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Retrospective Analysis of Patients Surgically Treated for Maxillofacial Trauma: A Single-Centre Experience

Maksillofasiyal Travma Nedeniyle Cerrahi Tedavi Uygulanan Hastaların Retrospektif Analizi: Tek Merkez Deneyimi

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Abstract

Background: This study aimed to identify regional trauma patterns by evaluating demographic characteristics, trauma etiologies, fracture localisations, and surgical treatment methods in patients who underwent surgical management for maxillofacial trauma (MFT).
Materials and Methods: This retrospective study included 182 patients who received surgical treatment for MFT between January 2021 and June 2025. Demographic data, trauma etiologies, fracture sites, fracture types, and surgical techniques were reviewed using patient medical records and the hospital information system. Fractures were classified based on anatomical location and number.
Results: The majority of patients were male (85.7%), with a mean age of 38 years. Assault was the most common cause of trauma. Single fractures were observed in 67.6% of cases, while 32.4% presented with multiple fractures. Among isolated fractures, the mandible (34.1%) and zygoma (25.3%) were the most frequently affected sites. In multiple fractures, the most common combinations involved the maxilla (28.6%), mandible (24.4%), and nasal bones (22.7%). Of the 132 mandibular fractures, subcondylar fractures were the most prevalent (29.5%). Le Fort II fractures were the most common maxillary fractures, tripod fractures predominated among zygomatic fractures, and anterior wall involvement was most frequent in frontal sinus fractures. Of the total 235 fractures, 201 were treated with open reduction and internal fixation, while 34 underwent closed reduction.
Conclusions: MFTs in Samsun province predominantly affected young male patients, with assault and traffic accidents being the leading etiologies. Mandibular and zygomatic fractures were the most common fracture types. These findings provide a better understanding of regional MFT patterns.
Keywords: Maxillary fractures, Maxillofacial trauma, Mandibular fractures, Surgical approach, Zygomatic fractures

Öz

Amaç: Bu çalışmanın amacı, kliniğimizde maksillofasiyal travma (MFT) nedeniyle cerrahi tedavi uygulanan hastaların demografik özellikleri, travma etiyolojileri, kırık lokalizasyonları ve cerrahi tedavi yöntemlerini değerlendirerek bölgesel travma paternlerini ortaya koymaktır.
Materyal ve metod: Bu retrospektif çalışmaya Ocak 2021–Haziran 2025 tarihleri arasında MFT nedeniyle cerrahi tedavi uygulanan 182 hasta dahil edildi. Demografik veriler, travma etiyolojileri, kırık lokalizasyonları, kırık tipleri ve uygulanan cerrahi teknikler hasta dosyaları ve hastane bilgi sistemi üzerinden geriye dönük olarak incelendi. Kırıklar anatomik lokalizasyonlarına ve sayılarına göre sınıflandırıldı.
Bulgular: Hastaların %85,7'si erkek olup, ortalama yaş 38 idi. Travmanın en sık nedeni darp olarak saptandı. Olguların %67,6'sında tek kırık, %32,4'ünde ise çoklu kırık mevcuttu. İzole kırıklar arasında en sık mandibula (%34,1) ve zigoma (%25,3) yer aldı. Çoklu kırıklarda en sık kombinasyonlar maksilla (%28,6), mandibula (%24,4) ve nazal kemikler (%22,7) idi. Toplam 132 mandibula kırığının en sık alt tipi subkondiler kırıklar (%29,5) olarak belirlendi. Maksilla kırıkları içinde en sık Le Fort II, zigomatik kırıklar içinde tripod tipi, frontal sinüs kırıkları içinde ise ön duvar tutulumu gözlendi. Toplam 235 kırığın 201'i açık redüksiyon ve internal fiksasyon, 34'ü ise kapalı redüksiyon ile tedavi edildi.
Sonuç: Samsun ilinde MFT'ler en sık genç erkeklerde görülmekte olup, başlıca etiyolojik faktörler darp ve trafik kazalarıdır. Mandibula ve zigoma kırıkları en sık saptanan kırık tipleridir. Bu bulgular bölgesel maksillofasiyal travma paternlerinin anlaşılmasına katkı sağlamaktadır.
Anahtar Kelimeler: Cerrahi yaklaşım, Maksiller kırıklar, Maksillofasiyal travma, Mandibular kırıklar, Zigoma kırıkları

