# Epidemiologic Changes of Facial Bone Fracture before and after Coronavirus Disease 2019: A Level 1 Trauma Center in Korea

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## Abstract

**Background** The coronavirus disease 2019 (COVID-19) outbreak has had a major impact worldwide. Several countries have implemented restrictions on social interaction ("social distancing"). Several studies have reported that the epidemiology of trauma patients, such as those with facial bone fractures, has changed after COVID-19 pandemic. This study aimed to further explore these specific changes.

**Methods** This was a retrospective study of patients who presented to a single institution with facial bone fractures between January 1, 2016, and December 31, 2020. Baseline patient demographics, clinical information, type of fracture, etiology, and operative management were compared before and after COVID-19.

**Results** Of all cases, 3,409 occurred before COVID-19, and 602 occurred after COVID-19. Since the outbreak of COVID-19, the number of patients with facial fractures has not decreased significantly. A significant increase was noted in fractures that occurred outdoors ($p < 0.001$). However, a decrease was observed in operative management between the groups ($p < 0.001$). There was no significant difference in the proportion of assault, fall-down, industrial accident, or roll-down. In contrast, the proportion of traffic accidents and slip-down categories increased significantly ($p < 0.05$). Moreover, a significant decrease was found in the proportion of the sports category ($p = 0.001$)

**Conclusions** It was confirmed through this study that COVID-19 pandemic also affected epidemiology of facial fractures. Focusing on these changes, it is necessary to develop safety measures to reduce facial fractures.

**Keywords**
- bone fracture
- epidemiology
- pandemic

## Introduction

In March 2020, the World Health Organization officially declared the outbreak of coronavirus disease 2019 (COVID-19) as a pandemic.[1] As of November 2021, there have been more than 257.4 million cases of COVID-19 infection worldwide and 5.15 million deaths attributed to the virus.[2] In an effort to stop COVID-19 after obtaining "pandemic" classification in March 2020, countries around the world implemented "social distancing," including home quarantine and curfews.[3] These

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public health measures reduced activity levels and exposure to sunlight, resulting in weakened bones and easier fractures.[4] Due to the direct influence of COVID-19, major changes in public behavior patterns have led to changes in regularly observed injury patterns (e.g., fear of going out and meeting people, change in shopping patterns).[5–9] Several trauma institutions have reported that the number of trauma patients, such as those with facial bone fractures, has decreased after COVID-19.[10,11] Since COVID-19 pandemic, the cause of facial fractures has also changed. Although there are differences due to regional and cultural differences, etiology has also changed due to changes in falls, traffic accidents, and sports injuries.[12,13] However, there have been few analyses on the trend or cause of this. This study aimed to confirm the epidemiological and etiological changes in facial bone fractures before and after the COVID-19 pandemic in patients who visited our hospital within the past 5 years.

## Materials and Methods

This was a 5-year retrospective study of patients who presented to a single institution with facial bone fractures. Our hospital is a tertiary trauma center that covers a wide area in the eastern and central parts of Korea. All patients selected through medical record analysis had at least one radiologically proven fracture of a facial bone between January 1, 2016, and December 31, 2020. Approval for this study was granted by the Institutional Review Board of our hospital (details blinded for peer review). Written informed consent was obtained from all the study participants.

Baseline patient demographics, clinical information, type of fracture (nasal, maxillary, zygomaticomaxillary complex, orbital floor, other orbital, mandible, frontal sinus, LeFort, nasoorbitoethmoid, or panfacial), cause of injury, and operative management were recorded. Traffic accidents included injuries from cars, motorcycles, bicycles, and electric scooters. Slip-down included cases of being injured by falling or bumping after drinking. Based on the declaration date of the COVID-19 pandemic on March 11, 2020, the patient groups were divided into before and after groups and compared. Statistical comparisons before and after COVID-19 were performed by *t*-test and chi-squared test, Fisher's exact test, and Poisson regression analysis using R software version 4.0.4 (R Foundation for Statistical Computing, Vienna, Austria). Statistical significance was set at $p$ less than 0.05.

