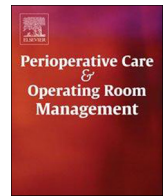




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Work characteristics of orthopaedic surgeons during the COVID-19 pandemic: A single center analysis



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ABSTRACT

Background: The coronavirus disease 2019 (COVID-19) pandemic has resulted in widespread cancellation of elective orthopaedic surgeries. During the pandemic period, many orthopaedic surgeons had been working at the front line to fight against COVID-19 in China, and the number of orthopaedic surgeries performed in our hospital decreased sharply.

Methods: The work characteristics of orthopaedic surgeons was evaluated by the workplaces of orthopaedic surgeons, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection rate of orthopaedic surgeons and the number of orthopaedic surgeries performed. January 23–April 7 in 2020, January 23–April 8 in 2019, and April 8–June 22 in 2020 was defined as the pandemic period, non-pandemic period and post-pandemic period, respectively. The number and types of orthopaedic surgeons during the pandemic period, non-pandemic period, and post-pandemic period was compared and summarized.

Results: During the pandemic period, 65.56% of the orthopaedic surgeons had been working at the front line to fight against COVID-19. The SARS-CoV-2 infection rate of the orthopaedic surgeons who worked at the front line in January and since February was 18.18% and 0.00%, respectively ($P=0.003$). The number of orthopaedic surgeries performed per day during the pandemic period decreased 95.74% compared with the same period in the past year ($P<0.001$). The number of orthopaedic surgeries performed during the post-pandemic period was 13.10 times that of the pandemic period ($P<0.001$), and 55.71% of the non-pandemic period ($P<0.001$).

Conclusions: The work characteristics of orthopaedic surgeons greatly changed during the COVID-19 pandemic.

1. Introduction

In December 2019, cases of the coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), were first reported in Wuhan, People's Republic of China.^{1–4} By July 23, 2020, more than 15,000,000 cases of COVID-19 had been reported around the world.⁵

During the COVID-19 pandemic, almost all the hospitals in Wuhan had been converted into infectious disease hospitals. There were about 42,000 doctors coming from different cities around China to fight against COVID-19. Moreover, due to the nosocomial transmission of COVID-19, orthopaedic surgeons were also redeployed to work in fever clinics or isolated wards.

In our hospital, a total of 1,866 beds were transformed from general beds to designated beds for patients with COVID-19, and 60% of the orthopaedic beds were converted into designated beds. About two thirds of the orthopaedic surgeons were redeployed to work in the fever clinics or isolated wards to fight against COVID-19. As a result, the

work characteristics of orthopaedic surgeons in our hospital greatly changed.

Only emergency or urgent surgeries were performed during the COVID-19 pandemic; therefore, the number of surgeries performed decreased sharply. To evaluate the influence of the COVID-19 pandemic on orthopaedic surgeons, the work characteristics of orthopaedic surgeons in our hospital during the pandemic period have been collected and analyzed.

2. Materials and methods

2.1. Data collection

The work characteristics of orthopaedic surgeons in the department of Orthopaedics, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology have been collected. The present study was conducted in accordance with the guidelines of the Declaration of Helsinki and was approved by the ethics committee of

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During January 23–April 7 in 2020, lockdown restrictions of Wuhan and the surrounding cities were performed to control the break of COVID-19, therefore it was defined as the pandemic period. January 23–April 8 in 2019, and April 8–June 22 in 2020 were defined as the non-pandemic period and post-pandemic period, respectively. The work characteristics of orthopaedic surgeons was evaluated by the workplaces of orthopaedic surgeons, SARS-CoV-2 infection rate of orthopaedic surgeons and the number of orthopaedic surgeries performed. The work characteristics of orthopaedic surgeons during the pandemic period, non-pandemic period, and post-pandemic period was compared and summarized.

According to the severity of orthopaedic disorders, surgeries were classified as emergency surgeries, urgent surgeries and elective surgeries. Emergency surgeries should be performed within 24 hours, urgent surgeries should be performed within 72 hours, while elective spinal surgeries could be delayed.

