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A Cross-sectional Study on the Impact of the Prevention and Control Response of the COVID-19 Pandemic on Children's Orthopedic Trauma in Shanghai

Chuang Qian
Children's Hospital of Fudan University https://orcid.org/0000-0003-2375-3614
Yiming Zheng
Children's Hospital of Fudan University
Junrong Meng
Children's Hospital of Fudan University
Hao Li
Children's Hospital of Fudan University
Dahui Wang (wangdahui@fudan.edu.cn)
Children's Hospital of Fudan University &National Children's Medical Center https://orcid.org/0000-0002-3101-702X

Research Article

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Abstract

Background: The Chinese government has taken strong prevention and control measures against the COVID-19 pandemic, and has achieved phased victory in the fight against it. The outbreak of COVID-19 pandemic provides an opportunity to study the influence of governmental prevention and control response on orthopedic trauma in children.

Methods: We collected and reviewed data on orthopedic trauma from the first half of 2018, 2019, and 2020. The data were divided according to the time of prevention and control response level in 2020. By comparing the relevant data from orthopedic emergency and operating rooms from the past three years, the influence of governmental pandemic prevention measures on orthopedic trauma in children was analyzed.

Results: A total of 36301 children were included in the study cohort. Before the prevention and control response, the data of the orthopedic emergency department in 2020 was the same as the previous two years. Under the first-level response, the number of fractures, open injuries, radial head subluxation, and surgery were significantly reduced, and the severity of patients with surgery was also significantly reduced. Under the second-level response, the number of operations began to increase, and the severity of the disease also began to rise. Under the third-level response control, the number of fractures, open injuries, and operations have returned to the levels of the previous two years. The severity of the operation has also returned to its previous level. The number of subluxations of the radial head is still different from before.

Conclusion: The pandemic of COVID-19 has affected the social activities of Shanghai residents and reduced the incidence of orthopedic trauma in children. With the control of the pandemic, the living conditions of Shanghai residents have basically recovered.

Level of Evidence: Retrospective study Level II

1. Background

About a quarter of all children go to the emergency department every year due to accidental injuries.[1] Fractures are the most common type of trauma in children,[2] and about a third of all children will suffer from a fracture before they reach adulthood.[3] The daily incidence of fractures in the United States is about 12.0-36.1/1000 per year.[4] The type and severity of fractures are related to gender, region, country, weather, and culture.[5, 6]

Due to the outbreak of COVID-19 pandemics in the world, the Shanghai government launched first-level prevention and control response in January 24, 2020. With the change of the pandemic situation, the response level of Shanghai's government response is constantly changing. At present, there is no study on the impact of infectious disease prevention and control on pediatric orthopedic trauma, and this pandemic provides the best opportunity for related research.

With the reduction of the response level of prevention and control, we can assess whether the life of the residents in Shanghai has recovered to the situation before the pandemic from the aspects of economy, life and politics. Pediatric orthopedic trauma is closely related to children's family care and campus life. By analyzing the changes of pediatric orthopedic emergency department in 2020, we can understand the recovery status of the residents in Shanghai and provide some evidence for other governments to formulate relevant pandemic prevention policies.

2. Materials And Methods

This study reviewed data of orthopedic emergency patients at our hospital from January to June in 2018, 2019, and 2020. The number of emergencies, type of injuries, emergency surgeries, surgical sites, the cause of the injuries, and the severity of the injuries over the last three years were documented. To ensure homogeneity of data over the last three years, patient information from February 29, 2020 was excluded.

2.1 Statistics of injury types in the emergency room

The diagnoses of emergency patients were categorized as fractures, open injuries, soft tissue injuries (including non-fracture and non-open injury), and radial head subluxations.

2.2 Diagnostic statistics of surgical patients

Based on the surgical site and type of injury, we divided the diagnoses of children who required surgical intervention into open fractures, open injuries, spinal fractures, fractures of the clavicle, pelvic fractures, fractures of the hand, forearm fractures, fractures of the upper arm, fractures of the thigh, fractures of the lower leg, and fractures of the foot.

2.3 Severity of injury

In order to distinguish the severity of injuries in surgical patients, we further divided the condition of all patients into three levels: moderate, severe, and critical. Unstable fractures with incomplete cortical fractures were defined as moderate injuries (including type I humeral lateral condyle fractures, angled phalanx fractures, type II supracondylar fractures of the humerus, and epiphyseal fractures after reduction). A complete cortical fracture of a single limb was defined as a severe injury (including type III humeral supracondylar fractures, radial and ulnar fractures, and fractures of the tibia and fibula). Spinal and pelvic fractures, multiple fractures, or fractures with other systemic injuries were identified as critical injuries (including lumbar burst fractures, pelvic fractures, and supracondylar fractures of the humerus combined with an injury of the median nerve).

2.4 Cause of injury

In this study, we collected the data of children who had been operated on due to traffic accident injuries, injury caused by falling from a height, and open injuries that occurred in the past three years; we then compared the causes.

