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Analysis of maxillofacial fracture victims in the Wenchuan earthquake and Yushu earthquake

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Abstract – *Objective:* To analyze retrospectively 419 patients after the Wenchuan earthquake and 46 after Yushu earthquake with maxillofacial fractures so as to provide reference on patients' treatment after an earthquake. *Method:* We investigated 419 patients after Wenchuan earthquake and 46 after Yushu earthquake with maxillofacial fractures who were admitted to the West China Hospital of Stomatology and other 46 hospitals in 10 provinces. *Result:* A total of 58 patients had maxillofacial fractures (13.8%) including 33 (56.9%) men and 25 (43.1%) women after the Wenchuan earthquake and 6 (13%) had maxillofacial fractures after Yushu earthquake. Most patients were injured by pressing or burying. The nasal-orbital-ethmoidal region was the most frequent site of the maxillofacial fracture (58.6% in the Wenchuan earthquake and 66.7% in the Yushu earthquake). The most prevalent pattern of maxillofacial fracture was multiple and/or comminuted fractures (87.9% in the Wenchuan earthquake and 100% in the Yushu earthquake). There were 48 (82.8%) patients with associated injuries, and the most common site was extremity injuries (58.6%) after Wenchuan earthquake. Few patients received adequate prehospital treatment, with bandages predominantly. Most patients (65.5% in the Wenchuan earthquake and 100% in the Yushu earthquake) underwent open reduction and rigid internal fixation. We failed to find any patients with generalized infection. However, all patients in our study presented the symptoms of post-traumatic stress disorder. *Conclusion:* We analyze the characteristics of maxillofacial fractures after the two earthquakes, so as to improve our medical emergency system when such disasters happen again.

The Wenchuan earthquake, occurring at 14:28 PM on May 12th, 2008, and measuring 8.0 on the Richter scale, struck most areas of Sichuan province, China (location shown in Fig. 1). It was considered as the gravest earthquake in China since the foundation of New China. The Chinese Ministry of Civil Affairs reported that deaths from this devastating earthquake rose to nearly 70 000. More than 370 000 people were severely injured, and more than 18 000 people were reported missing. Unfortunately, another strong earthquake attacked Yushu district, Qinghai Province, in the early morning of April 14th, 2010, which caused more than 2000 lives lost and over 100 000 injured.

A previous study suggested that major disasters should be followed by an increase in the incidence of complex injuries in victims (1). The collection and interpretation of earthquake injury data provide important information for clinicians, institutions, and governments related to the population's health and injury sustained in an earthquake. Attention should also be paid to the medical burden of such disasters, which is important for planning the effective use of limited hospital resources. The study of earthquake-related trauma is important for overall medical response to earthquake to provide references for emergency treatment and reduce the injuries during an earthquake in the future.

Although many articles about earthquake deaths, musculoskeletal injuries, and community hospital medical response have appeared on the Internet (2–5), we did not find many publications on earthquake-related maxillofacial injuries. In this article, we retrospectively investigated 58 victims with maxillofacial fractures after the Wenchuan earthquake and six patients with maxillofacial fractures after Yushu earthquake in the West China Hospital of Stomatology at the West China Medical Center in Chengdu, which is located at the southeast of the seismic center <160 km (location shown in Fig. 1), and other 46 hospitals from 10 provinces. The objective of this study is to analyse the clinical characteristics of earthquake-related maxillofacial fracture victims in China and present recommendations on prevention and management, so that the limited resources can be effectively targeted to the needs of the population.

Patients and methods

We examined the medical records of the 419 patients after Wenchuan earthquake and 46 patients after Yushu earthquake with earthquake-related maxillofacial injuries who were admitted to the West China Hospital of Stomatology and other 46 hospitals in 10 provinces. Of them all, a total of 58 patients in the Wenchuan

