

Evaluation of Panfacial Fractures in a German Supraregional Trauma Center between 2015 and 2017 – A Retrospective Study

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Abstract

Introduction: Panfacial fractures represent the most severe injuries to the face. The combination of these fractures determines the treatment strategy. This study aims to retrospectively review the data of adult patients treated for complex facial skull fractures in a hospital in Dortmund, Germany from 2015-2017. **Materials and Methods:** We extracted related patient data from the hospital electronic repository and reviewed the patient files and radiological images. The fractures were classified based on the AO-Classification. The statistical analysis was performed by descriptive statistical methods. The main goal was to determine the most common fracture combinations. **Results:** A total of 188 patients with panfacial fractures were identified (181 adults, 7 children and adolescents). The gender and age distribution corresponded to the international literature (male-to-female ratio: 3.1:1, most common injuries among young men). 2–9 fracture sites were identified per patient, resulting in a fracture frequency of 3.13 per patient. 69 different fracture combinations have been identified. The most common ones were combinations of lateral and central mid-face fractures, and combinations of nasal bone fractures with lateral midface fractures or nasal bone fractures combined with mandibular fractures. Between 1 and 13 osteosynthesis implants per patient were used for osteosynthesis; the most commonly used plates were 2.0 mm and 1.5 mm straight plates. The average inpatient stay was 3 days (standard deviation [SD] = 3.0 days), and the average operation time (incision to suture) was 39.5 min (SD = 53.5 min). **Discussion:** Panfacial fractures are the most complex maxillofacial injuries. The complication rate in this study (4.5%) is below the international data. The treatment of panfacial fractures requires designated centers with experienced teams and good interdisciplinary cooperation.

Keywords: Complex fractures, facial fracture, facial injury, panfacial fractures

INTRODUCTION

Complex fractures occur when a high force of energy hits the facial skull.^[1-3] This force often causes other injuries, such as traumatic brain injuries, eye injuries, or traumatization of other parts of the body, e.g., thorax, abdomen, or extremities.^[2,4,5] According to the literature, men are more often affected, and the male-to-female ratio is about 2:1–8.9:1.^[3,6-9] Young men are most often affected. In the age group between 15 and 29 years, jaw injuries are most frequently detected.^[8-13] Around half of the patients have at least two fractures.^[14] However, little is reported about the injury pattern. Several studies have found that mandibular fractures are the most common fracture entity.^[8,10,12] Satpathy *et al.* found fractures in multiple regions (lower face, mid-face, and forehead region) in 28.71% of patients. An average of two fracture locations per patient is reported.^[10]

One of the most recognized classifications of fractures, including those of the facial skull, has been published by the “Arbeitsgemeinschaft für Osteosynthesefragen” (AO, AO Foundation, Clavadelstrasse 8, 7270 Davos, Switzerland). This classification system contains a detailed description of all regions of the facial skull.^[15-19] Neither the AO papers nor other authors use the nomenclature for “panfacial fractures” or “complex fractures” consistently.^[4,7,19-21] According to the definition

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applied in our study, a panfacial fracture includes several fractures from different facial regions.^[4]

The diagnostic process can be improved if combinations of panfacial fractures are known. This study aims to retrospectively evaluate the panfacial injuries of patients who were treated with maxillofacial injuries from 2015 to 2017 in our clinic. The most important objective of the study was to determine the fracture combinations that occurred.

MATERIALS AND METHODS

The Ethics Commission of the University of Witten-Herdecke has approved this study (No. 152/2017, dated September 17, 2017). Informed consent forms are signed for the study. The study was conducted as per the Helsinki Declaration, laws and regulations of the European Union, Germany, North-Rhine-Westfalia, and Dortmund General Hospital.

This study was conducted as a retrospective, monocentric, descriptive study. The data regarding patients with panfacial fractures that have been treated in the in Dortmund, Germany, from January 1, 2015, to December 31, 2017, have been evaluated. The inclusion criteria were panfacial fractures diagnosed in the above period. The exclusion criteria were patient intention not to participate in the study.

