

Global Analysis of Chronic Osteomyelitis Publications with a Bibliometric Approach

✉ Sabit Numan Kuyubaşı¹, ✉ Nihat Demirhan Demirkıran¹, ✉ Süleyman Kozlu¹, ✉ Süleyman Kaan Öner¹, ✉ Sevil Alkan²

¹Department of Orthopedics and Traumatology, Kütahya Health Sciences University Faculty of Medicine, Kütahya, Türkiye

²Department of Diseases and Clinical Microbiology, Çanakkale Onsekiz Mart University Faculty of Medicine, Çanakkale, Türkiye

Abstract

BACKGROUND/AIMS: Although there have been innovations in the diagnosis and treatment of chronic osteomyelitis (CO), it is still considered as a challenging situation for both patients and clinicians. In this article, it was aimed to comprehensively examine publications on CO with bibliometric evaluation and to guide researchers and clinicians in reaching articles effectively in their literature searches.

MATERIALS and METHODS: The Scopus bibliometric database was used to identify articles related to CO. Original research articles and reviews made between 1940 and 2021 including the words “chronic” and “osteomyelitis” in their titles and keywords were found. Publications were analyzed according to their research parameters, such as publication year, authors, publication language, institutions, keywords, funding institutions, citations and their field of study.

RESULTS: There were a total of 2,881 publications on CO, and it was observed that the first publication was made in 1890. Among these publications, 2,565 (89.03%) were research articles and 129 (4.47%) were reviews. The United States of America was found to be the most prolific country with 484 (16.79%) articles; it was observed that the China Medical University Hospital was the leading institution in CO. Five hundred sixteen (17.91%) of the articles were published in open access (OA) journals. The largest number of articles on CO were published in the journal Vestnik Khirurgii Imeni II Grekova [n=57 (1.97%)]. The most commonly seen keyword was “osteomyelitis” [n=2,345 (81.39%)]. It was seen that most of the publications were in the field of medicine [n=2,724 (94.55%)] and the most cited article received 4,574 citations. The most pioneering funding sponsor in CO studies was the National Institutes of Health [n=30 (1.04%)]. Pediatricians constituted the majority of the most productive authors in CO studies.

CONCLUSION: In this bibliometric study, the economic size and level of development of countries were important factors in terms of their academic publication efficiency in the field of CO. Developing countries should be encouraged to increase studies on this subject. Considering that the multidisciplinary approach is a significant factor in the follow-up and treatment of CO, we believe that the contributions of surgical branches to this subject should be improved.

Keywords: Bibliometric analysis, chronic osteomyelitis, Scopus database

INTRODUCTION

The term “osteomyelitis” was first used by the French surgeon Chassaignac¹ in 1852. Injury in adult patients (mostly open fractures) and hematogenous spread after an episode of bacteremia in pediatric patients are among the common etiological factors. It usually results

in osteomyelitis, sequestrum and involucrum. This situation represents the presence of chronic osteomyelitis (CO).²

Due to the avascular nature of the sequester tissue, osteomyelitis is difficult to treat and can be associated with high morbidity and mortality for the patient. Treatment is aimed at completely eliminating

To cite this article: Kuyubaşı SN, Demirkıran ND, Kozlu S, Öner SK, Alkan S. Global Analysis of Chronic Osteomyelitis Publications with a Bibliometric Approach. Cyprus J Med Sci 2023;8(1):8-12

ORCID IDs of the authors: S.N.K. 0000-0002-3021-0581; N.D.D. 0000-0002-0724-9672; S.K. 0000-0001-5175-0600; S.K.Ö. 0000-0002-4333-0582; S.A. 0000-0003-1944-2477.



