Iran, Egypt, and China) published 531 articles with the citations of 6676 and *h* index of 38.

Research trends (before 2020 versus 2020–2025)

Based on the frequency of the keywords in all the reports on RCTs in orthodontics (Fig. 2A), a list of the common keywords is automatically recognized by the database. The most keyword of age group of RCTs in orthodontics was adolescent, followed by adult, child, young adult, and middle aged. The most keyword of location or tooth position was maxilla, followed by mandible, premolar tooth, bicuspid, canine tooth, incisor, and molar tooth. The most keyword of condition or related disease was malocclusion, followed by pain, mouth hygiene, tooth disease, dental caries, gingivitis, periodontal disease, and root resorption. Before 2020 and during Jan 2020–Jul 2025, there have always been the same common keywords such as orthodontic procedure, orthodontic tooth movement, tooth movement techniques, orthodontic appliance design, diagnostic imaging, cephalometry, cone beam computed tomography (CBCT), orthodontic brackets, orthodontic anchorage, orthodontic wires, and low-level laser therapy.

Based on the keywords of reports on RCTs in orthodontics published in different years (Fig. 2B), the more common keywords can basically reflect research trends. Before 2020, the keywords, such as aged, middle aged, analgesic agent, facial pain, drug effect, pathophysiology, patient compliance, dental alloys, dental models, equipment design, extraoral traction appliances, interceptive orthodontics, polysomnography, periodontics, resin cements, time factors, titanium nickelide, and tooth occlusion, were

more frequent. After 2020, the keywords, such as accelerated orthodontics, analgesia, angle class i/ii malocclusion, biofilm, bone screw, canine retraction, streptococcus mutans, etiology, fixed orthodontic appliance, removable orthodontic appliance, fluoride varnish, gingival crevicular fluid, gingival index, mouthwash, chlorhexidine, oral health, low-level laser therapy, photobiomodulation, overbite, pain intensity, pain management, palatal expansion, parallel design, platelet-rich fibrin, postoperative pain, and root resorption, were more common.

Research characteristics of different regions

To investigate the regional differences of RCTs in orthodontics, the distinct keywords of the articles originated from the representative 5 Western countries and 5 developing countries were analyzed (Fig. 2C). In Western countries, the keywords, such as school child, adverse device effect, equipment failure, extraoral traction appliances, face pain, patient compliance, removable orthodontic appliances, orthodontic retainer, interceptive orthodontics, overbite, palate, pathophysiology, resin cement, multicenter study, systematic review, titanium nickelide, toothbrushing, and toothpastes were more frequent. In developing countries, accelerated orthodontics, alveolar bone, analgesia, analgesic agent, ibuprofen, pain management, postoperative pain, biofilm, bone screw, canine retraction, chlorhexidine, clinical outcome, dental enamel, drug efficacy, fluoride varnish, gingiva, gingival crevicular fluid, gingival index, white spot lesions, diode laser, low-level laser therapy, low-level light therapy, microbiology, streptococcus mutans, micro-osteoperforation, mouthwash, open bite, placebo, and saliva, were more common.

Discussion

This study attempted to analyze the scientometric characteristics and research trends of all English reports on orthodontic RCTs since 1969 retrieved from the Scopus database. The previous studies analyzed the characteristics of RCTs in orthodontics retrieved from Web of Science database limited a period (Jan 1991—Oct 2022) and the 100 most-cited studies.[10,11] The advantage of the Scopus database can automatically exclude self-citing, and provide more coverage than Web of Science.[12] Bibliometric characteristics of this study revealed that the increasing number and citations of RCT reports in orthodontics each year, suggests that the field has governed increasing attention and investigation. The number of articles in the last 5 years exceeded the total number of articles before 2020, indicating that RCT in orthodontics research is undergoing a rapid developmental stage. It could be speculated that the numbers and citations will continue to grow in the coming years. Bibliometric items in sequence would aid clinicians