2.5 Unified timeline

Due to different spring festival holidays and school opening dates in the past three years, we rearranged the data for the three years using the Chinese New Year as a reference point. Arranged according to the Chinese New Year, According to the level of response in 2020, the data of three years are divided into four groups 'before response', 'first-level response', 'second-level response' and 'third-level response'. After rearrangement, the date segments of each group in the past three years are shown in the table (Table 1).

Table 1
The time line after unification

	2018	2019	2020
Before the response	01/21 – 02/14	01/12 – 02/03	01/01–01/23
First-level response	02/15 – 04/13	02.04-04/02	01/24 – 03/22
Second-level response	04/14 – 05/29	04/03–05/18	03/23 – 05/07
Third-level response	05/30 – 06/30	05/19 – 06/30	05/08 – 06/30

2.6 Statistical method

IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA), was used for statistical analysis. Relevant data from the emergency room (total number of daily emergencies, fractures, open injuries, radial head subluxations) and volume of daily operations were analyzed by multiple sample pairwise comparison analyses of variance, and a sample variance homogeneity test was conducted. Age and severity of injuries in surgical patients were compared using a rank-sum test with multiple samples; the statistically significant results were further compared. A chi-square test was used to analyze the differences in causes of injury (open injury, falling from a height, and traffic accidents) in surgical patients over the past three years. $P < 0.05$ was considered statistically significant.

3. Results

3.1 Conceptual data

A total of 36301 children were included in this study. There were 7093 cases of fracture, 23982 cases of soft tissue injury (including 7019 radial head subluxations); 5226 cases of open injury; and 1793 surgeries. The surgery rate was 4.93%.

3.2 Emergency room data

There were 14866 emergency cases in 2018, 13944 in 2019, and 7491 in 2020. There were statistical differences in the number of emergency cases between 2020 and the previous two years ($P < 0.01$), but no significant difference between 2018 and 2019 ($P = 0.22$). The detailed data of the emergency room visits for three years are shown in Fig. 1.

There was no significant difference between the total number of emergencies among the three years before the response (P = 0.249, P = 0.988). During the response, included first-level, second-level response and third-level response, there were significant differences in the total number of emergency treatments in 2020 compared with the previous two years (P < 0.01).

Before the response, there were no significant differences in the number of emergency fractures in 2020 compared with the previous two years(P = 0.06, P = 0.937). During first-level and second-level response, the number of emergency fractures in 2020 decreased significantly compared with those in the previous two years (P < 0.01). Until third-level response started, the number of emergency fractures began to rise. There was no significant difference between the number of emergency fractures in 2020 and that of the previous two years (P = 0.262, P = 0.394).

Before the response, there was no significant difference between the number of open injuries in 2020 and those of the previous two years (P = 0.122, P = 0.712). During first-level and second-level response, the number of open injuries in 2020 decreased significantly compared with those in the previous two years(P < 0.01). During third-level response, the number of open injury in 2020 was still significantly lower than that of 2018 (P < 0.01), but there was no statistical difference with that of 2019 (P = 0.357).

Before the response, there was no significant difference between the number of radial head subluxations in 2020 and the previous two years (P = 0.392, P = 0.128). In response to all levels of prevention and control, the number of radial head subluxation in 2020 decreased compared with the previous two years.

3.3 Operating room data

In the past 3 years, our department has carried out a total of 1793 orthopedic emergency operating procedures, including 671 in 2018 (4.22 sets/day), 615 in 2019 (3.62 sets/day), and 507 (2.85 sets/day) in 2020; there were significant differences between the three years (P < 0.01). The proportion of different body parts operated over the three years is shown in Fig. 2.

Before the response, there was no significant difference between the number of operations in 2020 and the previous two years (P = 0.134, P = 0.366). Under first-level response, the number of operations in 2020 decreased significantly (P < 0.01); under second-level response, the operation volume in 2020 was significantly different from that in 2018 (P < 0.01), but there was no statistical difference between 2020 and 2019 (P = 0.941). At third-level response, the number of operations recovered in 2020. There was no significant difference compared with the previous two years (P = 0.233, P = 0.168) (Fig. 3).

After our analysis, There was no significant difference between the severity of surgical patient in 2020 and that of the previous two years before the response, under second-level response and under third-level response (P = 0.736, P = 0.528, P = 0.334). During first-level response, the severity of surgical patients in 2020 decreased significantly compared with that in the previous two years (P = 0.001) (Table 2–5).