Address for Correspondence: Süleyman Kaan Öner

E-mail: skaanoner@gmail.com

ORCID ID: orcid.org/0000-0002-4333-0582

Received: 25.01.2022

Accepted: 17.05.2022



©Copyright 2023 by the Cyprus Turkish Medical Association / Cyprus Journal of Medical Sciences published by Galenos Publishing House.
Content of this journal is licensed under a Creative Commons Attribution 4.0 International License

the infection and maximizing the patient's function. Historically, debridement of infected bone with long antibiotic regimens and surgical treatment has been used in the treatment of osteomyelitis.³ Prior to the clear identification of microorganisms, the significance and principles of infection were not completely understood. Hence, the treatment of osteomyelitis consisted of the amputation of the infected extremity by the surgeon.²

Along with the identification of microorganisms in the treatment of CO and variability in age groups, the importance of multidisciplinary approaches has been revealed. Thus, patients were evaluated more effectively with a broad perspective. In conclusion, the multidisciplinary approach has led to great innovations and developments in the medical and surgical fields.^{4,5}

With the widespread use of the Internet, many researchers can easily access up-to-date information in the medical literature. However, the increase in the number of scientific publications creates the problem of focusing on the research to be carried out on a subject. It can be seen that there has been an increase in bibliometric studies in parallel with the increasing number of publications, particularly after the 2000s. Bibliometric analysis is a statistical analysis method which allows the examination of scientific publications in terms of many parameters. Researchers can readily and quickly access data on the subjects they wish to study with this method.⁶

Although there have been previous bibliometric studies in the field of orthopedics, there was no up-to-date and comprehensive bibliometric study on CO as of the time of writing.

In this study, we aimed to present a summary of the articles published on CO between the dates of 1 January, 1940 and 28 September, 2021 by means of bibliometric analysis.

MATERIALS AND METHODS

A quantitative study was planned using the bibliometric data analysis method to analyze global publications on CO. The Scopus bibliometric database (accessed: September 28, 2021) was searched in English. Original research articles and reviews made between 1 January, 1940 and 28 September, 2021 including the words "chronic" and "osteomyelitis" in their titles and keywords were found. Re-publications were included in the one-off review. Publications were analyzed bibliometrically according to their research parameters, such as their publication year, authors and institutions, keywords, funding institutions, and citations.

Ethics Committee

In this study, the Helsinki Declaration, which was revised in 2013, was complied with. Ethics committee approval was not required as there was no human or animal research.

RESULTS

There were a total of 2,881 publications on CO, and it was observed that the first publication was made in 1890. While the total number of articles was 666 (23.1%) before 1890-1979, it was found to be 857 (29.7%) solely between 2011-2021 (Figure 1). It was observed that there was a significant increase in the number of articles, particularly after the 2000s (Figure 2).

The majority of the articles [n=2,724 (94.55%)] were written in English; Russian [n=304 (10.55%)] and German [n=230 (7.98%)] are among the other most preferred publication languages. Moreover, it was determined that there were publications in 32 different languages. The United States was found to be the most prolific country with 484 (16.79%) articles. Germany, China, the United Kingdom, and India were among the top 5 countries to publish on CO. Our country, Türkiye, on the other hand, was in 10th place in this regard (Figure 3).

Among the publications, 2,565 (89.03%) were research articles and 129 (4.47%) were reviews. Five hundred sixteen (17.91%) of the articles were

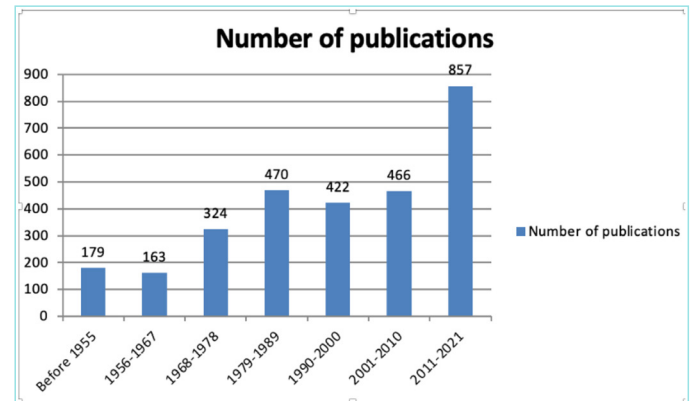


Figure 1. Numerical data of articles by years.

