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Review Article

Analysis of the 50 Most Impactful Publications Pertaining to COVID-19 and Orthopaedic Surgery: What Have we Learned?

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Purpose

There has been abundant research published regarding the impact of COVID-19 on orthopaedic surgical patients which have varying degrees of impact on clinical practice. Thus, the purpose of this study was to examine the most influential articles relating to COVID-19 and patients undergoing orthopaedic surgical procedures. Though the global pandemic is over, it is beneficial to understand how the resilience of the healthcare system adapted to guide policy development and improve patient care amidst a worldwide time of crisis.

Methods

The Clarivate Web of Science Core Collection was searched for 'COVID-19 AND orthopaedic surgery' and returned 388 articles. The most influential peer-reviewed

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Conflicts of Interest Statement for Lauren Ladehoff

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Conflicts of Interest Statement for Dr. Oni

publications were determined by citation number. Expert opinion and review articles were excluded. Article title, journal name, type of study, country of publication, and clinically relevant findings of each study were collected.

Results

The top-50 most influential manuscripts concluded these articles were collectively cited 1875 times. The total citations ranged from 13 to 111 citations per article with a mean of 38 (95% confidence interval [31, 44]). England (14), the United States (11), and Italy (10) had the top number of publications. The top affiliations were IRCCS Istituto Ortopedico Galeazzi (5) and the University of London (4). The most popular journals were Bone & Joint Open (10) and International Orthopaedics (10). Though the articles were largely heterogeneous, they described the necessity of orthopaedic surgeons during the pandemic as well as safety precautions to prevent COVID-19 transmission in orthopaedic patients.

Conclusion

This comprehensive analysis identified the 50 most influential peer-reviewed clinical publications regarding COVID-19 and orthopaedic surgery, which is a concise resource that can be used to inform patient decision-making regarding orthopaedic care and COVID-19. The top-50 articles highlighted the importance of resource utilization, increased use of telemedicine, enhanced infection control measures, patient-centered care, and the well-being of healthcare workers during the COVID-19 pandemic.

INTRODUCTION

Coronavirus disease 2019 (Covid-19) was declared a global pandemic by the World Health Organization (WHO) on 11 March 2020 (World Health Organization 2020). To date, there have been 664,873,023 confirmed cases and 6,724,248 reported deaths (World Health Organization 2023). As of the 24th of January 2023, there have been a total of 13,156,047,747 vaccine doses delivered (World Health Organization 2023). In the months and years following the onset of the pandemic, its effects have significantly disrupted patient health and healthcare systems in the US and across the globe (Haileamlak 2021; Poudel et al. 2021; J. Xiong et al. 2020; Li, Wang, and Wang 2021; Youn et al. 2022). These effects have also significantly affected the practice of orthopaedics, serving as the impetus for a vast amount of research and publications (Liu et al. 2021).

While COVID-19 precipitated a proliferation of scientific production in orthopaedics, many of the initial publications consisted of editorials, letters to the editors, and expert opinions (D'Ambrosi 2020). However, researchers have since conducted extensive clinical research, including the effects of the pandemic on incidences of trauma, major complications, and morbidity (Egol et al. 2020; Bram et al. 2020). These articles also delineated the impact COVID-19 had upon healthcare providers, patients, and the general practice of orthopaedics and have since been disseminated as published works to serve as guidance (Zagra et al. 2020; Hampton et al. 2020; Wong and Cheung 2020).

The reach of this aforementioned guidance and clinical evidence can be measured though bibliometric analysis (Soytas et al. 2021; Familiari et al. 2021; Mercurio et al. 2022). For example, it can gauge the quantity of citations and social media attention a research output has received, indicating what the clinical research field and the public deems most notable (Ellegaard and Wallin 2015; Robinson et al. 2021). Given the vast amount of research performed on COVID-19 and orthopaedic patients within the context of rapidly evolving information during the early stages of

the pandemic, it is important to retrospectively evaluate which articles gained the most attention and thus provided the most clinical utility. Presently, no published literature has been made to examine the breadth of work which has been published on COVID-19 and orthopaedic patients. Consequently, the aim of the current study is to: 1) assess the top-50 most influential articles pertaining to COVID-19 and orthopaedic surgery through determining the most cited articles as well as exploring Altmetric characteristics; 2) determine the locations and journal characteristics pertaining to the most influential articles; and 3) collate lessons learned within the most influential articles pertaining to the COVID-19 pandemic. Though the global pandemic is over, and an event exactly like it may never happen again, it is important to understand how the resilience of the healthcare system adapted during a worldwide time of crisis so that we may determine what, if any, durable evidence has emerged in the literature. Studying the most highly cited publications on this topic may also help demystify the overwhelming wave of research on this topic in the years immediately following the 2020 pandemic.

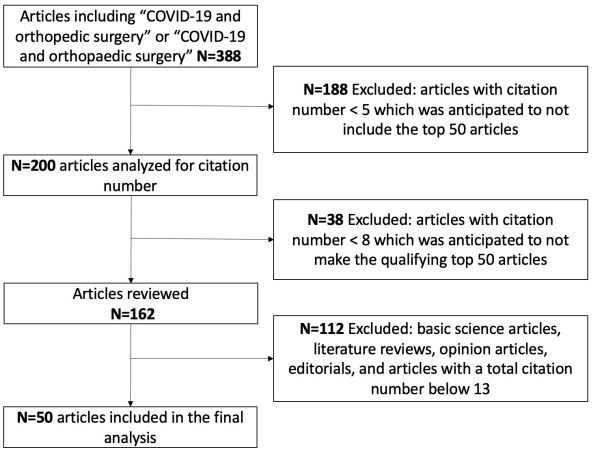

Figure 1. Article selection process for the top 50 articles pertaining to COVID-19 and orthopaedic surgery.

388 articles were found to detail COVID-19 and orthopaedic surgery, of which 200 articles were screened for citation number, and 162 articles were analyzed for inclusion criteria. Basic science articles, literature reviews, opinion articles, editorials, and articles with a citation number below 13 were excluded from the final analysis.

MATERIALS AND METHODS

DATA COLLECTION

The Clarivate Web of Science Core Collection was systematically used to gather data on COVID-19 and orthopaedic research from January 9 until January 22, 2023. The terms 'COVID-19 AND orthopaedic surgery' and 'COVID-19 AND orthopedic surgery' were used to search this database, returning 388 articles published since 2020.

ARTICLE SELECTION

The abstracts of the 388 articles were independently reviewed and categorized by LL, KR, JC, BC, AB, and each article was reviewed by a second author to ensure accuracy. 200 articles were queried due to the belief they contain the top 50 most cited articles after duplicates were removed (Figure 1). Expert opinion, systematic reviews, and review articles were excluded from this analysis, yielding only original studies. Systematic reviews with meta-analyses were included if each article within the article met the inclusion criteria of this study. Article title, journal name, type of study, country of publication, study information, and number of citations for each article were collected and reported using descriptive statistics. There were no restrictions based on the language in which the article was written. The most influential articles were determined to be the top-50 articles with the greatest number of citations meeting our inclusion criteria of original articles. Journal impact factors were determined using the Clarivate Web of Science Journal Citation Reports database.

ALTMETRICS DATA COLLECTION

Altmetrics, or alternative metrics, is a tool to discover online activity surrounding research, which may supplement traditional citations-based bibliometric data. Altmetrics data is accumulated more quickly than citations, which allows for a measure of immediate global research interest and engagement following publication (Altmetric 2023). The bibliometric data collected for each article through the Altmetric Explorer Database includes an Altmetric Attention Score (AAS), title, journal title, publication date, OA status, number of dimensions citations, number of Mendeley readers, and media mentions, including: news, blog, policy, patent, peer review, Twitter, Facebook, Reddit, Wikipedia, video, and syllabi mentions. The AAS is derived from an algorithm to represent a weighted count of online attention directed towards each article (Altmetric 2023). Further, AAS has been demonstrated to correlate with citation count for articles in previous literature (Collins et al. 2021). Thus, The Altmetric Explorer database was searched for the top-50 articles found during article selection to determine research engagement in addition to traditional citation-based metrics. Of the 50 articles in this analysis, Altmetrics data was reported for 35 articles. As Altmetrics data is not available for each individual article in this analysis, it was not the primary database used to determine the most influential articles published during this period.

STATISTICAL ANALYSIS

Descriptive statistics were calculated including mean ± standard deviation (SD) or N (%) where appropriate. Microsoft Excel was used to store data and to perform statistical analysis. Keywords were queried via PubMed and Clarivate, and quantities were analyzed using Microsoft Excel version 16.70, King County, Washington USA.