Table 2
Comparison of the severity of surgical patients before the response

Year	moderate	severe	critical
2018	6	25	8
2019	8	36	19
2020	4	36	12
Overall comparison: P = 0.736			

Table 3
Comparison of the severity of surgical patients under the first level response

Year	moderate	severe	critical
2018	28	153	49
2019	25	94	42
2020	29	35	12

Overall comparison	P = 0.001
2020 VS 2019	P = 0.002
2020 VS 2018	P < 0.01
2019 VS 2018	P = 0.6

Table 4
Comparison of the severity of surgical patients under second-level response

Year	moderate	severe	critical
2018	34	152	60
2019	26	122	34
2020	21	108	32
Overall comparison		P = 0.528	

Table 5
Comparison of the severity of surgical patients under third-level response

Year	moderate	severe	critical
2018	24	85	43
2019	35	124	48
2020	20	122	50
Overall comparison: P = 0.334			

For the years 2018, 2019, and 2020, 25, 19, and 10 cases of injuries by falling from a height were treated in our center, respectively, and there were significant differences between them (P = 0.016). The number of patients undergoing surgery due to open injuries was 218, 167, and 122, respectively. The number of patients who underwent surgery for motor vehicle accidents was 60, 53, and 30, respectively. There was no significant difference in the number of open injuries and traffic accidents between the three years (P = 0.78,P = 0.563) (Table 6).

Table 6
Comparison of the causes of injurie

	Vehicle accident	Fall from a height	Open injury
2018	60	25	218
2019	53	19	167
2020	30	10	122
P Value	0.563	0.016	0.78

4. Discussion

As a serious global public health emergency, the impact of the COVID-19 on people's lives all over the world has greatly exceeded that of Ebola virus in 2014, Middle East respiratory syndrome (MERS) in 2015 and SARS in 2003. COVID-19 has a long duration and a wide range of spread, which is far beyond the previous global public health events in recent years. Under the strong control by the Chinese government, the pandemic of COVID-19 did not break out in Shanghai. On January 24, 2020, the Shanghai government announced to launch the first-level response of prevention and control. Subsequently, residents in Shanghai have experienced the whole process from first-level response to third-level response (Shanghai still hasn't stopped third-level response of prevention and control). In the process of fighting the pandemic, the economy, life and politics will change with the changes of the pandemic situation. The hospital's treatment process has also been optimized[7]. In this study, we found that children's orthopedic emergency also changed with the pandemic situation.

Before the response, the data about pediatric orthopedic trauma in Shanghai kept at the same level as the previous two years in terms of emergency number, emergency diseases, number of operations, severity of surgery or injury mechanism. The disease spectrum did not change significantly in different years. With the change of climate and semester, the number of orthopedic trauma in children in Shanghai increased with the rise of temperature and the beginning of school.

Under first-level of prevention and control response, schools and classes were suspended and all public places were closed. Without outdoor activities and campus life, the injury probability of children living at home is significantly reduced, so the number of emergency and surgery are significantly reduced. Moreover, the severity of the disease in children undergoing surgery was lighter than that in the previous two years. With family care, especially with the care of parents (most people stop work under first-level response), orthopedic trauma in children can be effectively avoided, and even if injured, the severity of the injury is less than that after school beginning. Interestingly, starting with the response, this decrease in the number and severity of injuries is not only reflected in trauma, but also in the number of subluxations of the radial head. The incidence rate of radial head subluxation in girls is higher than that in boys because girls are more likely to be pulled by their parents[8]. Similarly, we can speculate that outdoor activities and campus life will increase the probability of guardians pulling children's arms. Therefore, parents and preschool teachers should pay more attention to the correct posture when protecting their children in outdoor activities, and avoid direct arm pulling.

After the response level of prevention and control was adjusted to second-level, Shanghai began to recover gradually. But, most of the children are still staying at home. In the late stage of second-level response, older students from the graduating class returned to the campus (on April 27, 2020, the ninth grade and senior three in Shanghai was resumed). At this time, we found that the number of orthopedic emergency and surgery increased slightly, and the severity of surgical children has begun to be the same as that in previous years. The increase of trauma is directly related to the return of guardians to work and the reduction of family care for young children, which reflects the importance of parents for children's family care.

Under third-level response, public places and stadiums have been reopened in Shanghai, and non-graduating students are recommended to the campus. At this stage, the number of orthopedic emergency and surgical operations this year are the same as those in previous years. The severity of the damage has also returned to the level of previous years. We can infer from the data of pediatric orthopedic trauma that most of the children's study and life have recovered under third-evel response in Shanghai. It should be noted that the number of cases undergoing surgical treatment due to falling from height has increased compared with previous years. We compared the opening date of school and the date of falling building in recent three years and found that the visiting time of children with high falling injury was concentrated in the middle of the semester. For example: Although the age and school start date of the 10 high falling patients in 2020 are different, they are all injured in the middle of the semester after the beginning of school in their grade (Table 7). We can infer that the pressure on students caused by academic pressure

will gradually increase with the progress of the semester. This provides guidance for the future school targeted psychological counseling.