Due to policy reasons, residents and postgraduates were asked to stay at home, and fellows were told to work in their own hospitals; therefore, all of them were not included in the study. Due to the exclusion of the residents, fellows and postgraduates, there were 90 surgeons in the department of orthopaedics of our hospital.

The study also evaluated the demographic characteristics and nosocomial transmission of COVID-19 in the orthopaedic surgeons.

2.2. Statistical analyses

All data are presented as mean \pm standard deviation. SPSS 22.0 (IBM Corp., Armonk, NY, USA) was used to perform the statistical analyses. GraphPad Prism 6 (Graph Pad Software, Inc., San Diego, CA, USA) was applied to generate plots. Normal distribution of the data was assessed using the Kolmogorov–Smirnov test. The independent samples *t* test was used to compare the data regarding two groups with normal distribution. Nonparametric data were analyzed by Mann-Whitney *U* test. A *p*-value of less than 0.05 was considered as statistically significant.

3. Results

3.1. Workplaces of orthopaedic surgeons

The workplaces of the orthopaedic surgeons during the pandemic period have been summarized in Table 1. During the pandemic period, 65.56% of the orthopaedic surgeons had been working at the front line to fight against COVID-19. The average age of those who worked as Orthopaedic surgeons full time, and those who were at the front line was 51.22 ± 7.94 years and 37.97 ± 5.93 years, respectively ($P < 0.001$). The average age of those who worked at the front line in January, and those who worked at the front line since February was 42.45 ± 4.18 years and 36.94 ± 5.82 years, respectively ($P = 0.002$).

3.2. The nosocomial transmission of COVID-19 in orthopaedic surgeons

Two orthopaedic surgeons tested positive for SARS-CoV-2 at the

outbreak of COVID-19, another two who worked at the front line in January also tested positive for SARS-CoV-2; however, none of the front-line orthopaedic surgeons who worked since February tested positive for SARS-CoV-2. The SARS-CoV-2 infection rate of the orthopaedic surgeons who worked at the front line in January and since February was 18.18% and 0.00%, respectively ($P = 0.003$).

3.3. Number of orthopaedic surgeries performed

A total of 135 orthopaedic surgeries were performed during the pandemic period, with 1.78 ± 2.32 surgeries performed on average per day; while a total of 3,180 orthopaedic surgeries had been performed during the same 76 days of 2019, with 41.84 ± 30.09 orthopaedic surgeries performed on average per day. As a result, the number of orthopaedic surgeries performed during the pandemic period decreased 95.74% compared with the same period in the past year ($P < 0.001$) (Table 2, Fig. 1).

Since April 8, 2020, when the lockdown restrictions were removed, more patients were admitted to undergo orthopaedic surgeries. A total of 1772 orthopaedic surgeries were performed during the first 76 days of the post-pandemic period, with an average of 23.31 ± 17.70 orthopaedic surgeries performed per day (Table 2). The number of orthopaedic surgeries performed during the post-pandemic period was 13.10 times that of the pandemic period ($P < 0.001$), and 55.71% of the non-pandemic period ($P < 0.001$).

The increase in the orthopaedic surgeries performed during the first 76 days of the post-pandemic period was mainly due to the reorganized daily schedule of the elective surgeries. Even though the number of orthopaedic surgeries during the first 76 days of the post-pandemic period was still much lower than that of the non-pandemic period, no more nosocomial transmission of COVID-19 has been observed till June 22, 2020.

The types of orthopaedic surgeries performed during the non-pandemic period, pandemic period and post-pandemic period were also summarized in Table 3. The orthopaedic surgeries could be classified as spine, joint, arthroscopy, bone tumor, trauma and pediatric orthopaedics surgeries. During pandemic period, only emergency or urgent surgeries were performed, including spine, bone tumor and trauma surgeries, while all the joint, arthroscopy and pediatric orthopaedics surgeries were delayed. During the post-pandemic period, different types of orthopaedic surgeries were all decreased.

4. Discussion

The work characteristics of orthopaedic surgeons greatly changed during the COVID-19 pandemic, including the workplaces of orthopaedic surgeons, SARS-CoV-2 infection rate of orthopaedic surgeons and the number of orthopaedic surgeries performed.

