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LE FORT I FRACTURES: CLINICAL, RADIOLOGIC, OPERATIVE, AND POSTOPERATIVE OUTCOME ANALYSIS WITH EMPHASIS ON RESIDUAL MALOCCLUSION

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Abstract
Le Fort I fractures remain clinically relevant because of their functional consequences, particularly postoperative malocclusion. Our study evaluated the demographic, clinical, radiologic, operative, and postoperative characteristics of surgically treated Le Fort I fractures and explored factors associated with residual malocclusion. Methods: A retrospective observational study was performed on 43 adult patients with CT-confirmed Le Fort I fractures treated by open reduction and internal fixation within 14 days after injury. Demographic, trauma-related, clinical, radiologic, operative, and follow-up data were collected from the medical records. Comparative analysis was performed between patients with and without residual postoperative malocclusion. Results: The cohort was predominantly male, and road traffic accidents were the most frequent cause of injury. Maxillary mobility and preoperative malocclusion were the most common clinical findings. Bilateral pterygoid plate fractures were present in all cases. Residual postoperative malocclusion was observed in 25.6% of patients, followed by persistent sensory disturbance, facial asymmetry, infection, and reoperation. Associated mandibular condylar fractures were more frequent in patients with postoperative malocclusion. Conclusions: Surgically treated Le Fort I fractures showed generally favorable outcomes, although residual malocclusion remained the main complication. Associated condylar fractures appeared to adversely influence postoperative occlusal stability.

Keywords: Le Fort I fracture, maxillofacial trauma, postoperative malocclusion, condylar fracture, open reduction internal fixation, computed tomography.

Introduction

Le Fort fractures remain a fundamental concept in the evaluation and management of midfacial trauma, despite the increasing recognition that contemporary fracture patterns often diverge from the classic descriptions. Among these, Le Fort I fractures represent a horizontal dissociation of the maxilla and continue to pose important diagnostic and therapeutic challenges, particularly when associated with occlusal instability, dentoalveolar trauma, or concomitant mandibular injuries. Recent clinical evidence has shown that Le Fort I fractures may present

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with variable surgical complexity and that postoperative malocclusion remains a relevant outcome, especially in patients with associated fractures affecting mandibular function [1].

Computed tomography has become the cornerstone of diagnosis in Le Fort injuries because it allows precise identification of fracture lines, pterygoid plate involvement, and extension into adjacent skeletal buttresses. The simplification of CT-based diagnosis has improved the recognition of classic Le Fort patterns and their variants, thereby supporting more accurate preoperative planning [1,2]. In this context, both two-dimensional and three-dimensional CT reconstructions have been shown to facilitate fracture classification and to improve understanding of fracture morphology, especially in complex or combined injuries [3].

Although the traditional Le Fort classification remains widely used, several studies have demonstrated that modern facial trauma frequently produces modified or incomplete fracture lines rather than idealized “pure” patterns. Observational CT-based studies have highlighted changing distributions of Le Fort fracture lines, suggesting that fracture trajectories are influenced by mechanism, force direction, and local structural resistance [4]. This concept has been further supported by biomechanical observations indicating that trauma velocity may influence the pathway of Le Fort I fractures through the lateral maxillary buttress [4,5].

From a broader clinical perspective, Le Fort fractures are often associated with high-energy trauma and may coexist with orbital, nasal, zygomatic, dentoalveolar, or mandibular injuries. Their evaluation, therefore, requires not only classification of the maxillary fracture itself, but also comprehensive assessment of the surrounding facial skeleton and functional disturbances [6]. Contemporary imaging approaches to maxillofacial trauma emphasize the importance of CT in identifying facial buttress disruption, fracture extension, and associated injuries that may alter surgical sequencing and fixation strategy [5-7].

The clinical relevance of these injuries extends beyond initial fracture reduction. Midfacial trauma, particularly when severe or associated with multiple skeletal units, may result in long-term physical and functional impairment [8]. Among postoperative sequelae, dysocclusion remains one of the most clinically significant complications in maxillofacial trauma, with implications for mastication, speech, temporomandibular balance, and quality of life [9]. In difficult cases, incomplete or unstable reduction of Le Fort fractures may require additional procedures, including osteotomy-based completion, to restore maxillary alignment and avoid persistent malocclusion [10]. Historical surgical experience has also shown that irreducible middle-third fractures present particular management difficulties and may compromise postoperative function if not adequately addressed [11].