Table 7
Information about patients with high falling injure in 2020

Patient No.	Gender	Age(y)	Opening Date (mm/dd)	Injury Date (mm/dd)	diagnose
1	male	10	last term	01/07	fracture of femur
2	male	14	last term	01/13	multiple injuries
3	male	3	-	02/06	Fracture of upper arm
4	female	10	06/02	03/07	fracture of tibia and fibula
5	male	16	04/02	05/07	fracture of spine
6	female	16	04/27	05/10	fracture of pelvis
7	male	17	05/06	05/16	multiple injuries
8	male	15	04/27	05/18	fracture of femur (bilateral)
9	male	14	05/06	05/20	multiple injuries
10	female	13	05/18	06/07	fracture of femur

5. Conclusion

The prevention and control response for COVID-19 in Shanghai has indeed affected the normal life of the residents in Shanghai. The response reduced the incidence of pediatric orthopedic emergency trauma. With the control of the pandemic, resident's lives in Shanghai have been basically restored.

6. Declarations

6.1 Ethics approval and consent to participate

This study was approved in ethics Council of Children's Hospital of Fudan University. Written permission was also obtained from the academic research office of Children's Hospital of Fudan University before data collection.

6.2 Consent for publication

Not applicable.

6.3 Availability of data and materials

Data supporting the conclusions and outcomes of this article are included in the article. The raw datasets presented and analyzed in this study are available upon request from the corresponding author.

6.4 Competing interests

The authors declare that they have no competing interests.

6.5 Funding

This work has not received any funding.

6.6 Authors' contributions

Chuang Qian, MS (Contribution: study design, data collection, statistical analysis, and manuscript preparation)

Yiming Zheng, MS (Contribution: data collection and statistical analysis)

Junrong Meng, MD (Contribution: data collection, statistical analysis)

Hao Li, MD (Contribution: study design, performed measurement and manuscript preparation)

Dahui Wang, MD (Contribution: study design and performed measurement)

6.7 Acknowledgements

Not applicable.