RESULTS

CHARACTERISTICS OF THE 50 MOST CITED ARTICLES

Our bibliometric analysis of the most influential manuscripts concluded the top-50 articles (Egol et al. 2020; Bram et al. 2020; Zagra et al. 2020; Hampton et al. 2020; Wong and Cheung 2020; Guo et al. 2020; Cipollaro et al. 2020; Catellani et al. 2020; LeBrun et al. 2020; Scott et al. 2020; Liebensteiner et al. 2020; Chaudhry, Nadeem, and Mundi 2020; Hernigou et al. 2020; Clement et al. 2020; Gruskay et al. 2020; Thaler et al. 2020; Sherman et al. 2020; Rizzi et al. 2020; Haffer et al. 2020; Luceri et al. 2020; Megaloikonomos et al. 2020; Benazzo et al. 2020; Siow et al. 2020; An et al. 2020; D.-G. Chang et al. 2020; J. Chang et al. 2020; Luengo-Alonso et al. 2020; Morelli et al. 2020; Giorgi et al. 2020; Thakrar et al. 2020; Lubbe et al. 2020; Greenhalgh et al. 2020; Dupley et al. 2020; MacDonald et al. 2020; G. Xiong et al. 2021; Baxter et al. 2020; Karayiannis et al. 2020; Meng et al. 2020; Chui, Thakrar, and Shankar 2020; Konda et al. 2020; Mitkovic et al. 2020; Yamada et al. 2020; Staunton et al. 2021; Probert et al. 2020; Andreata et al. 2020; Mackay et al. 2020; Zahra et al. 2020; Lazizi et al. 2020; Wignall et al. 2021; Lakhani et al. 2020) were published between April 23, 2020 and July 1, 2021 and were collectively cited 1,875 times. The mean number of total citations per article was 38 (95% confidence interval (CI) (Sherman et al. 2020; Thakrar et al. 2020)), ranging from a minimum of 13 to a maximum of 111 citations per article (Table 1). The most influential articles experienced the greatest increase in citations in 2021 with 915 total citations and an average of 18 citations per article, compared to 299 total citations in 2020 and 659 total citations in 2022 (Figure 3). All 50 study designs contained multiple human subjects, and there was a median sample size of 310 individuals in each study.

Additionally, we analyzed the keywords used in the top 50 articles, correcting for modifications of words or exact synonyms, for example, “COVID-19” and “coronavirus” (Table 4). All articles had a total of 115 keywords or phrases, and we found that the three most frequently used words were: “Coronavirus” (60), “Trauma” (23), “Fracture” (18). The most frequent key phrases, consisting of two or more words, were: “Hip Fracture” (6), “Orthopaedic surgery” (4), “Orthopaedic trauma” (4). 10 articles reported no keywords or key phrases for this analysis.

ALTMETRICS CHARACTERISTICS

The Altmetric Explorer database was utilized to gauge the social media impact of the 50 articles identified in this study. This assessment is advantageous as traditional citations can take many years to accumulate while an article’s AAS indicates the immediate impact of literature. Of the total 50 articles in this analysis, 35 articles were associated with an Altmetric Attention Score (AAS) and are reported alongside citation rankings in Table 1. The AAS scores ranged from 317 to 0, with a mean of 20.2 ± 54.1. These AAS scores have different weight corresponding with different media representations for each article (Altmetric 2023). These scores corresponded with news mentions ranging from 0 to 44 per article, with a mean of 2.02 ± 7.89; Twitter mentions ranging from 0 to 105, with a mean of 10.49 ± 18.73; Facebook mentions ranging from 0 to 2, with a mean of 0.26 ± 0.56; and a number of Mendeley readers ranging from 25 to 475, with a mean of 140.43 ± 96.65.

JOURNAL CHARACTERISTICS

The most popular journals for COVID-19 and orthopaedic research were Bone & Joint Open and International Orthopaedics each with 10 of the top-50 manuscripts (Table 6). All 50 articles were published in English. The top three countries included England (14), the United States (11), Italy (10) (Table 5). The top affiliations were IRCCS Istituto Ortopedico Galeazzi (5), and the University of London (4) (Table 1). The highest number of articles were published in September 2020 and August 2020 with 15 and 14 articles, respectively (Figure 2). A downward trend was observed in the number of publications per month between September 2020 and July 2021 (Figure 2).

CLINICALLY RELEVANT FINDINGS OF THE MOST CITED ARTICLES

Though the most cited articles were very heterogeneous, they touched on a few similar themes which emerged in the field of orthopaedic surgery during the COVID-19 pandemic. As healthcare workers adapted to the circumstances ahead of them, numerous articles were published documenting the lessons learned during this period. The most cited articles highlighted the change in resource utilization, growth of telemedicine, development of infection protocols, healthcare workers well-being, and patient-centered care within the field of orthopaedic surgery (Table 1).

Resource utilization was an important part of understanding change amidst a global pandemic and was emphasized in many of the top-50 manuscripts. The most cited article by Bram et al. described how the closure of schools, sports, and playgrounds precipitated by COVID-19 was followed by a significant decrease in pediatric orthopaedic trauma cases, which in turn led to the reallocation of resources to clinical areas with higher patient volume, increased emphasis on basic home safety precautions, and the simplification of pediatric care with a greater reliance on telemedicine and removable splinting (Bram et al. 2020). Another study by Wong, et. al. utilized the perspective of the initial Wuhan surge in COVID cases to describe modifications made to orthopaedic staffing and resource allocation, stating that despite a decrease in overall patient volume, demand for orthopaedic services remained high (Wong and Cheung 2020).

As infections rose and more stay-at-home orders were in place, telemedicine was increasingly utilized in the field of orthopaedic surgery. Some of the most cited articles explored the relationship between satisfaction levels between telemedicine and in-person visits, and another found that telemedicine would be beneficial to both providers and patients (Chaudhry, Nadeem, and Mundi 2020; Rizzi et al.

Table 1. The top-50 articles by citation number, including rank, title, authors, Altmetric Attention Score (AAS), Journal, Country, Affiliations, and Summary.

Rank	Title	Authors	Total Citations	AAS	Journal	Country of Origin	Affiliations	Summary
1	Where Have All the Fractures Gone? The Epidemiology of Pediatric Fractures During the COVID-19 Pandemic	Bram, Joshua T. et. al.	111	317	JOURNAL OF PEDIATRIC ORTHOPAEDICS	USA	1 Childrens Hosp Philadelphia, Div Orthopaed, 3401 Civ Ctr Blvd,Second Floor,Wood Bldg, Philadelphia, PA 19104 USA 2 Univ Penn, Perelman Sch Med, Philadelphia, PA 19104 USA	Given the decrease in pediatric orthopaedic trauma cases and increase in home-related injuries as a result of social distancing during the COVID-19 pandemic, orthopaedic surgeons should reallocate resources to clinical areas with higher patient volume, emphasize basic home safety precautions, and simplify pediatric care with a greater reliance on telemedicine and removable splinting. (Resource utilization)
2	Survey of COVID-19 Disease Among Orthopaedic Surgeons in Wuhan, People's Republic of China	Guo, Xiaodong et. al.	107	2	JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME	China	1 Huazhong Univ Sci & Technol, Union Hosp, Wuhan, Peoples R China 2 Huazhong Univ Sci & Technol, Union Hosp, Dept Orthoped, Wuhan, Peoples R China 3 Huazhong Univ Sci & Technol, Union Hosp, Ctr Stem Cell Res & Applicat, Inst Hematol, Wuhan, Peoples R China 4 Huazhong Univ Sci & Technol, Tongji Med Coll, Sch Publ Hlth, Wuhan, Peoples	Considering the high risk of COVID-19 infection, orthopaedic associations and surgeons should maintain a high level of clinical suspicion for COVID-19; use appropriate PPE including an N95 face mask; stay updated on training regarding infection prevention and resource conservation; consider minimizing, postponing, or cancelling elective procedures; follow U.S. CDC guidelines; avoid contact with family members at home following suspected exposure to infected persons; and minimize fatigue, which could decrease the body's immune response. (Resource utilization)

							R China 5 Wuhan Cent Hosp, Dept Orthoped, Wuhan, Peoples R China 6 Wuhan Puai Hosp, Dept Orthoped, Wuhan, Peoples R China	
3	Increased Mortality and Major Complications in Hip Fracture Care During the COVID-19 Pandemic: A New York City Perspective	Egol, Kenneth A. et. al.	96	1	JOURNAL OF ORTHOPAEDIC TRAUMA	Canada, USA	1 NYU Langone Orthoped Hosp, NYU Langone HIth, Dept Orthoped Surg, Div Orthoped Trauma Surg, New York, NY 10003 USA 2 Jama Hosp Med Ctr, Dept Orthopaed Surg, Richmond Hill, ON, Canada 3 Bellevue Hosp, Dept Orthoped Surg, New York, NY USA	Physicians treating confirmed or suspected COVID+ patients should counsel families of the significantly increased mortality and complications following hip fracture. (Patient-centered care)
4	Impact of COVID-19 on Orthopaedic and Trauma Service An Epidemiological Study	Wong, Janus Siu Him et. al.	89	2	JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME	China	1 Univ Hong Kong, Queen Mary Hosp, Hong Kong, Peoples R China 2 Univ Hong Kong, Li Ka Shing Fac Med, Dept Orthopaed & Traumatol, Hong Kong, Peoples R China	While staffing and allocating resources during the pandemic, healthcare professionals should understand that despite an overall decline in patient volume, there is still a considerably high demand for orthopaedic and trauma services. (Resource utilization)
5	Musculoskeletal symptoms in SARS-CoV-2	Cipollaro, Lucio et. al.	80	46	JOURNAL OF ORTHOPAEDIC SURGERY AND	Italy, England	1 Univ Salerno, Fac Med & Surg, Dept	Musculoskeletal symptoms, such as myalgia, arthralgia, and fatigue, are almost always present in a COVID-19 infection, even during

