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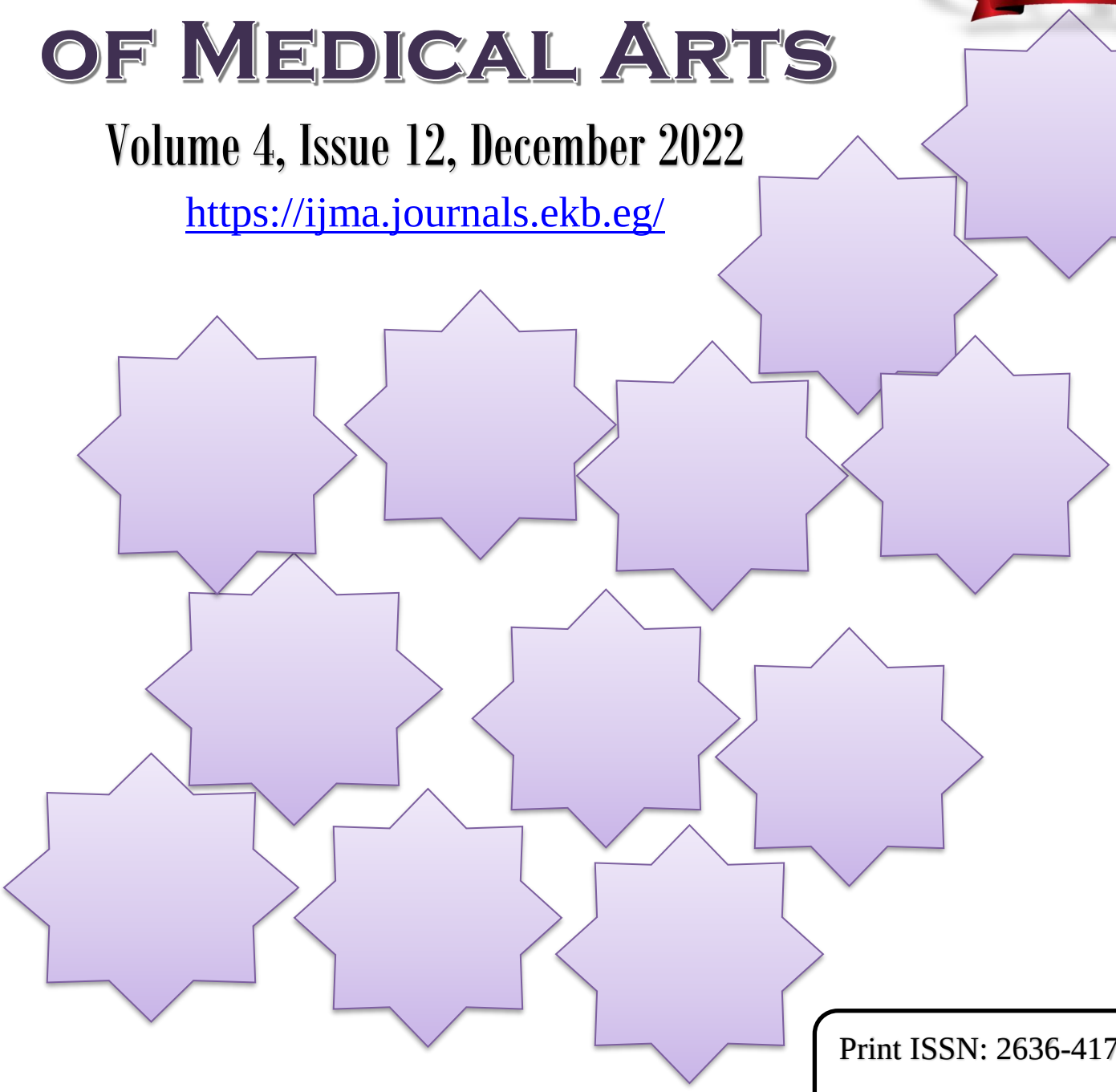

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Original Article

A Retrospective Analysis of Panfacial Fractures: Pattern of Injury and Short-Term Clinical Outcome

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ABSTRACT

Objective: The current work aimed to analyze the characteristics patterns of panfacial fractures [PFFs] and its associated outcome.

