



The growth of scientific publications in 2020: a bibliometric analysis based on the number of publications, keywords, and citations in orthopaedic surgery

Jing Sun¹ · Andreas F. Mavrogenis² · Marius M. Scarlat³

Published online: 1 August 2021
© SICOT aisbl 2021

Introduction

Science has grown since the mid-1600's. Specifically, three essential growth phases in the development of science have been identified; less than 1% up to the middle of the eighteenth century, to 2% to 3% up to the period between the two world wars, and 8% to 9% to 2010 [1]. Growth in science is driven by the publication of novel ideas and experiments, most usually in peer-reviewed journals. Currently, the number of published papers in different journals, social and mass media is increasing exponentially and the growth rates are significantly higher every decade.

Surgeons perform operations, complete hospital paperwork and additionally do research to improve clinical practice and the well-being of their patients, as well as to promote their own career, personal reputation, income and institutional/university position. Therefore, publication activity is time consuming and leads to overwhelming anxiety, and may be seen as a burden by young doctors who would enjoy performing surgery more. In orthopaedics, surgeons need to refocus some of their time and energies to communication and constructive research.

The pandemic time was a special period when the medical administration, governments, health-care payers were overwhelmed by the public medicine priorities and therefore the “unnecessary” surgery or medical care was postponed.

By observation of the activity of research processing within medical journals in 2020, we realised that the number of submissions increased dramatically. The media played a key role in promoting public health and influencing debate regarding health issues. Mass media coverage of COVID-19 pandemic has been exceptional with more than 180,000 articles published each day in 70 languages from March 8 to April 8, 2020. One may well wonder if this massive media attention ever happen in the past and if it has been finally proven to be beneficial or even just appropriate [2].

Before 2020, International Orthopaedics was receiving less than 3000 papers per year for consideration; approximately 400 were published. The submissions number rose to 3600 papers in 2020. A large number of papers analysed the new sanitary condition as perceived in orthopaedic surgery and traumatology. Other papers were retrospective clinical studies based on register data or on radiologic evidence, studies that did not require the physical presence of the patients.

This unusual rise in the volume of submissions encouraged us to perform this study measuring the dynamic and growth of the orthopaedic literature in 2020 based on the published papers, their specific keywords and citations.

Material and methods

Production analysis of orthopaedic literature during the pandemic

A database-based literature search was done on June 7, 2021. We observed and ran the PubMed and Embase search engines. Only journal articles were included. Recent-four year publications were retrieved and obtained from the databases, and the metadata were pooled and merged together by removing the duplicates using the software “Endnote 20” (Camelot UK Bidco Limited—Clarivate, UK).

✉ Marius M. Scarlat
mscarlat@gmail.com

¹ Orthopaedic Surgery, No. 406, Jie Fang Nan Road, Hexi District, Tianjin 300050, People's Republic of China

² First Department of Orthopaedics, School of Medicine, National and Kapodistrian University of Athens, Athens, Greece

³ Groupe ELSAN, Clinique St. Michel, Av. Orient, 83100 Toulon, France

The results were sorted by publication year, and the number of the papers was counted for analysis.

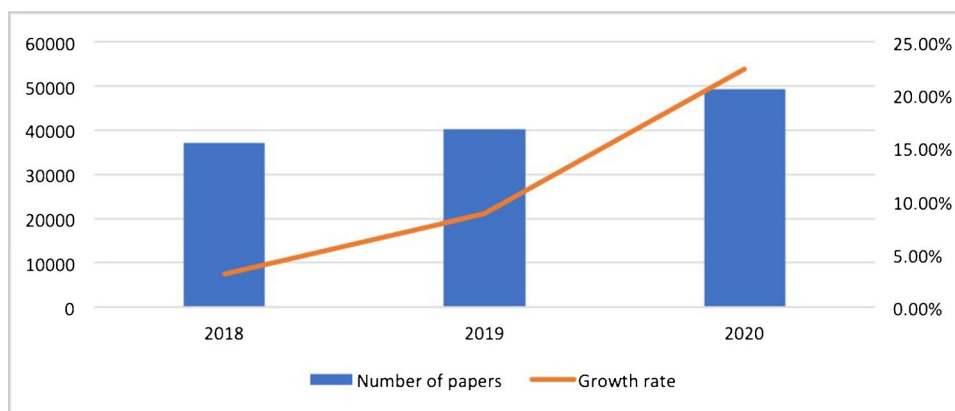
Characteristics and thematic analysis of orthopaedic literature during the pandemic