Residual complications following major midfacial fractures include sensory deficits, facial deformity, occlusal disturbances, and functional dissatisfaction, underlining the need for accurate reduction and stable fixation [12]. Moreover, the severity of Le Fort injuries may vary substantially depending on whether they occur in isolation or as part of broader midfacial trauma [13]. Clinical outcome may also be influenced by patient-related factors such as age, with recent data suggesting variability in Le Fort fracture outcomes across age groups [14]. In addition, alternative mechanical presentations, such as Le Fort fractures with maxillary immobility, have led to refined conceptual approaches to surgical treatment [13-15]. Finally, because condylar fractures are known to affect occlusion and temporomandibular joint function, their association with Le Fort I fractures may be particularly important when interpreting postoperative occlusal outcome [16].

Our study aimed to evaluate the clinical, radiological, operative and postoperative characteristics of surgically treated Le Fort I fractures, with a particular focus on postoperative residual malocclusion and the factors associated with its occurrence.

Materials and methods

Study design and patient selection

In our retrospective observational study, we included adult patients diagnosed with CT-confirmed Le Fort I fractures who underwent open reduction and internal fixation (ORIF) at the Department of Oral and Maxillofacial Surgery between January 2019 and December 2025. Only patients treated within 14 days of injury and with complete clinical, radiological, and follow-up records were considered eligible for inclusion. Inclusion criteria were age 18 years or older, diagnosis of Le Fort I fracture confirmed by computed tomography, surgical treatment with ORIF, treatment performed within 14 days of trauma, and availability of postoperative follow-up data for at least 3 months. Exclusion criteria included pediatric patients, non-surgically treated fractures, pathological fractures, incomplete medical records, absence of preoperative CT imaging, follow-up shorter than the predefined study interval, and complex cases of panfacial trauma in which the Le Fort I component could not be reliably assessed as a distinct fracture pattern. Our study was carried out in accordance with the Declaration of Helsinki. Due to the retroactive design, informed consent has been waived or obtained in accordance with institutional regulations.

Clinical and Radiologic Assessment

We collected demographic and trauma-related variables retrospectively from medical records, including age, gender, mechanism of injury, time from trauma to surgery, and duration of postoperative follow-up. Clinical examination results recorded at presentation included maxillary mobility, preoperative malocclusion, intraoral cuts, and sensory disturbances. Preoperative computed tomography (CT) was available to all patients and was used for both fracture confirmation and surgical planning. The radiological evaluation focused on identifying the Le Fort I fracture pattern and the associated skeletal involvement. CT findings evaluated included bilateral fractures of the pterygoid plates, involvement of the piriform opening, fractures of the zygomaticomaxillary buttress, fractures of the posterior maxillary sinus wall, alveolar extension, and associated maxillofacial fractures, especially mandibular and dentoalveolar condyle lesions.

Surgical management

We treated all patients through ORIF under general anesthesia. The surgical approach and fixation model were selected based on fracture morphology and intraoperative stability requirements. Maxillomandibular fixation (MMF) was used intraoperatively when necessary to restore the pretraumatic occlusal relationship and guide reduction. The fixation was performed with either two or four points, depending on the fracture's extent and stability. In selected cases with associated dentoalveolar involvement, additional alveolar stabilization was performed. Operational time and hospitalization duration were also recorded.

Outcome Measures

The main measure of the outcome of our study was the presence of a postoperative residual malocclusion at follow-up. Secondary outcome measures included persistent sensory disturbances, facial asymmetry or residual deformity, postoperative infections, and reoperation. For comparative analysis, patients were divided into two groups according to the presence or absence of postoperative residual malocclusion. Demographic, clinical, radiological, and operative variables were subsequently compared between the two groups to identify factors potentially associated with an unfavorable postoperative occlusal outcome.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation (SD), and categorical variables were reported as number and percentage. Given the limited sample size and the small number of events in several categorical subgroups, non-parametric methods were preferred. Continuous variables were compared using the Mann–Whitney U test, whereas categorical variables were analyzed primarily using Fisher's exact test. The chi-square test was applied only when appropriate. Statistical significance was set at $p < 0.05$.