Methodology: We retrospectively analyzed files of 41 patients with PFFs from June 2018 to June 2022. Files were reviewed for patient demographics, preoperative assessment, surgical intervention, and treatment outcome. The diagnosis was established by clinical and radiological evaluation. The pattern of PFFs was classified into five categories on the basis of included facial bone. 1] upper midfacial, lower midfacial and mandibular [ULM]; 2] frontal, upper and lower midfacial bones [FUL]; 3] frontal, upper midfacial and mandibular bones [FUM] and; 4] Fracture of the four bones [FULM], and 5] FLM. Concomitant body injuries were document and treatment were performed by multidisciplinary team [combined treatment]. Early postoperative complications were documented and categorized according to Clavien-Dindo classification system.

Results: The commonest pattern was ULM [21 patients; 51.2%], FUL [12 patients; 29.3%] and FULM [8 patients; 19.5%]. There was significant association between the pattern of injury and patient's age and etiology [ULM were the oldest, while FULM was the youngest. The FULM was mainly due industrial, ULM and FUL were due to road traffic accident]. Males were predominantly in all patterns with no significant differences. The pattern was also significantly associated with operative time and early postoperative complications [The FULM had the longest operative time, then FUL and ULM]. All patients in FULM pattern had early postoperative complications, compared to 75% in FUL and 66.7% in the ULM pattern. The mortality was only reported in FULM pattern [2 patients].

Conclusion: The ULM pattern was the commonest and PFFs patterns are associated with patient age, etiology, operative time and early postoperative complications. Defining the PFFs pattern could be an initial triage in a systemic management approach to improve clinical outcome.

Keywords: Facial Fractures; Concomitant injury; Multidisciplinary; Craniomaxillofacial; Reconstruction.

INTRODUCTION

Panfacial fracture [PFF] is defined as a fracture included at least three areas out of the four axial bones [frontal, upper midfacial, lower midfacial and mandibular] of the facial skeleton [i.e., simultaneous inclusion of the upper, mid and lower face] [1]. PFF is due to an external force over the whole body [e.g., falls, road traffic accidents, assaults [interpersonal violence], gunshots, industrial accidents and sports-related injury [2].

The pattern of PFF depends on the severity of the forces and its mechanism. PPF usually accompanied by injuries to the other body parts [3].

PFF is usually associated with multisystem injury. This reflected on the multidisciplinary treatment. After stabilization of the patient, the goal of treatment is to restore the total facial form and function as early as possible. The treatment varies from a conservative to multiple stages or aggressive one stage intervention. The multiple-stages surgery usually delayed, compared to early one stage procedure. The basis of optimal results includes preoperative high-resolution computed tomography [CT], sufficient surgical exposure, anatomical reduction, rigid fixation, bone grafting and tissue suspension [4].

In other words, the goal of PFF management is early restoration of the three-dimensional facial contours, and minimizing pain with the lowest possible cost. However, the sequence of treatment remains a great challenge to every surgical team [5].

Two classic surgical approaches have been described: the “bottom up and inside out” or “top down and outside in”. The preferred one starts by mandibular reconstruction, followed by reconstruction of the fronto-facial and zygomatico-orbital compartments [4].

In the current work, we aimed to analyze the characteristics of PFFs and to assess the results of treatment in the light of the pattern of PFFs for patient’s treatment at Al-Azhar University hospitals.

PATIENTS AND METHODS

We retrospectively analyzed the pattern and clinical outcome of 41 patients with panfacial fractures, treated at Al-Azhar University Hospital [Damietta, Al-hussein, Sayed Galal] through a period of 4 years [from June 2018 to June 2022]. Charts were reviewed for patient demographics, preoperative assessment, surgical intervention, and treatment outcome. The diagnosis was established on the basis of the results of clinical and radiological [high resolution CT, with three-dimensional reconstruction] evaluation. Routine laboratory investigation was carried out as a part of preoperative evaluation.

