

ORIGINAL ARTICLE

Characteristic changes of traumatic dental injuries in a teaching hospital of Wuhan under transmission control measures during the COVID-19 epidemic

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Abstract

Background/Aims: In December 2019, a novel coronavirus emerged in Wuhan City, and a retrospective analysis is necessary to provide clinicians with the characteristics of traumatic dental injuries (TDIs) during the epidemic. The aim of this study was to evaluate the changes in the characteristics of TDIs under the transmission control measures in Wuhan City utilizing an epidemiologic investigation.

Materials and method: In this retrospective study, epidemiologic information, including the number of patients, gender, age, and TDI parameters such as time since injury to the clinic visit, etiology, tooth location, and the type of injury was extracted from the records of patients in the hospital from two periods: period 1 (between January 23, 2020, and April 7, 2020) and period 2 (between January 23, 2019, and April 7, 2019). The data from the two periods were compared and analyzed.

Result: A total of 158 patients were treated for TDIs (120 in 2019 and 38 in 2020). Males were more likely to suffer from TDIs than females with a ratio of 1.5:1, both in 2020 and 2019. Other than that, there were characteristic changes in TDIs during the transmission control measures in the COVID-19 epidemic, which included the number of patients, age, time since injury to the clinic visit, etiology, tooth location and the type of TDI.

Conclusion: The transmission control measures during the COVID-19 epidemic had a significant impact on the epidemiology and etiology of TDIs in Wuhan City.

KEYWORDS

COVID-19, epidemiology, etiology, transmission control measures, traumatic dental injuries

1 | INTRODUCTION

Traumatic dental injuries (TDIs) are one of the most common oral health problems and present a significant public health problem worldwide,¹ which may be influenced by socioeconomic,

geographical, cultural, and environmental factors. However, epidemiological reports indicate the characteristics of TDIs have remained relatively consistent. Children and adolescents in general are more susceptible to these injuries than adults.² Etiologic factors are very much related to the age of the patient.¹ In adolescents and

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young adults, assaults and traffic accidents are the most common etiologic factors.³ In pre-school children, falls are the most common cause of oral injuries, whereas in school age children, injuries are most often caused by sports or hits by another person.¹ Dental trauma is most common in the anterior teeth and the upper central incisors in particular.^{4,5}

In December 2019, a novel coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in Wuhan City, Hubei Province, China.⁶ To prevent the novel coronavirus from proliferating further, China implemented national emergency response measures such as the suspension of municipal public transportation, closure of entertainment venues, and prohibition of public gatherings.⁷ The government shut down transit in and out of Wuhan City from 10:00AM on January 23rd, 2020, and orchestrated a massive lockdown with school and office closures, plus later strict stay-at-home orders centered around Wuhan. On April 8th, Wuhan City removed all travel restrictions in and out of the city after the outbreak was under control. However, as far as is known, no report has elucidated whether the transmission control measures during the COVID-19 epidemic had an impact on the epidemiology and etiology of TDIs.

As a result of the COVID-19 outbreak, many oral clinics across the world have issued a notice of suspension or delay in opening. An anonymous online survey of dentists practicing in Italy showed that all respondents reported practice closure or strong activity reduction, and the perception of this negative impact was accompanied by feelings of concern, anxiety and fear.⁸ However, critical oral care services for conditions such as acute toothache, TDI and maxillofacial trauma are still ongoing. Participants in dental practice face a significant risk of 2019-ncov infection due to face-to-face communication, exposure to saliva, blood and other body fluids, and sharp tools for handling.⁹ Many dental procedures can generate an aerosol, and the risk of airborne infection is considered high for dental practitioners.^{10,11} To provide clinicians with the characteristics of TDIs during the epidemic, a retrospective analysis is necessary. The aim of this study was to explore the characteristics of TDIs under the transmission control measures in Wuhan City during the COVID-19 epidemic utilizing an epidemiologic investigation.

2 | MATERIAL AND METHODS

All patients treated for TDIs in the Hospital of Stomatology at Wuhan University between January 23 and April 7 (2020 and 2019) were involved in this retrospective study. The hospital includes the largest patient center with oral and maxillofacial trauma in Hubei Province. To investigate the impact of transmission control measures on the epidemiology of TDIs, two distinct periods were defined: the period of transmission control measures during COVID-19 epidemic, from January 23, 2020, to April 7, 2020 (period 1), and the same period in the previous year, from January 23, 2019, to April 7, 2019 (period 2).

