

Cause analysis and enlightens of hand injury during the COVID-19 outbreak and work resumption period

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Research

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Abstract

Background: In light of the new circumstances caused by the current COVID-19 pandemic, an enhanced knowledge of hand injury patterns may help with prevention in factories as well as the management of related medical conditions.

Methods: A sample of 95 patients were admitted to an orthopedics department with an emergent hand injury within half a year of the COVID-19 outbreak. Data were collected between January 23rd, 2020 and July 23rd, 2020. Information was collected regarding demographics, type of injury, location, side of lesions, mechanism of injuries, place where the injuries occurred, surgical management, and outcomes.

Results: The number of total emergency visits due to hand injury during the COVID-19 outbreak decreased 37% when compared to the same period in the previous year. At the same time, work resumption injuries increased 40%. In comparison to the corresponding period in the previous year, most injured patients during the COVID-19 outbreak were women (60%) with a mean age of 56.7, while during the work resumption stage, most were men (82.4%) with a mean age of 44.8. The majority of injuries within the resumption period occurred at work (64.7%), significantly more than in the same period in 2019 (37.3%) ($P < 0.001$). Machine injuries were the most frequent (58.8%). Data show that different degrees of cutting injuries comprised the majority of total cases (82.4%), far more than simple fractures and dislocations, with fingers the most commonly injured body part. The majority of injuries were classified as either minor or moderate (90%) during the outbreak while major (40%) during the resumption of work. The proportion of major injuries during the work resumption stage in this year (40%) have been almost double that of the previous year (pre-pandemic) (21.8%) ($P = 0.006$).

Conclusion: The resumption of work following the COVID-19 outbreak is a time of high risk for hand injuries. The overall number of patients with hand injuries admitted into our department has decreased compared to the corresponding period last year. Workplace injuries, especially machine related ones, increased greatly during the six months after the outbreak of COVID-19. The proportion of major injuries increased by a large margin. Emergency and surgical service providers should be aware of this pattern of hand injuries during this atypical time in order to more effectively prepare and plan services.

Level of evidence: Level IV.

Introduction

In early December 2019, a series of pneumonia cases caused by a novel coronavirus emerged in Wuhan, Hubei Province, China¹. This coronavirus was first named the 2019 novel coronavirus (2019-nCoV) and has subsequently been widely recognized throughout the world. Indeed, on January 30th, 2020, the World Health Organization (WHO) declared this virus a public health emergency of international concern² and then officially named it the Coronavirus Disease-2019 (COVID-19) on February 11th, 2020. COVID-19 rapidly developed into a global disaster that has affected hundreds of countries. Data show that as of

November 21st, 2020, 57,274,018 confirmed cases and 1,368,000 deaths have been documented worldwide across 220 countries³. China has effectively controlled the spread of this epidemic at the start of the outbreak and remains vigilant as the situation worsens globally. As of the time of writing, COVID-19 has claimed 4,749 lives and infected 92,588 people on the Chinese mainland.

On February 19th, the number of new COVID-19 infections dropped to three digits and then on March 6th this fell to two digits where it has remained, with most cases imported⁴. The city of Hangzhou has reported no new cases of local infection for nine months, since February 20th 2020. In China, a four-tier public health emergency response system has generally been used, with level I the highest. Thus, on January 23rd, the government of Zhejiang Province officially launched a level I response. Subsequent to strict prevention and control measures being implemented throughout the whole city, this response level was adjusted to level II on March 2nd in a meeting of the standing committee of the provincial party committee and then on March 23rd, this was adjusted to level III⁵. The bulk of businesses were closed during this outbreak, except for the medical materials manufacturing enterprises. According to local authorities, enterprises that were on the 'white list of enterprises' (i.e., those factories that are involved in the production of medical supplies and daily necessities, as well as the construction of key projects important to the national economy or people's livelihoods) in Hangzhou resumed operations on February 10th, with local employees going back to work. As of February 20th, most factories had started functioning and their workers were returning to work⁶. Throughout this atypical year, many domestic companies, including the Guangzhou Automobile Group Company, the SAIC-GM-Wuling Automobile Company, and the Changan Company, transformed their businesses to provide medical supplies including face masks for epidemic prevention and control^{7, 8}.