The Web of Science (WOS; Clarivate Analytics, Philadelphia, USA) platform (database: SCI expanded) was adopted to perform the literature search on June 7, 2021. Eighty two (82) journal titles under the category “orthopedics” and “orthopaedics” were selected from the Journal Citation Reports (JCR) for the year 2019, [3] and were used as the searching terms by limiting to publication name. The journal titles using “OR” operator were placed in the searching window of platform with the index selecting “Publication Name”, and then all articles from the 82 journals were identified.

The papers were included if (i) they were published in the 82 orthopaedic journals mentioned above and (ii) they were published from 2020 to date. Editorials, meeting abstracts, letters, corrections, proceedings, biographical productions, book reviews, news, retraction announcements, and reprints were excluded from the present analysis.

After literature retrieval, the metadata was downloaded and analysed by using “biblioshiny” that is an application that provides a web-interface of R package (Bibliometrix 3.1, University of Naples Federico II, Via Cintia, I-80126, Naples, Italy). It performs science mapping analysis using the main functions of the bibliometrix package, and supports scholars in easy use of the main features of bibliometrix. The data was imported to the software and converted to frame collection, and then the converted metadata was analysed in terms of documents, sources and conceptual structure to reveal the trends of topics. The keywords used were selected in the MeSH thesaurus. MeSH (Medical Subject Headings) is the National Library of Medicine controlled vocabulary used for indexing articles for PubMed. Subgroup analyses on “pandemics”, “sports and arthroscopy”, “arthritis”, “shoulder and elbow”, and “Spine” were performed by the same method.

Fig. 1 Number of papers and growth rate of orthopaedic publications from 2017 to 2020



Results

Rise in production of orthopaedic literature

A total of 68,311 orthopaedic papers were retrieved in PubMed for the years 2017 (15,528 papers), 2018 (16,159 papers), 2019 (17,371 papers), and 2020 (19,253 papers). A total of 133,765 orthopaedic papers were retrieved in Embase for the years 2017 (29,001 papers), 2018 (30,167 papers), 2019 (33,401 papers), and 2020 (41,196 papers). The data from the two databases were merged by removing duplicates ($n = 39,757$); this returned 35,846 papers related to orthopaedics in 2017, 36,983 papers in 2018, 40,234 papers in 2019, and 49,256 papers in 2020. The growth rate of 2018 is 3.1%; it is 8.8% for 2019 and 22.4% for 2020. There is a significant rise in orthopaedic publications in 2020 (Fig. 1).

Characteristics of the orthopaedic publications from 2020 to date

A total of 22,399 articles were retrieved in WOS from 2020 to date, including 19,008 original articles and 2391 reviews. The average citations per documents were 0.9894. The number of references cited by these publications was 354,775, and the documents contained 32,316 keywords as defined by the authors.

Documents

Global citations measure the number of citations a document has received from documents included in the entire database (all disciplines). The most global cited document with 129 cites was the paper entitled “Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations” published in the *Journal of Physiotherapy*, and the top ten most global cited documents ranged from 129 to 43 citations (Table 1).

Local citations measure the number of citations a document has received from papers included in the analysed collection (same discipline). The most local cited document

with 31 cites was the paper entitled “Lateral extra-articular tenodesis reduces failure of hamstring tendon autograft anterior cruciate ligament reconstruction: two year outcomes from the STABILITY study randomized clinical trial” published in the *American Journal of Sports Medicine*, and the top ten most local cited documents ranged from 31 to 16 citations (Table 2).