All patient data were acquired from the electronic patient file. Radiological images were evaluated, too. The evaluation included the following variables: fracture localization, concomitant diseases and injuries, and economic data regarding surgery (operation duration, logistic needs and usage of osteosynthesis implants).

The fracture classification was performed according to the AO-Classification and based on biomechanical principles. To

determine the eligibility for the study, the following definition was used:

Panfacial fractures (complex fractures) are fracture combinations of at least two different facial regions (disrespecting the lateralization of the fractures) from the following:

- Forehead
- Lateral mid-face
- Central mid-face
- Maxillary dentoalveolar (not counted as a complex fracture with central mid-face fractures only)
- Mandibular dentoalveolar (not counted as a complex fracture with mandibular fractures only)
- Mandible.

Figure 1 shows a sample computed tomography (CT) scan of a patient with concomitant forehead, central and lateral midface and mandibular fractures. Complications have been divided into two groups. Nonsevere complications do require no further surgical treatment and resolve within 6 months. Severe complications are defined as complications that require surgical treatment and/or cause significant technical difficulties in a planned second surgery.

The data were summarized in a Microsoft Excel 2010 (® Microsoft Corp., Redmond, USA) database. The statistical evaluation was carried out by independent statisticians using R version 3.5.2 (December 20, 2018, The R Foundation for Statistical Computing c/o Institute for Statistics and Mathematics Vienna University of Economics and Business, Welthandelsplatz 11020 Vienna, Austria).

RESULTS

Table 1 presents an overview of the study data. The total number of all patients with head and neck injuries in the period 2015–2017 was 22,031, who were treated in 25,951 cases. After excluding outpatients and patients with other fracture types, 188 patients (7 children and adolescents, 181 adults) with panfacial fractures were identified. In 2015, 65 (35.9%) patients were treated with panfacial fractures; in 2016, 53 (29.3%); and in 2017, 63 (34.8%). Most patients were admitted to ward on Mondays (33 patients, 18.2%) and on weekends (on Saturday and Sunday, each 31 patients, 17.1%). Among the patients, 137 (75.7%) were male and 44 (24.3%) were female, so the male-to-female ratio in our study group is about 3.1:1. 68% of all patients were 18–60 years old, and 32% of all patients were older than 60 years old. In the 3 years examined, the total annual number of patients varied between 54 and 69. The most common accompanying injuries were traumatic brain injury, soft tissue injuries to the head and neck area, thoracic injuries, and injuries to the lower and upper extremities. The most common secondary diseases are high blood pressure and metabolic diseases (mainly diabetes mellitus), lung diseases, ischemic heart disease, eye diseases, and dementia. Intoxication with alcohol was documented in 27 cases.

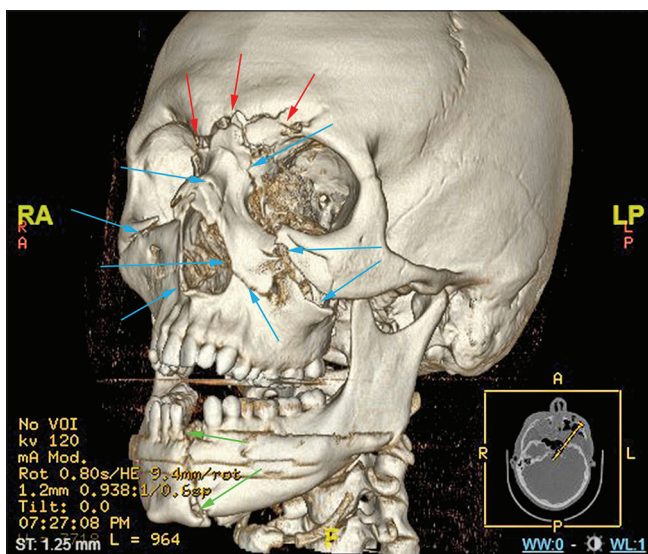


Figure 1: Clinical example of a panfacial fracture. Red arrows showing the major fractures of the frontal sinus wall, blue arrows showing the midface fractures (Le Fort I and II, naso-orbito-ethmoid and nasal bone fractures), and green arrows showing fractures in the paramedian mandible