In light of these new circumstances, a change in the pattern of hand injuries has attracted attention. We therefore summarized the pattern and epidemiology of hand injuries during the COVID-19 outbreak as well as during the work resumption period as the pandemic subsides. Our dual hypothesis is that hand injuries are more severe and that industrial machine injuries form the majority of these during the work resumption period. This study attempts to highlight the patterns of hand injuries after the COVID-19 outbreak, our management of these injuries, and outcomes in our hospital. As time progresses, other countries outside China have also launched economic recovery programs to mitigate unemployment and stabilize core industries⁹. We hope that this study may provide guidance for the prevention and management of hand injuries in the resumption of work in other regions.

Methods

We present a retrospective study of 95 cases in one designated hospital. All cases were hand injuries that were registered and assessed in our hospital throughout the epidemic between January 23rd, 2020 (when the coronavirus outbreak began) and July 23rd, 2020, when urban work returned to normal six months later. The period between January 23rd, 2020, and February 9th, 2020, was therefore defined as the 'outbreak phase' as factories began to resume operations since February 10th, 2020. The 'resumption

phase' was then defined as the period between February 10th, 2020, and July 23rd, 2020. Data were extracted and collected from emergency and orthopedics department databases. A descriptive analysis was carried out. Data of interest included demographics (age and gender), profession, and residence as well as time and date of event and treatment. The following variables were also collected for each hand injury: type of injury, location of injury, side of lesion, mechanism of injury, place where the injury occurred, surgical management, and outcome. Injuries were classified with the Modified Hand Injury Severity Score (MHISS). The Statistical Package for Social Sciences (SPSS) software (SPSS Statistics 17, for Windows, New York) was utilized for data analysis. We used the chi-square tests, the Fisher exact tests, and the Pearson test to assess the Relative Risk (RR), and *p* value between groups. Differences with values of *p* ≤ 0.05 were considered statistically significant.

Results

A total of 1,357 hand injury emergency visits were recorded between January 23rd, 2020, and July 23rd, 2020, including 46 cases during the outbreak between January 23rd, 2020, and February 9th, 2020, as well as 1,311 cases over the resumption of work period between February 10th, 2020, and July 23rd, 2020. Over the same period last year, 73 cases of hand injury emergency visits were recorded between January 23rd, 2020, and February 9th, 2020, as well as 939 between February 10th, 2020, and July 23rd, 2020. There were 37% fewer cases of emergency visits during the outbreak compared to the same period the previous year, and 40% more cases during the resumption of work than in the same period during the previous year. Out of all patients reviewed, 95 (7%) patients were admitted to hospital and treated in our department, including 10 (21.7%) during the outbreak phase and 85 (6.5%) during the resumption phase.

The bulk of patients treated during the outbreak phase were middle-aged and elderly housewives. These injured patients had a mean age of 56.7 years (10.9). In four cases (40%) during the outbreak, these injuries occurred at home. The percentage of hand injuries that occurred at home during the outbreak was 26.3% more than in the previous year (40% vs 16.7%) with knife lacerations the most common. Finger injuries constituted approximately nine (90%) of the total. As a result of traffic controls, eight (80%) patients were nearby residents (Table 1); the bulk of injuries were mild to moderate (90%), apart for one case that involved a high-pressure disinfectant liquid finger injection injury (Figure 1).