Journals

Among the 82 journals, the one that contributed most to the orthopaedic literature was the BMC Musculoskeletal Disorders. The number of publications for the top 20 most relevant journals ranged from 1230 to 388 (Table 3). The most local cited source was the *Journal of Bone and Joint Surgery*. The local citations of the top 20 journals ranged from 34,669 to 5081 (Table 4).

Table 1 Authors and journals of the 10 most cited orthopaedic papers in 2020

No	Paper	Total citations
1	THOMAS P., J PHYSIOTHER	129
2	TANAKA MJ., J BONE JOINT SURG AM	65
3	GUO XD., J BONE JOINT SURG AM	65
4	NUNEZ JH., INJURY	64
5	KOGAN M., J AM ACAD ORTHOP SUR	56
6	KLOPPENBURG M., OSTEOARTHRO CAR- TILAGE	55
7	HIRSCHMANN MT., KNEE SURG SPORT TRA	54
8	GETGOOD AMJ., AM J SPORT MED	48
9	LOEB AE., J AM ACAD ORTHOP SUR	46
10	JACOFISKY D., J ARTHROPLASTY	43
10	ARMSTRONG DG., J FOOT ANKLE RES	43

Table 2 Authors and journals of the 10 most local cited orthopaedic papers in 2020

No	Document	Local citations	Global citations	LC/GC ratio (%)
1	GETGOOD AMJ., AM J SPORT MED	31	48	64.58
2	TANAKA MJ., J BONE JOINT SURG AM	20	65	30.77
3	GUO XD., J BONE JOINT SURG AM	18	65	27.69
4	LIZAU-UTRILLA A., KNEE SURG SPORT TR A	18	22	81.82
5	LIZAU-UTRILLA A., KNEE SURG SPORT TR A-a	18	22	81.82
6	HIRSCHMANN MT., KNEE SURG SPORT TR A	17	54	31.48
7	VIVES JMM., J BONE JOINT SURG AM	16	34	47.06
8	SCHWARTZ AM., J ARTHROPLASTY	16	24	66.67
9	KOPF S., KNEE SURG SPORT TR A	16	21	76.19
10	QIN LL., J ARTHROPLASTY	16	21	76.19

Thematic trend of orthopaedic publications from 2020 to date

A tree map was applied to analyse the main topics according to the paper counts. The topics discussed the most were total knee arthroplasty ($n = 926$ papers, 9%), osteoarthritis ($n = 745$ papers, 7%), and knee ($n = 693$ papers, 7%) (Fig. 2).

To detect the thematic trend of orthopaedic publications, we applied thematic map to position the importance and development of the research themes based on density and centrality. The themes “Covid-19”, “hip arthroscopy”, and “femoroacetabular impingement” were relatively new themes that are expected to be emerging or declining (Fig. 2). The themes “spine”, “low back pain”, “osteoarthritis”, “knee”, and “MRI” were hot and essential. The themes “shoulder”, “arthroscopy”, “osteoporosis”, “hip fracture”, and “total knee/hip arthroplasty” were basic and transversal themes, signifying that more papers on these topics are currently published. Last, the themes “infection” and “anterior cruciate ligament” were highly developed but may be isolated (Fig. 3).

For subgroup analysis, the top three keywords for “pandemic” ($n = 382$ papers) were “covid-19” (28%), “pandemic” (8%), and “coronavirus” (7%); in this topic, “telemedicine” (3%) attracted more attention during pandemic. For “sports and arthroscopy” ($n = 1082$ papers), the top three keywords were “knee” (6%), “anterior cruciate ligament” (5%), and “sports” (4%). For “arthritis” ($n = 1071$ papers), the top three keywords were “osteoarthritis” (11%), “rheumatoid arthritis” (7%), and “total knee arthroplasty” (6%). For “spine” ($n = 2210$ papers), the top three keywords were “spine” (11%), “spine surgery” (7%), and “osteoporosis” (5%). For “shoulder and elbow” ($n = 2490$ papers), the top three keywords were “shoulder” (14%), “elbow” (5%), and “rotator cuff” (5%).