	(COVID-19) patients				RESEARCH		Musculoskeletal Disorders, Salerno, Italy 2 Univ Salerno, Dept Med Surg & Dent, Via S Allende, I-84081 Baronissi, SA, Italy 3 Univ Milan, Dept Biomed Sci Hlth, Milan, Italy 4 Queen Mary Univ London, Mile End Hosp, Barts & London Sch Med & Dent, Ctr Sports & Exercise Med, 275 Bancroft Rd, London E1 4DG, England 5 Keele Univ, Sch Med, Inst Sci & Technol Med, Thornburrow Dr, Stoke On Trent, Staffs, England	its initial stage. Thus, these MSK symptoms can be used to identify and isolate infected patients earlier and potentially determine the extent of the infection on the whole human body if effectively paired with laboratory findings. However, the mechanism of how COVID-19 affects the MSK system is still unclear. (Infection protocol)
6	Treatment of Proximal Femoral Fragility Fractures in Patients with COVID-19 During the SARS-CoV-2 Outbreak in Northern Italy	Catellani, Francesco et. al.	71	N/A	JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME	Italy, England	1 Humanitas Gavazzeni, Bergamo, Italy 2 Humanitas Gavazzeni, Dept Orthopaed & Traumatol, Bergamo, Italy 3 IRCCS Ist Ortoped Galeazzi, Milan, Italy	Early surgical intervention in COVID+ elderly patients who have sustained proximal femoral fractures may improve their overall stabilization, seated mobilization, physiological ventilation, and general comfort in bed. However, early surgical intervention should not be pursued for COVID+ elderly patients with life-threatening clinical presentations, such as severe dyspnea (pO2 <90%), hyperpyrexia (>38°C), and systemic organ dysfunction. (Patient-centered care)
7	Hip Fracture Outcomes During the COVID-19 Pandemic: Early	LeBrun, Drake G. et. al.	66	38	JOURNAL OF ORTHOPAEDIC TRAUMA	USA	1 Hosp Special Surg, Dept Orthopaed Surg, 535 East 70th	Inpatient mortality was significantly higher in hip fracture patients who were COVID+ compared to those who tested negative or who were not screened. Further research is

	Results From New York						St, New York, NY 10021 USA 2 Hosp Special Surg, HSS Res Inst, 535 E 70th St, New York, NY 10021 USA 3 Weill Cornell Med Coll, Dept Physiol & Biophys, New York, NY USA 4 Weill Cornell Med Coll, New York, NY USA 5 NewYork Presbyterian Queens, Orthopaed Trauma Serv, Dept Orthopaed Surg, Flushing, NY USA 6 Hosp Special Surg, Dept Orthopaed Surg, Orthopaed Trauma Serv, 535 E 70th St, New York, NY 10021 USA	required to pinpoint the patient care variables that can be changed to potentially improve outcomes in the high-risk population of elderly hip fracture patients. (Patient-centered care)
8	The effects of a UK lockdown on orthopaedic trauma admissions and surgical cases A MULTICENTRE COMPARATIVE STUDY	Hampton, M. et. al.	64	19	BONE & JOINT OPEN	England	1 Rotherham NHS Fdn Trust, Rotherham Dist Gen Hosp, Rotherham, S Yorkshire, England 2 Rotherham Gen Hosp NHS Trust, Trauma & Orthopaed, Rotherham, S Yorkshire, England	Patients with fragility fractures during the COVID-19 pandemic should still be managed as a surgical priority, in line with updated guidelines form the British Orthopaedic Association. (Patient-centered care)

							3 Sheffield Childrens Hosp Sheffield Childrens NHS, Trauma & Orthopaed, Sheffield, S Yorkshire, England 4 Sheffield Teaching Hosp NHS Fdn Trust, Sheffield, S Yorkshire, England	
9	Population mobility and adult orthopaedic trauma services during the COVID-19 pandemic: fragility fracture provision remains a priority	Scott, C. E. H. et. al.	53	10	BONE & JOINT OPEN	Scotland	1 Royal Infirm Edinburgh NHS Trust, Edinburgh Orthopaed Trauma, Edinburgh, Midlothian, Scotland	While orthopaedic trauma referrals have significantly decreased secondary to changes in behavior during the early COVID-19 pandemic, the incidence of fragility fractures has remained unchanged, and thus care for these patients should continue. (Resource utilization)
10	Massive cutback in orthopaedic healthcare services due to the COVID-19 pandemic	Liebensteiner, M. C. et. al.	52	5	KNEE SURGERY SPORTS TRAUMATOLOGY ARTHROSCOPY	Austria, Switzerland	1 Med Univ Innsbruck, Dept Orthopaed Surg, Innrain 52, Innrain 6020, Austria 2 Kantonsspital Baselland Bruderholz Liestal Laufen, Dept Orthopaed Surg & Traumatol, Liestal 4101, Switzerland 3 Univ Basel, Basel, Switzerland 4 HealthPi Med Ctr, Schulterzentrum	In the early stages of the COVID-19 pandemic, there was an overall decrease in orthopaedic services across Austria, Germany and Switzerland with a reported sharp decline in arthroscopic treatments such cruciate ligament reconstruction and rotator cuff surgery, as well as an almost complete cessation of elective total joint arthroplasty. Although long-term consequences of this decrease in patient volume is unclear, it is necessary to consider this described disturbance in the field as historic. (Resource utilization)

							Wien, Wollzeile 1-3, Vienna, Austria	
11	How Satisfied Are Patients and Surgeons with Telemedicine in Orthopaedic Care During the COVID-19 Pandemic? A Systematic Review and Meta-analysis	Chaudhry, Harman et. al.	51	23	CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	Canada	1 Univ Toronto, Div Orthopaed Surg, Toronto, ON, Canada 2 Univ Toronto, Div Orthopaed Surg, 43 Wellesley St E,Suite 319, Toronto, ON M4Y 1H1, Canada	Though satisfaction levels are comparable between telemedicine and in-person visits, orthopaedic surgeons should maintain a low threshold for in-person follow-up until more telemedicine research, specifically examining safety endpoints and evidence-based implementation, is conducted. (Telemedicine)
12	Staying home during COVID-19 decreased fractures, but trauma did not quarantine in one hundred and twelve adults and twenty eight children and the tsunami of recommendations could not lockdown twelve elective operations	Hernigou, Jacques et. al.	48	6	INTERNATIONAL ORTHOPAEDICS	France, Belgium	1 EpiCURA Hosp, Orthoped Dept, Baudour, Hornu, Belgium 2 Univ Paris Est, Hosp Henri Mondor, Creteil, France	Time to surgery and ultimately hospital stay should be reduced to be efficient with medical resources when treating patients needing orthopaedic care during COVID-19. (Resource utilization)
13	IMPACT-Restart: the influence of COVID-19 on postoperative mortality and risk factors associated with SARS-CoV-2 infection after orthopaedic and trauma surgery	Clement, N. D. et. al.	46	38	BONE & JOINT JOURNAL	Scotland	1 Royal Infirm Edinburgh NHS Trust, Edinburgh, Midlothian, Scotland	Perioperative shielding may be beneficial for patients at risk of contracting COVID-19 postoperatively. (Infection protocol)
14	Universal Testing for COVID-19 in Essential	Gruskay, Jordan A. et. al.	46	2	JOURNAL OF BONE AND JOINT SURGERY-	USA	1 Hosp Special Surg, New York, NY 10021 USA	Preoperative COVID-19 screening based on symptom presentation is inadequate. More research is required to determine the most

	Orthopaedic Surgery Reveals a High Percentage of Asymptomatic Infections				AMERICAN VOLUME		2 Hosp Special Surg, Dept Orthopaed Surg, 535 E 70th St, New York, NY 10021 USA 3 Hosp Special Surg, HSS Res Inst, New York, NY 10021 USA 4 Weill Cornell Med Coll, Dept Physiol & Biophys, New York, NY USA	effective technique for preoperative COVID-19 screening and to describe the postoperative outlook in asymptomatic COVID-19 patients. Following this study, all surgical patients at this NY hospital will receive preoperative chest radiography, an RT-PCR swab, and serum antibody testing to determine surgical eligibility. (Infection protocol)
15	Changes of clinical activities in an orthopaedic institute in North Italy during the spread of COVID-19 pandemic: a seven-week observational analysis	Zagra, Luigi et. al.	46	N/A	INTERNATIONAL ORTHOPAEDICS	Italy, Poland	1 IRCCS Ist Ortoped Galeazzi, Hip Dept, Via Riccardo Galeazzi 4, I-20161 Milan, Italy 2 IRCCS Ist Ortoped Galeazzi, Lab Expt Biochem, Milan, Italy 3 IRCCS Ist Ortoped Galeazzi, Hlth Management, Milan, Italy 4 Poznan Univ Phys Educ, Dept Athlet Strength & Conditioning, Poznan, Poland 5 IRCCS Ist Ortoped Galeazzi, Milan, Italy 6 IRCCS Ist Ortoped Galeazzi, ER	During the COVID-19 pandemic, this orthopaedic center in Milan decreased elective surgeries, restricted outpatient admissions, and saw an increase in orthopaedic trauma volume due to its new role as a referral orthopaedic center. (Resource utilization)