In contrast, throughout the resumption period between February 9th, 2020, and July 23rd, 2020, hand injuries sustained at work were 27.4% more common than in the previous year (64.7% vs 37.3%), and occurred overwhelmingly in middle-aged males. This observation is statistically significant with a *P* value < 0.001. Injured patients had a mean age of 44.8 (13.4) years; machine injuries made up the majority in these patients (58.8%) and occurrences were 27.9% more common than in the previous year (*P* < 0.001). Throughout this period, such injuries were common amongst department admittances. Indeed, many injuries resulted in muscle, tendon, nerve, and vascular damage; palm, wrist, and arm injuries made up about 34.1% of the total. Hand injuries tended to be more severe and even disabling over this period, often requiring emergency operations. The majority of injuries were classified as major (40%) in the work resumption phase. This was almost double that of the previous year (21.8%), with a *P* value of 0.006. The

amputation rate in this phase reached 8.2%, triple the level of the previous year (2.7%), while fractures and dislocations remained comparable (21.2% vs 22.7%). The mean range of stays was 20.3 days during the outbreak compared to 7.9 days during the resumption of work phase. The data in Table 1 shows results for patients during the outbreak and the work resumption period compared to the same period in the previous year. (Table 2)

One case of a crush injury sustained during delivery of medical supplies (Figure 2), and another case of forearm injury that was caused by a cutting machine in a mask factory (Figure 3). Special cases of hand injuries directly related to the pandemic are listed in Table 3; these occurred mainly during the production and delivery of medical supplies.

Discussion

The COVID-19 pandemic shattered daily routines and disrupted businesses, schools, lifestyles, and economies around the globe. Social distancing and self-quarantine aim to slow the increase of new infections, mitigating a surge in demand for health care¹⁰. Some measures such as telemedicine, are now recommended to reduce hospital visits for some mild injuries^{11, 12}. Nevertheless, even during a time of social distancing, patients with severe injuries require urgent treatment and the number of such injuries has not decreased as was supposed. The economic recovery is accelerating all over the world after a long period of social distancing and economic stagnation. Workers have successively begun to return to their workplaces. Our study is pioneering in that it describes unique patterns of injuries which occurred this non-typical time. We highlight spikes in hand injuries during the work resumption following the COVID-19 pandemic.

Trauma at home accounts for the majority of all hand injuries seen during the outbreak period, inevitable as people stayed at home. Non-local patients visits were also significantly reduced because of traffic restrictions. However, as industrial work resumed, we observed a distinct change in patterns of hand injuries. High social demand after a long shutdown has motivated workers to throw themselves into high-intensity work. Thus, workplace injuries, especially manufacturing traumas, increased rapidly during the work resumption period. The proportion of major injuries has also tended to increase; our research illustrates this via comparison with the same period in the previous year. As a result of pandemic and economic stagnation, members of the public have also experienced an increase in psychological problems^{13, 14}. Research has suggested that anxiety, depression, and stress in workers may increase the risk of unintentional injuries during the resumption of work¹⁵. One type of hand injury was relatively typical in this non-standard year, those sustained in the medical supplies manufacturing industry, the first to return to work. Compared with a control group, the study group had a longer length of stay on average. This does not necessarily reflect worse injuries. It could be due to the situation in which these injuries occurred during an atypical time when the medical services are slowed down.

Educational campaigns aimed at factories as well as an increase in the availability of professional workers during this atypical time are needed to reduce the incidence of hand injuries. In particular, in

companies that have newly transformed to provide medical supplies, a lack of experience was a common phenomenon. It is recommended that the resumption of work proceeds sequentially and in segments. Local workers without a history of exposure to areas affected by the epidemic were allowed to return to work first⁶.

Hospitals must re-orientate health care resources at this unique time to meet actual injury burden. Indeed, in order to reduce the risk of exposure in transit, patients were encouraged to seek treatment in nearby hospitals and preventive measures should be put in place to avoid the risk of COVID-19 spreading. These include the registration of personal information, regular disinfection, body temperature monitoring, and a cap on daily visitors, all strictly implemented across all departments in our hospital to lower the risks of infection. However, despite the necessity of ensuring effective inspection, the time required for emergency preoperative preparation was not significantly prolonged during the period of the epidemic.