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Introduciton

Maxillofacial trauma (MFT) accounts for a substantial proportion of emergency admissions to plastic, reconstructive, and aesthetic surgery clinics. The facial region is crucial for vital functions such as respiration, mastication, speech, and vision, as well as for aesthetic appearance and psychosocial interaction. Consequently, facial bone fractures may result in significant functional, cosmetic, and psychosocial impairments (1). MFTs may present as isolated injuries or as part of multiple trauma and are often associated with intracranial, cervical vertebral, or extremity injuries (2).

The aetiology of trauma varies according to socioeconomic status, cultural structure, urbanisation level, and safety measures. In developing countries, assault and traffic accidents are the most common causes, whereas falls, sports injuries, and occupational accidents predominate in developed countries (3). Studies from Türkiye indicate that physical violence and traffic accidents are the leading etiological factors, particularly among young men (4). Recent data show a global increase in MFT incidence, which represents a significant public health burden, especially among 18-40-year-olds. According to the World Health Organisation, traffic accidents and interpersonal violence remain the primary causes of MFTs in developing countries (5).

Advances in high-resolution computed tomography and three-dimensional imaging techniques have enabled more accurate fracture assessment. At the same time, mini-plate and screw systems, rigid fixation principles, and endoscopy-assisted approaches have become prominent in surgical management (6). In this context, the modern management of MFTs requires a multidisciplinary approach aimed not only at achieving anatomical reduction but also at optimising functional, aesthetic, and psychosocial outcomes (7).

Heavy traffic flow, a high proportion of the population employed in construction and industrial sectors, limited use of protective equipment in rural areas, and the widespread occurrence of physical violence are among the main factors contributing to the increased incidence of MFTs. In regions where these factors are particularly evident, MFTs are frequently encountered (8). Tertiary care centres such as Samsun City Hospital serve as regional referral centres for the diagnosis and treatment of these traumas.

In this study, the demographic characteristics, trauma etiologies, fracture localisations, and surgical treatment methods of patients who underwent surgical management for MFTs in our clinic were retrospectively evaluated. The aim was to delineate the etiological distribution of MFTs in Samsun, to provide data comparable with similar studies conducted in Türkiye, and to contribute to a better understanding of region-specific trauma dynamics.

Materials and Methods

Ethics Committee Approval

This study included 182 patients who underwent surgical treatment for MFTs at the Plastic, Reconstructive and Aesthetic Surgery Clinic between January 2021 and June 2025. Ethical approval was obtained from the Samsun University Clinical Research Ethics Committee (approval no: 2022/10/6, date: October 19, 2022).

Study Design

The inclusion criteria were defined as patients who were diagnosed with facial fractures due to trauma, underwent surgical intervention at our institution between January 2021 and June 2025, and whose medical records and imaging data were complete and accessible. Exclusion criteria comprised fractures managed conservatively, patients with facial soft tissue trauma without radiologically confirmed fractures, cases operated on at external centres during the same period with incomplete records, and pediatric patients with injuries limited solely to dentoalveolar trauma.

Demographic data (age and sex), trauma aetiology, fracture sites, number of fractures, whether fractures were isolated or multiple, associated injuries, and surgical treatment modalities were retrieved from patient medical records. Fractures were classified as single or multiple, and further categorised as isolated or combined fractures. Nasal bone fractures were not evaluated as an isolated fracture category in this study and were recorded only as components of multiple fracture combinations. This approach was adopted because the study primarily focused on surgically treated major MFTs. Isolated fractures included mandibular, zygomatic, maxillary, orbital wall, and frontal sinus fractures. In contrast, combined fractures were defined as various combinations involving the maxilla, mandible, nasal bones, zygoma, frontal, and orbital regions (5).