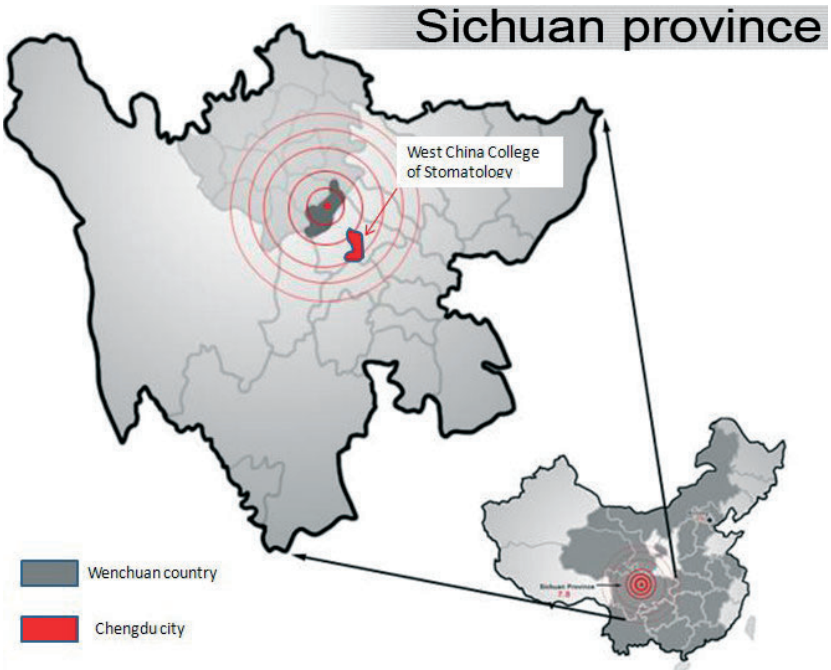

Fig. 1. Map showing epicenter of 2008 Wenchuan earthquake and the location of West China Hospital of Stomatology.

earthquake and six patients in the Yushu earthquake who suffered from maxillofacial fractures were included in our research. Patients with simple dental injuries or dentoalveolar injuries were not included. We designed a record form to collect patients' information including patient age, gender, psychologic status, etiology, anatomic sites, and patterns of fractures, associated injuries, prehospital management, complications, and psychologic status. Every patient with maxillofacial injuries had been given proper examinations such as X-rays or computed tomography to make clinical diagnosis clear and exact. The protocol of the study was reviewed by the Institutional Review Board (IRB) of the West China Medical Center, Sichuan University, China, and each subject in the project signed a detailed informed consent form.

Results

Maxillofacial fractures after the Wenchuan earthquake

Of the 419 patients, 58 patients (13.8%) experienced maxillofacial fracture injuries. Of those patients, 33 (56.9%) were men and 25 (43.1%) were women, ranging in the age from 7 to 90 years (Fig. 2). The majority of patients were between 11 and 40 years old, while the patients older than 80 years or younger than 10 years accounted for a small proportion. We put injury etiology into four categories, pressing or burying, blunt force, tumbling, and falling. Most were caused by pressing or burying (35/58, 60.3%); injury caused by other three mechanisms (blunt force, tumbling, and falling injuries) accounted for 39.7% (23/58).

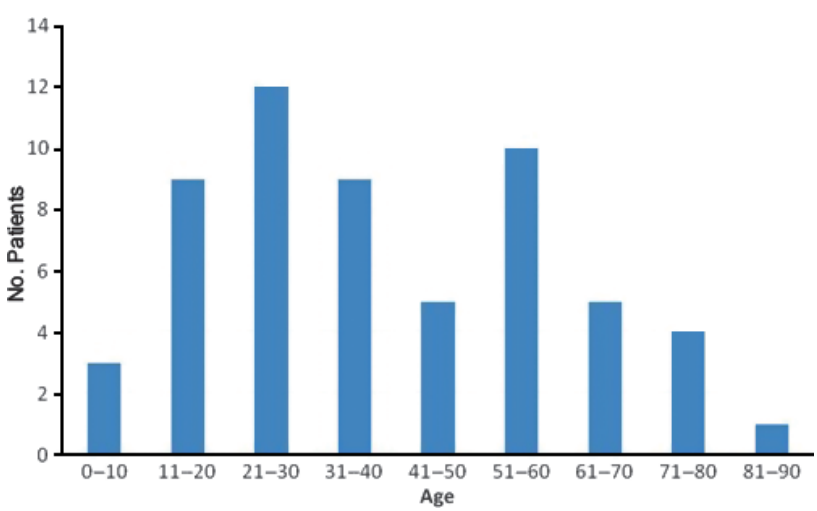

Fig. 2. Age distribution of patients with maxillofacial fractures in the Wenchuan earthquake.