Wang et al.⁷ reported that 41.3% of the COVID-19 patients in their case series were presumed to have been infected in the hospital, including 12.3% of them who were patients hospitalized for other reasons, and 29% of them who were healthcare workers. Even though orthopaedic surgeons were encouraged to work at the front line, most of the older employees were not allowed to do so due to higher risk of infection of SARS-CoV-2.^{1–3,6,7} Two orthopaedic surgeons tested

Table 1
Workplaces of the Orthopaedic surgeons in our hospital during the pandemic period.

Workplaces of Orthopaedic Surgeons	Average age (years)	Number	Rate (%)
Worked as Orthopaedic surgeons full time	51.22 ± 7.94	18	20.00
Worked at the front line in January	42.45 ± 4.18	11	12.22
Worked at the front line since February	36.94 ± 5.82	48	53.33
Tested positive for SARS-CoV-2 at the early stages	32.00 ± 5.66	2	2.22
Undergoing further education abroad	32.2 ± 4.12	11	12.22
Sum up	39.78 ± 8.62	90	-

Table 2
Data of Orthopaedic surgeries performed in our hospital during the non-pandemic period, pandemic period and post-pandemic period.

Year	Date	Period	Days	Orthopaedic surgeries (N)	Orthopaedic surgeries per day (N)
2019	January 23 -April 8	non-pandemic period	76	3180	41.84 ± 30.09
2020	January 23 -April 7	pandemic period	76	135	1.78 ± 2.32*
2020	April 8 - June 22	post-pandemic period	76	1772	23.31 ± 17.70# &

* P<0.001 compared with non-pandemic period;

P<0.001 compared with pandemic period;

& P<0.001 compared with non-pandemic period.