Anatomical subtypes of mandibular, maxillary, zygomatic, and frontal sinus fractures were determined based on three-dimensional computed tomography (3D-CT) images obtained at presentation. Mandibular fractures were classified as subcondylar, angular, corpus, symphysis, parasymphysis, and ramus fractures (9). Maxillary fractures were evaluated according to the Le Fort I-III classification and alveolar fractures (10). Zygomatic fractures were categorised as tripod, arch, body,

and non-specific fractures, while frontal sinus fractures were recorded as anterior wall, bilateral involvement, and nonspecific fractures (11,12).

Data regarding surgical management were obtained from patient files. Surgical techniques applied for mandibular, zygomatic, maxillary, and frontal region fractures included open reduction and internal fixation (ORIF), closed reduction, Gillies and lever techniques, and intermaxillary fixation. All surgical procedures were performed under general anaesthesia in accordance with the institutional standard surgical protocols.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean, minimum, and maximum values, while categorical variables were presented as numbers and percentages (%). As the study was descriptive, data analysis primarily relied on descriptive statistical methods. Fracture types, anatomical localisations, trauma etiologies, and surgical treatment modalities were analysed using frequency and percentage distributions.

Results

A total of 182 patients were evaluated, of whom 156 (85.7%) were male, and 26 (14.3%) were female. The median age was 38 years (range: 1-77 years). Among patients with MFTs, 8.7% had associated injuries, including traumatic brain injury, thoracic trauma, and extremity injuries. Analysis of trauma aetiology revealed that assault was the most common cause (30.6%), followed by traffic accidents (29.7%) and falls (26.4%). Occupational accidents, sports-related injuries, and other traumatic causes were observed at lower rates, and animal-related trauma (kicks) was identified in two patients (Table 1).

Table 1. Demographic characteristics of patients and trauma aetiology

Variables		
Age*	38	1-77
Gender**		
Male	156	85.7
Female	26	14.3
Etiology**		
Assault	57	30.6
Traffic accident	54	29.7
Fall	48	26.4
Occupational accident	8	4.4
Sports injury	4	2.2
Animal attack	2	1.1
Other injuries	9	5.6

Table 1. Continued

* median (min-max); **n (%)

Evaluation of fracture characteristics showed that approximately two-thirds of patients had a single fracture, while the remaining patients had multiple fractures. Representative images of single and multiple fractures in the study population are shown in Figure 1.

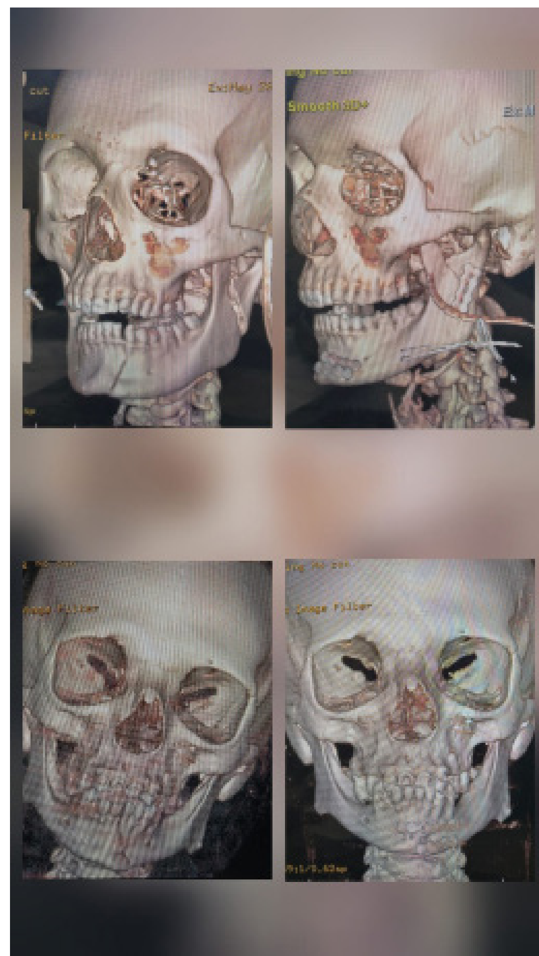

Figure 1. Representative images of single and multiple fractures in the study group

