American Academic Scientific Research Journal for Engineering, Technology, and Sciences
ISSN (Print) 2313-4410, ISSN (Online) 2313-4402
http://asrjetsjournal.org/

Clinical Aspects and Treatment of Midface Fractures through Inter-personal Violence: A 10 Year Cross-Sectional Cohort Retrospective Study

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Abstract

The incidence of midface fractures due to inter-human aggression (IPV) has increased dramatically in industrialized countries recently. In this context, the World Health Organization considers the treatment and counseling of IPV victims an international priority. The aim of this study was to determine the characteristics of midface fractures by IPV in order to create the premises for a correct and rapid diagnosis by the clinician, as well as to evaluate the effectiveness of treatment methods applied depending on the number and type of postoperative complications. Materials and methods: Patients hospitalized and treated in a tertiary hospital for oral and maxillofacial surgery for a period of 10 years were available for this study. After the statistical analysis of the variables followed, a value of $p < 0.005$ was considered statistically significant. Results: The most common was zygomatic complex fracture n = 87 (51.80 %), followed by fracture of nasal bones n = 30 (17.90%), orbit n = 36 (21.40 %) . Most patients had fractures with displacement n = 124 (73.80%) and closed n = 150 (89.3%). The opening of the fracture was most common in the case of zygomatic complex fractures (p = 0.045). The most common soft tissue lesion was present in 134 patients (57.26%), followed by excoriation n = 58 (24.79%) and laceration n = 42 (17.95%).

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Most patients were treated with closed treatment methods n = 145 (86.32%), followed by combined treatment methods open reduction with internal fixation (ORIF) + maxilla-mandibulo fixation (MMF) n = 12 (7.14%) and n = 11 (6.55%) strictly ORIF. Conclusions: Inter-human aggression most frequently causes complex-zygomatic fractures, complete, with displacement and without opening the fracture outbreak accompanied by hematomas of the soft parts. The severity of the soft tissue associated injuries is directly proportional to the underlying fracture pattern.

Keywords: midface fracture; inter-humanl violence; aggression; zygomatic fractures.

1. Introduction

The incidence of facial trauma by inter-human aggression (iPV) has increased exponentially in recent times, reaching epidemic proportions in developed countries [1]. Midface fractures are a special pathology in oro-maxillo-facial pathology due to the close relations with the endocranium, orbits, maxillary sinuses, frontal and ethmoid and last but not least the cervical spine [2]. In this context, the cases can have a complex appearance with multiple associated lesions and comorbidities that are often a challenge for the oro-maxillo-facial surgeon and the multidisciplinary team involved [3]. Managing victims of interpersonal aggression is often difficult, due to the emotional and psychological implications of the victim but also due to a potential poor collaboration with this type of patient, most often the trauma being associated with alcohol or toxic psychoactive substances [4]. Inadequate therapeutic behavior in these cases can have major aesthetic, emotional and psychological implications that are difficult to correct later [5]. The pattern, characteristics and associated lesions of midface fractures by IPV have a special clinical picture compared to those of other etiologies due to the trajectory, kinetic energy or consistency of the injured agent and the position of the head at the moment of impact, the victim tending to turn his head to protect his eyes and centro-facial structures [6]. Associated soft tissue lesions can often mask the underlying fracture pathways, creating diagnostic problems among less experienced clinicians [4,5]. In this context, the knowledge of the inter-relationship between the injuries associated by the parties and the underlying fracture trajectory is fundamental both to establish a rapid diagnosis, but also to frame the trauma as IPV in a context in which the victim hides the etiology [8]. The identification and co-signing of IPV as an etiology is extremely important for the distribution of funds in health, the use of insurance policies and last but not least the major legal implications [4-8]. The aim of this study was to determine the characteristics of midface fractures by IPV and their relationship to the type of lesions associated with soft tissue, as well as the correctness of treatment methods applied by assessing the incidence of postoperative complications. We will use these results to train outpatient physicians to identify whether interpersonal aggression is a factor associated with oro-maxillofacial trauma in order to ensure both impeccable surgical treatment and the inclusion of these patients in specialized national programs for moral and psychological support.