The city of Hangzhou was the first in China to launch a health QR code system to curb the spread of infection as it tentatively restarted production¹⁶. This health QR code and body temperature were checked at first contact upon entry into the hospital. Thus, only patients with a green QR code and normal body temperature were allowed into the emergency department; those with temperatures higher than 37.3°C are guided to the fever clinic first for infection screening. A nucleic acid test and a lung CT scan are then performed simultaneously. In our hospital, patients who are suspected of being infected are examined in a separated CT room, distinct than the one used for other patients. Statements with a consensus agreement from an international Delphi process supported a distinction of surgery between protocols involving patients with suspected COVID-19 and those perceived to be free from infection¹⁷. Patients are admitted to the ward only when pneumonia has been excluded by sputum culture and CT. Preoperative preparation includes blood work, a medical evaluation, a chest x-ray, and an EKG, all performed while waiting for COVID-19 test results. The initial clinician is responsible for the diagnosis and preliminary management of the injuries throughout the whole process. As direct contact poses a high risk for healthcare professionals performing wound care, surgery, and resuscitation^{10, 18}, the appropriate use of personal protective equipment, as well as strict disinfection and hand hygiene are required of every clinician^{10, 19}. A total of 105 patients with COVID-19 are either undergoing intensive therapy or have been cured in our center. We have also achieved substantial success with zero nosocomial infections and have a zero mortality rate. In addition, none of the staff in our center have been infected, even in the isolation wards, no SARS-Cov-2 RNA has been detected amongst objective samples²⁰.

It is also the case that at this unique time, medical workers may become anxious and may be afraid to work. This is a time for solidarity, not fear; the COVID-19 outbreak is a test of solidarity in the political, financial, and scientific spheres, as stated by WHO Director-General Tedros Adhanom Ghebreyesus²¹. Thus, all doctors in our center have remained at their posts since the outbreak in a show of solidarity.

Conclusion

The resumption of work following the COVID-19 outbreak is a time of enhanced risk for hand injuries. The overall number of hand injuries admitted into our department has decreased compared to the corresponding period last year. However, workplace injuries, in particular machine injuries, increased significantly over the six months following the COVID-19 outbreak. The proportion of major injuries increased by a large margin. Emergency and surgical service providers should be aware of this pattern of hand injuries throughout this unique time so that they can prepare and plan services accordingly.

Declarations

Ethics approval and consent to participate

These study protocols were approved by the Medical Ethics Committee of the First Affiliated Hospital, Zhejiang University School of Medicine.

Consent for publication

All patients gave informed consent.

Availability of data and material

The dataset supporting the conclusions of this article is included within the article.

Competing Interests

The authors declare that they have no competing interests.

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Authors' contributions

Qianjun Jin conceived of the study. Hui Lu and Haiying Zhou participated in the design of the study. Qianjun Jin and Haiying Zhou drafted the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1 Hand injuries during the outbreak of pandemic compared with the same period of last year

Variable	Outbreak	Last year	RR	P	Age, mean (SD)	56.7 10.9	44.3 18.7
Gender, male, No. (%)	4 (40%)	5 (83.3%)	0.48	0.145			
Site							
At home	4 (40%)	1 (16.7%)	2.398	0.588			
At work	5 (50%)	3 (50%)	1	1			
Others	1 (10%)	2 (33.3%)	0.3	0.518			
Mechanism of injury, No. (%)							
Sharp injury	2 (20%)	4 (66.7%)	0.3	0.118			
Machine injury	5 (50%)	2 (33.3%)	1.499	0.633			
Fall injury	1 (10%)	0					
Motor vehicle crash	0	0					
Penetrating injury	1 (10%)	0					
Crush injury	1 (10%)	0					
Diagnosis, No. (%)							
Laceration	6 (60%)	6 (100%)	0.6	0.234			
Fracture	3 (30%)	0					
Dislocation	1 (10%)	0					
Injured part							
Left	8 (80%)	2 (33.3%)	2.398	0.118			
Right	2 (20%)	4 (66.7%)	0.3	0.118			
Thumb	3 (30%)	2 (20%)	1.5	1			
Index	1 (10%)	0					
Middle	4 (40%)	0					