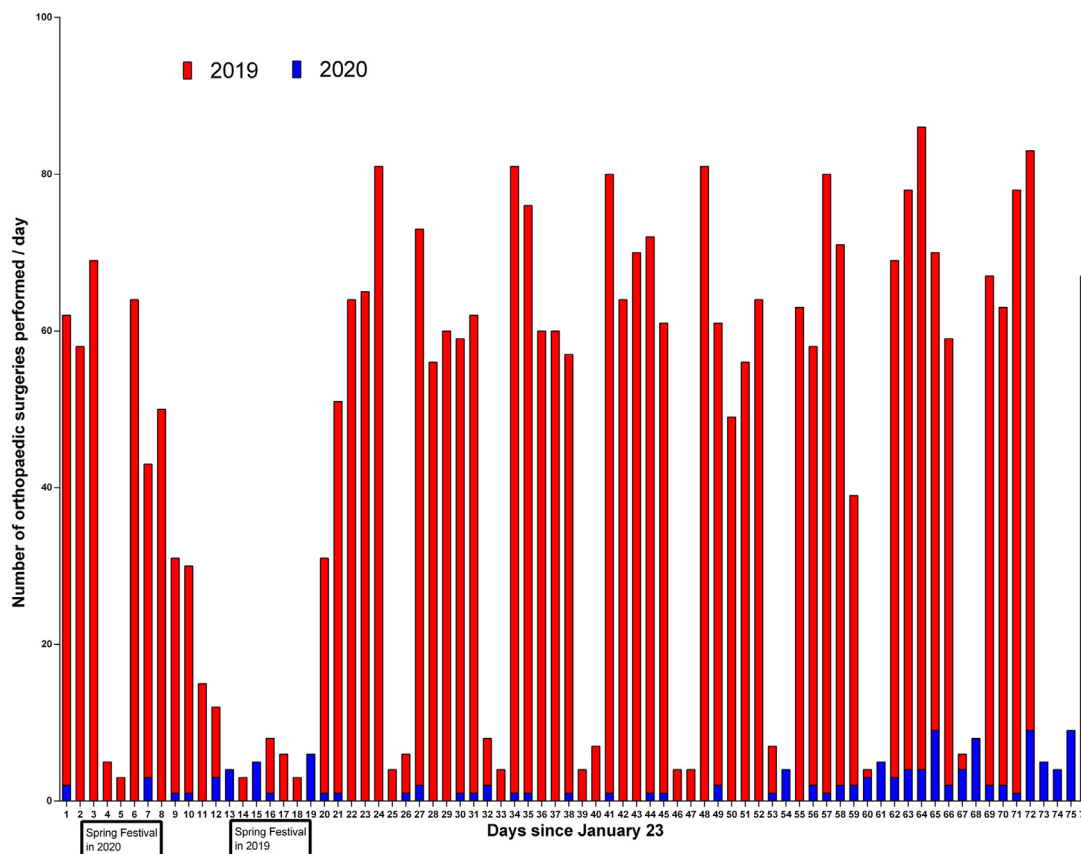


Fig. 1. The number of orthopaedic surgeries performed per day during the pandemic period decreased 95.74% compared with the same period in the past year.

positive for SARS-CoV-2 at the initial stages of COVID-19; they performed spinal surgeries for patients in the incubation period of COVID-19, and had close contacts with the patients. Another two orthopaedic surgeons who tested positive for SARS-CoV-2 were of older age, and had been working at the front line without standard personal protective equipment (PPEs). When lockdown restrictions of Wuhan were performed, PPEs in our hospital were nearly exhausted, and many of the healthcare workers who worked at the front line were not equipped with standard PPEs. Fortunately, many volunteers around the world dispatched plenty of PPEs to Wuhan during the pandemic period. Compared with those who had been working at the front line in January, none of the orthopaedic surgeons who worked at the front line since February tested positive for SARS-CoV-2. Therefore, system

training on in-hospital infection control of COVID-19 and availability of appropriate PPEs are important for the healthcare workers to prevent the infection of SARS-CoV-2.

Several factors contributed to the sharp decrease in the number of orthopaedic surgeries performed during the pandemic period. First, lockdown restrictions of Wuhan and the surrounding cities made it difficult for most of the patients to come to our hospital. Second, general out-patient service was closed during the first two months of the pandemic period, and patients could only visit the emergency department or seek online consultation. Third, most patients feared contracting COVID-19 and stayed at home unless they suffered from serious illness or trauma. Fourth, only emergency or urgent surgeries were performed during the pandemic period, and all the elective surgeries

Table 3
Types of orthopaedic surgeries performed in our hospital during the non-pandemic period, pandemic period and post-pandemic period.

Period	Spine surgery	Joint surgery	Arthroscopy surgery	Bone tumor surgery	Trauma surgery	Pediatric orthopaedics surgery	Sum up
non-pandemic period	528	545	689	79	841	498	3180
pandemic period	32	0	0	18	85	0	135
post-pandemic period	438	269	386	67	331	281	1772