When fracture distribution was analysed by sex, male patients predominated in both single- and multiple-fracture groups. Analysis of isolated fracture sites demonstrated that mandibular fractures were the most common, followed by zygomatic and maxillary fractures. Orbital wall and frontal sinus fractures were among the least frequently encountered fracture types. In cases with multiple fractures, combinations involving the maxilla, mandible, nasal bones, and zygoma were most common, whereas frontal and orbital fractures accompanied these patterns less frequently (Table 2).

Table 2. Distribution of maxillofacial fractures according to gender, number of fractures, and anatomical location

Variable	n	%
Number of fractures		
Single	123	67.6
Multiple	59	32.4
Gender distribution		
Male (single fracture)	106	58.2
Male (multiple fractures)	50	27.7
Female (single fracture)	17	9.3
Female (multiple fractures)	9	4.8
Isolated mandibular fracture		
Male	57	91.9
Female	5	8.1
Isolated zygomatic fracture		
Male	37	80.4
Female	9	19.6
Isolated maxillary fracture		
Male	5	83.3
Female	1	16.7
Isolated orbital wall fracture		
Male	5	71.4
Female	2	28.6
Isolated frontal sinus fracture		
Male	2	100.0
Female	0	0.0
Multiple fractures		
Maxilla bones	34	26.8
Mandible bones	29	22.8
Nasal bones	24	18.9
Zygoma bones	27	21.2
Frontal sinus	5	4
Orbital wall	8	6.3

All MFTs were evaluated separately according to their anatomical localisation. In patients with mandibular fractures, a total of 132 mandibular fracture sites were identified. Of these, 39 (29.5%) were subcondylar fractures, 26 (19.7%) angular fractures, 23 (17.4%) corpus fractures, 21 (15.9%) symphyseal fractures, 15 (11.4%) parasymphyseal fractures, and 8 (6.1%) ramus fractures. A total of 37 maxillary fractures were identified, of which 20 (54.1%) were classified as Le Fort II, 8 (21.6%) as Le Fort I, 7 (18.9%) as Le Fort III, and 2 (5.4%) as alveolar fractures. Nasal bone fractures were not included as an isolated category in the study and were evaluated only as accompanying fractures; nasal fractures were identified in 24 patients with multiple fractures. Evaluation of zygomatic fractures revealed a total of 74 zygomatic fracture sites, including 39 (52.7%) tripod fractures, 26 (35.1%) arch fractures, 1 (1.4%) zygomatic body fracture, and 8 (10.8%) nonspecific fractures. About frontal sinus fractures, a total of 14 fractures were identified; 8 (57.1%) involved the anterior wall, 2 (28.6%) demonstrated bilateral involvement, and 4 (14.3%) were classified as non-specific fractures (Figure 2).

When surgical approaches applied to the total of 235 fractures included in the study were analysed, ORIF using titanium plate and screw systems was identified as the most frequently preferred treatment modality. ORIF was performed in 201 fractures, whereas 34 fractures were managed using closed reduction techniques. Among fractures treated with closed reduction, techniques commonly used for zygomatic fractures were most common. Specifically, the Gillies technique was used in 24 cases, and the Lever technique in 9; in one patient, closed reduction with intermaxillary fixation using an arch bar was

performed for mandibular stabilisation. Surgical approaches were selected based on fracture localisation, degree of displacement, and functional requirements (Figure 3).