Table 3 The top 20 most relevant orthopaedics journals

No	Sources	No. of articles
1	BMC MUSCULOSKELETAL DISORDERS	1230
2	KNEE SURGERY SPORTS TRAUMATOLOGY ARTHROSCOPY	1044
3	JOURNAL OF ARTHROPLASTY	989
4	JOURNAL OF ORTHOPAEDIC SURGERY AND RESEARCH	858
5	INJURY-INTERNATIONAL JOURNAL OF THE CARE OF THE INJURED	683
6	ARCHIVES OF ORTHOPAEDIC AND TRAUMA SURGERY	647
7	ORTHOPAEDIC JOURNAL OF SPORTS MEDICINE	617
8	JOURNAL OF SHOULDER AND ELBOW SURGERY	595
9	EUROPEAN SPINE JOURNAL	585
10	INTERNATIONAL ORTHOPAEDICS	557
11	GAIT & POSTURE	539
12	AMERICAN JOURNAL OF SPORTS MEDICINE	493
13	JOURNAL OF ORTHOPAEDIC RESEARCH	490
14	SKELETAL RADIOLOGY	454
15	JOURNAL OF KNEE SURGERY	443
16	SPINE	424
17	BONE & JOINT JOURNAL	419
18	JOURNAL OF PEDIATRIC ORTHOPAEDICS	410
19	CLINICAL BIOMECHANICS	394
20	ARTHROSCOPY-THE JOURNAL OF ARTHROSCOPIC AND RELATED SURGERY	388

Table 4 The top 20 most local cited orthopaedic journals

No	Sources	Local citations
1	JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME	34,669
2	CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	27,449
3	AMERICAN JOURNAL OF SPORTS MEDICINE	26,895
4	JOURNAL OF ARTHROPLASTY	22,727
5	BONE & JOINT JOURNAL	19,552
6	SPINE	19,310
7	KNEE SURGERY SPORTS TRAUMATOLOGY ARTHROSCOPY	17,030
8	ARTHROSCOPY-THE JOURNAL OF ARTHROSCOPIC AND RELATED SURGERY	15,234
9	JOURNAL OF SHOULDER AND ELBOW SURGERY	11,916
10	FOOT & ANKLE INTERNATIONAL	8443
11	INTERNATIONAL ORTHOPAEDICS	8054
12	EUROPEAN SPINE JOURNAL	8010
13	INJURY-INTERNATIONAL JOURNAL OF THE CARE OF THE INJURED	7850
14	JOURNAL OF HAND SURGERY-AMERICAN VOLUME	7067
15	JOURNAL OF ORTHOPAEDIC TRAUMA	6984
16	OSTEOARTHR CARTILAGE	6586
17	JOURNAL OF PEDIATRIC ORTHOPAEDICS	6242
18	ARCHIVES OF ORTHOPAEDIC AND TRAUMA SURGERY	6119
19	JOURNAL OF ORTHOPAEDIC RESEARCH	5188
20	BMC MUSCULOSKELETAL DISORDERS	5081