The variables included in the analyses were the following: basic demographic data regarding the number of patients (total, the monthly distribution of daily visits, and daily visits across days of the

week), gender, age, dental injury epidemiological data about the time since injury to the clinic visit, etiology, tooth location and the type of dental injuries. All of the data were collected from the patients' records.

Patients were classified into five agegroups (0-6, 7-12, 13-18, 19-59, and ≥ 60 years old). The time since injury to the clinic visit was classified into four groups (0-1 hour, 2-6 hours, 7-24 hours, 2-7 days, and >7 days). The type of TDI was classified according to the most serious tooth injury in each episode,¹² which included dental hard tissues injuries (enamel infraction, uncomplicated crown fracture, complicated crown fracture, crown-root fracture, root fracture), periodontal tissue injuries (concussion, subluxation, extrusive luxation, lateral luxation, intrusive luxation, avulsion), supporting bone injuries (alveolar fracture, jaw fracture) and gingival or oral mucosa injuries.

The data were entered into a spreadsheet in Microsoft Excel 2016 and imported into a statistical software package (SPSS version 26) for analysis. The co-investigators reviewed the data if any calibration was required. Continuous variables used were the mean and standard deviation to describe the data. Categorical variables of frequency and percentage were used to describe data. Independent t test was used to compare the average of daily visits by month from January to April. Chi-squared test was used for comparison of proportional analysis. The level of significance was set to 0.05 (two-sided). Any missing or unclear information was categorized as not reported.

3 | RESULTS

A total of 158 patients were treated for TDIs (120 in 2019 and 38 in 2020). A significant change was seen in the monthly distribution of daily visits in the two periods ($P < .01$). In 2020, the higher average daily visits by month was observed in March ($n = 0.9$), with the lower average daily visits in January ($n = 0.2$) and February ($n = 0.2$). In 2019, the lowest average daily visits by month presented in February ($n = 1.1$) (Table 1). The majority of patient visits occurred

TABLE 1 Distribution of patients by gender, month, mean age (\pm SD), and mean time since injury to the clinic visit (\pm SD) in 2019 and 2020 ($n = 158$, * = $P < .05$)

	2019 (n = 120)	2020 (n = 38)	P value
Gender			
Male	72 (60%)	23 (60.5%)	.954
Female	48 (40%)	15 (39.5%)	.954
Month			
Jan	22 (18.3%)	2 (5.3%)	.002**
Feb	34 (28.3%)	6 (15.8%)	.001**
Mar	55 (45.8%)	26 (68.4%)	.003**
Apr	9 (7.5%)	4 (10.5%)	.226
Mean age	26.3 \pm 17.6	21.6 \pm 20.9	.902
Mean time (h)	99.4 \pm 324.8	55.4 \pm 109.1	.042*

*** = $P < .01$

on weekdays (especially Monday and Friday) in 2019, with less patients on the weekends (Figure 1). The average daily visits on weekdays and weekends remained at the same level in 2020.

TDI were diagnosed in 95 males (60.1%) and 63 females (39.9%). The male/female ratio was about 1.5:1 in both 2020 and 2019 ($P > .05$, Table 1). The mean age of the patients was 21.6 years in 2020 and 26.3 years in 2019 ($P > .05$, Table 1). However, significant difference was only shown in the 0-6 year agegroup ($P < .01$) and the 19-59 year agegroup ($P < .05$) between the two periods. In 2019, those aged 19-59 (55.8%) were the majority, followed by 7-12 years old (20.0%) while in 2020 the majority of patients were aged 0-6 (36.8%) followed by those aged 19-59 (34.2%) years (Table 2).

The time since injury to the clinic visit in the two periods is displayed in Figure 2. The percentage of patients who visited the hospital