## Results

The total number of patients who received treatment at our hospital for facial bone fractures between 2016 and 2020 was 4,011. ►**Table 1** shows the description of the cohort by mean age, sex, cognitive impairment, psychosis, cerebral infarction, site of injury, and operative management sustained per group. Of the cases, 3,409 were before COVID-19 and 602 were after COVID-19. There was a significant age difference between the groups; the patients in the before-COVID-19 group were younger than those in the after-COVID-19 group ($43.4 \pm 19.8$ versus $48.6 \pm 20.1$, respectively) ($p < 0.001$). No statistical difference was noted between the two groups regarding gender or past history that could affect trauma. However, the proportion of patients with psychosis increased with a $p$-value of 0.05, and a significant increase was observed in fractures that occurred outdoors ($p < 0.001$). However, a decrease was found in operative management between the groups ($p < 0.001$, ►**Table 1**). When analyzing differential distribution of the prevalence of fracture cases based on Poisson regression, the number of patients before the COVID-19 outbreak was significantly high (coefficient: –0.858, 95% confidence interval [CI]: –1.179––0.537, $p$-value $< 0.001$), compared with those after the outbreak (►**Fig. 1**). However, the fracture cases in January 2016 exhibited a remarkably high prevalent numbers compared with other times; therefore, we considered it as outlier. After removing the cases in January 2016, the number of fracture cases did not differ before and after the COVID-19 outbreak (coefficient: –0.334, –0.686–0.019, $p$-value: 0.063). In addition, no significant difference was noted between the two groups as regards the type of fracture, except for LeFort fractures (95% CI: 1.018–1.129, $p$-value $= 0.002$, ►**Table 2**, ►**Supplemental Table S1**, available in the online version). No statistical difference was observed in the proportions of assault, fall-down, industrial accident, or roll-down. In contrast, the proportion of traffic accidents increased significantly

**Table 1** General characteristics of the study population ($n = 4{,}011$)

| Variables | Before COVID-19 | | After COVID-19 | | *p*-Value |
|---|---|---|---|---|---|
| | *n* | % | *n* | % | |
| | **3,409** | **85.0** | **602** | **15.0** | |
| Age (years), mean ± SD | 43.4 ± 19.8 | | 48.6 ± 20.1 | | <0.001[a] |
| **Sex** | | | | | |
| Male | 2,613 | 76.7 | 482 | 80.1 | 0.066 |
| Female | 796 | 23.3 | 120 | 19.9 | |
| **Cognitive impairment** | | | | | |
| Yes | 37 | 1.1 | 7 | 1.2 | 0.867 |
| No | 3,372 | 98.9 | 595 | 98.8 | |
| **Psychosis** | | | | | |
| Yes | 28 | 0.8 | 10 | 1.7 | 0.050 |
| No | 3,381 | 99.2 | 592 | 98.3 | |
| **Cerebral infarction** | | | | | |
| Yes | 19 | 0.6 | 5 | 0.8 | 0.423 |
| No | 3,390 | 99.4 | 597 | 99.2 | |
| **Site** | | | | | |
| Outside | 2,562 | 75.2 | 529 | 87.9 | <0.001[a] |
| Indoor | 847 | 24.8 | 73 | 12.1 | |
| **Operation** | | | | | |
| Yes | 1,520 | 44.6 | 210 | 34.9 | <0.001[a] |
| No | 1,889 | 55.4 | 392 | 65.1 | |

Abbreviations: COVID-19, coronavirus disease 2019; SD, standard deviation. *t*-test and chi-squared test were used. [a]Significant at 95% confidence level.

 