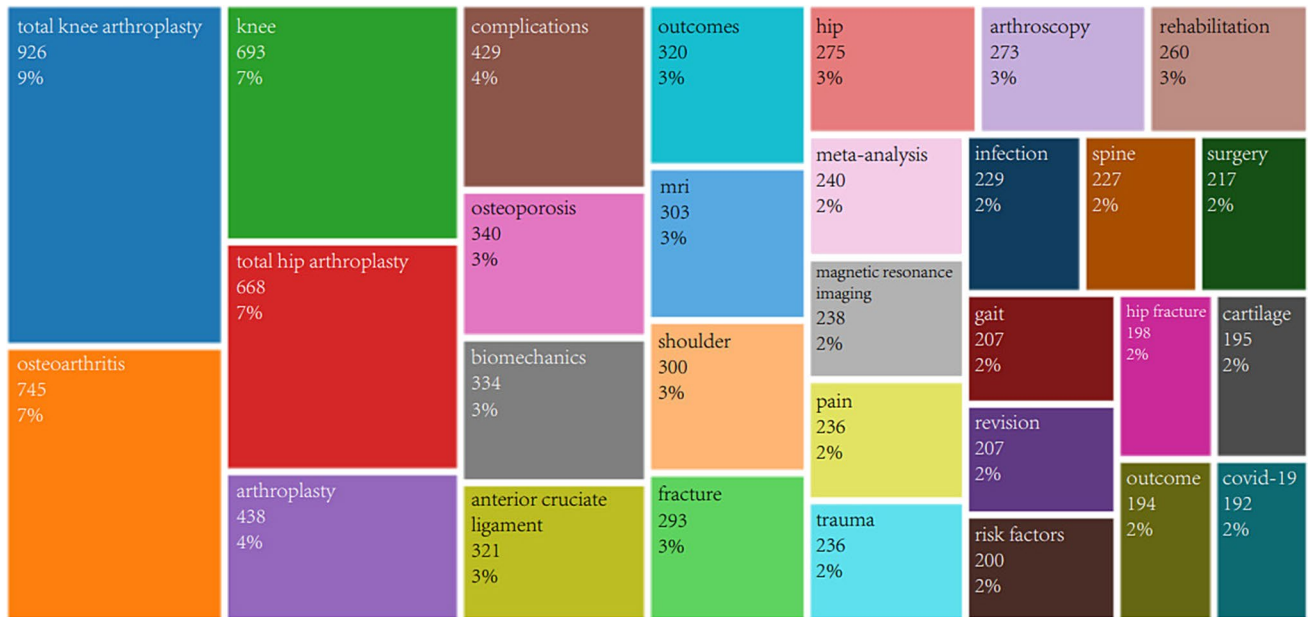


Fig. 2 Tree map of 30 prominent themes with orthopaedic papers counts and percentage

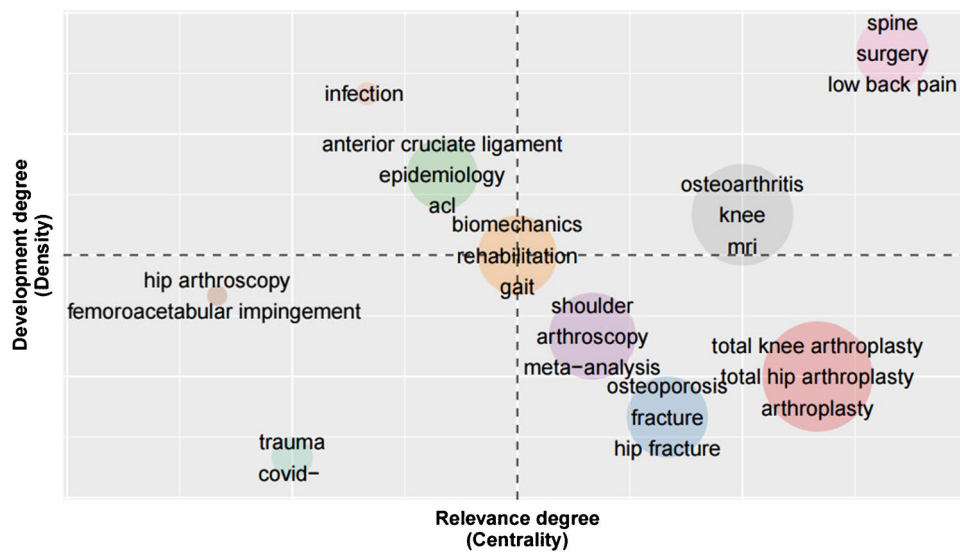


Fig. 3 Thematic map of the trends in orthopaedic publications. The centrality measures the importance, and the density measures the development. Four zones represent different trends. The upper left zone refers to topics with high density but low centrality, which means the themes may highly developed but isolated. The upper right

zone is with high density and centrality, which means the themes are developed and essential (motor theme). The lower left zone is with low density and low centrality, which refers to the emerging or declining themes. The lower right zone with low density but high centrality represents the basic and transversal theme

Discussion

Keywords-based research reveals keywords that have generated the most traffic to sites in a specific publications market. This information may be used to build keyword groups, to find trending topics, and to point out specific fields of interest. The growth of the overall volume of publications is an objective fact that could not be ignored.

