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Review

Impact of the Covid-19 Pandemic on Orthopaedic and Trauma Surgery – A Systematic Review of the Current Literature

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Abstract. *Background/Aim: The Coronavirus disease 2019 (COVID-19) has led to significant disruptions in various medical specialties. We herein aimed to provide a systematic review of the published literature on the impact by the Covid-19 pandemic on orthopaedic and traumatological care by focusing on the number of clinical visits, surgeries and reasons for consultation. Materials and Methods: The published literature was reviewed using PubMed. Of 349 studies published between December 1, 2019 and October 1, 2020, 36 original articles met the inclusion criteria. Articles were selected on the basis of the PRISMA guidelines. October 1, 2020 was used as the concluding date of publication. Results: The number of elective visits declined by 50.0% to 74.0%. The number of emergency and trauma visits showed a decrease of 37.7% to 74.2%. Trauma surgery decreased by 21.2% to 66.7% and elective surgeries by 33.3% to 100%. Conclusion: Orthopaedic and trauma surgery is clearly influenced by the pandemic. It will be important to maintain treatment and surgical care of patients in order to avoid negative effects on treatment progress.*

Since the first cases of a novel respiratory disease occurred in Wuhan, China in December 2019, Coronavirus disease 2019 (Covid-19) has spread worldwide (1). While the World Health Organization (WHO) classified Covid-19 as a public health emergency on January 30, 2020, it changed the classification on March 11, 2020 and rated Covid-19 as a pandemic (2). Since November 29, 2020, 61,866,635 people have been infected with the novel coronavirus. In addition, 1,448,990 infected people have died (3).

The Covid-19 pandemic and associated lockdowns have changed our daily lives dramatically, not only by exerting a major impact on our activities and the economy, but especially on our healthcare systems. The large number of infected persons in certain parts of the world has caused hospitals to restructure their departments in order to increase treatment capacity for Covid-19 patients. Angelico *et al.* reported a 25% decrease in organ transplantations in response to available intensive care unit capacity in the first four weeks in Italy, which was one of the first European countries to deal with the Covid-19 pandemic (4). Furthermore, fewer cases of colorectal carcinoma were diagnosed in Spain during the state of emergency compared to the previous year, probably due to a restriction in endoscopic and surgical procedures and a reduced number of cancer prevention screenings (5). In addition to these medical disciplines, the Covid-19 pandemic also affected orthopaedics and traumatology, where elective surgeries were postponed and nonurgent consultations cancelled to minimize the risk of infection for patients and medical staff (6, 7).

The aim of this systematic literature review was to provide an overview of the impact of the Covid-19 pandemic on orthopaedic and traumatologic care by comparing previously published reports from different countries, especially focusing on the number of clinical visits, surgeries and reasons for consultation.

Material and Methods

A comprehensive literature search was conducted covering a period from December 1, 2019 to October 1, 2020 to include all possible matching articles since the appearance of the new coronavirus. PubMed served as the primary database for the literature search. The search was performed using the following search string: "*orthopaedics*" OR "*orthopedics*" OR "*traumatology*" AND "*covid-19*" OR "*sars-cov-2*" OR "*coronavirus*". The review was