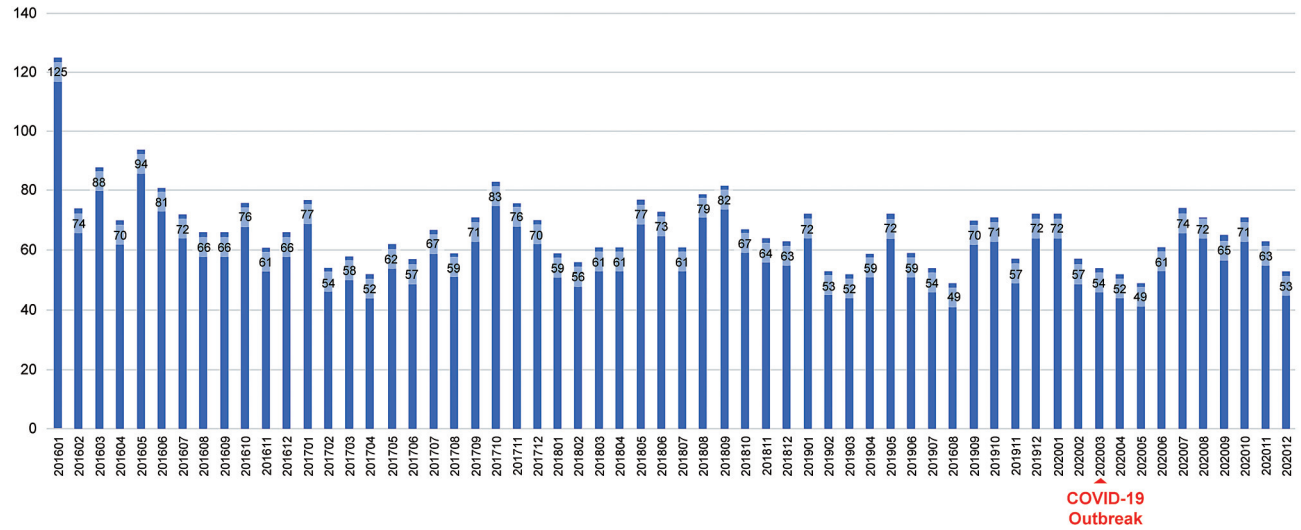


**Fig. 1** Number of facial bone fracture patients per month. COVID-19, coronavirus disease 2019.

(95% CI: 1.000–1.058, $p$-value = 0.042) and slip-down categories also increased significantly (95% CI: 0.001–1.018, $p$-value = 0.001). However, the proportion of the sports category decreased significantly (95% CI: 0.898–0.961, $p$-value = 0.001, ►**Table 3**, ►**Supplemental Table S1**, available in the online version ).

## Discussion

COVID-19 has resulted in widespread changes to a relatively sedentary lifestyle and decreased exposure to light (vitamin D deficiency). A consequence of stay-at-home policies is a negative change in bone health and environmental surroundings that has led to age-related changes in the number of traumatic bone fractures.[4]

Despite these changes after COVID-19 pandemic, the occurrence of facial fractures did not decrease. The reason for this is that most outdoor sports have decreased, but it can be thought of as an increase in new means of transportation (e.g., electric scooters) and an increase in alcohol consumption.[14–17]

However, the average age of injuries has increased, which may have affected the decline in sports, where young people are mainly injured, and alcohol consumption is only available for adults, so this may have affected it. Furthermore, because of social distancing policies, the etiology of facial bone fractures has changed. Outdoor activities, such as vigorous exercise, decreased, and the occurrence of facial fractures subsequently decreased. However, there was an increase in fractures occurring outdoors rather than indoors due to a significant increase in slip-down injuries and traffic accidents. Slip-down injuries likely increased as a result of excessive alcohol consumption; hazardous alcohol use increased for those under lockdown compared with those not under restrictions.[14,15]

A few possible reasons for the increase in facial bone injuries due to traffic accidents have been identified. The use of electric kickboards in Korea has increased rapidly in recent years, resulting in increased fractures.[16,17] The greater use of kickboards was possibly due to a reluctance to use public transportation and a desire to avoid crowded spaces. For an accurate analysis, additional data should be recorded and reflected in future studies.

The reason for the decrease in surgical treatment is that hospitals are very crowded places, and people are reluctant to visit and even be admitted to hospitals because of the fear of COVID-19. In addition, before hospitalization for surgery, there were cases where COVID-19 was confirmed and the appropriate surgery period was missed due to isolation treatment.

Among the types of facial fractures, the only one that was statistically significant was the LeFort fracture, which may be caused by high-energy trauma (e.g., traffic accidents). However, in the similar case of panfacial fracture, no significant difference was noted; hence, it is believed that additional etiologic analysis is necessary.

This study had several limitations. First, it was conducted in a single institution; thus, representativeness may be low. Second, the study period did not include the full 1-year period after the COVID-19 pandemic declaration. In Korea, there are four distinct seasons, and there may be seasonal differences in the occurrence of facial bone fracture. Therefore, since the after-COVID-19 group does not reflect all seasons, the epidemiology of facial fractures may not account for changes depending on the season. Finally, the COVID-19 pandemic has become more severe over time. Social distancing policies have also become stricter, and further studies are needed to understand the effects of updated circumstances.

The COVID-19 pandemic has significantly changed the lifestyles of people around the world. For example, changes in alcohol consumption and means of transportation occurred as a result of the pandemic. This study confirmed that the epidemiology and etiology of facial fractures also changed. Because of these changes, it is necessary to prepare policies and safety measures to reduce facial fractures.