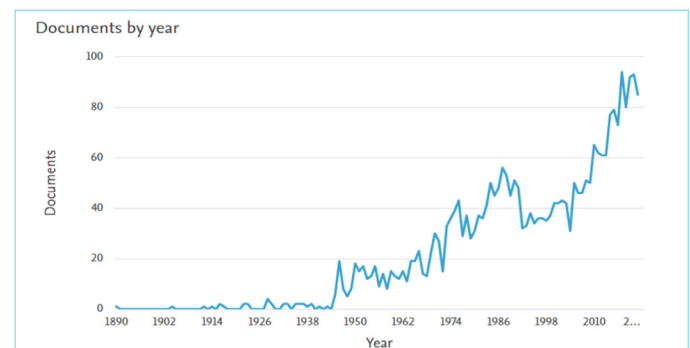


Figure 2. Distribution of articles by years.

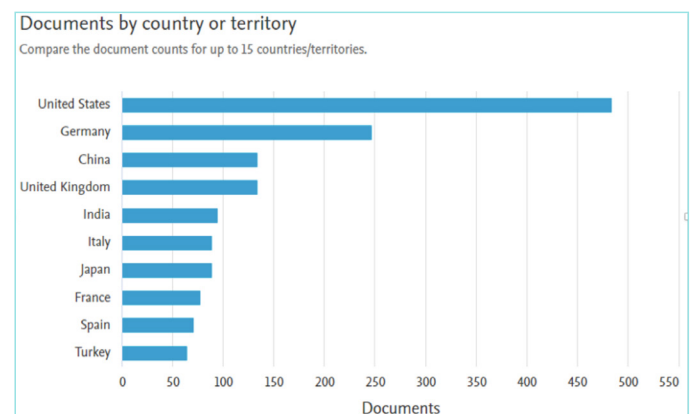


Figure 3. Top 10 countries with the highest number of articles published.

published in open access journals. It was observed that the China Medical University Hospital was the leading institution in publishing articles on CO (Table 1). The largest number of articles on CO were published in the journal Vestnik Khirurgii Imeni II Grekova [n=57 (1.97%)]. The most commonly used keyword was “osteomyelitis” [n=2,345 (81.39%)], followed by human [n=2,176 (75.5%)], article [n=1,854 (64.35%)], chronic disease [n=1,338 (46.44%) and male [n=1,328 (46.09%)]. Most publications were in the fields of medicine [n=2,724 (94.55%)], dentistry [n =146 (5.06%)], and Immunology and Microbiology [n=129 (4.47%)]. 1,156 (40.12%) of the publications had not been cited at the time of writing. The most cited article received 384 citations (Table 2).

The top three funding sponsors for CO studies were the National Institutes of Health [n=30 (1.04%)], the National Natural Science Foundation of China [n=27 (0.93%)], and the US Department of Health and Human Services [n=21 (0.72%)]. Pediatricians and rheumatologists constituted the majority of the most prolific authors in CO studies. Polly J. Ferguson from the IOWA University Pediatrics Clinic was the clinician with the most publications on CO among the authors, with 22 articles written by her (Table 3).

DISCUSSION

According to our bibliometric analysis results with 22,881 articles, while the number of articles on CO for every 10 years published between 1979-2010 varied between 422 and 470, a significant increase was observed especially between the years 2011-2021. This indicates that researchers value the subject of CO. Based on these data, we anticipate that there may be an increase in the number of articles to be published in the future.