Ring	3 (30%)	0		
Little	4 (40%)	3 (50%)	0.8	1
Palm	1 (10%)	2 (33.3%)	0.3	0.518
Wrist	0	0		
Arm	0	0		
Hospital stays, mean (SD)	20.3 (27.2)	6.7 (7.0)		
MHISS				
Minor	5 (50%)	3 (50%)	1	1
Moderate	4 (40%)	2 (33.3%)	1.2	1
Major	1 (10%)	1 (16.7%)	0.6	1
Treatment				
Restoration	10 (100%)	6 (100%)	1	1
Amputation	0	0		

Note. MHISS=Modified Hand Injury Severity Score, RR=relative risk, #:P<0.05

Table 2 Hand injuries during the work resumption of pandemic compared with the same period of last year

Variable	Resumption	Last year	RR	P
Age, mean (SD)	44.8±13.4	41.7±17.2		
Gender, male, No. (%)	70±82.4%	88±80%	1	1
Site				
At home	20±23.5%	40±36.4%	0.647	0.054
At work	55±64.7%	41±37.3%	1.736	0.000#
Others	10±11.8%	29±26.4%	0.446	0.011#
Mechanism of injury, No. (%)				
Sharp injury	18±21.2%	35±31.8%	0.665	0.098
Machine injury	50±58.8%	34±30.9%	1.905	0.000#
Fall injury	4±4.7%	15±13.6%	0.345	0.037#
Motor vehicle crash	3±3.5%	3±2.7%	1.296	0.378
Penetrating injury	1±1.2%	2±1.8%	0.647	0.718
Crush injury	9±10.6%	21±19.1%	0.555	0.103
Diagnosis, No. (%)				
Laceration	70±82.4%	85±77.3%	1.066	0.384
Fracture	13±15.3%	22±20%	0.765	0.396
Dislocation	5±5.9%	3±2.7%	2.155	0.271
Injured part				
Left	51±60%	60±54.5%	1.1	0.446
Right	34±40%	51±46.4%	0.863	0.374
Thumb	17±20%	6±5.5%	3.663	0.002#
Index	28±32.9%	24±21.8%	1.511	0.882
Middle	19±22.4%	29±26.4%	0.848	0.519
Ring	14±16.5%	17±15.5%	1.066	0.847
Little	9±10.6%	14±12.7%	0.832	0.646
Palm	14±16.5%	10±9.1%	1.812	0.120
Wrist	8±9.4%	8±7.3%	1.294	0.589
Arm	7±8.2%	11±10%	0.824	0.673

Hospital stays, mean (SD)	7.9(8.3)	6.7(7.0)		
MHISS				
Minor	19(22.4%)	47(42.7%)	0.523	0.003#
Moderate	32(37.6%)	39(35.5%)	1.062	0.752
Major	34(40%)	24(21.8%)	1.835	0.006#
Treatment				
Restoration	78(91.8%)	107(92.6%)	0.943	0.084
Amputation	7(8.2%)	3(2.7%)	3.021	0.084

Note. MHISS=Modified Hand Injury Severity Score, RR=relative risk, #:P<0.05

Table 3 Special cases of hand injuries directly related to this pandemic

No	Age	Gender	Occupation	Cause of injury	Injury part	Treatment	Hospital stay	MHISS
1	39	Female	Factory worker	High-pressure disinfectant liquid injection injury	Left ring finger and palm	Emergent surgery	96	Major
2	52	Male	Driver	Crush injury while delivering medical supplies	Right wrist and forearm	Emergent surgery	29	Major
3	31	Male	Factory worker	Cutting machine injury of the forearm in a mask factory	Left elbow and forearm	Emergent surgery	45	Major