 

**Table 2** Facial bone fracture type ($n = 4,011$)

| Variables | Before COVID-19 | | After COVID-19 | | *p*-Value |
|---|---|---|---|---|---|
| | *n* | % | *n* | % | |
| | **3,409** | **85** | **602** | **15** | |
| **Nasal** | | | | | |
| Yes | 1,487 | 43.6 | 240 | 39.9 | 0.087 |
| No | 1,922 | 56.4 | 362 | 60.1 | |
| **Maxillary** | | | | | |
| Yes | 56 | 1.6 | 12 | 2 | 0.539 |
| No | 3,353 | 98.4 | 590 | 98 | |
| **ZMC** | | | | | |
| Yes | 439 | 12.9 | 67 | 11.1 | 0.265 |
| No | 2,970 | 87.1 | 535 | 88.9 | |
| **Orbital floor** | | | | | |
| Yes | 301 | 8.8 | 53 | 8.8 | 0.984 |
| No | 3,108 | 91.2 | 549 | 91.2 | |
| **Other orbital** | | | | | |
| Yes | 490 | 14.4 | 100 | 16.6 | 0.153 |
| No | 2,919 | 85.6 | 502 | 83.4 | |
| **Mandible** | | | | | |
| Yes | 281 | 8.2 | 46 | 7.6 | 0.619 |
| No | 3,128 | 91.8 | 556 | 92.4 | |
| **Frontal** | | | | | |
| Yes | 27 | 0.8 | 7 | 1.2 | 0.36 |
| No | 3,382 | 99.2 | 595 | 98.8 | |
| **LeFort** | | | | | |
| Yes | 215 | 6.3 | 59 | 9.8 | 0.002[a] |
| No | 3,194 | 93.7 | 543 | 90.2 | |
| **NOE** | | | | | |
| Yes | 4 | 0.1 | 2 | 0.3 | 0.224[b] |
| No | 3,405 | 99.9 | 600 | 99.7 | |
| **Panfacial** | | | | | |
| Yes | 109 | 3.2 | 16 | 2.7 | 0.482 |
| No | 3,300 | 96.8 | 586 | 97.3 | |

Abbreviations: COVID-19, coronavirus disease 2019; NOE, naso-orbito-ethmoidal; ZMC, zygomaticomaxillary.
[a]Statistically significant $p < 0.05$.
[b]Fisher's exact test.

**Table 3** Cause of injury ($n = 4,011$)

| Variables | Before COVID-19 | | After COVID-19 | | *p*-Value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| | **3,409** | **85.0** | **602** | **15.0** | |
| **Traffic accident** | | | | | |
| Yes | 755 | 22.1 | 157 | 26.1 | 0.042[a] |
| No | 2,654 | 77.9 | 445 | 73.9 | |
| **Assault** | | | | | |
| Yes | 612 | 18.0 | 91 | 15.1 | 0.106 |
| No | 2,797 | 82.0 | 511 | 84.9 | |
| **Fall-down** | | | | | |
| Yes | 304 | 8.9 | 54 | 9.0 | >0.999 |
| No | 3,105 | 91.1 | 548 | 91.0 | |
| **Industrial accident** | | | | | |
| Yes | 167 | 4.9 | 20 | 3.3 | 0.114 |
| No | 3,242 | 95.1 | 582 | 96.7 | |
| **Roll-down** | | | | | |
| Yes | 126 | 3.7 | 18 | 3.0 | 0.463 |
| No | 3,283 | 96.3 | 584 | 97.0 | |
| **Slip-down** | | | | | |
| Yes | 933 | 27.4 | 207 | 34.4 | 0.001[a] |
| No | 2,476 | 72.6 | 395 | 65.6 | |
| **Sports** | | | | | |
| Yes | 291 | 8.5 | 26 | 4.3 | 0.001[a] |
| No | 3,118 | 91.5 | 576 | 95.7 | |
| **Others** | | | | | |
| Yes | 221 | 6.5 | 29 | 4.8 | 0.138 |
| No | 3,188 | 93.5 | 573 | 95.2 | |

Abbreviation: COVID-19, coronavirus disease 2019.
Chi-square test was used. [a]Statistically significant $p < 0.05$.

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Authors' Contributions
J.K. conceptualized this study. J.H.K. contributed to data curation. J.H.K. did formal analysis. J.H.K. investigated the study. C.E.Y., S.W.K., and J.K. were involved in methodology. S.W.K., and C.E.Y. did the project administration. C.E.Y., S.W.K., and J.K. helped in providing resources. J.H.K. helped in providing software. C.E.Y., S.W.K., and J.K. supervised the study. S.W.K. and J.K. validated the study. J.H.K. contributed to visualization. J.H.K. wrote the original draft. J.K. reviewed and edited the manuscript. All the authors provided approval of final manuscript.

Ethical Approval
The study was approved by the Institutional Review Board of Wonju Severance Christian Hospital (IRB CR321049) and performed in accordance with the principles of the Declaration of Helsinki. The informed consent was waived because this study design is a retrospective chart review.

Conflict of Interest
None declared.

 

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