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Figures

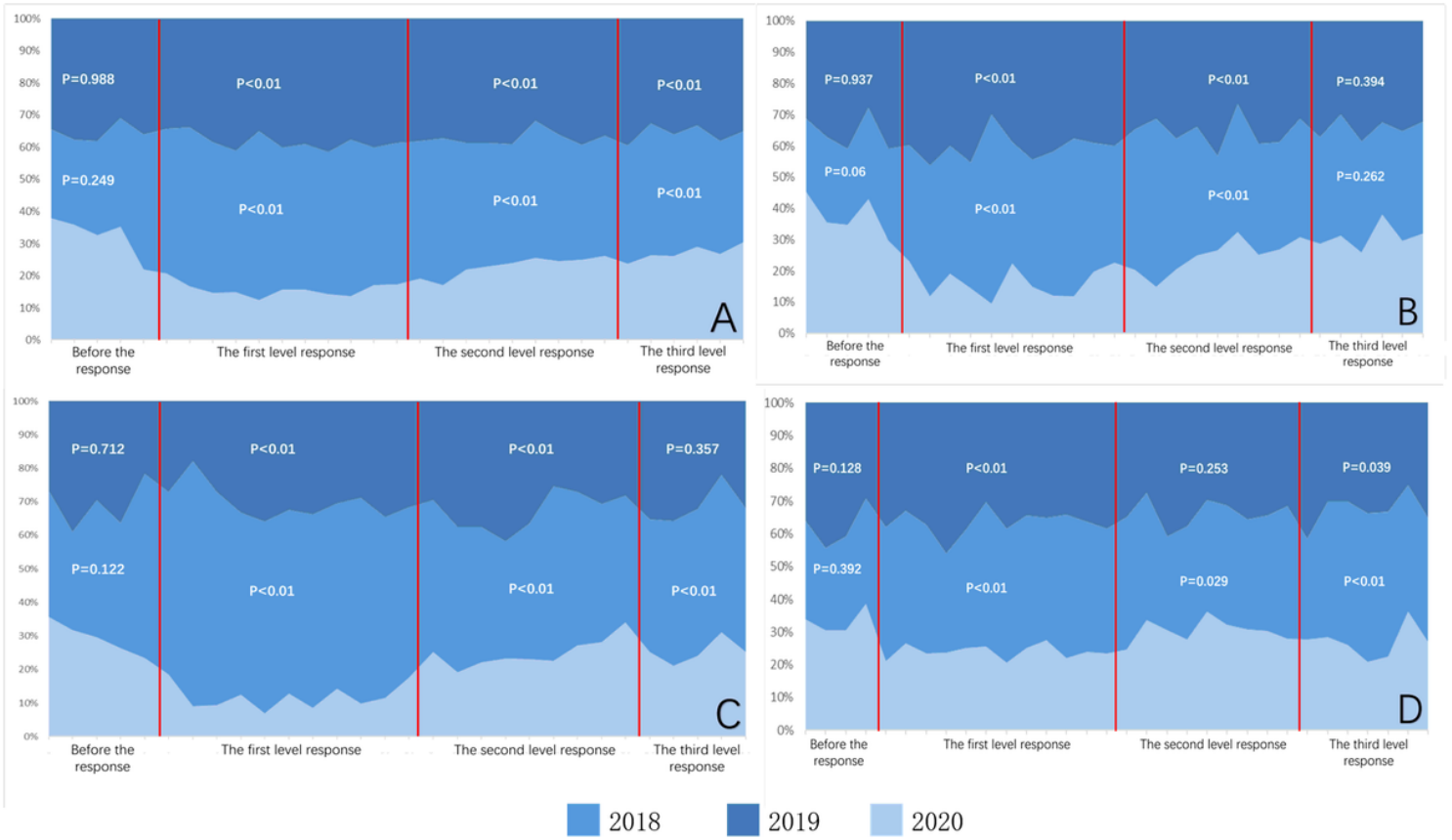
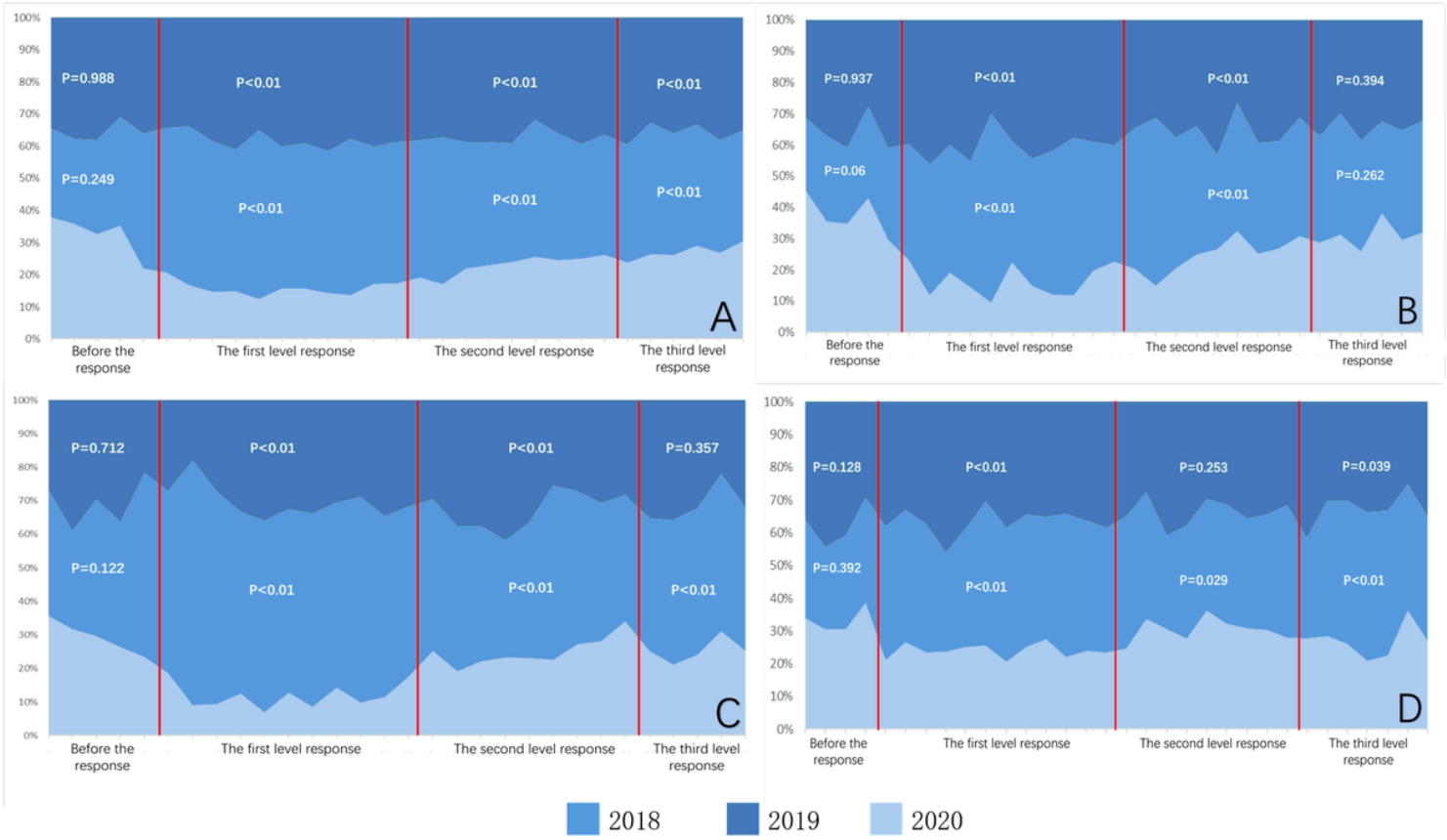


Figure 1

(A) Comparison of the total number of emergency cases in the last three years; (B) comparison of the total number of fractures in the last three years; (C) comparison of open injuries in the last three years; and (D) comparison of the number of radial head subluxations in the last three years.