Table 1: Summary of the statistical data

Variable	<i>n</i>	NAs	Value
Patients with panfacial fracture; <i>n</i> (%)	188	0	
<18			7
>18			181
Adult patients with panfacial fracture			
Sex	181	0	
Male			137 (75.7)
Female			44 (24.3)
Age (years), mean (SD)	181	0	49.5 (21.9)
Age groups			
18-59			123 (68.0)
60+			58 (32.0)
Number of affected fracture sites, <i>n</i> (%)	181	0	
2			82 (45.2)
3			61 (33.7)
4			24 (13.3)
5			7 (3.9)
6			2 (1.1)
7			2 (1.1)
8			1 (0.6)
9			2 (1.1)
(Severe) complications and causes for secondary surgery	8	174	
Hypesthesia			1 (12.5)
Removal of implants without complications			7 (87.5)
Length of inpatient stay, mean (days) (SD)	181	0	3.0 (2.0)
Number of surgeries, <i>n</i> (%)	146	35	
1			136 (93.2)
2			6 (4.1)
3			3 (2.1)
4			1 (0.6)
Total surgery time (incision to sutures ready) (min), mean (SD)	145	36	39.0 (56.0)
Total surgery time from anaesthesia start to end (min); mean (SD)	144	37	106.0 (56.0)
Number of plates, <i>n</i> (%)	78	104	
1			22 (28.6)
2			15 (19.5)
3			11 (14.3)
4			9 (11.7)
5			4 (5.2)
6			9 (10.4)
7			3 (3.9)
8			3 (3.9)
9			1 (1.3)
13			1 (1.3)
Screws per patient (pcs), mean (SD)	181	0	10.8 (14.6)

SD: Standard deviation, NAs: Not available for analysis

A total of 567 fracture sites were identified, and the fracture rate is 3.13 per patient. Figure 2 shows the distribution of the different fracture combinations. The six most common combinations are shown. These (165 out of 181 cases) represent 91.3% of all cases. The most common are combinations of central and lateral mid-face fractures in combination with other fractures. A co-injury to the forehead region (upper face) is very rare (9 cases, 5.4%). 69 different fracture combinations have been identified (not counting the left and right differences). These injuries have been grouped.

Figure 3 presents the ten most common combinations of different fracture localization.

Figure 4 shows the type of osteosynthesis materials used. The most commonly used osteosynthesis plates are 2.0 mm and 1.5 mm thick. This means that the majority of facial skull fractures have been solidly treated with mini-plate osteosynthesis, even in the case of panfacial fractures.

Figure 5 shows the relationship between the number of fractures and the length of stay in the hospital. As the number