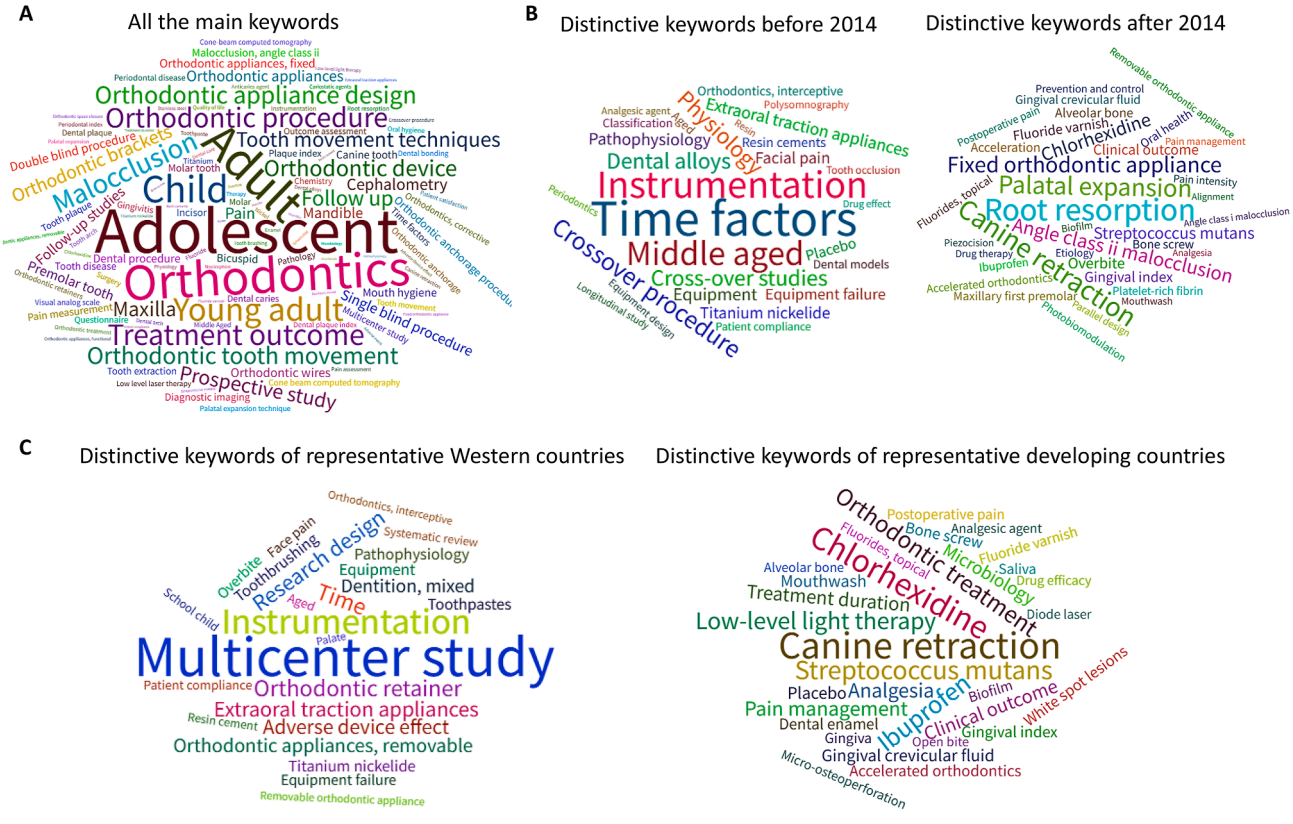

Figure 2 Research characteristics of the reports on RCTs in orthodontics. (**A**) Cloud graph of all the main keywords. (**B**) Cloud graphs of the distinctive keywords of articles published before 2020 and during Jan 2020—Jul 2025. (**C**) Cloud graphs of the distinctive keywords of articles origined from representative Western countries and developing countries. The font size indicates the number of articles; a larger size means more articles in the cloud graphs.

and researchers in choosing target journals, finding potential collaborators or partner institutions, as well as promoting mutual understanding and more reciprocal cooperation in multicenter study.

In this study, we observed that the research trend of has changed to accelerated orthodontics, photobiomodulation, platelet-rich fibrin, overbite, oral health, mouthwash, chlorhexidine, fluoride varnish, biofilm, low-level laser therapy, pain management and gingival crevicular fluid after 2020.[13] Notably, compared with Western countries mainly United Kingdom and United States promoting the development of orthodontic RCTs, developing countries such as India, Brazil, Iran, Egypt, and China as the new entrants have made important contributions in this field in recent years. The investigators from these countries more concerned with accelerated orthodontics, diode laser, low-level laser therapy, micro-osteoperforation, open bite, pain management, ibuprofen, fluoride varnish, biofilm, gingival crevicular fluid, and white spot lesions. In recent years, RCTs on approaches to accelerate orthodontic tooth movement significantly increased, such as photobiomodulation, micro-osteoperforation, and injection of platelet-rich fibrin. Photobiomodulation therapy is a noninvasive method with no adverse effects that has been used to accelerate tooth movement in orthodontics.[14] Micro-osteoperforation as a new surgical assistive technique, promotes orthodontic tooth movement through small perforations in the alveolar bone without major surgical trauma.[15]

To achieving a balance between function and esthetics in orthodontic effects, making the orthodontic process more comfortable and conditions has always been the concerns of orthodontists.[16] Investigators focus on periodontal health, oral health, and tooth health in orthodontics.[17—19] For instance, fixed appliances provide additional living space for biofilms, thus increasing the risk of demineralization in the enamel. This produces a white, opaque, chalky appearance referred to as white spot lesions, the treatment and prevention are often mouthwash and resin infiltration, especially the use of fluoride varnish.[20,21] Besides, orthodontic pain is a significant concern for both patients and clinicians, often being a primary deterrent for initiating and continuing treatment. Studies conducted orthodontic pain assessment and pain management for different orthodontic treatments, specifically analyzing the effects of low-level laser therapy, analgesics such as ibuprofen.[22,23] The limited number of robust clinical trials makes it difficult to draw a definitive conclusion, thus more studies are needed in this area in the future. Regarding the limitations of the current study, we only searched all the English articles from the Scopus database and thus may overlook important RCTs published in other languages and other databases. Moreover, the more recent RCTs could not accumulate a large number of citations at the time of this study. The quality of RCTs did not be evaluated and high- and low-quality RCTs were considered to be the same.

In summary, this scientometric study elucidated the comprehensive schema and research trends in the field of RCT in orthodontics. Finding in this study revealed that accelerating the efficacy and efficiency of orthodontic tooth movement is a hotspot and remains direction of orthodontics.[24,25] Additionally, several topics, including oral health, pain, orthodontic appliances and related conditions during orthodontic treatment and retention, are worthy of concern.

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.2025.08.022.

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