Table 1. Distribution of maxillofacial fractures in the Wenchuan earthquake

Site	No. patients	% Total patients (n = 58)
Fontal bone	4	6.9
Nasal-orbital-ethmoidal region	34	58.6
Zygomatic bone	30	51.7
Maxilla	14	24.1
Mental region	15	25.9
Mandibular angle	11	19.0
Mental foramen region	6	10.3
Mandibular ramus	5	8.6
Condylar	0	0

There were totally 119 fractures sustained by the 58 patients. Only seven patients (12.1%) sustained simply maxillofacial fractures. Most had combined injuries such as soft tissue injuries and dentoalveolar injuries. We divided the locations into three parts: frontal bone, midface, and mandible. The midface consisted of maxilla, the nasal-orbital-ethmoidal region, and zygomatic bone. Of those patients, four patients were with fontal bone fracture, 44 with midface fracture and 31 with mandibular fracture. The most common location was nasal-orbital-ethmoidal region (34/58, 58.6%). That was closely followed by zygomatic bone (30/58, 51.7%). The maxilla and mental region accounted for 24.1% (14/58) and 25.9% (15/58), respectively. Other parts had a less proportion with mandibular angle (11/58, 19%), mental foramen region (6/58, 10.3%), mandibular ramus (5/58, 8.6%), and frontal bone (4/58, 6.9%). Interestingly, we did not find any condylar fracture. The fractures often occurred in at least two sites (Table. 1).

Maxillofacial injuries may appear over isolation or may be associated with other injuries. Forty-eight (82.8%) patients with maxillofacial fractures also had significant organ injuries or extremity injuries. All of them were victims of collapsed buildings. The most common area of associated injuries was extremity (34 patients, 58.6%) and head (18 patients, 32.1%), along with other organs, such as, chest, abdomen, and spine (data not shown). No patient suffered gangrene, tetanus, fat emboli syndrome, or death during their hospital stay.

Only two patients (3.4%) had fracture management before they were sent to the hospitals. Among the patients received prehospital treatment, most were treated with simple measures. Compared with bandages, the percentage of debridement, fracture management, and anti-inflammation was low (data not shown).

Of those patients investigated, 4 (6.9%) were treated conservatively, 16 (27.6%) underwent closed reduction and fixation by standard arch bars, and 38 (65.5%) underwent open reduction and rigid internal fixation (RIF).

In this study, we failed to find any patients with generalized infection. But four patients (6.9%) sustained maxillofacial wound infection.

All patients presented one or several symptoms of post-traumatic stress disorder (PTSD), including fearing sleep inside their ward in the hospital, nightmares, being easily startled, sadness, depression, anger, helplessness, and anxiety. Psychologic nursing was given to all patients with the help of psychiatrists.

Maxillofacial fractures after the Yushu earthquake

A total of six patients suffered maxillofacial fractures of the 46 patients (6/46, 13%). Of these patients, five were women and one was men, ranging the age from 12 to 75 years, with the majority between 20 and 40 years old. Most were caused by pressing or burying (4/6, 66.7%). None of the patients sustained simply maxillofacial fractures. The nasal-orbital-ethmoidal region (4/6, 66.7%) and zygomatic bone (3/6, 50%) were the most vulnerable areas. Maxillary region accounted for 33.3% (2/6), mental foramen region and mandibular ramus for 16.7% (1/6; 1/6). Other areas with fractures were not found in Yushu earthquake. Three people sustained associated injuries, with one extremity injury, one chest injury and one spine injury. Only one patient received debridement before hospital. All the patients underwent open reduction and RIF. No patient was found suffering from infection. But all the patients showed one or several symptoms of PTSD.

Discussion

Although maxillofacial injuries are part of general injuries, a few reports exist regarding the mechanisms and treatment of earthquake-related maxillofacial injuries. Oral and maxillofacial region is highly susceptible to damage because of its position. Although maxillofacial injuries are not so important as brain injuries and other organs injuries, the influence on chewing function, facial appearance, and attendant social and psychologic disorder are much more than others (6).

In our study, 58 patients suffered from maxillofacial fractures in a total of 419 patients with Wenchuan earthquake-related injuries. The investigation into patients from Yushu earthquake showed a similar result. A previous study of earthquake injuries also concurred with our result (7). The incidence of maxillofacial fractures was lower than that of other parts. The reason may be that many patients injured in the earthquake sustained other injuries that may have led to death, so those victims were excluded from this evaluation (8).

A variety of the findings of previously published work demonstrated that the predominance of maxillofacial fractures occurred in young people, especially in the 20- to 30-year age group (9, 10). In our study, however, earthquake-related maxillofacial fractures also involved those being older than 50 years old with high incidence. The Wenchuan earthquake happened at 14:28; it is possible that there were more elderly in buildings, and elderly people might be slower and clumsier compared with the young, thus making them more vulnerable to earthquake injuries, consequently leading to higher rates of maxillofacial fractures. Yushu earthquake, which happened at the early morning, may lead to the same result. Another reason may be that 72.7% of the population is between the ages of 15 and 65 according to the National Bureau of Statistics in 2007. The age

distribution of the earthquake patients is similar to the distribution of the overall population.