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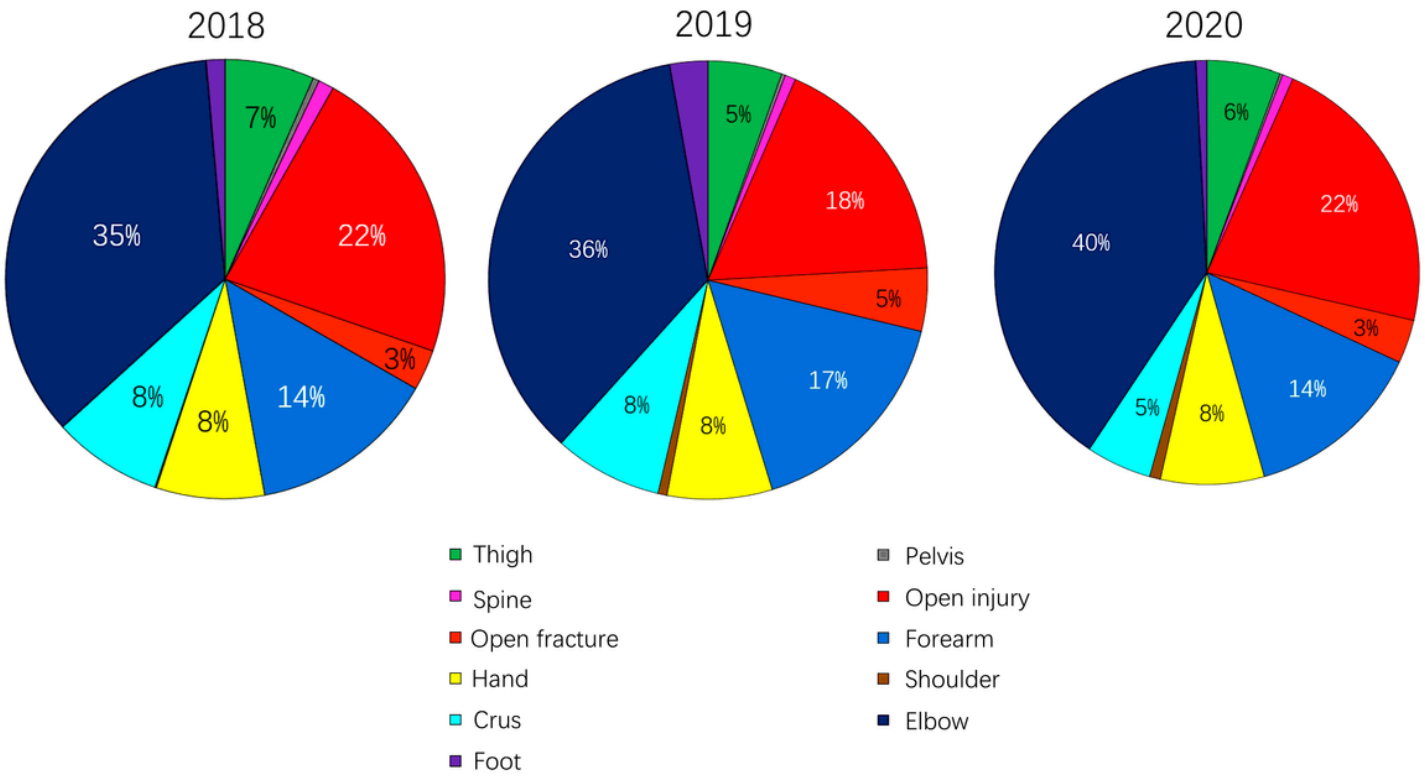
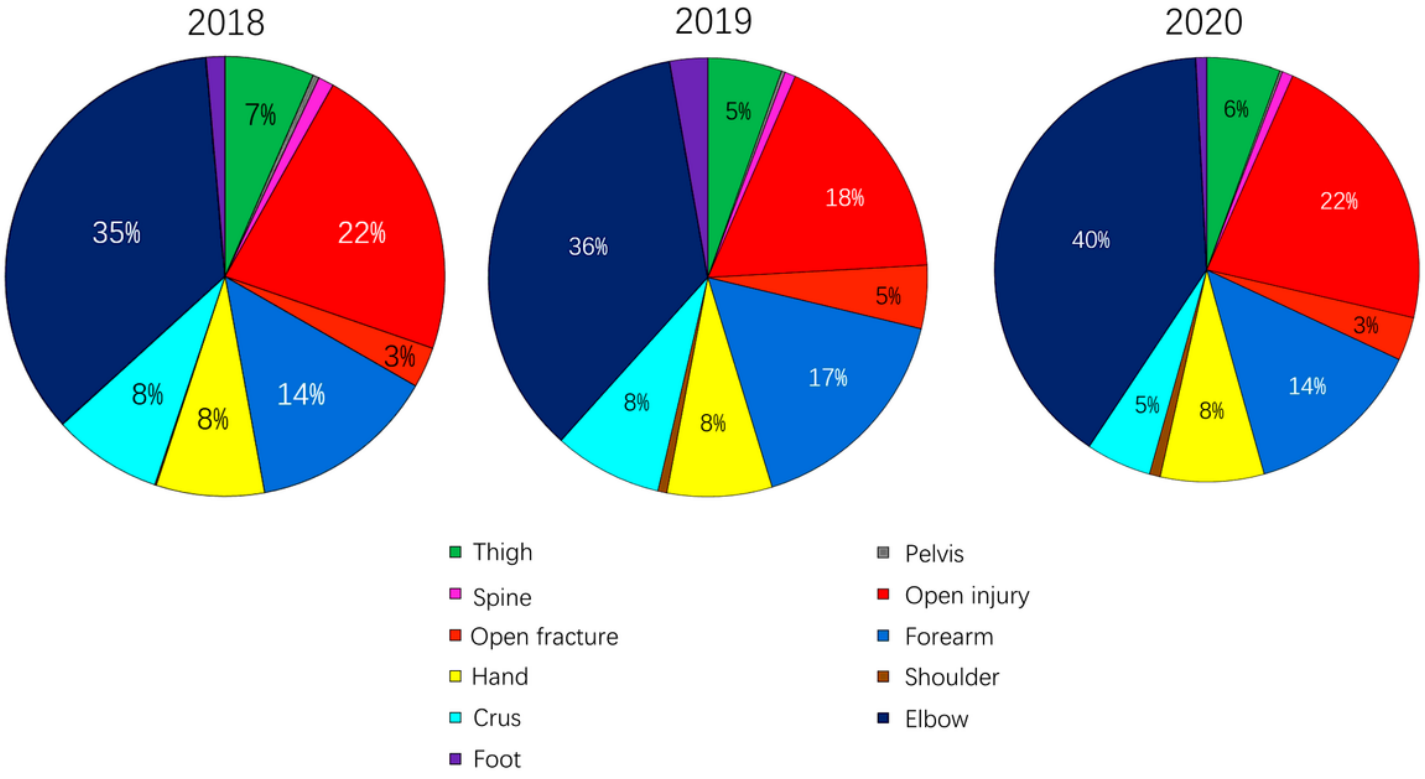