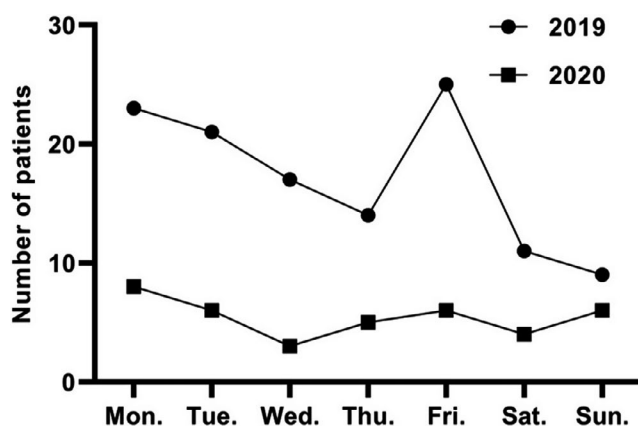


FIGURE 1 Changes in the number of patients across days of the week in 2019 and 2020

within 24 hours after trauma was 79.0% in 2020 and 72.7% in 2019 ($P > .05$). The percentage of patients visiting within one hour in 2020 was 15.8%, and 15.4% in 2019 ($P > .05$). There was a statistically significant difference in the mean time between the two periods, which was 55.4 hours in 2020 and 99.4 hours in 2019 ($P < .05$, Table 1).

In 2019, most TDIs were caused by falls (35.0%), traffic accidents (36.7%) and sporting accidents (18.3%). In 2020, approximately 89.5% of TDIs were caused by falls, followed by traffic accidents (7.9%). Other causes included occupational accident (period 2:5.0%; period 1:0%), interpersonal violence (period 2:4.2%; period 1:2.6%), and others (period 2:0.8%; period 1:0%). A statistically significant difference was found for falls ($P < .001$), traffic accidents ($P < .01$) and sporting injuries ($P < .01$) between the two periods (Table 2).

In terms of tooth location, the upper central incisors were the most commonly injured teeth both in primary teeth (period 1: $n = 14$, period 2: $n = 16$) and permanent teeth (period 1: $n = 26$, period 2: $n = 138$), followed by the upper lateral incisors. The number of teeth involved in posterior tooth trauma was four in 2019 and two in 2020. The patients suffered an average of 2.1 teeth injured in 2019 and an average of 1.5 teeth in 2020 (Figure 3).

In both period 1 and period 2, periodontal tissue injuries (51.8% and 46.8%, respectively) were the most common, followed by dental hard tissue injuries (28.6% and 28.2%, respectively), gingival or oral mucosa injuries (17.8% and 18.1%, respectively), and supporting bone injuries (1.8% and 6.9%, respectively). The most frequent injuries to the dental hard tissues were complicated crown fractures, which were 62.5% ($n = 10$ teeth) in 2020 and 44.3% ($n = 27$ teeth) in 2019. The predominant periodontal tissue injuries recorded were avulsion ($n = 24$ teeth, 23.8%) and subluxation ($n = 23$ teeth, 22.8%) in 2019, while in 2020 it was subluxation ($n = 9$ teeth, 31.0%). There

TABLE 2 Distribution of TDI causes according to patients' age-groups in 2019 and 2020 ($n = 158$, * = $P < .05$, ** = $P < .01$, *** = $P < .001$)

Age-group n (%)	Age-group n (%)					Total (%)
	0-6***	7-12	13-18	19-59*	60-77	
2019						
Fall***	14 (100.0)	11 (45.8)	4 (36.4)	13 (19.4)	0	42 (35.0)
Traffic accidents**	0	1 (4.2)	4 (36.4)	39 (58.2)	0	44 (36.7)
Sporting injuries**	0	12 (50.0)	3 (27.3)	7 (10.4)	0	22 (18.3)
Occupational accidents	0	0	0	6 (9.0)	0	6 (5.0)
Interpersonal violence	0	0	0	1 (1.5)	4 (100.0)	5 (4.2)
Others	0	0	0	1 (1.5)	0	1 (0.8)
Total	14 (11.7)	24 (20.0)	11 (9.2)	67 (55.8)	4 (3.3)	120 (100.0)
2020						
Fall***	13 (92.9)	5 (100.0)	3 (100.0)	10 (76.9)	3 (100.0)	34 (89.5)
Traffic accidents**	1 (7.1)	0	0	2 (15.4)	0	3 (7.9)
Sporting injuries**	0	0	0	0	0	0
Occupational accidents	0	0	0	0	0	0
Interpersonal violence	0	0	0	1 (7.7)	0	1 (2.6)
Others	0	0	0	0	0	0
Total	14(36.8)	5 (13.2)	3 (7.9)	13 (34.2)	3 (7.9)	38 (100.0)

was a higher occurrence of alveolar fractures in 2019 (n = 15 teeth, 6.9%) than in 2020 (n = 15 teeth, 1.8%) (Table 3).