							Dept, Milan, Italy 7 IRCCS Ist Ortoped Galeazzi, Dept Anesthesiol, Milan, Italy	
16	Disruption of joint arthroplasty services in Europe during the COVID-19 pandemic: an online survey within the European Hip Society (EHS) and the European Knee Associates (EKA)	Thaler, M. et. al.	44	7	KNEE SURGERY SPORTS TRAUMATOLOGY ARTHROSCOPY	Austria, Switzerland, Netherlands, Italy, France	1 Med Univ Innsbruck, Dept Orthopaed Surg, Innrain 52, Innsbruck 6020, Austria 2 Kantonsspital Baselland Bruderholz Liestal Laufen, Dept Orthopaed Surg & Traumatol, Bruderholz 4101, Switzerland 3 Univ Basel, Basel, Switzerland 4 CortoClinics, Schijndel, Netherlands 5 IRCCS Ist Ortoped Galeazzi, Hip Dept, Milan, Italy 6 Ctr Res & Documentat Arthroplasty, Houdain, France	Europe saw a substantial decrease in arthroplasties, specifically primary TJA and revision TJA, even in massively failed TJA with collapse, dislocation, component failure or imminent dislocation. Regarding trauma, only life-threatening cases such as periprosthetic fractures and acute septic TJA were treated. (Resource utilization)
17	How Did the Number and Type of Injuries in Patients Presenting to a Regional Level I Trauma Center	Sherman, William F. et. al.	41	4	CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	USA	1 Tulane Univ, Sch Med, Dept Orthopaed Surg, 1430 Tulane Ave, New Orleans, LA 70112 USA	Given the decrease in orthopaedic trauma volume and changing mechanisms of injury during the pandemic, staffing and scheduling practices should maximize efficiency and minimize risk of infection. (Resource utilization)

	Change During the COVID-19 Pandemic with a Stay-at-home Order?						2 Tulane Univ, Sch Med, 1430 Tulane Ave, New Orleans, LA 70112 USA 3 Univ Texas Hlth, Dept Orthoped Surg, McGovern Med Sch, Houston, TX USA 4 Louisiana State Univ, Dept Orthopaed Surg, Hlth Sci Ctr, Sch Med, New Orleans, LA USA	
18	The new 'normal': Rapid adoption of telemedicine in orthopaedics during the COVID-19 pandemic	Rizzi, Andrew M. et. al.	40	13	INJURY-INTERNATIONAL JOURNAL OF THE CARE OF THE INJURED	USA	1 Univ Chicago, Dept Orthopaed Surg & Rehabil Med, Med Ctr, Chicago, IL 60637 USA 2 Univ Chicago, Pritzker Sch Med, 5841 South Maryland Ave, Chicago, IL 60637 USA	The incorporation of telemedicine into orthopaedic outpatient clinics will be beneficial to both providers and patients but should not replace all-in person clinic visits. (Telemedicine)
19	Impact of the COVID-19 Pandemic on Orthopaedic and Trauma Surgery in University Hospitals in Germany Results of a Nationwide Survey	Haffer, Henryk et. al.	39	N/A	JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME	Germany	1 Charite Univ Med Berlin, Ctr Musculoskeletal Surg, Berlin, Germany 2 Univ Hosp Giessen, Dept Orthopaed & Orthopaed Surg, Giessen, Germany 3 Rhein Friedrich Wilhelms Univ Bonn, Dept Orthopaed &	Orthopaedic surgeons in Germany followed hospital policy and government mandates to minimize the spread of COVID-19 and maximize resources while suffering significant financial losses. (Resource utilization)

							Trauma Surg, Bonn, Germany 4 Westfalische Wilhelms Univ, Dept Trauma Hand & Reconstruct Surg, Munster, Germany	
20	Italy and COVID-19: the changing patient flow in an orthopedic trauma center emergency department	Luceri, Francesco et. al.	38	N/A	JOURNAL OF ORTHOPAEDIC SURGERY AND RESEARCH	Italy, England	1 IIRCCS Ist Ortoped Galeazzi, Milan, Italy 2 Univ Milan, Residency Program Orthopaed & Traumatol, Milan, Italy 3 Univ Milan, Dept Biomed Sci Hlth, Milan, Italy 4 Univ Salerno, Dept Med Surg & Dent, Via S Allende, I-84081 Baronissi, SA, Italy 5 Keele Univ, Sch Med, Sch Pharm & Bioengn, Thornburrow Dr, Stoke On Trent, Staffs, England 6 Queen Mary Univ London, Mile End Hosp, Barts & London Sch Med & Dent, Ctr Sports & Exercise Med, 275 Bancroft Rd, London E1	Social isolation during the pandemic resulted in changes in patient volume and types of injuries, which then had effects on triage, imaging, and discharge modalities. (Resource utilization)

							4DG, England	
21	Impact of the COVID-19 pandemic on orthopaedic and trauma surgery training in Europe	Megaloikonomos, Panayiotis D. et. al.	38	N/A	INTERNATIONAL ORTHOPAEDICS	Greece, Austria, Germany, Italy, Bosnia and Herceg, Portugal, Switzerland	1 Natl & Kapodistrian Univ Athens, ATTIKON Univ Hosp, Sch Med, Dept Orthopaed 1, 1 Rimini St, Athens 12462, Greece 2 Med Univ Innsbruck, Dept Orthopaed Surg, Innsbruck, Austria 3 Spine Ctr Stuttgart, Diakonie Kinikum Stuttgart, Stuttgart, Germany 4 Humanitas Univ, Dept Biomed Sci, Milan, Italy 5 Univ Hosp Mostar, Dept Orthopaed, Mostar, Bosnia & Herceg 6 Ctr Hospitalar Sao Joao, Dept Orthopaed, Porto, Portugal 7 Langenthal Hosp, Dept Orthopaed, Langenthal, Switzerland	Orthopaedic trainees expected that the reduction in workload and educational opportunities as a result of the pandemic would negatively impact their training. (Healthcare workers well-being)
22	The orthopaedic and traumatology scenario during Covid-19 outbreak in Italy:	Benazzo, Francesco et. al.	36	3	INTERNATIONAL ORTHOPAEDICS	Italy	1 Fdn Poliambulanza, Sez Chirurg Protes Indirizzo Robot, UO	The proportion of femoral neck fracture cases stayed constant despite reductions in other orthopaedic trauma injuries during the pandemic. (Resource utilization)

	chronicles of a silent war						Ortoped & Traumatol, Unita Traumatol Sport, Via Bissolati 57, I-25124 Brescia, Italy 2 Fdn IRCCS Policlin San Matteo, Clin Ortoped & Traumatol, Pavia, Italy 3 Univ Pavia, Pavia, Italy 4 Guglielmo da Saliceto Hosp, Orthopaed & Traumatol Dept, Piacenza, Italy 5 Policlin Univ, Azienda Osped Univ, UOC Ortoped & Traumatol, Bari, Italy 6 Azienda Osped Univ Parma, Clin Ortoped, Parma, Italy 7 Univ Padua, Dept Orthopaed & Orthopaed Oncol, Padua, Italy 8 Univ Torino, Sch Med, Clin Ortoped & Traumatol Citta Salute & Sci CTO, Turin, Italy 9 AORN San Giuseppe Moscati, Avellino, Italy 10 Az Osped San	

							Giovanni Addolorata, UOC Ortoped & Traumatol, Rome, Italy 11 Piedimonte Matese Hosp, Orthopaed & Traumatol Unit, ASL Caserta, Piedimonte Matese, Italy 12 Di Venere Hosp, Orthoped & Trauma Dept, Bari, Italy 13 Azienda Sanit Univ Giuliano Isontina ASU GI, SC UCO Clin Ortoped & Traumatol, Trieste, Italy 14 Univ Insubria, Div Orthopaed & Traumatol, Dept Biotechnol & Life Sci DBSV, ASST Sette Laghi, Varese, Italy 15 Osped Santa Maria Croci Ravenna, Ortotrauma Dept, Ravenna, Italy 16 CTO ASST Pini CTO, Ctr Specialistico Ortoped & Traumatol Gaetano Pin, Milan, MI, Italy 17 SS	

							Annunziata Hosp, Orthopaed & Trauma Dept, Savigliano, CN, Italy 18 Univ Naples Federico II, Dept Orthopaed Surg, Naples, Italy	
23	What Was the Change in Telehealth Usage and Proportion of No-show Visits for an Orthopaedic Trauma Clinic During the COVID-19 Pandemic?	Siow, Matthew Y. et. al.	32	1	CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	USA	1 Univ Calif San Diego, Dept Orthopaed Surg, 200 West Arbor Dr, San Diego, CA 92103 USA	Orthopaedic surgeons should consider using telemedicine to reduce in-person interactions, thereby protecting both at-risk patients and the healthcare workforce during the pandemic. (Telemedicine)
24	How Are Orthopaedic Surgery Residencies Responding to the COVID-19 Pandemic? An Assessment of Resident Experiences in Cities of Major Virus Outbreak	An, Tonya W. et. al.	30	N/A	JOURNAL OF THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS	USA	1 Cedars Sinai Med Ctr, Dept Orthopaed Surg, Los Angeles, CA 90048 USA 2 Hosp Special Surg, 535 E 70th St, New York, NY 10021 USA 3 Tulane Univ, Sch Med, Dept Orthopaed Surg, New Orleans, LA 70112 USA 4 Univ Washington, Dept Orthopaed Surg, Seattle, WA 98195 USA 5 Univ Calif Los Angeles, Dept Orthopaed Surg, Los Angeles, CA USA	Resident safety, including access to appropriate PPE, COVID-19 screening, and up-to-date information, should be prioritized during the pandemic. (Healthcare workers well-being)