Figures

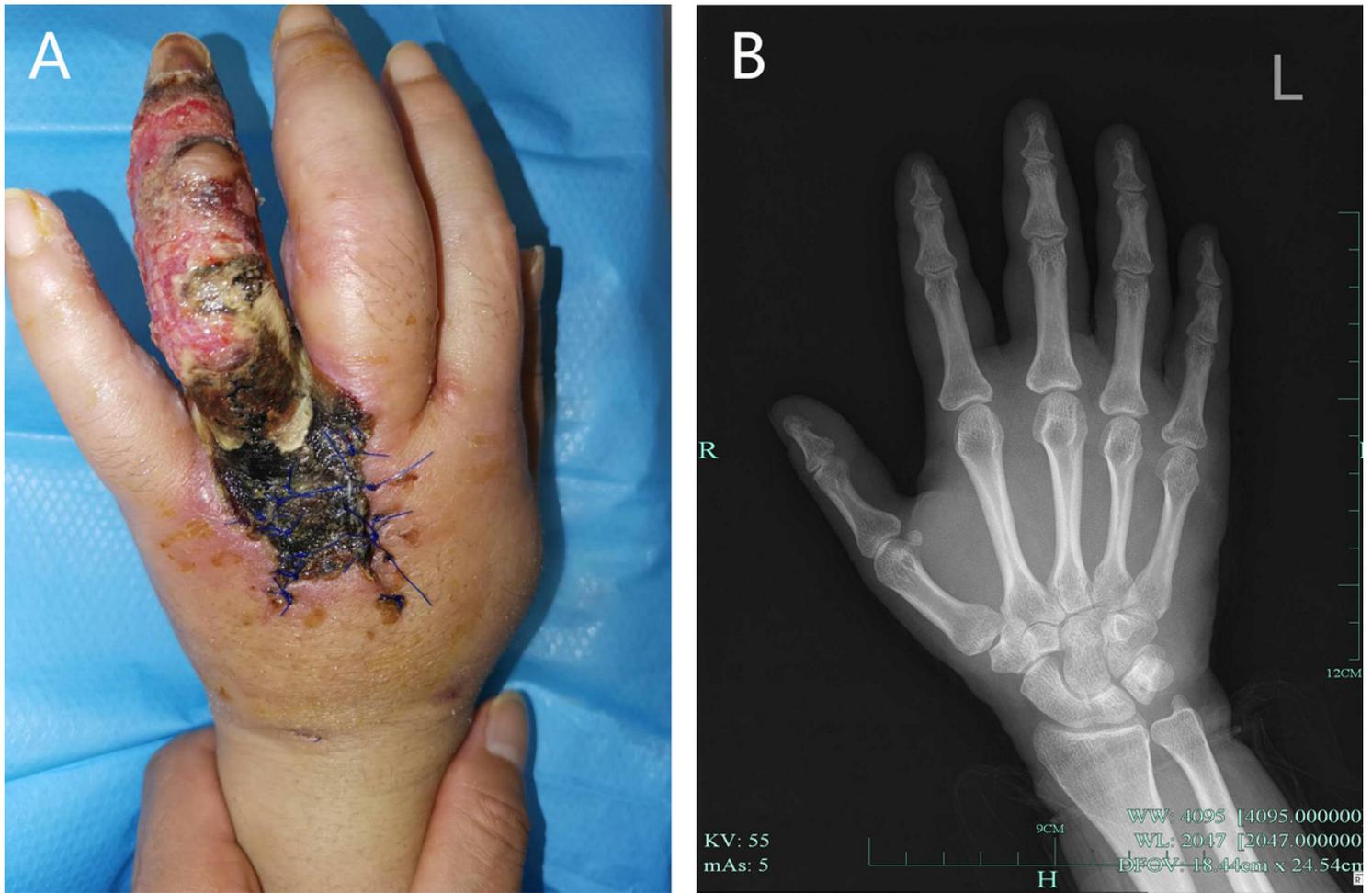


Figure 1

Case 1. A 39-year-old female worker suffered high-pressure disinfectant liquid injection injury of the left ring finger and palm (a) Preoperative appearance of the injured finger. (b) Radiologic appearance of the injured hand.



Figure 2

Case 2. A 52-year-old male driver suffered crush injury while delivering medical supplies (a) Preoperative appearance of the injured hand. (b) Radiologic appearance of the injured hand.



Figure 3

Case 3. A 31-year-old male worker suffered forearm injury caused by the cutting machine in a mask factory (a) Preoperative appearance of the injured arm. (b) Radiologic appearance of the injured arm.