In both the primary (2019: n = 11 teeth, 2020: n = 12 teeth) and mixed (2019: n = 3 teeth, 2020: n = 18 teeth) dentitions, periodontal tissue injuries were the most common, whereas in the permanent dentition, periodontal tissue injuries (n = 13 teeth) were most frequently seen in 2020. However, injuries to the dental hard tissues (n = 51 teeth) were mainly observed in 2019 (Figure 4).

4 | DISCUSSION

The transmission control measures resulted in strategic achievements in fighting COVID-19 in Wuhan. It was the largest attempted restriction or quarantine movement in human history to prevent the spread of an infectious disease. The aim of the study was to investigate the characteristic changes of TDIs under the transmission control measures during the COVID-19 epidemic, by comparing data

from the special period of this year with a historic sample from the same period of the previous year. The results showed that men were more likely to suffer from TDI than women both in 2019 and 2020. The male: female ratio of 1.5:1 in both periods 1 and 2 was similar to other studies.¹³⁻¹⁵ Other than that, the transmission control measures during the epidemic had an influence on the epidemiology of TDIs, which included the number of patients, age, time since injury to the clinic visit, etiology, tooth location, and the type of injuries.

The data showed that the number of patients can be a characteristic change of TDIs caused by varying circumstances. When comparing both periods in 2019 and 2020, a significant decrease in the total number of patients was seen under the transmission control measures. The monthly distribution of daily visits was high in March of the two periods. Work resumption and the start of the new semester accounted for this situation in 2019. This result represents the passage from an indoor life for children to outdoor life following their return from semester holiday.¹⁶ Compared with other months, there were more TDIs in March of 2020, which may be due to the traffic restrictions being partially lifted, and some patients had accumulated injuries in the previous two months. The incidence of TDIs was low in February of 2019, which may be related to the Spring Festival holiday in China. In addition, there were significant changes in the daily visits across days of the week. In 2019, the major prevalence of TDIs was on Mondays and Fridays, which was associated with intense social activity on weekdays. Interestingly, TDIs during weekends were the lowest. However, other studies have shown a different pattern with most TDIs occurring during weekends.^{17,18} This may be related to the different living habits of people in different regions. Due to the transmission control measures, the prevalence of TDIs in 2020 stayed at the same level across the days of the week.

Approximately three-fourths of the patients visited hospital within 24 hours in the two periods. It is common that patients request treatment after dental trauma on the same day of the accident.¹⁴ The average time since injury to the clinic visit in 2020 was shorter than that of 2019. Of note, most of the patients visited hospital within

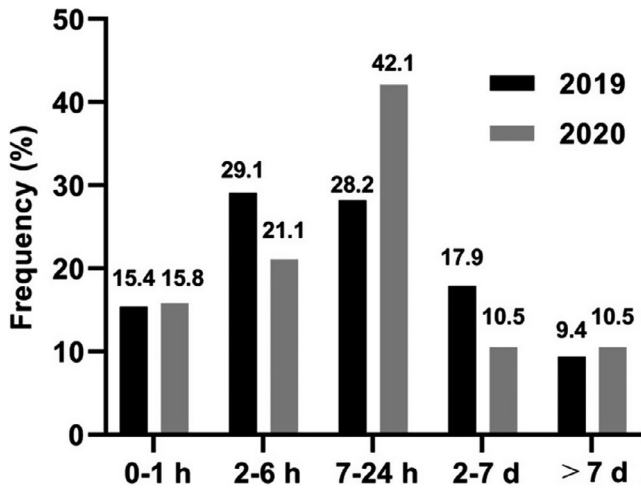


FIGURE 2 Distribution of the time since injury to the clinic visit in 2019 and 2020 (Missing = 3 patients, P = .562)