The inclusion criteria were patients who had PFFs [at least three of the four axial segments of the facial skeleton], had preoperative computed tomography and treated by combined approach [multidisciplinary teams].

On the other side, Patients who had a single line fractures, isolated disjunctions of one or both zygomatic bones, and who had isolated fractures of the mandible, were excluded from the study.

The PFF were classified after Beogo *et al*. [6] into five categories. The classification based on concomitant fractures of different facial bones. The categories are: 1] fracture included upper midfacial, lower midfacial and mandibular bones [ULM]; 2] fractures of frontal, upper and lower midfacial bones [FUL]; 3] Fracture of the whole four bones [FULM]; 4] fracture of frontal, upper midfacial and mandibular bones [FUM] and 5] fracture of frontal, lower midfacial and mandibular bones]. For more clarification, the frontal sinus and orbital roof fractures were in the frontal bones. The upper mid-facial fractures included fractures of the lateral and medial orbital wall fractures, nasal and naso-orbital ethmoid fractures and zygomatic arch fractures. The lower mid-facial fractures included fractures of the maxillary sinus, bony plate and pterygofacial bones. Finally, fractures of the zygomatico-maxillary complex, LeFort II and III fractures, were categorized in the mandibular fractures.

Concomitant injuries were document and classified according to included part of the body. For the purpose of the study, six areas were defined: cranium, neck, upper limb, thorax, abdomen and lower limb.

All patients treated by multidisciplinary team [combined treatment]. Patients were divided into early and late-treatment groups according

to timing of intervention. When patients did not need neurosurgical intervention, the management performed within 72 hours after their admission and stabilization. All patients were operated under general anesthesia using submental intubation or tracheostomy. All patients received broad spectrum gram-negative and gram-positive antibiotics in their preoperative period. These antibiotics were continued for the end of the first postoperative week or extended beyond according to hospital protocol. Radiological evaluation was performed immediately and one month after operation to check the adequacy of fracture reduction and fixation. In addition, early postoperative complications were document and classified according to Clavien-Dindo classification system [Table 1] [7].

No oral intake was permitted on the day of surgery. Patients were instructed to have liquid diet initially after neurosurgical clearance was confirmed. Guidance elastics were used for 7-10 days to guide satisfactory occlusion. After that, if occlusion is not satisfactory, maxilla-mandibular fixation [MMF] was continued for the next 3 to 5 weeks, till achievement of satisfactory occlusion.

Table [1]: Classification of early postoperative complications [7]

Grade	Definition
I	Any deviation from the normal postoperative course without the need for pharmacological treatment, or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications Blood transfusions and total parenteral nutrition are also included
IIIa	Requiring surgical, endoscopic, or radiological intervention. Intervention not under general anesthesia
IIIb	Requiring surgical, endoscopic, or radiological intervention. Intervention under general anesthesia.
IVa	Life-threatening complications [including central nervous system complications] requiring IC/ICU management. Single organ dysfunction [including dialysis]
IVb	Life-threatening complications [including central nervous system complications] requiring IC/ICU management. Multiorgan dysfunction.
V: Mortality	Death of a patient

Analysis of data: the collected data fed to an excel sheet, where it was coded and anonymized. Then, transferred to the statistical package for social sciences [SPSS] version 18 [IBM®SPSS® Inc., Chicago, USA]. Quantitative data are presented by the arithmetic mean and standard deviation [SD]. However, Qualitative data are presented by relative frequency and percentages calculated from each group. Patients were grouped according to the pattern of their injury as described before. Groups were compared by one-way analysis of variance and Chi-square tests for quantitative and qualitative data respectively. P value < 0.05 was set as the value of statistical significance.