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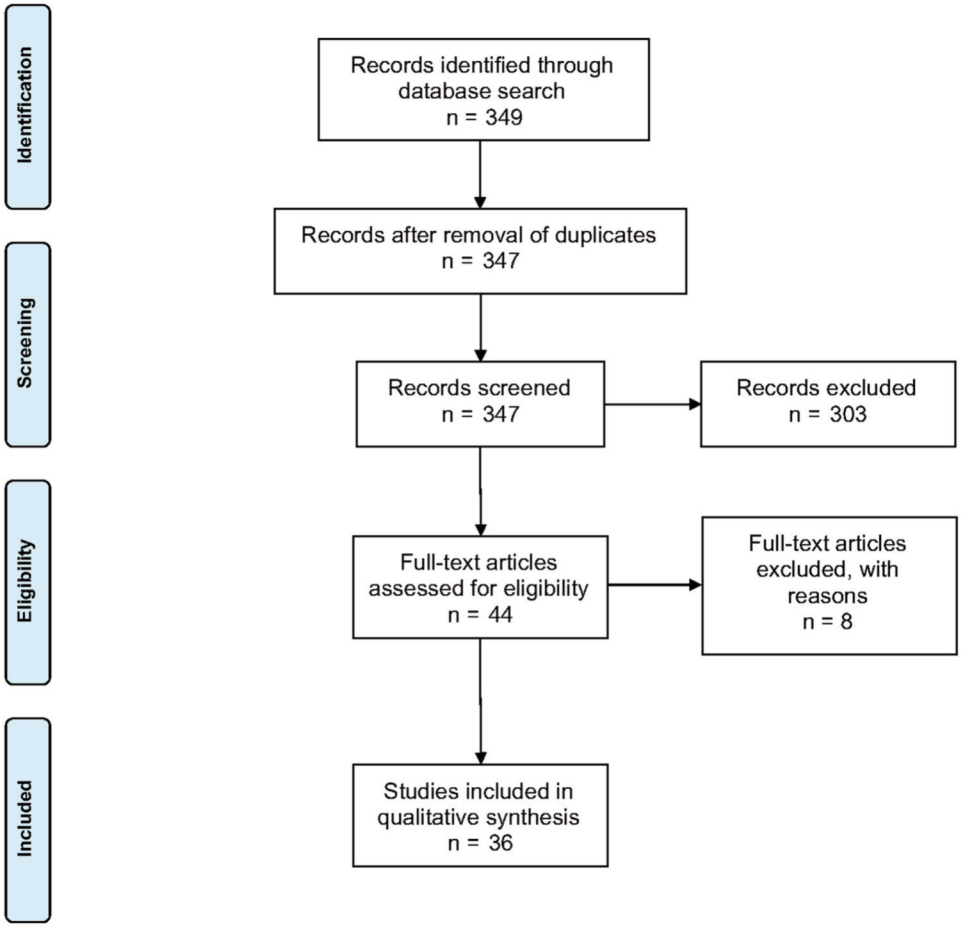

Figure 1. *PRISMA flow chart showing study selection process.*

conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (8). In light of the fact that the Covid-19 pandemic began less than a year ago, we considered retrospective studies, survey-based studies and observational studies as well as case series and letters. Two authors independently screened the published studies by title and abstract. All publications focusing on a comparison of the number of visits, surgeries or reasons for consultation before and during the pandemic in an orthopaedic or trauma center were included, regardless of the age of the study group. Inclusion was also possible by only indicating the change in percent. Furthermore, publications in English and German were included. No study was excluded on the basis of its country or the type of study.

Results

In total, 349 studies were identified. Based on the inclusion and exclusion criteria, 36 publications were found to be eligible for analysis. Most of the included studies were conducted in Europe (n=25), followed by Asia (n=5) and North America (n=4). In addition, one study was from South America (n=1) and one from Australia (n=1). The European studies came from Italy (n=12), the UK (n=5), Spain (n=3), Belgium (n=1), France (n=1), Germany (n=1), Ireland (n=1) and Serbia (n=1). The Asian studies were conducted in China (n=2), India (n=2) and Hong Kong (n=1). Furthermore, three studies were performed in the United States of America (n=3), whereas one North American study was from Mexico (n=1). The remaining two trials were conducted in Brazil (n=1) and Australia (n=1). The literature selection process was conducted in accordance with the PRISMA guidelines (8) and is shown as a flow diagram in Figure 1. Table I presents detailed study characteristics of included publications.

Visits. Overall, 25 of the 36 included studies reported the number of visits, broken down for emergency or elective and total (6, 7, 9-31). Sixteen studies (10-19, 25, 27-29, 31) described the change in total number of patient visits, whereby all 16 reported a decrease of between 20.9% and 90.1% during the Covid-19 pandemic (10, 12). The largest

Table I. *Detailed study characteristics of included publications*.