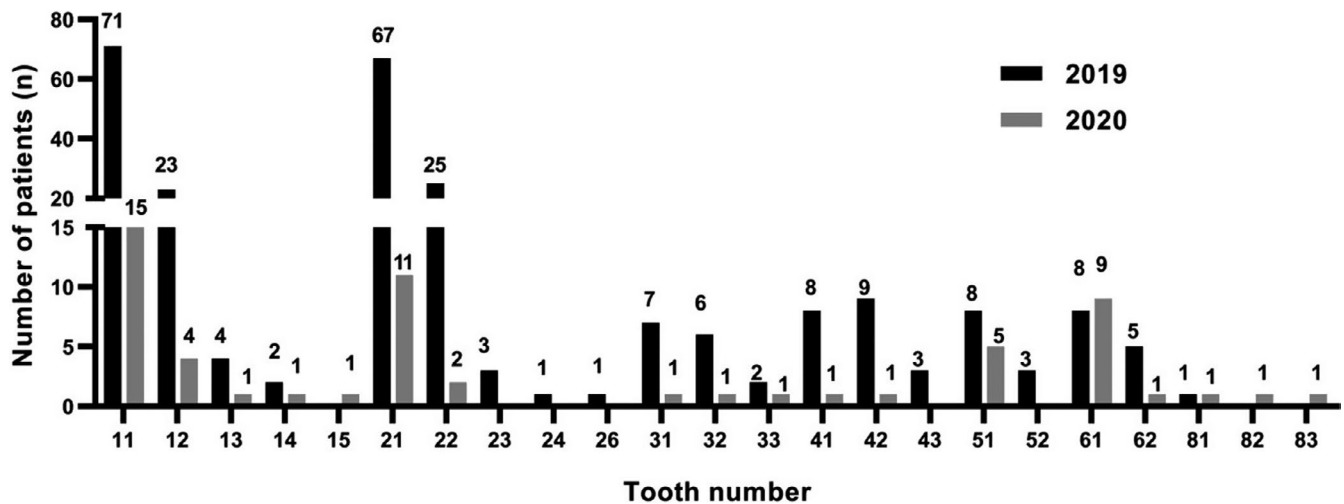


FIGURE 3 Distribution of dental trauma for different teeth

one hour, which was due to the strict stay-at-home orders under the transmission control measures. The citizens in quarantine were not dominated by other things. Therefore, patients could go to the hospital directly when a TDI occurred.

Although the mean age of the patients in the two periods was similar, the proportion of patients in different age-groups changed greatly. In 2020, the high proportion of fall injuries was a remarkable finding, and children aged 0-6 were the majority. The possible explanation is that the children stayed at home with limited living space, and their self-protection awareness was worse than that of adults. This led to an increased risk of TDIs in children aged 0-6. The etiology of TDIs was closely related to the age of the patient.

This study indicated that the prevalence of traffic accidents was highest in 2019, which was mainly distributed among adults aged 19-59. In the developing world, traffic accidents are the most common cause of injuries, as shown in many studies.^{1,19} Due to the implementation of traffic control measures, it is not surprising that the proportion of TDIs caused by traffic accidents decreased greatly in 2020.

The TDIs caused by sports took place most frequently among schoolchildren in the 7-12 age-group in 2019. There were no sports injuries in 2020, which was attributed to people being quarantined at home without outdoor activities. The similar situation was

observed in the TDIs related to occupational accidents and interpersonal violence. Under the transmission control measures, Wuhan orchestrated a massive lockdown with factory and office closures and strict stay-at-home orders to limit the contact of people.

The upper central incisors were injured more frequently than any other tooth in both the primary and permanent dentitions, which is consistent with other studies.^{18,20} The reason is their location in the dental arch, making them more vulnerable to injury. The occurrence of posterior tooth injuries is related to the causes, especially in traffic accidents. The number of teeth involved in posterior tooth trauma was also reduced in 2020 due to fewer traffic accidents. Furthermore, an average of 0.3 fewer teeth were involved per accident in 2020 than in 2019, which indicated that traffic control measures had an impact on the severity of TDIs.

The frequency of TDIs in 2019 was considerably higher than that in 2020, whether in the primary, mixed or permanent dentitions. This was related to all people being quarantined at home. Compared with 2019, the proportion of dental tissue and periodontal tissue injury increased in 2020, whereas the proportion of soft tissue and supporting bone injuries decreased in 2020. All these results demonstrate that the severity of TDIs can be reduced by transmission control measures.

Complicated crown fractures were the most common dental tissue injuries in the two periods. Most TDIs involved the anterior teeth. Anterior teeth that are fully erupted are more prone to complicated crown fractures, and teeth that are partially erupted tend to have uncomplicated crown fractures. Crown fractures in the posterior region are usually uncomplicated, mainly involving the cusps, due to the protection of the jaw bone and facial soft tissues.