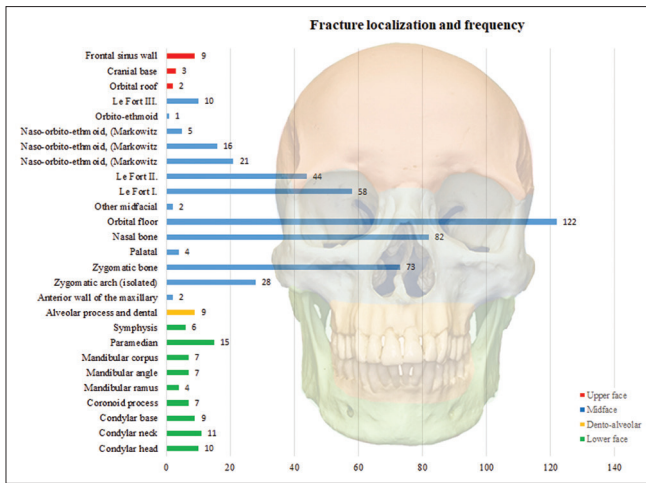


Figure 2: Summary of the fracture sites

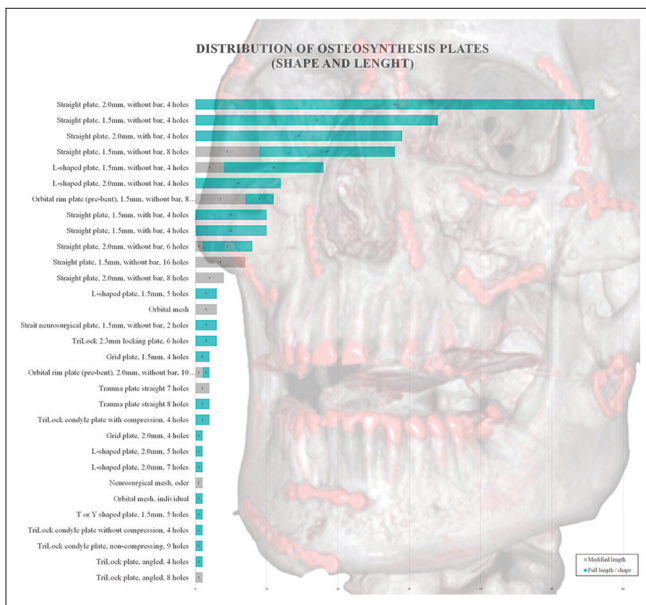


Figure 4: Summary of the osteosynthesis implants, the cut of data was performed at 90% of the plates

of fractures increases, the need for care and thus the length of stay in hospital also do increase.

Between 1 and 13 osteosynthesis plates were used for intraoperative care, the average duration of the operation was 39 min (standard deviation [SD] = 56.0 min), and the anaesthesia lasted for an average of 106 min (SD = 56.0 min). 136 patients (93.2%) were successfully treated with just one surgical intervention, and 10 (6.8%) patients needed further surgical interventions (2–4 interventions in total). The average length of stay was 3 days (SD = 3 days). χ^2 tests were carried out on the above data to check the significance of the relationships: only the gender difference between men and women was highly significant, with a $P < 0.001$.

Seven patients have been identified with severe complications (3.2% of all patients with panfacial fractures).

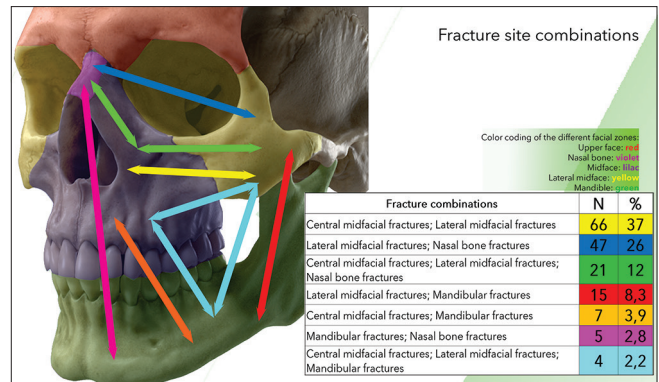


Figure 3: Summary of most common fracture site combinations. A cut is made at 90% of the fracture combinations. Please note that the wording “dentoalveolar” refers to maxillary dentoalveolar in case of mandibular fractures and to mandibular dentoalveolar if only a midface fracture is present