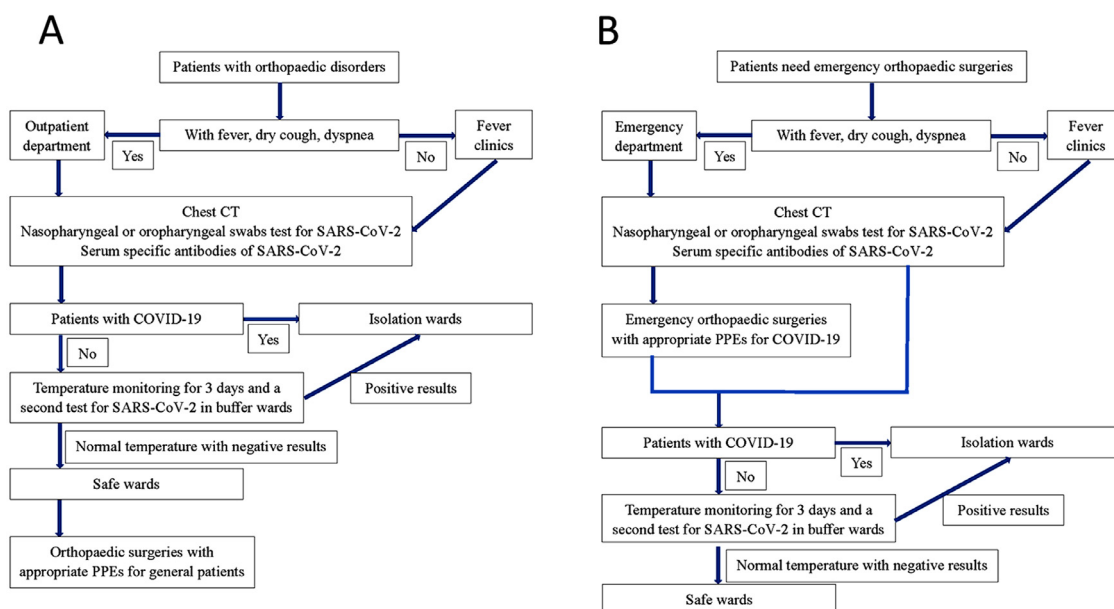


Fig. 2. The rigorous screening procedures for general patients and patients needing emergency surgeries. (A) general patients; (B) patients needing emergency surgeries.

were postponed. Fifth, most of the orthopaedic surgeons volunteered to work at the front line to fight against COVID-19; therefore, the restriction of orthopaedic surgeons made it difficult to perform the elective surgeries during the pandemic period.

To prevent the nosocomial transmission of COVID-19, it is necessary to conduct rigorous screening of each patient before being admitted to our hospital at the outpatient department, emergency department, or fever clinics. The stringent screening procedures for general patients, and patients needing emergency surgeries have been shown in Fig. 2. All the patients confirmed with COVID-19 were sent to the isolation wards. All the patients who tested negative for COVID-19 were monitored in the buffer wards for at least three days, and then transferred to the safe wards subject to continuous negative results on COVID-19 tests. Disposable surgical caps and N95 (or FFP2) respirators should be used during surgeries for patients with negative results on COVID-19 tests. For emergency surgeries or for patients with COVID-19, the following materials ought to be used: disposable surgical caps, N95 (or FFP2) respirators, disposable surgical masks, surgical undergarments, disposable medical protective uniforms, disposable isolation clothing, disposable latex gloves, goggles, and waterproof surgical shoe covers.⁸

Even though all the 90 orthopaedic surgeons have been back to work, and the lockdown restrictions were removed during the post-pandemic period, the number of the orthopaedic surgeries was still much lower than that during the non-pandemic period. Several factors contributed to the slow increase in the number of orthopaedic surgeries performed during the post-pandemic period. First, most patients still had fears regarding COVID-19, and stayed at home unless they suffered from serious illness or trauma. Second, more than 80% of the patients were transferred from other cities during non-pandemic period, while only about 50% of the patients were transferred from other cities due to the COVID-19 pandemic. Third, the rigorous screening procedures for general patients reduced the number of admitted patients and the efficiency of admission preparation.

Even though the preliminary influence of the COVID-19 pandemic on the work characteristics of orthopaedic surgeons can be found in the present study, the work characteristics of orthopaedic surgeons in different countries or districts may vary due to the differences in the severity of the COVID-19 pandemic.

5. Conclusions

The work characteristics of orthopaedic surgeons greatly changed during the COVID-19 pandemic. During the pandemic period, 65.56% of the orthopaedic surgeons worked at the front line to fight against COVID-19. The SARS-CoV-2 infection rate of the orthopaedic surgeons who worked at the front line were much higher in January than since February. The number of orthopaedic surgeries performed during the pandemic period decreased 95.74% compared with that during the non-pandemic period. The number of orthopaedic surgeries performed during the post-pandemic period greatly increased compared with the pandemic period.

Statement

- 1 Appropriate EQUATOR guidelines: SRQR – qualitative research.
- 2 Clinical Trial registration: not required.

Funding sources

No funding was received.

Ethics policy for human subjects

The present study was conducted in accordance with the guidelines of the Declaration of Helsinki and was approved by the ethics committee of Tongji Medical College, Huazhong University of Science and Technology.

CRediT authorship contribution statement

Wenbin Hua: Conceptualization, Methodology, Software, Data curation, Writing - original draft. **Yukun Zhang:** Data curation. **Xinghuo Wu:** Data curation. **Yong Gao:** Data curation. **Cao Yang:** Supervision.

Declaration of Competing Interest

None.

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