25	The impact of COVID-19 pandemic on orthopaedic resident education: a nationwide survey study in South Korea	Chang, Dong-Gune et. al.	30	1	INTERNATIONAL ORTHOPAEDICS	South Korea, India, Singapore	1 Inje Univ, Coll Med, Dept Orthopaed Surg, Inje Univ Sanggye Paik Hosp, Seoul, South Korea 2 Catholic Univ Korea, Dept Orthopaed Surg, Uijeongbu St Marys Hosp, Coll Med, 271 Cheonbo Ro, Uijeongbu Si 11765, Gyeonggi Do, South Korea 3 Seoul Natl Univ, Dept Orthopaed Surg, Seoul Natl Univ Hosp, Coll Med, Seoul, South Korea 4 Madras Med Coll & Govt Gen Hosp, Inst Orthoped & Traumatol, Orthoped Spine Surg Unit, Chennai, Tamil Nadu, India 5 Natl Univ Hlth Syst, Univ Spine Ctr, Dept Orthopaed Surg, Natl Univ Hosp, Singapore, Singapore	As orthopaedic surgery training in South Korea was negatively impacted by COVID-19, the non-contact education system must be improved to reclaim lost learning opportunities and increase resident satisfaction while not compromising on safety. (Healthcare workers well-being)
26	Restarting elective orthopaedic services during the COVID-19	Chang, J. et. al.	30	N/A	BONE & JOINT OPEN	England	1 Univ Coll London Hosp, London, England 2 Univ Coll	Orthopaedic surgeons should continue to prioritize safety and emphasize risk for COVID-19 infection even as routine orthopaedic services resume. (Infection

	pandemic DO PATIENTS WANT TO HAVE SURGERY?						London Hosp NHS Fdn Trust, Orthopaed, London, England 3 Univ Coll London Hosp NHS Fdn Trust, Trauma & Orthopaed, London, England	protocol)
27	Critical adjustments in a department of orthopaedics through the COVID-19 pandemic	Luengo-Alonso, Gonzalo et. al.	30	N/A	INTERNATIONAL ORTHOPAEDICS	Spain	1 Univ Autonoma Madrid, Dept Orthoped Surg & Traumatol, Hosp Univ Fdn Jimenez Diaz, IIS Fdn Jimenez Diaz, Avda Reyes Catol 2, Madrid 28040, Spain	Health care delivery modalities within orthopaedic and trauma surgery will evolve following the changes in patient volume and increased utilization of telehealth witnessed during the pandemic. (Telemedicine)
28	COVID-19: not a contraindication for surgery in patients with proximal femur fragility fractures	Morelli, Ilaria et. al.	26	N/A	JOURNAL OF ORTHOPAEDIC SURGERY AND RESEARCH	Italy, England	1 Univ Milan, Residency Program Orthopaed & Traumatol, Via Festa Perdono 7, I-20122 Milan, Italy 2 IRCCS Ist Ortoped Galeazzi, Equipe Regenerat & Reconstruct Orthopaed EUORR, Via Riccardo Galeazzi 4, I-20161 Milan, Italy 3 IRCCS Ist Ortoped Galeazzi, Trauma Unit, Via	Early surgical intervention for elderly patients with proximal femoral fractures is also beneficial for those with COVID-19, but this should be verified by higher quality research. (Patient-centered care)

							Riccardo Galeazzi 4, I-20161 Milan, Italy 4 IRCCS Ist Ortoped Galeazzi, Emergency Dept, Via Riccardo Galeazzi 4, I-20161 Milan, Italy 5 IRCCS Ist Ortoped Galeazzi, Anesthesiol Serv, Via Riccardo Galeazzi 4, I-20161 Milan, Italy 6 IRCCS Ist Ortoped Galeazzi, Intens Care Unit, Via Riccardo Galeazzi 4, I-20161 Milan, Italy 7 Univ Milan, Dept Biomed Sci Hlth, Via Mangiagalli 31, I-20133 Milan, Italy 8 Univ Salerno, Dept Med Surg & Dent, Via S Allende, I-84081 Baronissi, SA, Italy 9 Queen Mary Univ London, Mile End Hosp, Ctr Sports &	

							Exercise Med, Barts & London Sch Med & Dent, 275 Bancroft Rd, London E1 4DG, England 10 Keele Univ, Sch Med, Sch Pharm & Bioengn, Thornburrow Dr, Stoke On Trent ST4 7QB, Staffs, England	
29	The management of emergency spinal surgery during the COVID-19 pandemic in Italy A PRELIMINARY REPORT	Giorgi, P. D. et. al.	25	16	BONE & JOINT JOURNAL	Italy	1 ASST Grande Osped Metropolitcrno Niguarda, Milan, Italy	The updated protocol for emergency spine surgery at this Italian hospital optimizes resources, reduces hospital stay, and can be used as a scientific foundation for countries that have yet to face a large COVID-19 surge. (Infection protocol)
30	Thirty-Day Mortality Rate of Patients With Hip Fractures During the COVID-19 Pandemic: A Single Centre Prospective Study in the United Kingdom	Thakrar, Amit et. al.	25	1	JOURNAL OF ORTHOPAEDIC TRAUMA	England	1 Barking Havering & Redbridge Univ Hosp NHS Trust, Trauma & Orthoped Dept, Queens Hosp, Romford, Essex, England	Patients presenting with hip fractures should still be prioritized for surgery as COVID-19 infection was a strong predictor of 30-day mortality during the first 30 days of the pandemic in the UK . (Patient-centered care)
31	Effect of Statewide Social Distancing and Stay-At-Home Directives on Orthopaedic Trauma at a Southwestern Level 1 Trauma Center During the COVID-19 Pandemic	Lubbe, Ryan J. et. al.	23	N/A	JOURNAL OF ORTHOPAEDIC TRAUMA	USA	1 Univ Nevada, Sch Med, Dept Orthopaed Surg, 1701 W Charleston Blvd,Suite 440, Las Vegas, NV 89102 USA 2 OptumCare, OptumCare Orthopaed & Spine, Las Vegas,	Orthopaedic trauma care remains essential during the pandemic even with adjusted patient volume and distributions in mechanisms of injury. (Resource utilization)

							NV USA	
32	Where did all the trauma go? A rapid review of the demands on orthopaedic services at a UK Major Trauma Centre during the COVID-19 pandemic	Greenhalgh, Michael et. al.	22	N/A	INTERNATIONAL JOURNAL OF CLINICAL PRACTICE	England	1 Royal Preston Hosp, Preston, Lancs, England	While a large proportion of staff and resources were reallocated during the pandemic, surgical intervention for certain orthopaedic trauma cases, such as proximal femur fractures, was still required and may even increase as social restrictions are removed. (Resource utilization)
33	30-day mortality for fractured neck of femur patients with concurrent COVID-19 infection	Dupley, Leanne et. al.	21	0	EUROPEAN JOURNAL OF ORTHOPAEDIC SURGERY AND TRAUMATOLOGY	England	1 Hlth Educ North West, Trauma & Orthopaed, Manchester M1 3BN, Lancs, England 2 Royal Preston Hosp, Lancashire Teaching Hosp, Sharoe Green Lane, Preston PR2 9HT, Lancs,	The substantial increase in mean 30-day mortality rate of femoral neck fractures seen in patients with concurrent COVID-19 infection highlights need for counselling patients in the associated increased risks. (Patient-centered care)
34	Effects of the COVID-19 lockdown on orthopaedic trauma: a multicentre study across Scotland	MacDonald, D. R. W. et. al.	21	6	BONE & JOINT OPEN	Scotland	1 Aberdeen Royal Infirm, Dept Trauma & Orthopaed, Aberdeen, Scotland 2 Ninewells Hosp, Dept Trauma & Orthopaed, Dundee, Scotland 3 Queen Elizabeth Univ Hosp, Dept Trauma & Orthopaed, Glasgow, Lanark, Scotland	The UK COVID-19 lockdown has resulted in a marked reduction in orthopaedic trauma surgeries in Scotland with changes in types and mechanisms of injury and concerning increase in mortality for these patients. (Resource utilization)

							4 Glasgow Royal Infirm, Glasgow, Lanark, Scotland 5 Raigmore Hosp, Inverness, Scotland 6 Univ Aberdeen, Div Appl Med, Aberdeen, Scotland	
35	Telemedicine Use in Orthopaedic Surgery Varies by Race, Ethnicity, Primary Language, and Insurance Status	Xiong, Grace et. al.	20	96	CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	USA	1 Harvard Med Sch, Harvard Combined Orthopaed Residency Program, Boston, MA 02115 USA 2 Harvard Med Sch, Brigham & Womens Hosp, Dept Orthopaed Surg, 75 Francis St, Boston, MA 02115 USA	Hispanic, Asian, underinsured, and non-English speakers established orthopaedic care via telemedicine during the COVID-19 pandemic less when compared with a similar patient group one year prior. (Telemedicine)
36	Paediatric orthopaedics in lockdown A STUDY ON THE EFFECT OF THE SARS-COV-2 PANDEMIC ON ACUTE PAEDIATRIC ORTHOPAEDICS AND TRAUMA	Baxter, I et. al.	20	5	BONE & JOINT OPEN	England	1 Sheffield Childrens NHS Fdn Trust, Sheffield, S Yorkshire, England 2 Sheffield Childrens Hosp, Dept Trauma & Orthopaed, Sheffield, S Yorkshire, England 3 Rotherham Dist Gen Hosp, Trauma & Orthopaed, Rotherham, S Yorkshire,	Pediatric orthopaedic trauma cases saw changes in mechanism of injury and decreased in number, age of presentation, K-wire procedures, and manipulation under anesthetic procedures. (Resource utilization)