2. Materials and method

This study was performed with patients with midface fractures by IPV hospitalized and treated in a tertiary hospital for Oro-maxillofacial surgery in Romania. This study was approved by the Territorial Ethics

Commission and have therefore been performed in accordance with the ethical standards laid down in the 2008 Declaration of Helsinki and its later amendments (This study was approved by the ethics commission of the University of Oradea, Romania No. 28247 / 29.04.2020). All patients included in the study signed an informed consent at the time of hospitalization, giving their consent for the use of their medical data for the purpose of scientific research. In the case of patients under the age of 18, the agreement was signed by their parents or legal guardian. The inclusion criteria in the study were: the presence of at least one fracture line in the middle floor, the confirmation of the etiology of inter-human aggression in writing by the patient, episode of acute trauma, the existence in the observation sheet of imaging investigations (radiography, orthopantomogram or computed tomography) to confirm the clinical diagnosis of the fracture and to highlight the topographic location, its pattern and characteristics, the treatment of the fracture was performed in the host hospital of the study, postoperative follow-up of patients for at least 8 weeks. The exclusion criteria from the study were: patient without a fracture line in the middle floor, etiology of the fracture other than inter-human aggression, patient's refusal to confirm in writing the etiology of inter-human aggression of the fracture, absence from the clinical observation sheet of the patient of the complementary imaging examinations, the lack of one or more variables followed from the observation sheet, the self-suppression of the MMF intermaxillary immobilization device by the patient earlier than the recommended time (in the case of patients treated by this means), the impossibility of postoperative follow-up at least 8 weeks. The variables were extracted from the clinical observation sheets, following the following: topographic location of fractures at midface level, number of fracture trajectories, degree of bone interest, association of mandibular fractures, existence and type of associated general pathologies, degree of displacement of bone fragments, the relationship with the external environment of the fracture site, the concomitant presence and the type of associated soft tissue lesions, the type of treatment performed, the incidence and the type of postoperative complications. We mention that we classified the soft tissue lesions into: hematoma, laceration and excoriation. We did not classify post-traumatic edema as a single associated soft tissue injury, which is part of the pathophysiology of trauma. Thus, posttraumatic edema being present in almost all facial fractures or contusions, its classification as a variable is not statistically relevant in this context. We mention that in our clinic the zygomatic bone fractures are reduced semi-open strictly by the Gillies type method. In this study we included this treatment method in the Closed Treatment category. To prevent bias the first author and one member of the statistical department double-checked the clinical sheets.The size of this study was achieved due to the 10 year period in which the patients were diagnosed of IPV midface fractures in our clinic. Centralization of data in electronic format was done using Microsoft Excel. The descriptive statistics of the evaluated cases were performed with a percentage fidelity of two decimals. Statistical analysis was carried out with MedCalc Statistical Software version 20.011 (MedCalc Software Ltd, Ostend, Belgium; 53 https://www.medcalc.org; 2021). Continuous data were expressed as mean and standard deviation, while nominal data were expressed as frequency and percentage. The comparisons of the frequencies of a nominal variable between the categories of another nominal variable were performed using the chi-square test. The comparison of a continuous nominal variable between two groups was performed via the T test for independent variables. A p value <0.05 was considered statistically significant. We acknowledge that this study was conducted according to the STROBE guidelines.