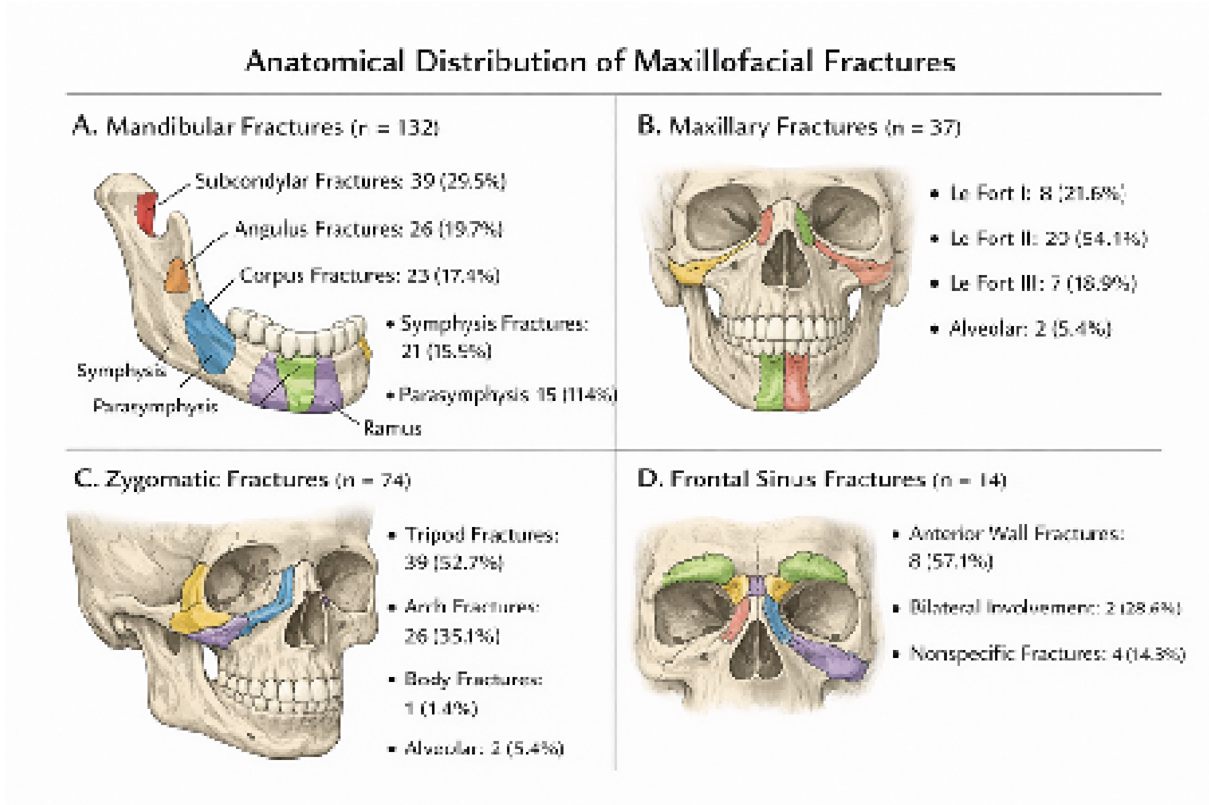

Figure 2. Anatomical distribution of maxillofacial fractures

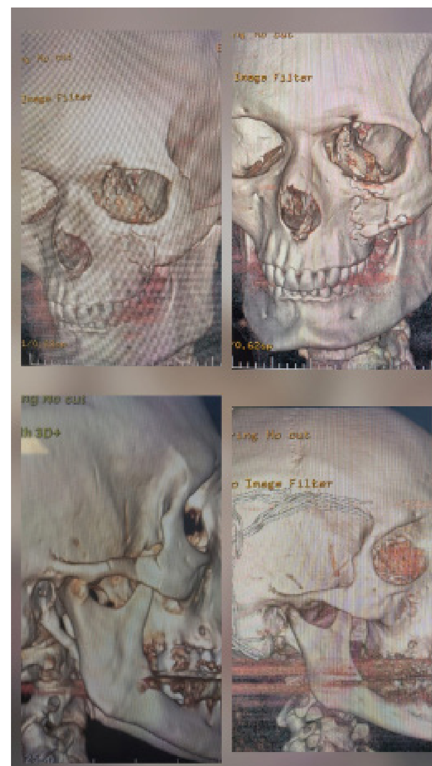

Figure 3. Representative images of surgical treatment modalities. Upper images: ORIF technique. Lower images: Gillies technique