							England	
37	30-day mortality following trauma and orthopaedic surgery during the peak of the COVID-19 pandemic A MULTICENTRE REGIONAL ANALYSIS OF 484 PATIENTS	Karayiannis, P. N. et. al.	19	N/A	BONE & JOINT OPEN	North Ireland, Scotland	1 Craigavon Area Hosp, Trauma & Orthopaed, Craigavon, North Ireland 2 Craigavon Area Hosp, Craigavon, North Ireland 3 Musgrave Pk Hosp, Outcomes Unit, Belfast, Antrim, North Ireland 4 Ninewells Hosp, Dundee, Scotland 5 Ulster Hosp Dundonald, Belfast, Antrim, North Ireland 6 Royal Victoria Hosp, Belfast, Antrim, North Ireland 7 Altnagelvin Hosp, Derry, Londonderry, North Ireland	Reintroduction of elective surgery should consider patient risk profile and ASA grade even with low 30-day postoperative mortality (Resource utilization)
38	A clinical pathway for pre-operative screening of COVID-19 and its influence on clinical outcome in patients with traumatic fractures	Meng, Yutong et. al.	18	N/A	INTERNATIONAL ORTHOPAEDICS	China	1 Capital Med Univ, Beijing Chaoyang Hosp, Dept Orthopaed, Beijing, Peoples R China	Surgical delay due to COVID-19 screening can be minimized such that reasonable and acceptable clinical outcomes are achieved. (Infection protocol)
39	Evaluating the efficacy of a two-site ('COVID-19' and	Chui, K. et. al.	18	4	BONE & JOINT OPEN	England	1 Barking Havering & Redbridge Univ Hosp NHS Trust,	A two-site 'COVID' and 'COVID-free' trauma service is safe and effective in managing hip fractures during the COVID-19 pandemic. (Resource utilization)

	'COVID-19-free') trauma and orthopaedic service for the management of hip fractures during the COVID-19 pandemic in the UK						Romford, Essex, England	
40	Modification of a Validated Risk Stratification Tool to Characterize Geriatric Hip Fracture Outcomes and Optimize Care in a Post-COVID-19 World	Konda, Sanjit R. et. al.	17	1	JOURNAL OF ORTHOPAEDIC TRAUMA	USA	1 NYU Langone Orthopaed Hosp, NYU Langone Hlth, Dept Orthopaed Surg, Div Orthopaed Trauma Surg, New York, NY USA 2 Jama Hosp, Med Ctr, Dept Orthopaed Surg, Queens, NY USA 3 Bellevue Hosp, Dept Orthopaed Surg, New York, NY USA 4 NYU Winthrop Hosp, Dept Orthopaed Surg, Mineola, NY USA 5 NYU Langone Hosp Brooklyn, Dept Orthopaed Surg, Brooklyn, NY USA	A modified Score for Trauma Triage in the Geriatric and Middle-Aged tool can be modified with a COVID-19 input and used to predict patient outcomes. (Infection protocol)
41	Influence of coronavirus disease 2019 pandemic state of emergency in orthopaedic fracture surgical	Mitkovic, Milan M. et. al.	17	N/A	INTERNATIONAL ORTHOPAEDICS	Serbia	1 Clin Ctr Nis, Clin Orthopaed & Traumatol, Nish, Serbia 2 Univ Nis, Fac Med, Nish, Serbia	Increased time in the home during the COVID-19 pandemic influenced a decrease in fracture incidence and changed the gender distribution of femoral neck fractures. (Resource utilization)

	treatment						3 Clin Ctr Serbia, Clin Orthopaed & Traumatol, Belgrade, Serbia 4 Univ Belgrade, Fac Med, Belgrade, Serbia 5 Inst Hlth Care Children & Youth Vojvodina, Novi Sad, Serbia 6 Clin Ctr Serbia, Belgrade, Serbia	
42	The COVID-19 outbreak limits physical activities and increases sedentary behavior: A possible secondary public health crisis for the elderly	Yamada, Keiko et. al.	16	N/A	JOURNAL OF ORTHOPAEDIC SCIENCE	Japan	1 Univ Tokyo Hosp, Dept Planning Informat & Management, Tokyo, Japan 2 Locomo Challenge Council, Tokyo, Japan 3 Chiba Univ, Collage Liberal Arts & Sci, Chiba, Japan 4 Sato Orthopaed Clin, Tokyo, Japan 5 Northern Osaka Housenka Hosp, Dept Orhtopaed Surg, Osaka, Japan 6 NTT Med Ctr, Dept Orhtopaed Surg, Tokyo, Japan	The COVID-19 pandemic was found to limit physical activity which may lead to a public health crisis for certain sections of the population. (Patient-centered care)
43	Regional trauma patterns during the COVID-19	Staunton, Peter et. al.	15	7	SURGEON-JOURNAL OF THE ROYAL	Irelands	1 Natl Orthopaed Hosp, Dept	In Dublin, orthopaedic trauma volume significantly decreased in during COVID-19 although home-related injuries increased.

	pandemic				COLLEGES OF SURGEONS OF EDINBURGH AND IRELAND		Orthopaed Surg, Cappagh Rd, Dublin 11, Ireland	(Resource utilization)
44	Impact of COVID-19-related social restrictions on orthopaedic trauma in a level 1 trauma centre in Sydney: the first wave	Probert, Annabel C. et. al.	15	1	ANZ JOURNAL OF SURGERY	Australia	1 Royal North Shore Hosp, Dept Orthopaed & Trauma Surg, 7C Clin Adm,Level 7,Acute Serv Bldg, Sydney, NSW 2065, Australia 2 Royal Prince Alfred Hosp, Dept Orthopaed & Trauma, Sydney, NSW, Australia	COVID-19 and related social distancing has decreased surgical volume and influenced the frequency of the mechanism of action of different injuries in Australia. (Resource utilization)
45	Operating room efficiency and timing during coronavirus disease 2019 outbreak in a referral orthopaedic hospital in Northern Italy	Andreata, Mauro et. al.	15	N/A	INTERNATIONAL ORTHOPAEDICS	Italy, Poland	1 IRCCS Ist Ortoped Galeazzi, Hip Dept, Milan, Italy 2 IRCCS Ist Ortoped Galeazzi, Lab Expt Biochem & Mol Biol, Milan, Italy 3 IRCCS Ist Ortoped Galeazzi, Milan, Italy 4 Poznan Univ Phys Educ, Dept Athlet Strength & Conditioning, Poznan, Poland	COVID-19 was found to significantly decrease the efficiency of OR facilities. (Resource utilization)
46	The impact of COVID-19 on trauma and orthopaedic	Mackay, N. D. et. al.	14	11	BONE & JOINT OPEN	England	1 Univ Hosp Coventry & Warwickshire, Dept Trauma &	Patients undergoing procedures with a local or regional anesthetic have low risk of being infected with COVID-19 during the procedure. (Infection protocol)

	patients requiring surgery during the peak of the pandemic A RETROSPECTIVE COHORT STUDY						Orthopaed, Coventry, W Midlands, England	
47	Safety evaluation of a strategy to restart elective orthopaedic surgery during the de-escalation phase of the COVID-19 pandemic	Zahra, W. et. al.	14	11	BONE & JOINT OPEN	England	1 Royal Berkshire NHS Fdn Trust, Royal Berkshire Hosp, Reading, Berks, England 2 Royal Berkshire NHS Fdn Trust, Reading, Berks, England 3 Circle Reading Hosp, Reading, Berks, England	Elective orthopaedic surgery is safe during the pandemic in environments with appropriate precautions and patient screening. (Infection protocol)
48	Orthopaedic surgery in a time of COVID-19 USING A LOW PREVALENCE COVID-19 TRAUMA SURGERY MODEL TO GUIDE A SAFE RETURN TO ELECTIVE SURGERY	Lazizi, M. et. al.	14	1	BONE & JOINT OPEN	England	1 Royal Cornwall Hosp NHS Trust, Trauma & Orthopaed Surg, Truro, England	Elective operating can resume with careful patient screening in communities with low prevalence of SARS-COV2. (Infection protocol)
49	The impact of COVID-19 on the management and outcomes of patients with proximal femoral fractures: a multi-centre study of 580 patients	Wignall, Alice et. al.	13	1	JOURNAL OF ORTHOPAEDIC SURGERY AND RESEARCH	England	1 Leeds Teaching Hosp NHS Trust, Leeds, W Yorkshire, England 2 Huddersfield Royal Infirm, Huddersfield, W Yorkshire, England	Hip fracture patient with COVID-19 were found to have seven times higher rate of mortality compared to their counterparts. (Patient-centered care)

							3 Sandwell & West Birmingham Hosp NHS Trust, Lyndon, England	
50	Nosocomial infection with SARS-CoV-2 and main outcomes after surgery within an orthopaedic surgery department in a tertiary trauma centre in Spain	Lakhani, Kushal et. al.	13	7	INTERNATIONAL ORTHOPAEDICS	Spain	1 Univ Hosp Vall dHebron, Dept Traumatol & Orthoped Surg, Passeig Vall dHebron 119-129, Barcelona 08035, Spain 2 Univ Autonoma Barcelona, Passeig Vall dHebron 119-129, Barcelona 08035, Spain	The nosocomial infection rate of SARS-CoV-2 was 6.48% and is reduced with proper protocol and patient screening. (Infection protocol)