Results

Patient Demographics and Injury Characteristics

A total of 43 consecutive adult patients with CT-confirmed Le Fort I fractures who underwent open reduction and internal fixation (ORIF) within 14 days after injury were included in our study. The cohort comprised 34 men (79.1%) and 9 women (20.9%), with a mean age of 36.8 ± 11.4 years (range: 19–62 years). The most frequent mechanism of injury was road traffic accidents (19 cases, 44.2%), followed by interpersonal violence (11 cases, 25.6%), falls (9 cases, 20.9%), and occupational or sports-related trauma (4 cases, 9.3%). The mean interval between injury and surgery was 4.6 ± 2.3 days, and the mean follow-up period was 6.8 ± 2.7 months. Preoperative malocclusion was present in 31 patients (72.1%), while associated facial fractures were recorded in 24 cases (55.8%). Baseline demographic and injury-related characteristics are summarized in Table 1.

Table 1. Baseline demographic and injury-related characteristics of our study population.

Variable	Value
Number of patients	43
Age, mean ± SD (years)	36.8 ± 11.4
Age range (years)	19–62
Male sex, n (%)	34 (79.1)
Female sex, n (%)	9 (20.9)
Time from injury to surgery, mean ± SD (days)	4.6 ± 2.3
Follow-up duration, mean ± SD (months)	6.8 ± 2.7

Variable	Value
Mechanism of injury, n (%)	
Road traffic accidents	19 (44.2)
Interpersonal violence	11 (25.6)
Falls	9 (20.9)
Occupational/sports-related trauma	4 (9.3)
Preoperative malocclusion, n (%)	31 (72.1)
Associated facial fractures, n (%)	24 (55.8)
Soft-tissue injuries, n (%)	18 (41.9)

Legend: Data are presented as mean ± standard deviation (SD) or number (%), as appropriate.

Clinical, Radiologic, and Operative Findings

Maxillary mobility and preoperative malocclusion were the most frequent clinical findings, observed in 35 (81.4%) and 31 (72.1%) patients, respectively. Intraoral lacerations and sensory disturbance were recorded in 16 (37.2%) and 12 (27.9%) cases. CT imaging confirmed bilateral pterygoid plate fractures in all patients. Additional findings included piriform aperture involvement in 29 (67.4%), zygomaticomaxillary buttress fractures in 21 (48.8%), posterior maxillary sinus wall fractures in 18 (41.9%), and an alveolar component in 14 (32.6%) cases. All patients underwent ORIF; intraoperative maxillomandibular fixation was used in 32 cases (74.4%), and four-point fixation was more frequent than two-point fixation. The main clinical, radiologic, and operative findings are presented in Table 2.

Table 2. Clinical, radiologic, and operative findings of our study group

Variable	n	%	Mean ± SD
Clinical findings			
Maxillary mobility	35	81.4	—
Preoperative malocclusion	31	72.1	—
Intraoral lacerations	16	37.2	—
Sensory disturbance	12	27.9	—
CT findings			
Bilateral pterygoid plate fracture	43	100.0	—
Piriform aperture involvement	29	67.4	—
Zygomaticomaxillary buttress fracture	21	48.8	—
Posterior maxillary sinus wall fracture	18	41.9	—
Alveolar component	14	32.6	—
Operative findings			
Intraoperative maxillomandibular fixation	32	74.4	—
Two-point fixation	11	25.6	—
Four-point fixation	26	60.5	—
Additional alveolar stabilization	6	14.0	—
Operative time (min)	—	—	94.7 ± 21.3
Length of hospital stay (days)	—	—	5.2 ± 1.8

Abbreviations: CT, computed tomography; ORIF, open reduction and internal fixation; SD, standard deviation.

Postoperative Outcomes and Factors Associated with Residual Malocclusion

Postoperative healing was uneventful in most patients. Residual malocclusion was recorded in 11 patients (25.6%), while persistent sensory disturbance was noted in 8 cases (18.6%). Facial asymmetry or residual deformity was observed in 5 patients (11.6%), postoperative infection in 3 cases (7.0%), and reoperation in 2 patients (4.7%). Associated mandibular condylar fractures were more frequent in the malocclusion group than in patients with stable postoperative occlusion (45.5% vs. 12.5%, p = 0.03). Longer time from injury to surgery and lower use of four-point fixation were also observed in the malocclusion group, although these differences were not statistically significant. Comparative findings are summarized in Table 3, and the distribution of postoperative malocclusion according to condylar fracture status is shown in Figure 1.