CO causes bone death, soft tissue deterioration, functional impairment, systemic disease, and eventually significant morbidity. For the eradication of infection and the restoration of function, new and reliable techniques, both medical and surgical, have been developed. Surgery continues to be the focus for the treatment of CO. However, multidisciplinary studies are essential to achieve satisfactory results.⁷ In our study, Polly J. Ferguson from the IOWA University Pediatrics Clinic was the clinician with the most publications on CO among the authors with 22 articles. In addition to pediatricians, it is noteworthy that the

Table 1. Top 10 institutions with the highest number of articles published

| Institution | Number of publications |
|--|------------------------|
| China Medical University Hospital | 21 |
| Klinikum der Universität München | 20 |
| Julius-Maximilians-Universität Würzburg | 20 |
| China Medical University Hospital | 19 |
| National Ilizarov Medical Research Center for Traumatology & Orthopedics | 19 |
| Seattle Children’s Hospital | 19 |
| University of Iowa Carver College of Medicine | 18 |
| Technische University Dresden | 15 |
| Hospital for Sick Children University of Toronto | 15 |

Table 2. Most cited articles

| Document title | Authors, year, country | Source | Citing count | Document type, language |
|--|--|---|--------------|-------------------------|
| Use of the muscle flap in chronic osteomyelitis: Experimental and clinical correlation | Mathes Stephen J., 1982, USA | Plastic and reconstructive surgery | 384 | Article, English |
| Subacute and chronic “symmetrical” osteomyelitis | Giedion, A., 1972, Switzerland | Annales de radiologie | 338 | Article, English |
| *Homozygous mutations in LPIN2 are responsible for the syndrome of chronic recurrent multifocal osteomyelitis and congenital dyserythropoietic anaemia (Majeed syndrome) | Ferguson, Polly J., History map of the USA in 2005 | Journal of medical genetics | 282 | Article, English |
| *Osteomyelitis and the role of biofilms in chronic infection | Brady, Rebecca A., 2008, USA | FEMS Immunology and Medical Microbiology | 266 | Short survey, English |
| *Systemic antibiotics therapy for chronicle osteomyelitis in adults | Spellberg B., 2012, USA | Clinical Infectious Diseases | 246 | Article, English |
| The accuracy of diagnostic imaging for the assessment of chronic osteomyelitis: A systematic review and meta-analysis | Termaat MF, 2005, Netherlands | Journal of Bone and Joint Surgery - Series A | 222 | Review, English |
| Diagnostic Value of Sinus-tract Cultures in Chronic Osteomyelitis | Mackowiak, PA, 1978, USA | JAMA: The Journal of the American Medical Association | 211 | Article, English |
| Chronic recurrent multifocal osteomyelitis: Clinical outcomes after more than five years of follow-up | Huber, A.M., 2002, Canada | Journal of pediatrics | 210 | Article, English |
| *Imaging of chronic recurrent Multifocal Osteomyelitis | Khanna, G., 2009, USA | Radiographics | 204 | Article, English |

authors with the most articles were pediatricians, rheumatologists, and neurologists. Although surgery is the main treatment for CO, data demonstrate that orthopedic and plastic surgeons do not show interest in this subject. We believe that surgeons should share their experiences on CO and their innovations in follow-up and treatment methods more frequently in the literature.

The authors, institutions, and countries which have published the largest number of articles each show not only their contribution to the literature on a particular subject, but also their research capabilities and degree of influence on the subject. It is expected that these authors, institutions, and countries will contribute significantly to science on the subject they are interested in going forwards. Furthermore, some studies have reported that the economic size or level of development of countries has a significant effect on their academic publication efficiency.^{8,9} In our study, when the distribution of publications of the countries was examined, it was observed that most publications on CO were made by developed countries (USA, Germany, England, Italy, Japan, France, Spain) or by developing countries with large economies (China, India, Türkiye). As a result of our study, it was determined that our country, Türkiye, is in the 10th rank according to the number of publications on CO. We think that the interest of researchers in our country on this subject and the number of effective publications should be increased.