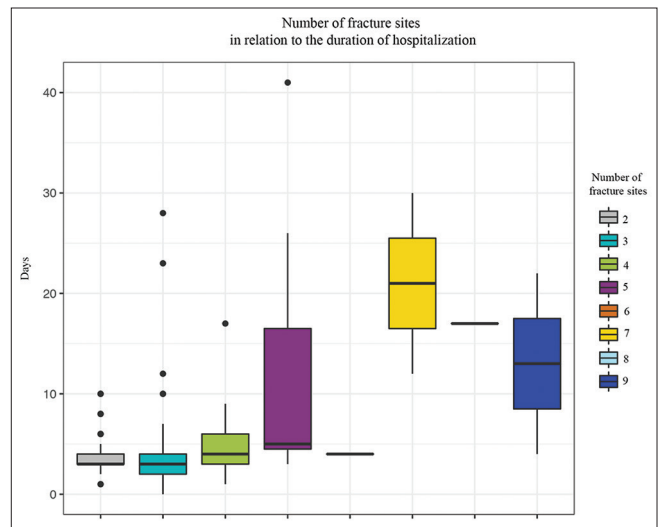


Figure 5: Boxplot diagram showing the relation between the increase of the number of fracture sites and inpatient stay

These include pansinusitis, wound infection, loosening of the implants, and excessive scarring at the mental foramen and mandibular body area, e.g., pseudoarthrosis of the mandibular angle.

DISCUSSION

The basis of our study was the fracture classification of the AO.^[15-19] Thus, this study is comparable with data from the international literature. The study objectives are covered by the results.

Consistent with the literature, we found a male-to-female ratio of 3.1:1 in patients with panfacial fractures.^[2,3,6,9,10,13,14,22-25] We found two or three fracture sites in most patients (a total of 77.4% of all patients with panfacial fracture); in a few patients, up to nine fracture sites had been identified and treated. The fracture frequency was higher than in the literature (3.13 vs. 2).^[10] The presentation of the most

common fractures is a useful clinical tool that helps even for inexperienced trainees in diagnostic process.

The distribution of accompanying injuries and comorbidities also corresponds to that of international literature.^[1,3,4,7,14] Soft tissue injuries to the face and head, craniocerebral trauma from the slightest commotion to an open brain injury are noted.

The descriptive statistics on the osteosynthesis implants are unique. There are also a few health economic articles on the importance of jaw fractures.^[26-29] The length of stay of 3 days is below the published average.^[13] As can be expected, it can be determined that a higher number of fractures in a patient is associated with longer operation time and a longer hospital stay. The operative interventions, especially in complex cases, are always carried out by experienced surgeons. The average operation time of the primary cases is 39 min (SD = 53.5 min). The very large SD is justified by a large scale of complexity.

In the patients who underwent surgery for complex fractures ($N = 31$ with 38 complications), seven with serious complications were identified, that is, 3.87%. The complication rate in our study is thus significantly below the internationally published average, which is given as up to 17%.^[2,5,7,14] Besides, the number is significantly lower than for isolated mandibular fractures (8.17%). However, it is significantly higher than that of mid-face fractures (1.15%) because the complication rate includes both reduction errors, infections, patient noncompliance, and failure of the osteosynthesis material.

CONCLUSION

We can state that osteosynthesis with the currently used implant set is a safe method that is recommended as the first choice of therapy in cases with complex facial injuries. This paper provides a clinical tool with the most common combinations in the case of panfacial fractures. This helps improve the diagnostic process and therapy planning even in emergency rooms in most acute situations. The exact knowledge of the most common fracture combinations is a safety tool for trainees in acute situations and an important basis to correctly determine needs and processes during the whole treatment.

Limitations of the study

The study is limited by its retrospective design. From the analysis of the data over only 3 years, it was not possible to work out a trend for the prevalence (e.g., total number of injuries in the maxillofacial area). In future research by expanding the study period, trends could be specified. This also could provide more cases for further analysis of combinations.

SUMMARY

The study presented is an analysis of patients with panfacial fractures from 2015 to 2017. The results of the study showed data comparable to the international literature in many areas

with good therapy results and a low complication rate. The panfacial fractures are the most complex trauma cases that are treated in oral and maxillofacial surgery. The therapy of these patients requires designated centers with experienced teams and good interdisciplinary cooperation.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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