Table 3. Comparative analysis of patients with and without residual postoperative malocclusion

Variable	Malocclusion group (n = 11)	No malocclusion group (n = 32)	p-value
Age (years), mean ± SD	39.1 ± 10.8	35.9 ± 11.2	0.31
Male sex, n (%)	9 (81.8)	25 (78.1)	0.79
Time from injury to surgery (days), mean ± SD	5.8 ± 2.6	4.2 ± 2.1	0.08
Preoperative malocclusion, n (%)	10 (90.9)	21 (65.6)	0.14
Associated condylar fracture, n (%)	5 (45.5)	4 (12.5)	0.03
Associated dentoalveolar fracture, n (%)	3 (27.3)	5 (15.6)	0.39
Four-point fixation, n (%)	5 (45.5)	21 (65.6)	0.29
Additional alveolar stabilization, n (%)	3 (27.3)	3 (9.4)	0.14
Sensory disturbance at follow-up, n (%)	4 (36.4)	4 (12.5)	0.08
Facial asymmetry/residual deformity, n (%)	3 (27.3)	2 (6.3)	0.06
Infection, n (%)	1 (9.1)	2 (6.3)	0.75
Reoperation, n (%)	1 (9.1)	1 (3.1)	0.41

The rate of postoperative malocclusion was higher in patients with associated mandibular condylar fractures than in those without condylar involvement, as illustrated in Figure 1.

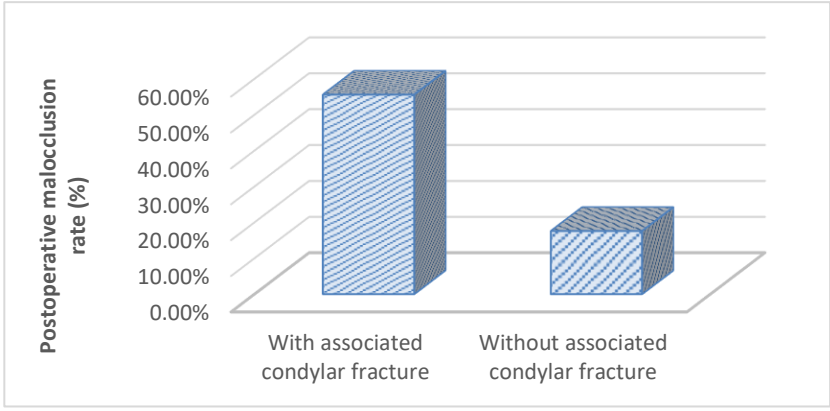

Figure 1. Rate of postoperative malocclusion in patients with and without associated mandibular condylar fractures after surgical treatment of Le Fort I fractures.

Discussion

We evaluated the demographic, clinical, radiological, operative, and postoperative characteristics of surgically treated Le Fort I fractures, with a particular focus on postoperative residual malocclusion and the variables associated with its occurrence. The main findings of our study were that Le Fort I fractures occurred predominantly in young and middle-aged men, were most commonly caused by road accidents, and were frequently associated with preoperative malocclusion, maxillary mobility, and additional maxillofacial injuries. Furthermore, postoperative residual malocclusion was identified in about a quarter of the cohort and was significantly more common in patients with associated mandibular condylar fractures.

The demographic profile observed in our study is consistent with the overall epidemiology of Le Fort and the average facial fractures reported in the literature. High-energy trauma remains the dominant mechanism in these injuries, especially in active adult male populations, with road accidents continuing to be a major etiological factor [1,6]. This distribution also supports the view that Le Fort I fractures, although sometimes considered less complex than higher-level facial dissociations, often occur in the context of substantial traumatic force and should not be considered minor injuries.

From a diagnostic perspective, the present study further confirms the central role of computed tomography in the assessment of Le Fort I fractures. Bilateral pterygoid plate fractures were identified in all patients, while variable extension toward the piriform aperture, zygomaticomaxillary buttress, posterior maxillary sinus wall, and alveolar segment was also documented. These findings are in agreement with previous studies showing that CT is indispensable not only for confirming the Le Fort fracture pattern, but also for identifying associated skeletal extension and guiding operative planning [2,3,7]. In addition, the radiologic distribution observed in this cohort supports the concept that contemporary midfacial trauma often does not follow idealized textbook trajectories. Instead, fracture lines may vary according to trauma energy, direction, and buttress resistance, as previously suggested by CT-based observational and biomechanical studies [4,5].