3. Results

Following the evaluation of the clinical observation sheets, 476 patients were identified as having middle-floor fractures due to inter-human aggression within the established 10-year interval. Of these, 294 patients were excluded from the study for the following reasons: 67 patients did not present data on the degree of displacement, 35 patients did not present data on associated soft tissue lesions, 24 refused to perform definitive treatment in the clinic opting to be treated in another service. Thus, the inclusion criteria in the study were met by 168 patients. The most common was the fracture of zygomatic complex n = 87 (51.80 %), followed by fracture of nasal bones n = 30 (17.90%), orbit n = 36 (21.40 %), complex naso-orbito-ethmoidal (NOE) n = 18 (8.22%), Le Fort II n = 1 (0.06%), Le Fort III n = 5 (3.00%). 12 patients (7.14%) also had concomitant mandibular fractures, 156 (92.86%) had strictly midface fractures. Most of the fractures were complete n = 168 (98.20%), the incomplete ones being a minority n = 3 (1.8%). Most patients had fractures with displacement n = 124 (73.80%) and n = 44 (26.20%) fractures without displacement of the fractured fragments. Most patients presented closed fractures n = 150 (89.3%), those with open fractures being in a smaller number n = 18 (10.70%). The characteristics of the fracture focus in relation to the topographic location are found in table 1. The displacement of the fractured fragments occurred most frequently in the fractures of the zygomatic complex, nasal bones and NOE (p = 0.006). The opening of the fracture focus was most common in the case of zygomatic complex fractures (p = 0.045). The results are statistically significant.

Table 1: Fracture pattern depending on the topographic location.

		Fracture location						Total
		Le fort II	Le fort III	Zygomatic complex	Nasal Bones	NOE	Orbit	
Degree of bone involvement	Incomplete	0	0	1	0	2	0	3
		0,0%	0,0%	1,1%	0,0%	22,2%	0,0%	1,8%
	complete	1	5	86	30	7	36	165
		100,0%	100,0%	98,9%	100,0%	77,8%	100,0%	98,2%
Total		1	5	87	30	9	36	168
		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
								P=0,001
Bone displacement	With	1	5	70	20	9	19	124
		100,0%	100,0%	80,5%	66,7%	100,0%	52,8%	73,8%
	Without	0	0	17	10	0	17	44
		0,0%	0,0%	19,5%	33,3%	0,0%	47,2%	26,2%
Total		1	5	87	30	9	36	168
		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
								P=0,006
Type of fracture	Closed	0	5	79	26	8	32	150
		0,0%	100,0%	90,8%	86,7%	88,9%	88,9%	89,3%
	Open	1	0	8	4	1	4	18
		100,0%	0,0%	9,2%	13,3%	11,1%	11,1%	10,7%
Total		1	5	87	30	9	36	168
		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
								P=0,045

The most common soft tissue lesion was present in 134 patients (57.26%), followed by excoriation n = 58 (24.79%) and laceration n = 42 (17.95%).

Table 2 shows the incidence of soft tissue associated injuries depending on the underlying fracture pattern. An increased incidence of hematoma can be observed in the case of complete fractures (p = 0.045), with displacement (p = 0.005) and closed (p = 0.003). There is also an increase in the incidence of laceration and abrasion in the case of complete and displaced fractures, but the result is not statistically significant.

Table 2: Distribution of the type of associated soft tissue injuries depending on the degree of bone involvement, displacement and the relationship with the external environment of the fracture.

		Hematoama		Total	Lacerations		Total	Escoriations		Total
		No	Yes		No	Yes		No	Yes	
Degree of bone involvement	incomplete	1	2	3	2	1	3	1	2	3
		2,9%	1,5%	1,8%	1,6%	2,4%	1,8%	0,9%	3,4%	1,8%
	complete	33	132	165	123	41	165	109	56	165
		97,1%	98,5%	98,2%	98,4%	97,6%	98,2%	99,1%	96,6%	98,2%
Total		34	134	168	125	42	168	110	58	168
		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
				P=0,045			P=1,000			P=0,274
Bone displacement	With	30	94	124	96	27	123	87	37	124
		88,2%	70,1%	73,8%	76,8%	64,3%	73,7%	79,1%	63,8%	73,8%
	Without	4	40	44	29	15	44	23	21	44
		11,8%	29,9%	26,2%	23,2%	35,7%	26,3%	20,9%	36,2%	26,2%
Total		34	134	168	125	42	168	110	58	168
		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
				P=0,005			P=0,014			P=0,050
Type of fracture	Closed	30	120	150	113	36	149	104	46	150
		88,2%	89,6%	89,3%	90,4%	85,7%	89,2%	94,5%	79,3%	89,3%
	Open	4	14	18	12	6	18	6	12	18
		11,8%	10,4%	10,7%	9,6%	14,3%	10,8%	5,5%	20,7%	10,7%
Total		34	134	168	125	42	168	110	58	168
		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
				P=0,003			P=0,398			P=0,060

Most patients were treated with closed treatment methods n = 145 (86.32%), followed by combined treatment methods open reduction with internal fixation (ORIF) + maxilla-mandibulo fixation (MMF) n = 12 (7.14%) and n = 11 (6.55%) strictly ORIF.