Identifying core journals with high publication and co-citation counts provides significant information for authors to select high-quality journals. Authors may not have the necessary knowledge or experience to select the most appropriate journals for the publication of their research. Therefore, the results from the current bibliographic study provide some guidance to clinical research authors in the field of CO.¹⁰ In our bibliometric study, the research titled "Use of the muscle flap in CO: Experimental and clinical correlation", published by Mathes Stephen et al. was the most cited. The other most cited articles are indicated in Table 2. We consider that it would be beneficial for researchers interested in CO to first read these studies determined by citation. The fact that the rate of uncited articles in our study was 40.2% shows the necessity of improving the level and quality of research in the field of CO.

When the keyword analysis was evaluated, it was seen that the keywords osteomyelitis, human, article, chronic disease, and male are frequently used in articles related to CO. In addition, the use of osteomyelitis with a rate of 81.39% makes us think that this keyword will assist researchers to reach their aims more readily on this subject.

Until 2004, the Web of Science (WoS) database, which was among the publications of Tomson Reuters, was the only database used in bibliometric studies. With the establishment of Scopus and Google Scholar in 2004, the number of bibliometric databases increased.^{11,12} In our study, Scopus, which is used for bibliometric analyzes and has the largest database feature, was preferred.

Bibliometrics is the quantitative analysis of research articles using mathematical and statistical methods. It includes a set of criteria to evaluate the impact and trends of research articles published with this analytic method. It can be used to identify models associated with publications in a particular field. Additionally, it is also a useful method for detecting citation data, understanding basic research areas, and predicting future research directions.¹³ In the literature, it was seen that bibliographic studies were conducted in the field of orthopedics.¹⁴⁻¹⁶ In our study, we examined the subject of CO, which is still open to debate in the follow-up and treatment of orthopedists, other clinicians, and patients, and had not previously had a bibliometric study.

Study Limitations

One limitation of our study was that we only analyzed research articles and reviews published in the Scopus database. The PubMed and WoS databases were not included. If more than one database is used in bibliometric studies where thousands of articles are analyzed, including the same articles more than once, this may adversely affect the data. Another limitation of bibliometric studies is that they can only be conducted on publications cited and indexed in journals and do not include unpublished studies or publications, theses, and books in non-indexed journals. In our study, there was no analysis of the articles' contents, and only the characteristics of the publications were examined.

CONCLUSION

In this clinical study published on CO, it was found that the number of publications increased rapidly, particularly after the 2000s. It was clearly seen that the most important contribution to the increase in the number of publications was made by those countries with high economic size and development levels. It was remarkable that pediatricians were at the forefront of CO, which is followed up and treated with the contribution of many disciplines.

Table 3. Authors with the most articles in chronic osteomyelitis research

| Authors name | Affiliation, country | Number of publications |
|---------------------------|--|------------------------|
| Polly J. Ferguson | University of Iowa, Department of Pediatrics, Iowa City, United States | 22 |
| Hermann Josef Girschick | Vivantes Klinikum im Friedrichshain, Department of Pediatrics and Adolescent Medicine, Berlin, Germany | 19 |
| Henner Morbach | Universitätsklinikum Würzburg, Department of Pediatrics, Würzburg, Germany | 19 |
| Fritz Schilling | Johannes Gutenberg-Universität Mainz, Mainz, Germany | 18 |
| Christian Michael Hedrich | University of Liverpool, Department of Women's and Children's Health, Liverpool, United Kingdom Alder Hey Children's NHS Foundation Trust, Department of Pediatric Rheumatology, Liverpool, United Kingdom | 17 |
| Chunhuang Tseng | School of Medicine, Department of Neurology, Taichung, Taiwan | 17 |
| Yongdong Zhao | University of Washington, Department of Pediatrics, Seattle, United States | 16 |
| Ronald M Laxer | Hospital for Sick Children University of Toronto, Division of Rheumatology, Toronto, Canada | 12 |
| Chih Hsin Muo | China Medical University, Management Office for Health Data, Taichung, Taiwan | 11 |

MAIN POINT

- Bibliometric studies have become very popular in recent years. It was the first in the literature to conduct a bibliometric study on a subject that should be approached multidisciplinary, such as chronic osteomyelitis
- In this study; It is the examining 2881 articles as a result of scanning the words CO in the Scopus bibliometric database between 1940-2021.