RESULTS

In the current work, the commonest pattern of injury was ULM pattern [21 patients; 51.2%], followed by FUL pattern [12 patients; 29.3%] and finally FULM pattern [8 patients; 19.5%]. There was significant association between the pattern of injury and patient's age and etiology [ie., patients with ULM pattern were the oldest, while those with FULM pattern were the youngest. The FULM pattern commonest etiology was industrial, while road traffic accident [RTA] was the commonest for ULM and FUL patterns]. Males were predominantly represented in all patterns of injury with no significant differences [Table 2].

In addition, there were significant association between the pattern of injury and each of operative time and early complications. The FULM pattern had the longest operative time, followed by FUL and ULM]. In addition, all patients in FULM pattern had early postoperative complications, compared to 75% of FUL pattern and 66.7% of the ULM pattern. Finally, in hospital mortality was only reported with FULM pattern [2 patients; 25% of the group] [Table 3].

Table [2]: Patient's characteristic in relation to pattern of injury

Variables	Measures	ULM [n=21]	FUL [N=12]	FULM [n-8]	test	p
Age [years]	Mean ± SD	45.81±5.43	41.33±6.38	32.13±8.09	13.80	**<0.001***
	Min.-Max.	39-58	25-50	19-42		
Gender [n, %]	Male	16 [76.2%]	10[83.3%]	5[62.5%]	1.14	0.56
	Female	5 [23.8%]	2[16.7%]	3 [37.5%]		
Etiology	RTA	18[85.7%]	7 [58.3%]	2 [25.0%]	11.38	**0.023***
	Fall or violence	0 [0.0%]	1 [8.3%]	2 [25.0%]		
	Industrial	3 [14.3%]	4 [33.3%]	4 [50.0%]		
Number of Concomitant injuries	None	2 [9.5%]	2[16.7%]	1[12.5%]	2.53	0.86
	One	5 [23.8%]	2[16.7%]	2 [25.0%]		
	Two	8 [38.1%]	4[33.3%]	1[12.5%]		
	Three or more	6 [28.6%]	4[33.3%]	4 [50.0%]		
Site of concomitant injury	Cranium	12 [57.1%]	8[66.7%]	6[75.0%]	0.87	0.64
	Thorax	10 [47.6%]	7 [58.3%]	3 [37.5%]	0.85	0.65
	Lower limb	1 [4.8%]	1 [8.3%]	1 [12.5%]	0.53	0.76
	Upper limb	5 [23.8%]	2 [16.7%]	1 [12.5%]	0.55	0.75
	Abdomen	6 [28.6%]	2 [16.7%]	4 [50.0%]	2.58	0.27
	Neck	4 [19.0%]	2 [16.7%]	1 [12.5%]	0.17	0.91

Table [3]: Early surgical outcome in relation to pattern of injury

Variables	Measures	ULM [n=21]	FUL [N=12]	FULM [n-8]	test	p
Operative time [h]	Mean±SD	5.67±1.02	5.83±1.25	7.19±0.53	**6.65**	**0.003***
	Min.- Max.	4-7	4.5-8	6.5-8		
Total duration of hospitalization [days]	Mean±SD	26.38±2.39	25.83±1.99	24.87±2.41	1.26	0.29
	Min.- Max.	22-31	22-29	20-28		
Early complications [Clavien-Dindo Classification]	None	7[33.3%]	3 [25.0%]	0 [0.0%]	**24.83**	**0.016***
	I	6 [28.6%]	2 [16.7%]	0 [0.0%]		
	II	3 [14.3%]	1 [8.3%]	2 [25.0%]		
	IIIa	3 [14.3%]	2 [16.7%]	3 [37.5%]		
	IIIb	2 [9.5%]	0 [0.0%]	0 [0.0%]		
	IV	0 [0.0%]	4 [33.3%]	1 [12.5%]		
	V: Mortality	0 [0.0%]	0 [0.0%]	2 [25.0%]		

DISCUSSION

The pattern of injury in the current work revealed that, ULM was the commonest followed by FUL and finally FULM pattern. This is in accordance with **Cynthia *et al.*** [8] who reported that, the ULM pattern was more due to its mechanism of injury. However, FULM pattern was the least to occur, as it requires massive force to fracture all the axial segments of the face. **Abdelrahman *et al.*** [9] also reported comparable results.