The distribution of treatment methods according to the fracture pattern can be found in table 3. There is an

increased incidence of closed treatment methods in case of fractures without communication with the external environment (p = 0.002). ORIF treatment predominated in the case of displaced fractures (p = 0.146), but the result was without statistical significance.

Table 3: Distribution of the type of treatment depending on the fracture pattern.

		Type of treatment			Total
		Closed	Orif	Combined	
Degree of bone involvement	incomplete	3	0	0	3
		2,1%	0,0%	0,0%	1,8%
	complete	142	11	12	165
		97,9%	100,0%	100,0%	98,2%
Total		145	11	12	168
		100,0%	100,0%	100,0%	100,0%
					P=0,785
Bone displacement	with	110	8	6	124
		75,9%	72,7%	50,0%	73,8%
	without	35	3	6	44
		24,1%	27,3%	50,0%	26,2%
Total		145	11	12	168
		100,0%	100,0%	100,0%	100,0%
					P=0,146
Type of fracture	closed	133	10	7	150
		91,7%	90,9%	58,3%	89,3%
	open	12	1	5	18
		8,3%	9,1%	41,7%	10,7%
Total		145	11	12	168
		100,0%	100,0%	100,0%	100,0%
					P=0,002

Most patients performed favorably n = 156 (92.6%), only 12 patients developing postoperative complications n = 12 (7.14%). The distribution of postoperative complications by treatment can be found in Table 4. Malunion was the only complication recorded and had the highest incidence among patients treated by closed methods (p = 0.003), the result being statistically significant. No reoperation was required in any case, the patients not claiming functional or aesthetic disorders.

Table 4: Distribution of post-operative complications depending on the type of treatment.

		Type of treatment			Total
		Closed	Orif	Combined	
Complications	No	134	11	11	156
		92,4%	100,0%	91,7%	92,6%
	Malunion	11	0	1	12
		7,6%	0,0%	8,3%	7,14%
Total		145	11	12	168
		100,0%	100,0%	100,0%	100,0%
					P=0,003

3. Discussion

The most common localization at the midface level of fractures was in this study the zygomatic complex, a result found in the studies of other authors [1,8-13]. These results can be explained primarily by the prominence of the zygomatic bone in the facial contour, being more exposed to trauma [8,9]. Another explanation can be given by the fact that in our geographical region, due to the current legislative context of banning the possession of firearms or knives, most traumas by inter-human aggression are by punch [13]. The aggressor will aim to compromise the appearance and facial aesthetics of the victim, aiming in this context to aim more frequently at the bones that make up the face, while the victim will often be tempted to turn his head at the moment of impact, to protect the eyeballs and centrofacial structures. [2]. Contrary to our findings, other authors indicate an increased incidence of orbital fractures [4,14-17] or nasal bones [18-20] by IPV. It is known that the zygomatic bone forms part of the orbital cavity [4]. In this context, the results may vary depending on the classification of the data in one category or another by the statistical team [3]. In our study, the orbital side wall fractures located at the level of the fronto-malar suture and the lower orbital rim fractures without the interest of the orbital floor were included in the category of zygomatic complex fractures. In this context, the high number of zygomatic fractures in this study is explained. Most of the fractures in this study were complete, a result also found in the literature [14 - 19]. In the middle floor, poor representation of bone cortex due to pneumatization of the paranasal sinuses and the presence of nostrils, incomplete fractures occur rarely, bones fracture to full thickness even after trauma with low kinetic energy [17-20]. Displaced and closed fractures predominated in this study. These results are also supported by other authors [21-23]. At the midface level, although secondary movements are rare, the fractured fragments move easily in the primary, through the direct action of the injuring agents due to the thin cortices at this level [17-23]. Most of the open fractures in this study were in the case of zygomatic fractures. Outbreaks of fracture in the zygomatic bone may be most commonly open endo-orally, due to the adhesion of the mucoperiosteum to the zygomatic-alveolar pillar [11]. In the case of fractures with considerable displacement, the mucoperiosteum can be easily torn under the direct action of bone fragments [11]. Of course, in the case of violent trauma, the fracture site may be open and exo-oral due to lacerations caused by the increased kinetic energy of the injuring agent [11]. Contrary to our results, other authors indicate in the case of inter-human aggression the predominance of fractures without moving at the midface level [10]. Hematoma was the most common lesion associated with midface fractures in this study, similar to other authors [9,18,26]. Other authors report the highest incidence of laceration [4,17,24,25] or excoriation [16]. The increased incidence of hematoma in this study once again highlights the low kinetic energy caused by midface fractures in our region [13]. In areas where human aggression is more violent, through firearms or even explosives, lacerations predominate [25]. Our results show that the incidence of associated lesions is directly proportional to the displacement of the fractured fragments and the degree of bone interest, a result also supported by other authors [4,17,24,25]. The most common treatment methods in this study were closed ones, similar to the results of other authors [6,9,10]. Contrary to our findings, other authors prefer ORIF surgical methods [3,4,11,15,27,28]. As we mentioned the Gillies-type instrumental reduction methods in this study, we included them as variables in the closed treatment category. In the case of fractured fragments of zygomatic bone that are stable after Gillies reduction, we do not intervene surgically unless the reconstruction of the orbit is necessary. We find similar opinions in other authors [10,27]. Also, in the case of nasal bone fractures, we routinely practice closed