Figure 2

Injury spectrum of orthopedic emergency surgery in the last three years.



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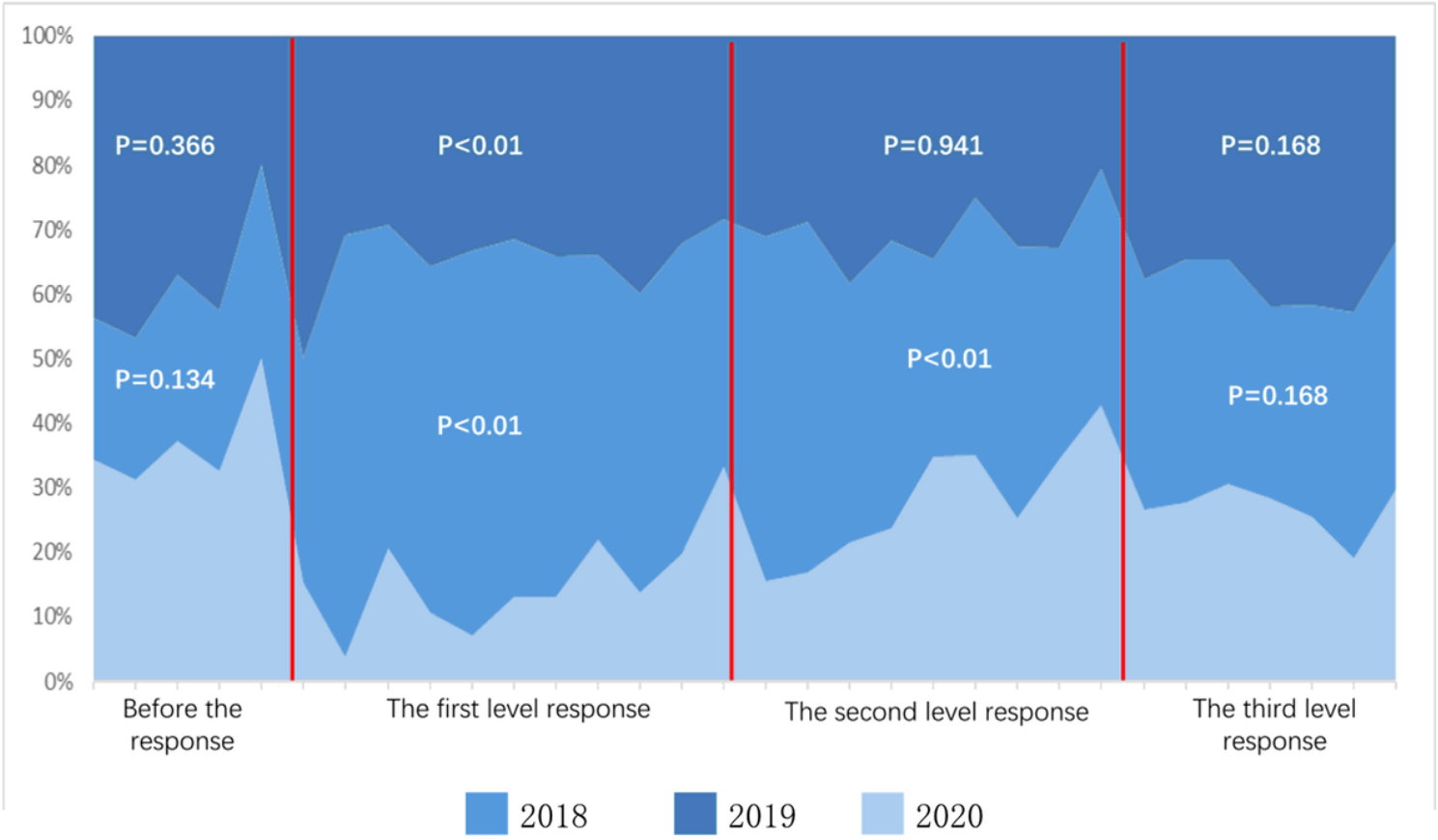
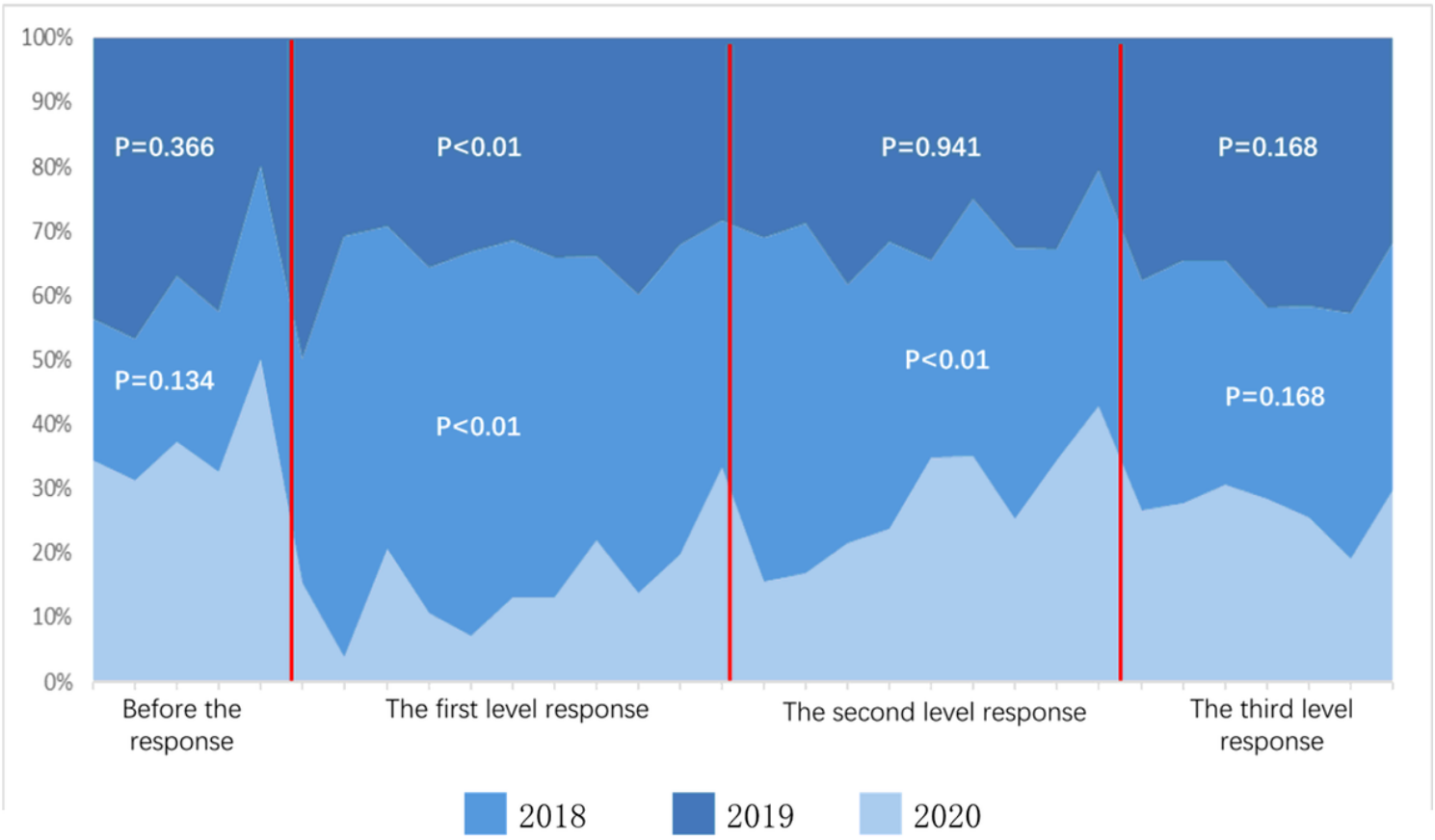


Figure 3

Summary of changes in the total number of emergency operations in the last three years.



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