Age was significantly associated with the pattern of injury. This is in line with previous studies of **Allareddy *et al.*** [10] and **Pau *et al.*** [2] who reported that, FULM fractures involving the broadest fracture areas and were associated with the youngest age. However, ULM pattern had the oldest age.

In the current work, there were 31 males and 10 females [~ 3:1]. This is reported in previous studies of **Ramalingam *et al.*** [11] and **Jang *et al.*** [3]. Interestingly, **Jang *et al.*** [3] reported male: female ratio of 5.25: 1, and they also did not find any significant association between patient gender and pattern of injury as the current work. Furthermore, **Cynthia *et al.*** [8] reported that, 94.7% of their patients were males.

The etiology of injury was significantly associated with the injury pattern [p = 0.023]. However, RTA was the commonest etiology in the study [reported in 27 patients] followed by industrial cause [11 patients] and finally fall or interpersonal violence [3 patients]. These results are in line with previous two studies [6, 12]. However, it is contradicting with that of **Jang *et al.*** [3] who reported fall as the second most common cause of PFFs. This could be attributed to the fact that, one of Al-Azhar university hospitals [i.e., New Damietta] lie inside an industrial district.

Associated other injuries did not significantly different between patterns of PFFs. However, only 5 patients had no associated injuries, reflecting the burden of associated injuries. It could be attributed to the etiology of injury [highly momentum external forces]. The complication rate is significantly higher among FULM than FUL and ULM patterns. This could be explained by the higher concomitant injuries in the FULM type compared with others. These results are in accordance with that reported by **Jang *et al.*** [3]. **Cynthia *et al.*** [8] also reported that, the postoperative complications were significantly associated with the pattern of injury. The FULM pattern of PFFs had the maximum number of complications directly postoperative and up to six months postoperatively.

The mortality rate in the current work was 4.9% [2 out of 41 patients]. This is higher than previous literature [0.3% to 2.0%] [2, 10]. However, it is lower than **Jang *et al.*** [3] who reported a rate of 8.1%. The possible explanation may be related to timing of intervention and different pattern of PFFs. For example, a FUM pattern reported among **Jang *et al.***'s study not reported in the current one. They explained the high mortality rate reported in their work by increased concomitant injuries, especially that of the cranium. For example, the death was due to brain damage in three, hypovolemic shock in three, and one patient died due to cardiac arrest and another one due to brain contusion. **Cynthia *et al.*** [8] also reported that, all FULM patients [n=9] had persistent complications after 6 months. However, no mortality was reported among them. These patients had combinations of many combined complications. Thus, more careful management planning is required.

Overall, the results of the current work are in accordance with **Koraitim** [13], who reported that, 83.56% of patients were males. RTAs was the most common etiology of trauma. The commonest involved site was the middle and lower thirds [58%]. In addition, **Lin *et al.*** [14] reported that, four patterns of PFFs were defined: FULM [n = 60], FUL [n = 39], ULM [n = 127], and FUM [n = 1]. This distribution is comparable to the current study. However, **Lin *et al.*** reported significant association between PFFs patterns and sex [p = 0.018], and the number of concomitant injuries [p = 0.014]. Different PFFs patterns were significantly correlated with different types of concomitant injuries and complications. These results in line with the current work, regarding association with complications, but different regarding significant association with sex and concomitant injuries. The possible explanation may be related to difference in sample size and other patient criteria [e.g., patient's age].

The main limitation of the study is its retrospective nature, which resulted in lack of some data such as certain operative details and other detailed complications.

In short, the current study showed that, different patterns of PFFs are associated with different patient characteristics [e.g., age] and etiology. This pattern also affects operative time and short-term postoperative complications. Thus, defining the pattern of PFFs could be an initial triage in a systemic management approach aiming to improve clinical outcome. However, due to small number of included patients [a limitation of the current study], the results must be treated with caution. Future large-scale studies are warranted.

Conflict of Interest and Financial Disclosure: None.

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