The operative findings of the present study also reflect the functional priorities of Le Fort I fracture management. Intraoperative maxillomandibular fixation was used in most cases, and four-point fixation was more frequent than two-point fixation. This pattern is clinically relevant because restoration of the pretraumatic occlusal relationship remains one of the fundamental goals in the treatment of horizontal maxillary fractures. The need for stable reduction and reliable buttress fixation is well recognized in the literature, especially in fractures with occlusal disruption or associated dentoalveolar injury [1,10,15]. In this regard, the higher use of four-point fixation in our series may reflect the surgical preference for greater stability in fractures with broader maxillary involvement.

An important clinical finding of our study was the rate of postoperative residual malocclusion. Although postoperative healing was eventless in most patients, residual malocclusion remained the most relevant functional complication, affecting 25.6% of the cohort. This observation is consistent with broader analyses of maxillofacial trauma, in which dysocclusion has been identified as one of the most significant postoperative sequelae due to its direct impact on chewing, speech, temporomandibular balance, and patient satisfaction [8,9]. Similarly, historical reports of middle fractures have pointed out that inadequate reduction or

incomplete restoration of maxillary alignment can lead to persistent functional impairment and complex postoperative management issues [11,12].

The most notable comparative result of our study was the significant association between mandibular condylar fractures and postoperative residual malocclusion. Patients with condylar involvement had a substantially higher rate of postoperative occlusal disorders than those without such fractures. This finding is clinically plausible and biomechanically relevant. Condylar fractures are known to alter mandibular position, occlusal load, and temporomandibular joint function, thereby compromising the reliability of intraoperative occlusal guidance even when maxillary reduction appears satisfactory [16]. The current result is also consistent with recent data indicating that associated condylar fractures represent an important risk factor for unfavorable occlusal outcome in the management of Le Fort I fractures [1]. From a practical point of view, this suggests that patients with combined Le Fort I lesions and condyles require particularly careful preoperative planning, intraoperative occlusal verification, and postoperative follow-up.

Other variables, including a longer interval from injury to surgery and less use of four-point fixation, were more common in the malocclusion group, although these differences did not reach statistical significance. These trends can still be clinically significant. Delayed treatment may increase technical difficulty due to edema, early fibrosis, or imperfect adaptation of fracture segments, while less extensive fixation may provide reduced resistance to functional displacement in certain cases. However, given the sample size of our study, these observations should be interpreted with caution and may require further investigation in larger courts.

Our study has several limitations. First, its retrospective design introduces the possibility of selection and informational bias. Second, the sample size was relatively limited, especially in the residual malocclusion subgroup, which restricts statistical power and may explain why some potentially relevant associations did not reach significance. Third, the study reflects the experience of a single surgical center, which may limit generalizability. Finally, the postoperative assessment was based on the available clinical follow-up data, without formal patient-reported outcome measures or standardized long-term functional scales.

Despite these limitations, our study also has relevant strengths. It focuses specifically on Le Fort I fractures, integrates clinical, CT-based, and operative variables, and evaluates a functionally meaningful endpoint, namely residual postoperative malocclusion. In addition, the comparative analysis provides practical information for surgical decision-making by highlighting the adverse influence of associated condylar fractures on postoperative occlusal stability.

Conclusions

Our study showed that surgically treated Le Fort I fractures occurred predominantly in adult male patients exposed to high-energy trauma and were frequently associated with marked functional impairment at presentation, particularly maxillary mobility and preoperative malocclusion. Computed tomography proved essential for confirming the fracture pattern and documenting associated skeletal extension. Although postoperative evolution was favorable in most cases, residual malocclusion remained the most relevant complication. These findings underline the importance of structured diagnostic assessment, accurate fracture reduction, and stable fixation in achieving satisfactory functional and occlusal outcomes after Le Fort I

fracture surgery. A relevant finding of our study was the association between postoperative residual malocclusion and concomitant mandibular condylar fractures, suggesting that the combined lesions may compromise postoperative occlusal stability despite appropriate surgical treatment. From a clinical perspective, these patients may require particularly careful preoperative planning, precise intraoperative occlusal control, and closer postoperative follow-up. Our study also supports the value of integrating demographic, radiological, operative, and outcome data when evaluating Le Fort I fractures in the surgical setting. Further studies with larger multicenter cohorts and longer follow-up periods are needed to better define prognostic factors and optimize treatment strategies for patients with complex maxillofacial trauma.