Ethics Committee Approval: Ethics committee approval was not required as there was no human or animal research.

Informed Consent: Informed consent approval was not required as there was no human or animal research.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: S.N.K., N.D.D., S.K., S.K.Ö., S.A., Design: S.N.K., N.D.D., S.K., S.K.Ö., S.A., Data Collection and/or Processing: S.N.K., N.D.D., S.K., S.K.Ö., S.A., Analysis and/or Interpretation: S.N.K., N.D.D., S.K., S.K.Ö., S.A., Literature Search: S.N.K., N.D.D., S.K., S.K.Ö., S.A., Writing: S.N.K., N.D.D., S.K., S.K.Ö., S.A.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study had received no financial support.

References

1. Chassignac E. De l'osteomyelite. Paris: Bull Mem Soc Chir. 1852: 431-6.
2. Parsons B, Strauss E. Surgical management of chronic osteomyelitis. *Am J Surg.* 2004; 188(1A Suppl): 57-66.
3. Jackson R. *Doctors and Diseases in the Roman Empire.* University of Oklahoma Press, Oklahoma City. 1988.p.116-7.
4. Patzakis MJ, Abdolahi K, Sherman, Holtom RP, Wilkins J. Treatment of chronic osteomyelitis with muscle flaps. *Orthop Clin North Am.* 1993; 24(3): 505-9.
5. May JW, Jupiter JB, Gallico GG 3rd, Rothkopf DM, Zingarelli P. Treatment of chronic traumatic bone wounds. Microvascular free tissue transfer: a 13-year experience in 96 patients *Ann Surg.* 1991; 214(3): 241-50; discussion 250-2.
6. Guler S, Ozmanevra R, Çapkin S. Global Scientific Outputs of Microsurgery Publications: A Bibliometric Approach About Yesterday, Today, and Tomorrow. *Cureus.* 2020; 12(12): 12205.
7. McNally M, Nagarajah K. Osteomyelitis. *Orthop Trauma.* 2010; 24(6): 416-29.
8. Doğan G, Karaca O. A bibliometric analysis of the field of anesthesia during 2009-2018. *Braz J Anesthesiol.* 2020; 70(2): 140-52
9. Kiraz M, Demir E. Bibliometric analysis of publications on spinal cord injury during 1980-2018. *World Neurosurg.* 2020; 136: 504-13.
10. Wang SQ, Gao YG, Zhang C, Xie YJ, Wang JX, Xu FY. A Bibliometric Analysis Using CiteSpace of Publications from 1999 to 2018 on Patient Rehabilitation After Total Knee Arthroplasty. *Med Sci Monit.* 2020; 26: e920795.
11. Kawuki J, Yu X, Musa TH. Bibliometric Analysis of Ebola Research Indexed in Web of Science and Scopus (2010-2020). *Biomed Res Int.* 2020; 2020: 5476567.
12. Karasözen B, Bayram ÖG, Zan BU. Comparison of the WoS and Scopus Databases. *Turkish Librarianship.* 2011; 25(2): 238-60.
13. Reuters T. Using Bibliometrics: A guide to evaluating research performance with citation data. White paper. 2008. http://ips.clarivate.com/m/pdfs/325133_thomson.pdf
14. Zhou T, Xu Y, Xu W. Emerging research trends and foci of studies on the meniscus: A bibliometric analysis. *J Orthop Surg (Hong Kong).* 2020; 28(3): 2309499020947286.
15. Zhang Y, Wumaier M, He D, Xiao B, Zhang J. The 100 Top-Cited Articles on Spinal Deformity: A Bibliometric Analysis. *Spine.* 2020; 45(4): 275-83.
16. He J, He L, Geng B, Xia Y. Bibliometric Analysis of the Top-Cited Articles on Unicompartamental Knee Arthroplasty. *J Arthroplasty.* 2021; 36(5): 1810-8.