Construction collapse is the greatest threat to the population during and after earthquakes (11). Earthquakes usually contribute to the massive construction collapse, and with the increased magnitude of the earthquake, there was an increasing risk of being a victim of earthquake-related injuries. The present study demonstrated that the most frequent cause of maxillofacial fractures in the Wenchuan earthquake was pressing or burying caused by building collapse, accounting for 60.3% of injuries in accordance with the result of Yushu earthquake and previous studies (3, 4). Information about the causes of maxillofacial fractures can provide a guideline for the prevention of maxillofacial injury when earthquake disaster happens again.

The sites of fractures are the results of the mechanism of injury. The mandible and the zygomatic bone could sustain injury because of their prominent positions in the maxillofacial region. But our data showed that nasal-orbital-ethmoidal region was the most prevalent, followed by zygomatic bone. Other studies of maxillofacial injuries showed different results (12, 13). But none of these studies investigated the patients after earthquakes. Moreover, our study showed that most prevalent pattern of maxillofacial fractures (87.9%) was multiple and/or comminuted fractures, whereas single fracture accounted for 12.1% in the Wenchuan earthquake. All the patients from Yushu earthquake suffered from multiple and/or comminuted fractures. Our data support the fact that maxillofacial fractures sustained during an earthquake may be more severe and complex than other common maxillofacial fractures (10, 14).

The previous study showed that severely injured patients with maxillofacial fractures were frequently associated with craniocerebral, orthopedic, abdominal, and thoracic injuries (15). Our data about Wenchuan earthquake showed that the most common associated injuries were extremity injuries (58.6%), followed by head or craniocerebral injuries (32.1%). In the Yushu earthquake, there was no difference in associated injuries because of the sample size. Previous studies reported that head or craniocerebral injury was the most commonly associated injury in maxillofacial fracture because of the close anatomic relationship (15, 16). However, head or craniocerebral injury was also the most life-threatened during maxillofacial injury (17). Many patients may die of head or craniocerebral injury and be excluded from our study. Our data showed that severe associated injuries, such as, cerebral hematoma, asphyxia, compartment syndrome, and acute renal failure owing to extremity crush injury, severe pulmonary injuries, abdominal injuries, and so on, should be paid attention to from the very first hours, or these will result in life-threatening consequences. Therefore, a team mainly consisting of oral and maxillofacial surgeons, neurologic surgeons, orthopedic surgeons, abdominal surgeons, thoracic surgeons, ophthalmologists, and nephrologists is required for the assessment and management of patients with earthquake-related maxillofacial fractures.

To our disappointment, a few patients received fracture management before they were sent to the hospital. Of those patients receiving prehospital treatment, most were given bandages; proportion of debridement, anti-inflammatory, or fracture management was low. These data showed a limitation of our emergency management because of the location of the Wenchuan with hills and rocks around, which resulted in poor transportation services and inadequate medical resources. And Yushu was in the same condition.

Open reduction and RIF may be a useful approach for the management of multiple or comminuted maxillofacial fractures caused by an earthquake according to our experience. Moreover, early careful and meticulous cleaning of the wounds and the use of antibiotics could be an effective measure in minimizing infection. In this study, we failed to find any patient with generalized infection.

It was significant to note that all the patients with maxillofacial fractures showed different extents of PTSD in our study, as previously reported (3, 18). The reason for the high rate of psychologic problems was that the sudden earthquake struck the psychology of most affected people who had experienced the terrible site of the earthquake damage and suffered from their families' death and injury (3, 18). Therefore, active psychologic nursing and treatment was urgently needed for patients with earthquake-related maxillofacial fractures, and effective management of earthquake injuries as in other disasters requires a multidisciplinary approach (18). These data showed that psychologists should form an integral part of the multidisciplinary medical team, as previously reported (19).

Conclusion

We analyze the characteristics of maxillofacial fractures after the Wenchuan earthquake and Yushu earthquake, which showed some similarity in some ways, such as, incidence rate of maxillofacial fractures, patterns, anatomic sites, and so on, so as to improve our medical emergency system when such disasters happen again. When an earthquake happens, a multidisciplinary team consisting of oral and maxillofacial surgeons, neurologic surgeons, orthopedic surgeons, abdominal surgeons, thoracic surgeons, ophthalmologists, nephrologists, and psychologists is required for the assessment and management of patients with earthquake-related maxillofacial fractures to minimize the casualty rate and reduce the rate of PTSD.

China is a country with a high incidence of earthquake. We must collect and analyze the data from any earthquake to provide a guideline of emergency treatment when such an earthquake happens again.

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