reduction and their immobilization with internal and external conformers, practicing ORIF only in the case of NOE type fractures. The large number of non-comminutative zygomatic complex fractures as well as the number of own nasal bones in this study explain the increased incidence of closed treatment methods in this study. We practiced the combined ORIF + MMF treatment in patients with associated mandibular fractures to restore optimal and stable occlusion. We find similar behavior in other authors [10,15]. Most patients in this study performed favorably, with complications developing in 12 patients. All patients presented malunion, 11 secondary to closed treatment and 1 secondary to combined treatment. These results are explicable, the closed reduction can never be as perfect as the one secondary to the ORIF treatment where the fractured fragments are reduced and immobilized perfectly under the direct visualization of the fracture focus [3,4,11,15,27,28]. This fact is also found in our results, the patients treated surgically ORIF developing absolutely no post-operative complications, all evolving favorably. The increased incidence of malunion among postoperative complications of midface fractures is also found in other specialized studies [29-31]. Fortunately, no malnutrition patient required or wanted reoperation, as they did not have diplopia, sensory disturbances, or facial asymmetry of such magnitude as to require reoperation. The limitations of this study are multiple and are due to its retrospective nature. Data in the observation sheets may be poorly or incorrectly recorded by clinicians. The possibility of a much larger number of patients with mandibular fractures by IPV during this time, which would have hidden the type of etiology at the time of fear or shame, should also be considered. Thus, by selecting only the complete data sheets, a large number of cases may have been lost. For these reasons, our results do not have the same impact as those of a prospective controlled study. A prospective study on this issue is needed in the future to cement our results. Another limitation derives from the inter-relationship between orbital fractures and those of zygomatic complex. The zygomatic bone is taking part in the composition of 2 of the 4 walls of the orbit. In this context, the two categories often intersect, an orbital fracture being statistically included by the authors in the category of zygomatic bones and vice versa. In order to prevent this in the future the variables should be more clearly defined.

4. Conclusion

Inter-human aggression most frequently causes complex-zygomatic fractures, complete, with displacement and without opening the fracture outbreak accompanied by hematomas of the soft parts. The severity of the soft tissue associated injuries is directly proportional to the underlying fracture pattern. The most effective method of treatment for midface fractures is ORIF. Closed treatment methods have the highest rate of complications.

Acknowledgements

All authors had equal contribution in writing and preparing this manuscript

5. Disclosure

The author reports no conflicts of interest in this work

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