Periodontal tissue injuries in the primary and mixed dentitions were more common than the other three tissue injuries in the two periods. The most frequent type of periodontal tissue injuries was avulsion and subluxation in 2019, whereas in 2020 the most frequent was subluxation. This finding is in accordance with previous studies.²¹⁻²³ It has been reported that the reason why periodontal tissue injury was more common in the primary and mixed dentitions is related to the surrounding bone which is less mineralized.²⁴ The reduction in the proportion of avulsion injuries in 2020 was associated with the quarantine with restricted activities. Interestingly, as for the permanent dentition, periodontal tissue injuries were most frequently seen in 2020, but injuries to the dental tissues were mainly observed in 2019. A possible explanation for this may be that the majority of injuries in 2020 were among children aged 0-6 years, who tend to have luxation injuries. Conversely, permanent tooth injuries often result in tooth fracture.

TABLE 3 Types of TDI in 2019 and 2020

	2019 (n = 216)	2020 (n = 56)
Dental hard tissues	61 (28.2%)	16 (28.6%)
Enamel infraction	4 (6.5%)	0 (0)
Uncomplicated crown fracture	19 (31.1%)	2 (12.5%)
Complicated crown fracture	27 (44.3%)	10 (62.5%)
Crown-root fracture	6 (9.8%)	4 (25.0%)
Root fracture	5 (8.2%)	0 (0)
Periodontal tissues	101 (46.8%)	29 (51.8%)
Concussion	18 (17.8%)	3 (10.3%)
Subluxation	23 (22.8%)	9 (31.0%)
Extrusive luxation	20 (19.8%)	5 (17.2%)
Lateral luxation	10 (9.9%)	3 (10.3%)
Intrusive luxation	6 (5.9%)	4 (13.8%)
Avulsion	24 (23.8%)	5 (17.2%)
Supporting bone	15 (6.9%)	1 (1.8%)
Gingival or oral mucosa	39 (18.1%)	10 (17.8%)

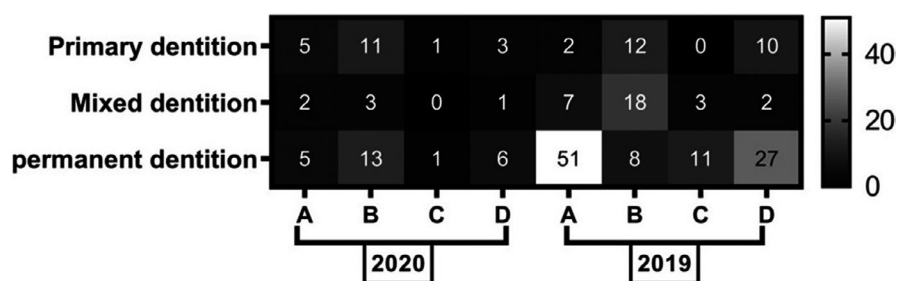


FIGURE 4 Types of TDI in the primary, mixed, and permanent dentitions. A. Dental hard tissues injuries; B. Periodontal tissue injuries; C. Supporting bone injuries; D. Gingival or oral mucosal injuries

In previous studies, the frequency of soft tissue injuries was reported to be 59.1%¹⁴ and 21%.¹⁶ In this study, it was 19.9% in 2019 and 18.52% in 2020. Soft tissue injuries heal within approximately 1 week, and most patients will not seek medical or dental services. Due to the outbreak of the epidemic and people's lack of attention to soft tissue injuries, the proportion of soft tissue injuries was reduced to a certain extent in 2020.

Alveolar fractures were rare in 2020. According to one study, adult dentoalveolar trauma most often occurs because of sports activities and traffic accidents.²⁵ One study showed that alveolar fractures most commonly occurred between 15 and 25 years of age.²⁶ Obviously, the transmission control measures greatly reduced the incidence of alveolar fractures.

In summary, there has been limited research on TDIs during the COVID-19 epidemic, and there are inherent limitations in this retrospective study. The data in this study were limited to one hospital. Although the hospital includes the largest patient center with oral and maxillofacial trauma in Hubei Province, the study could not show the full view of TDIs in Wuhan City. In addition, the statistical data may be misleading because of the high discrepancy between the numbers of patients treated in 2019 and 2020. However, the conclusion can still be drawn that the transmission control measures during the COVID-19 epidemic had a significant impact on the epidemiology and etiology of TDIs in Wuhan City. This study has provided much-needed information regarding the characteristic changes of TDIs in this special period.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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