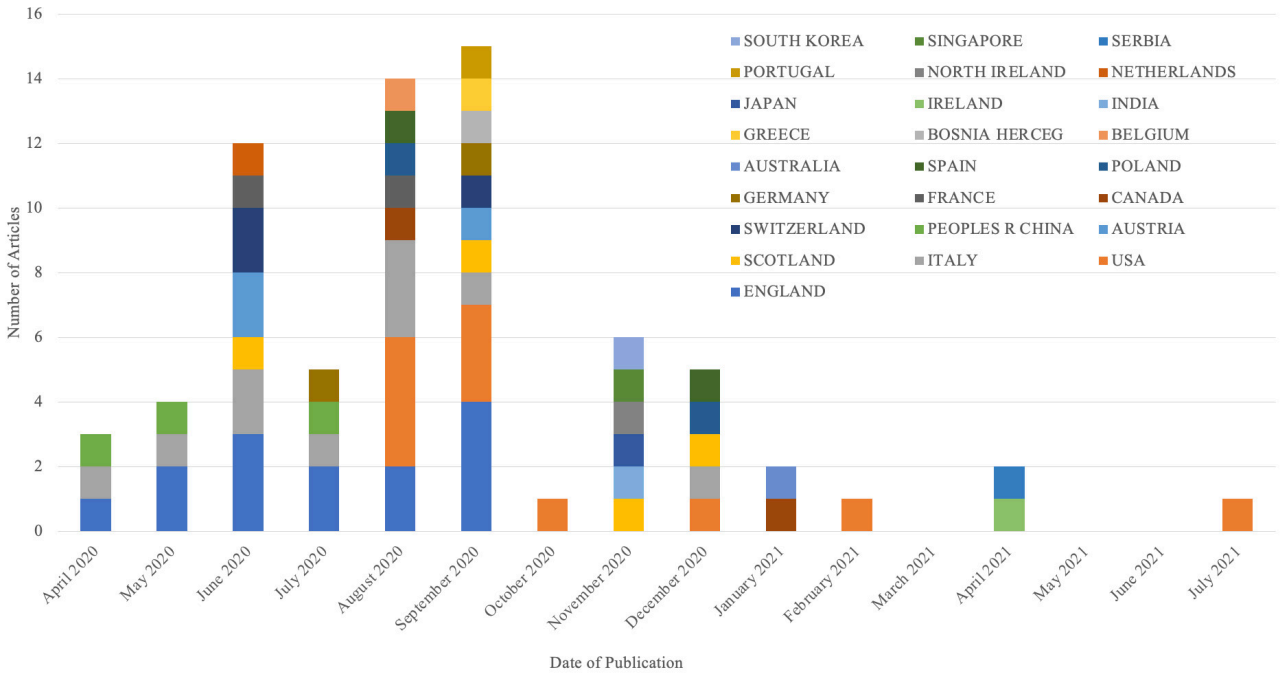

Figure 2. Trends in monthly publications by country of origin. 25 countries contributed to the top 50 articles in COVID-19 and orthopaedic surgery.

Articles were published between April 2020 and July 2021.

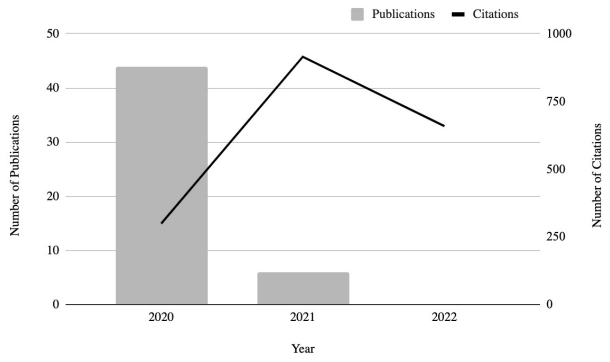

Figure 3. Trends in publications and citations by year.

Articles were published between April 2020 and July 2021; citations were collected as yearly totals from 2020 to 2022.

2020). Telemedicine played a pivotal role in the delivery of healthcare during the pandemic and allowed orthopaedic surgeons to see patients virtually for rehabilitation monitoring, post-operative evaluations, and initial assessments. The success of telemedicine in the field of orthopaedics during the pandemic signified its potential for long-term utilization into patient care in the post-pandemic period.

Alongside resource allocation and telemedicine utilization, many of the most influential articles contained information regarding infection protocols for COVID-19. Guo et al. described the risk of COVID-19 infection for orthopaedic surgeons and provided guidance on necessary precautions to minimize risk factors (Guo et al. 2020). Specific recommendations for orthopaedic surgeons included using appropriate PPE (including an N-95 respirator); staying updated on training regarding infection prevention and resource conservation; considering the minimization, postponement, or cancellation of elective procedures; following U.S. CDC guidelines; avoiding contact with family members at home following suspected exposure to infected persons; and reducing fatigue, which could decrease the body's immune response. In addition, the fifth most-influential study, a meta-analysis by Cipollaro et al., discussed musculoskeletal symptoms associated with COVID-19 infection, specifically identifying near ubiquitous myalgia, arthralgia, and fatigue (Cipollaro et al. 2020). The authors suggested these symptoms be incorporated in early detection of infection and can be used to approximate the extent of infection on the human body if effectively paired with laboratory findings (Cipollaro et al. 2020). In another study by Chang, et. al., the authors emphasized that even in the post-pandemic period when routine orthopaedic services resume, orthopaedic surgeons should continue to prioritize safety and emphasize risk for COVID-19 infection (J. Chang et al. 2020). The infection protocols enacted during the pandemic were used to ensure the safety of patients and healthcare workers during COVID-19 and remains an important safety measure even in the post-pandemic period.

Certain articles additionally touch on the well-being of healthcare workers during the pandemic period within the field of orthopaedic surgery. The pandemic placed immense stress on orthopaedic surgeons, and mental health concerns were evident during this period. With regards to residency training, Megaloikonomos et. al. found that orthopaedic trainees expected that the reduction in workload and educational opportunities during the pandemic would negatively impact their training (Megaloikonomos et al. 2020). Other articles consequentially discussed the impact

Table 2. Levels of evidence for the top 50 articles.

Level of Evidence	Number of Articles
I	2
II	0
III	30
IV	10
V	7
VI	1

Table 3. Study design for the top 50 articles.

Study Design	Number of Articles
retrospective/prospective cohort	27
survey	10
case series	4
observational study	3
meta-analysis	2
cross-sectional	2
case-control	1
therapeutic study	1

Table 4. Quantity of keyword appearance in all articles with greater than 3 occurrences.

Keyword	Count
Coronavirus	60
Trauma	23
Fracture	18
Orthopaedic	17
Surgery	11
Hip	9
Pandemic	9
Hip fracture	6
Mortality	4
TELEHEALTH	4
Orthopaedic surgery	4
Orthopaedic trauma	4
Paediatric	4
Arthroplasty	3
Disease	3
Social Distancing	3

the pandemic had on orthopaedic residency training and hoped for a fostering work environment in the future (An et al. 2020; D.-G. Chang et al. 2020).

The final lesson obtained in these articles discussed the importance of patient-centered care during the COVID-19 pandemic. In a prospective cohort study by Egol et al., the authors described how the pandemic influenced hip fracture care in New York City and noted an increase in morbidity and mortality in these patients (Egol et al. 2020). As such, they recommended that physicians treating patients with confirmed or suspected COVID-19 infection should counsel their family of the significantly increased risk of complications and death following hip fracture. Patient-centered care became even more valuable during the pandemic as orthopaedic surgeons were required to engage in transparent discussions with patients and their families re-

Table 5. Number of articles by country distribution.

Country	Number of Articles
England	14
USA	11
Italy	10
Scotland	4
Austria	3
People's Republic of China	3
Switzerland	3
Canada	2
France	2
Germany	2
Poland	2
Spain	2
Australia	1
Belgium	1
Bosnia Herzegovina	1
Greece	1
India	1
Ireland	1
Japan	1
Netherlands	1
Northern Ireland	1
Portugal	1
Serbia	1
Singapore	1
South Korea	1

garding risks and alternatives to surgery when priorities had to be changed due to COVID-19.

DISCUSSION

As it has been over three years since the World Health Organization declared COVID-19 a public health emergency of international concern, numerous articles have been published related to COVID-19 and orthopaedic surgery ("Determination That a Public Health Emergency Exists" 2020). As the pandemic was a turbulent time of uncertainty with rapidly evolving knowledge, it is useful to perform bibliometric citation analyses for the identification and mapping of the rapid paced changes which occurred (Osareh 1996). The number of citations of an article is frequently used as a measure of influence, as the increased number of citations indicate that a contribution was significant (Callaham 2002). Studying the citations of a paper allows for tracking of the dissemination of the information they contain and how it has been applied toward training, future investigations, and changing clinical practice (Arshi et al. 2016).

Reflecting on the literature published in the field of orthopaedic surgery provides a direct snapshot of how the field responded to changes from COVID-19. From the top 50 most cited papers during that time, there was an average of 38 citations per paper with a minimum of 13 and maximum of 111. The greatest number of citations occurred in 2021 versus 2020, with an average increase of 18 citations per paper. When considering citations over time, these results can be compared to the top-100 most cited papers between 1944 and 2014 across all orthopaedic surgery research. Lum, et. al. analyzed notable trends in the top-100 articles and found the average number of growth of citations for each article of 85 across a 5-year period (range 0-535), and the 6-month average growth of citations was 5 per article (range 0-45) (Lum et al. 2020). Within only one to two years of publication, the number of citations in 2021 for orthopaedic related COVID-19 literature outpaces the rate of citation for the 100 most cited papers across all orthopaedic surgery literature, when the average citation rate is extrapolated for one year over the rates for 5 years (17 per year) and 6 months (10 per year). These findings point to the demand for literature addressing how COVID-19 affected the field of orthopaedic surgery (Tahamtan, Safipour Afshar, and Ahamdzadeh 2016). The two journals with the most articles (10) in the top-50 most impactful publications related to COVID-19 and orthopaedic surgery were Bone & Joint Open with an impact factor of 5.082, and Interna-

Table 6. Number of articles by publication title.