ID	Study	Year	Region	Country	Study type	LoE
1	Gumina *et al*. (9)	2020	Europe	Italy	Retrospective study	3
2	Rizzi *et al*. (10)	2020	North America	USA	Survey-based study	4
3	Andrea *et al*. (11)	2020	Europe	Italy	Retrospective study	3
4	Lubbe *et al*. (12)	2020	North America	USA	Retrospective study	3
5	Dhillon *et al*. (13)	2020	Asia	India	Retrospective observational study	3
6	Greenhalgh *et al*. (14)	2020	Europe	UK	Retrospective study	3
7	Sugand *et al*. (15)	2020	Europe	UK	Retrospective study	3
8	Andreata *et al*. (32)	2020	Europe	Italy	Retrospective study	3
9	Luceri *et al*. (16)	2020	Europe	Italy	Retrospective study	3
10	Staunton *et al*. (33)	2020	Europe	Ireland	Retrospective study	3
11	Maryada *et al*. (17)	2020	Asia	India	Retrospective study	3
12	Hua *et al*. (34)	2020	Asia	China	Retrospective study	3
13	Yu *et al*. (18)	2020	Asia	China	Retrospective study	3
14	Wong *et al*. (19)	2020	Australia	Australia	Retrospective cohort study	3
15	ORCA Collaborative (20)	2020	Europe	UK	Survey-based study	4
16	Espinosa-Uribe *et al*. (21)	2020	North America	Mexico	Letter to the editor	5
17	Mitkovic *et al*. (42)	2020	Europe	Serbia	Retrospective study	3
18	Ruggieri *et al*. (35)	2020	Europe	Italy	Retrospective study	3
19	Druel *et al*. (36)	2020	Europe	France	Retrospective study	3
20	Ohliger *et al*. (22)	2020	North America	USA	Retrospective study	3
21	Wong *et al*. (23)	2020	Asia	Hong Kong	Retrospective cohort study	3
22	Murphy *et al*. (37)	2020	Europe	UK	Retrospective study	3
23	Ghermandi *et al*. (38)	2020	Europe	Italy	Retrospective observational study	4
24	Benazzo *et al*. (6)	2020	Europe	Italy	Observational study	3
25	Park *et al*. (24)	2020	Europe	UK	Longitudinal observational study	3
26	Tamburrelli *et al*. (39)	2020	Europe	Italy	Retrospective study	3
27	Lima *et al*. (25)	2020	South America	Brazil	Retrospective study	3
28	Peiro-Garcia *et al*. (26)	2020	Europe	Spain	Retrospective observational study	4
29	Dercks *et al*. (27)	2020	Europe	Germany	Retrospective study	3
30	Luengo-Alonso *et al*. (28)	2020	Europe	Spain	Single-center cross-sectional study	4
31	Giuntoli *et al*. (29)	2020	Europe	Italy	Retrospective study	3
32	Hernigou *et al*. (40)	2020	Europe	Belgium	Retrospective observational study	4
33	Zagra *et al*. (41)	2020	Europe	Italy	Retrospective study	3
34	Gumina *et al*. (30)	2020	Europe	Italy	Case series	4
35	Nunez *et al*. (7)	2020	Europe	Spain	Retrospective observational study	4
36	Maniscalco *et al*. (31)	2020	Europe	Italy	Retrospective study	3

LoE: Level of evidence.

decrease in patient visits was reported by Rizzi *et al*. with the total number of visits dropping from 4,228 in January to 417 in April (10). From April to May, Rizzi *et al*. were able to offer a telemedicine conference as a phone or video call in 612 cases, after which 92.2% of the patients stated that they would participate in a telemedical conference call again (10). Furthermore, ten studies (6, 7, 9, 19, 23-25, 27, 28, 30) investigated the number of emergency and trauma visits, showing a decrease ranging between 37.7% and 74.2% (7, 19). Five studies provided information on the change in the number of elective visits (6, 19, 20, 25, 27). The decrease in the number of elective visits ranged between 50.0% and 74.0% (6, 19).

Surgery. A total of 23 studies presented a comparison of the number of performed orthopaedic and trauma surgeries (6, 11-15, 19, 20, 23-25, 28, 29, 32-41). Of these 14 reported the total number of surgeries (12, 13, 15, 19, 23, 25, 28, 32, 33, 35, 37-39, 41). While most studies (n=13) showed a decrease between 5.4% and 88.8% in the total number of surgeries, an increase of 47.8% was observed in one trial (38). Furthermore, performed trauma surgery decreased by 21.2% to 66.7% in 11 studies (6, 11, 15, 20, 23-25, 29, 35, 36, 40). In contrast, three studies reported an increase of 32.1% to 94.2% in the number of trauma surgeries (32, 39, 41). In addition, all nine studies reporting the number of elective surgeries showed a decrease ranging between 33.3% and 100% (6, 14, 20, 23, 25, 29, 35, 39, 41).

Reasons for consultation. Of the included studies 21 reported the change in the reasons for consultation (6, 7, 11-13, 15-17, 22-24, 29-31, 36-40, 42). During the Covid-19 pandemic,

there was a decrease of between 5.6% and 77.1% in polytraumas (24, 29). Additionally, consultations due to traffic accidents decreased by 26.4% to 88.9% (23, 39). Moreover, sports injuries massively decreased by 59.3% to 100% (6, 23). In contrast, eight studies described different changes in the number of domestic accidents (6, 11, 17, 23, 29, 31, 36, 39). While in five studies (6, 17, 23, 29, 31) the number of domestic accidents decreased by 20% to 50%, three studies reported an increase ranging between 22% and 300% (11, 36, 39). The total number of fractures decreased between 3.9% and 63.1% (17, 40).