References

1. Cho JY, Ryu J: *Management of Le Fort I Fractures.* **Craniomaxillofac Trauma Reconstr.** 2024. 17,4,NP225-NP229. doi: 10.1177/19433875241278796.
2. Rhea JT, Novelline RA: *How to simplify the CT diagnosis of Le Fort fractures.* **AJR Am J Roentgenol.** 2005. 184,5,1700-5. doi: 10.2214/ajr.184.5.01841700.
3. Chen WJ, Yang YJ, Fang YM, Xu FH, Zhang L, Cao GQ: *Identification and classification in le fort type fractures by using 2D and 3D computed tomography.* **Chin J Traumatol.** 2006. 9,1,59-64. PMID: 16393519.
4. Patil RS, Kale TP, Kotrashetti SM, Baliga SD, Prabhu N, Issrani R: *Assessment of changing patterns of Le fort fracture lines using computed tomography scan: an observational study.* **Acta Odontol Scand.** 2014. 72,8,984-8. doi: 10.3109/00016357.2014.933252.
5. Roumeliotis G, Ahluwalia R, Jenkyn T, Yazdani A: *The Le Fort system revisited: Trauma velocity predicts the path of Le Fort I fractures through the lateral buttress.* **Plast Surg (Oakv).** 2015. 23,1,40-2. doi: 10.4172/plastic-surgery.1000899.
6. Phillips BJ, Turco LM: *Le Fort Fractures: A Collective Review.* **Bull Emerg Trauma.** 2017. 5,4,221-230. doi: 10.18869/acadpub.beat.5.4.499.
7. Fabrega M: *Imaging of Maxillofacial Trauma.* **Oral Maxillofac Surg Clin North Am.** 2023. 35,3,297-309. doi: 10.1016/j.coms.2023.02.001.
8. Girotto JA, MacKenzie E, Fowler C, Redett R, Robertson B, Manson PN: *Long-term physical impairment and functional outcomes after complex facial fractures.* **Plast Reconstr Surg.** 2001. 108,2,312-27. doi: 10.1097/00006534-200108000-00005.
9. Kommers SC, van den Bergh B, Boffano P, Verweij KP, Forouzanfar T: *Dysocclusion after maxillofacial trauma: a 42 year analysis.* **J Craniomaxillofac Surg.** 2014. 42,7,1083-6. doi: 10.1016/j.jcms.2013.05.013.
10. Scolozzi P, Imholz B: *Completion of nonreducible Le Fort fractures by Le Fort I osteotomy: sometimes an inevitable choice to avoid postoperative malocclusion.* **J Craniofac Surg.** 2015. 26,1,e59-61. doi: 10.1097/SCS.0000000000001178.
11. Vaughan ED, Obeid G, Banks P: *The irreducible middle third fracture, a problem in management.* **Br J Oral Surg.** 1983. 21,2,124-8. doi: 10.1016/0007-117x(83)90057-4.
12. Steidler NE, Cook RM, Reade PC: *Residual complications in patients with major middle third facial fractures.* **Int J Oral Surg.** 1980. 9,4,259-66. doi: 10.1016/s0300-9785(80)80032-9.

13. Bagheri SC, Holmgren E, Kademani D, Hommer L, Bell RB, Potter BE, Dierks EJ: *Comparison of the severity of bilateral Le Fort injuries in isolated midface trauma.* **J Oral Maxillofac Surg.** 2005. 63,8,1123-9. doi: 10.1016/j.joms.2005.04.003.
14. Limanto CA, Galvez Cabezas K, Saadat GH, Fu CY, Phillips BJ, Bokhari F, Brown LR: *Age-Related Outcomes in Le Fort Fractures.* **Am Surg.** 2023. 89,8,3547-3549. doi: 10.1177/00031348231161683.
15. Liao HT, Mittal R, Kang G, Chen CT: *Le Fort Fractures With Maxillary Immobility: Classification and the Moment Concept to Rationalize Optimal Surgical Treatment.* **Ann Plast Surg.** 2021. 86,2S Suppl 1,S58-S63. doi: 10.1097/SAP.0000000000002651.
16. Silvennoinen U, Raustia AM, Lindqvist C, Oikarinen K: *Occlusal and temporomandibular joint disorders in patients with unilateral condylar fracture. A prospective one-year study.* **Int J Oral Maxillofac Surg.** 1998. 27,4,280-5. doi: 10.1016/s0901-5027(05)80615-0.

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