Publication Titles	Number of Articles
Bone & Joint Open	10
International Orthopaedics	10
Journal of Bone and Joint Surgery, American Volume	5
Journal of Orthopaedic Trauma	5
Clinical Orthopaedics and Related Research	4
Journal of Orthopaedic Surgery and Research	4
Bone & Joint Journal	2
Knee Surgery, Sports Traumatology, Arthroscopy	2
ANZ Journal of Surgery	1
European Journal of Orthopaedic Surgery and Traumatology	1
Injury International Journal of the Care of the Injured	1
International Journal of Clinical Practice	1
Journal of Orthopaedic Science	1
Journal of Pediatric Orthopaedics	1
Journal of the American Academy of Orthopaedic Surgeons	1
Surgeon Journal of the Royal Colleges of Surgeons of Edinburgh and Ireland	1

tional Orthopaedics with an impact factor of 3.479. Bone & Joint Open was ranked third and International Orthopaedics was ranked seventh in highest impact factor among all 16 journals included in our analysis. In consideration for the lower impact factor ranking of International Orthopaedics yet high number of impactful publications, an initial explanation could be that COVID-19 was a pandemic that increased demand for academic contribution globally. However, several other journals on our list included international journals without as many impactful publications. With respect to the individual quality of each publication, the evidence level of III had the most articles (30), which may be due to the limited time frame during COVID-19 and lack of prior research (Table 3). Similarly, when looking at the studies performed, most studies (27) were retrospective or prospective cohort studies, which allow us to make comparisons between pre- and post-COVID-19 groups (Table 4).

The countries with the most publications in the top 50 were England (14), the USA (11), and Italy (10). As Italy is the only non-English speaking country, their larger proportion of publications is likely due to Italy being the first European nation affected by COVID-19. As Italy was the first country in Europe that was severely impacted by COVID-19, they were unprepared for the ultimate serious consequences of the pandemic and likely faced a high demand for emerging literature on COVID-19 (Indolfi and Spaccarotella 2020).

As the most frequently used keywords in this analysis were: "Coronavirus" (60), "Trauma" (23), and "Fracture" (18) the high frequency of these words was hypothesized to correlate with the most common topics (Table 4). Thus, during COVID-19, the clinical literature reflected that the field was focused on how the trauma service was changed, including admissions, patient flow, and clinical decision making. Treatment for traumatic injury is often emergent and indicates the need for surgery. In particular, the word "surgery" appeared frequently in titles and was complicated during the pandemic for multiple reasons, including uncertain pathology of COVID-19, personnel shortages, new prophylactic measures, and elective versus emergency surgery (Kibbe 2020). A large component of orthopaedic trauma is fracture care, which likely explains its increased prevalence in the literature. Timely surgical repair of fractures is essential and can be lifesaving, which was a challenge for orthopaedic surgeons to overcome as COVID-19 evolved (Pietri and Lucarini 2007). Compared with other specialties, telehealth is a popular alternative for treatment, but it is not as often seen in the most influential clinical literature for orthopaedic surgery which may be due to the urgency of orthopaedic trauma injuries mandating them as a higher priority for the field (Soytas et al. 2021).

Correspondingly, data from the Altmetrics Data Explorer provided useful information regarding the online activity surrounding COVID-19 and orthopaedics research. The AAS scores ranged from 317 to 0, with a mean of 20.2 per article. These scores correspond with a study conducted by Lynch et al. in which the researchers found the average AAS value to be 4.8 +/- 20.7 for non-open access articles and 6.8 +/- 32.1 for open access articles in a study of 5245 lumbar spine articles in 2022 (Lynch et al. 2022). Additionally, Grillo et al. analyzed Altmetric attention scores amongst the top 50 articles involving oral health during the COVID-19 pandemic and found a mean AAS was 65.56, which ranged from 27 to 2149 (Grillo, Lopes, and Teixeira 2022). Consequentially, the AAS analysis of articles involving COVID-19 and orthopaedic surgery indicates that the top-50 most cited articles addressing the effects of COVID-19 on orthopaedics garnered a larger social media impact than traditional open access articles involving orthopaedic surgery, such as lumbar spine surgery, but had

less online impact than articles involving oral health during the pandemic. This is likely due to large public interest of aerosols and oral infectious susceptibility to COVID-19.

Of the top-50 most cited articles published regarding COVID-19 and orthopaedic surgery, many articles contained meaningful lessons pertaining to the practice of orthopaedics during the pandemic. This included resource utilization, expanding telemedicine, developing infection protocols, insuring healthcare workers well-being, and increasingly applying patient-centered care. The initial stages of the COVID-19 pandemic were a time of uncertainty for the field of medicine, and future research was necessary to direct changes in surgical practice. The COVID-19 pandemic resulted in fewer patients being seen for orthopaedic injuries and increased a lack of confidence in the future of elective orthopaedic procedures (Table 1). Alongside a decreased patient population, the relationship between patients infected with COVID-19 and postoperative outcomes had yet to be established. The necessity for more research in the field of orthopaedic surgery during the pandemic was fulfilled on a global scale in the months and years following the start of the pandemic. The top-50 most influential articles were published within a 16-month period from April, 2020 to July, 2021 and served to guide clinical practice during the pandemic and beyond. Despite fewer patients with primary orthopaedic complaints, the top articles explained how orthopaedic surgeons remained essential for patients experiencing life-threatening and traumatic injuries, and precautions emerged to prevent patient and provider infection with COVID-19 due to its effects on postoperative outcomes and unknown long-term effects.

The lessons learned from the top-50 articles remains impactful in the post-pandemic period. The utilization of resources during the pandemic was critical in managing orthopaedic trauma and patients with orthopaedic injuries who were infected with COVID-19 to ensure the best care during this time of need, and information learned from these studies can be used to guide the optimization of resources if future crises were to arise. As more patients continue to be diagnosed with COVID-19 in 2023, research involving the utilization of resources when caring for these patients remains imperative. Telemedicine protocols additionally discussed in the top-50 articles are likely to continue to play a role in improving access to orthopaedic care through reducing unnecessary in-person visits and increase healthcare delivery to patients who may not be able to attend every orthopaedic visit in-person. Moreover, infection protocols developed during COVID-19 will remain essential in preventing infectious diseases. In the post-pandemic period, orthopaedic resident education and well-being has been heavily impacted by COVID-19, and educational experiences have been adapted to improve learning opportunities. Additionally, the emphasis COVID-19 placed on patient-centered care will continue to persist to increase patient engagement with their treatment and healthcare decisions. The top-50 articles written during the COVID-19 pandemic pertaining to orthopaedic surgery thus serve as a valuable guide for a more robust, efficient, and patient-centered healthcare system today.

LIMITATIONS

There are few limitations to this study with respect to the modes of analysis used. Though citation number was used to determine the impact of a particular study, citation number is not always the best method to determine significance. In using citation number as a primary metric of influence, the highest ranked articles are subject to citation biases including popularity of publishing journal, author self-citation, and the generation of citations through increased exposure (Familiari et al. 2021; Lefaivre, Shadgan, and O'Brien 2011; Kuhn 1962). Furthermore, articles are not always assessed and valued independently of their scientific rigor prior to each instance of citation (Familiari et al. 2021; Kuhn 1962). Many of the top-50 articles deemed significant in this analysis come from journals which may be regarded as having lower impact or significance as indicated by platforms such as Scimago and Google Scholar. Though the citation index was high for many of these papers, this number may be artificially inflated and not reflect a truly impactful research article during the COVID-19 pandemic. Though self-citation may cause falsely elevated citation numbers, in some cases self-citation may be appropriate when building upon research findings, particularly during the COVID-19 pandemic when little research was known about how it would impact orthopaedic practice and patient care. Citation number was nonetheless chosen for this analysis for it provides a useful metric to determine the most influential articles regarding a particular topic within an academic setting as they provide a context to evaluate rapidly evolving information, and most journals report citation number over other metrics used to assess article viewership and impact.

As the authors only utilized one database for this analysis, the Clarivate Web of Science, there may be limitations regarding the selection of articles. The Web of Science has been shown to prioritize English-language content and regional content, which may result in exclusion of valuable published research in other languages and countries from less widely recognized sources (Pranckutė 2021). Though the authors utilized only one database in this study, the Web of Science remains one of the leading databases containing bibliometric data and metrics and has taken effort in recent years to expand their coverage of articles in non-English languages and additional regions (Pranckutė 2021).

Articles excluded in this study were those of narrative reviews, opinion pieces, method demonstrations, theoretical models, and literature reviews in favor of articles contributing results through the study of patient data. The influence of gray text, including website articles, textbooks, non-journal articles (Familiari et al. 2021; Cassar Gheiti et al. 2012; Lefaivre, Shadgan, and O'Brien 2011; Seglen 1997), and mass media coverage of the COVID-19 pandemic on the selected list of articles is unknown. These articles were excluded to keep articles which provided foundational changes to the field of orthopaedic surgery during the COVID-19 pandemic and exist as foundational research today.

CONCLUSION

Since the beginning of the COVID-19 pandemic in early 2020, 388 peer-reviewed articles have been published related to COVID-19 and orthopaedic surgery. This study systematically compiled and analyzed the top-50 most influential articles. Common topics included trauma and fracture care, and the majority of evidence is level III. The most clinically relevant findings relate to the demand for orthopaedic surgery during the COVID-19 pandemic and recommendations to limit infection to improve patient outcomes with a patient-centered view of healthcare. The authors hope this bibliometric analysis of the 50 most influential papers assists researchers in uncovering impactful areas for additional research and highlights the advances research made during the pandemic in shaping the current practice of orthopaedic surgery today.

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