Discussion

Ever since the coronavirus spread throughout the world in early 2020, its impact on daily life has diminished only slightly. The objective of the present study was to analyze the current literature regarding the influence of the Covid-19 pandemic on orthopaedic and trauma surgery. Several studies from different countries reported on the impact of the pandemic by comparing pre-pandemic and pandemic data. We aimed to provide an overview of the influence on visits, surgeries and reasons for consultations in orthopaedic and trauma surgery during the Covid-19 pandemic.

The current literature shows a dramatic decline in nearly all aspects of orthopaedic and trauma surgery. The total number of patient visits as well as the number of emergency visits decreased by up to 90.1% and 74.2%, respectively (10, 25). In comparison, a similar high decrease (84.45%) was also observed in a multispecialty surgical emergency department in Italy (43). Many countries around the world have imposed quarantine and travel restrictions to slow the spread of infection and thereby ensure that the healthcare system does not collapse (7). Furthermore, the population was encouraged to stay home. This is also reflected in the reasons for consultations. Consequently, the number of traffic accidents decreased in some countries. For example, Nunez *et al*. reported a 78.6% reduction in traffic accident admissions at a tertiary trauma center in Spain (7). Other studies from Italy, the UK, India or the USA confirm these findings with similar data (6, 12, 13, 24). In addition, admissions due to sports injuries also decreased by up to 100% as team sports were prohibited in many countries (6). Reports on domestic accidents yielded different results (11, 29). While Giuntoli *et al*. reported a 57.2% decrease in domestic accidents, the number of domestic hand and wrist injuries tripled according to Andrea *et al*. (11, 29). It is important to remember that people spent more time at home because of government regulations, by the fear of possible exposure to Covid-19 might have kept people from seeking out a hospital. While there is no doubt that some injuries require immediate local treatment, telemedicine could be an option for providing safe and effective healthcare services in the outpatient setting (44). Rizzi *et al*. implemented telemedicine during the Covid-19 pandemic and conducted 612 orthopaedic telemedicine conferences between April and May 2020, whereby 92.2% of these patients said they would participate in such a conference again (10).

In view of the reduced number of emergency visits and cancelled elective procedures in some places, it does not seem surprising that the total number of surgeries performed also decreased in most hospitals (13, 25, 28). Paradoxically, Ghermandi *et al*. showed increased surgical activity at a department of oncology and spinal surgery in Italy, probably due to the fact that oncological spinal pathologies or degenerative disease with functional and neurological deficits cannot be postponed in the course of treatment (38). Even though the primary mode of transmission is respiratory tract shedding, several studies revealed that the virus was isolated in blood samples of patients infected with Covid-19 (45-47). It is well known that the use of power drills and saws, as common in orthopaedic and trauma surgery, is an aerosol-generating procedure, resulting in a significant risk of the infection being transmitted to the theatre staff (48, 49). On the other hand, postponed surgeries lead to prolonged pain and possibly a worsening of the patient outcome (50, 51). Karikis *et al*. followed 71 patients over ten years and reported that patients who underwent a late anterior cruciate ligament reconstruction needed significantly more meniscectomies at index surgery and showed more osteoarthritis on the medial side of the knee ten years after reconstruction than did those with early reconstruction (50). Furthermore, after ten years Moosmayer *et al*. observed a significantly poorer outcome in patients with rotator cuff tears and delayed repair than in those who underwent early tendon repair (51). Strategies should therefore be developed to enable these patients to be treated promptly, even in the event of a continuing pandemic. At the same time, proper protection of the staff is required.

The primary limitations of this systematic literature review are the minimized exclusion criteria as well as the low level of evidence of included studies. In addition, most of the studies particularly refer to the first large wave of the Covid-19 pandemic. As a result, the impact may appear overestimated in relation to the current situation. The main strength is the heterogeneous origin of the included literature, which gives a good overall view of the global impact had by the Covid-19 pandemic on orthopaedics and trauma surgery.

Conclusion

Although orthopaedics and trauma surgery does not appear to be in the front line of the pandemic, this specialty is clearly influenced by it. The majority reported a clear decrease in the number of cases in all areas examined. In the future, despite the pandemic, it will be important to maintain treatment and especially surgical care of patients in order to

avoid negative effects on treatment progress. In addition, an analysis of the situation during the second wave at the end of 2020 should be attempted.

Conflicts of Interest

The Authors declare that there are no conflicts of interest.

Authors' Contributions

P. Blum: Literature research, data analysis, editing and writing of the article. D. Putzer: Data analysis and proofreading. M. Liebensteiner: co-editing and proofreading of the article. D. Dammerer: study protocol, study design, literature research, editing, writing and proofreading of the article. All Authors made pertinent contributions to the article, proofread and approved the final article before submission.

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