The published papers discuss basically the same topics observed in the previous two years. New terms of interest such as viral infection or COVID were observed but they were not found responsible for such an impressive rise of the number of publications in 2020. The research items in orthopaedics were sensibly the same as in the recent past; however the volume of papers published for the same MeSH terms had a significant growth in number.

Unfortunately, there is no application to control for the quality of the published papers; only the number of citations may be considered for evaluating the utility of a publication and this has to be considered in the following years.

The present study does not provide a reasonable explanation for the substantial growth of orthopaedic publications in 2020. Also, we cannot predict if this growth is sustainable or only punctual, and/or if it was generated or related to the decrease of the scheduled surgical operations in the specific time frame of the pandemic. We could presume that the increased number of published papers can be explained by the fact that the surgeons were for a long time away from the operating theaters, as the number of scheduled operations was strongly decreased secondary to the pandemic. However, meanwhile the academic pressure for academic rise, prestige and promotion was constant as the doctors were still working for achieving academic status and progressing in their professional career and status. A surgeon's main activity is to perform surgery and care. However, a big number of publications in the years 2017 to 2020 were related to alternative methods for managing orthopaedic conditions, medical treatments, infiltrations, physical therapy, patient education, diet, and so many others [4–6].

Many of the published papers in 2020 describe a decrease in the surgical management of different bone and joint conditions during the pandemic, resulting eventually in a loose of quality and volume of care in different services. This could eventually lead to a change in the overall number of papers published in each journal in the future. Because the research begins and ends to the patients, we hope but we

are not very positive that this growth in publications might eventually lead to a change in clinical practice.

References

1. Bornmann L, Mutz R (2015) Growth rates of modern science: a bibliometric analysis based on the number of publications and cited references. *JASIST* 66:2215–2222. <https://doi.org/10.1002/asi.23329>
2. Romanò CL, Drago L, Del Sel H, Johari A, Lob G, Mavrogenis AF, Benzakour T (2020) World Association against Infection in Orthopedics and Trauma (WAIOT) Study Group On Bone And Joint Infection Definitions Loud and silent epidemics in the third millennium: tuning-up the volume. *Int Orthop*. 44(6):1019–1022. <https://doi.org/10.1007/s00264-020-04608-8>
3. Fang D, Fan M, Jia Z (2016) Fifty top-cited fracture articles from China: a systematic review and bibliometric analysis. *J Orthop Surg Res* 11(1):1–8
4. Bezuglov EN, Tikhonova AA, Chubarovskiy PV, Repetyuk AD, Khaitin VY, Lazarev AM, Usmanova EM (2020) Conservative treatment of Osgood-Schlatter disease among young professional soccer players. *Int Orthop* 44(9):1737–1743. <https://doi.org/10.1007/s00264-020-04572-3>
5. Shanmugasundaram S, Vaish A, Chavada V, Murrell WD, Vaishya R (2021) Assessment of safety and efficacy of intra-articular injection of stromal vascular fraction for the treatment of knee osteoarthritis—a systematic review. *Int Orthop* 45(3):615–625. <https://doi.org/10.1007/s00264-020-04926-x>
6. Gou PG, Zhao ZH, Zhou JM, Ren LH, Wang XY, Mu YF, Wang YG, Chang F, Xue Y (2021) Vertebral collapse prevented following teriparatide treatment in postmenopausal Kummell's disease patients with severe osteoporosis. *Orthop Surg* 13(2):506–516. <https://doi.org/10.1111/os.12959>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.