Discussion

The findings of the present study are broadly consistent with data reported in the national and international literature. In our cohort, 85.7% of patients with MFTs were male, which aligns with previous studies demonstrating a clear male predominance (4,5,13,14). This pattern is commonly attributed to socioeconomic and occupational factors, including greater exposure to high-risk environments and interpersonal violence. MFTs are known to occur predominantly in young adults, with assault and traffic accidents representing the leading etiological factors in most series, although their relative proportions vary (14,15). In our region, the relatively high proportion of assault-related injuries may reflect specific sociodemographic characteristics and regional safety dynamics (7). One of the strengths of the present study is its ability to provide region-specific epidemiological data from Samsun province, a major referral centre in the Black Sea region of Türkiye. The dense transportation network, the high proportion of young male individuals working in industrial and construction sectors, and regional sociocultural dynamics may help explain the etiological distribution of maxillofacial trauma observed in this cohort.

In the present study, 67.6% of MFTs-related fractures were single fractures, whereas 32.4% were multiple fractures. This distribution is broadly consistent with previously reported data. Recent large-scale series indicate that single fracture rates generally range from 70% to 80% (16). In a Malaysian series of 1,044 cases, the single fracture rate was 77.1% (17). Similarly, a study comparing pediatric and adult populations reported single fracture rates of 81% in adults and 85% in children (18). Conversely, some centres have reported markedly higher rates of multiple fractures; for example, Kadanthode et al. reported a multiple fracture rate of 79.5% in a series covering the pandemic period (19). The relatively lower rate of multiple fractures observed in our study may be related to regional differences in trauma dynamics.

Evaluation of the anatomical distribution of mandibular fractures revealed that the subcondylar region was most frequently affected, followed by angular, corpus, and symphyseal fractures. This pattern is consistent with previous reports (20). The condylar–subcondylar region has been described as one of the biomechanically weakest areas of the mandible, making it more susceptible to fracture (21). Reported rates of 15–25% for angular and corpus fractures and 10–20% for symphyseal fractures are comparable with our findings (17,19). The low incidence of ramus fractures observed in our study is consistent with the literature (20). These findings support the notion that mandibular fracture patterns are closely related to trauma mechanisms and biomechanical properties.

Among maxillary fractures, Le Fort II fractures were the most common, followed by Le Fort I and Le Fort III fractures. The literature similarly reports Le Fort II as the most frequently encountered maxillary fracture type (22). It has been emphasised that a substantial proportion of midfacial fractures are still classified according to the Le Fort system and that the Le Fort I–III classification remains widely used in clinical practice (23). Maxillary fractures are generally associated with high-energy trauma, and fracture lines are known to propagate along structurally weak buttresses of the midface (24). The predominance of Le Fort II fractures in our cohort may therefore be related to the specific trauma characteristics of our patient population.

In zygomatic fractures, tripod fractures were most frequently observed, followed by arch fractures. This distribution is consistent with current literature on zygomaticomaxillary complex injuries. Tripod fractures are reported to be the most common type, due to force transmission through the articulations between the zygoma and the maxilla, and between the frontal and temporal bones (25). Furthermore, zygomatic fractures typically result from direct lateral facial impacts, explaining the high rates of tripod and arch fractures reported in clinical series (10).

Among orbital fractures, medial and inferior wall fractures were most commonly identified. This finding is in accordance with studies reporting that orbital blow-out fractures predominantly involve these walls (26). The thin anatomical structure of the medial and inferior orbital walls and the redirection of traumatic energy into the adjacent sinus cavities provide a plausible explanation. In addition, sudden increases in intraorbital pressure following lateral impacts have been reported to result in fractures at selectively vulnerable orbital wall regions (27).

Regarding frontal sinus fractures, anterior wall fractures were the most common pattern observed, whereas posterior wall and complex fractures were less frequent. The literature similarly indicates that anterior wall fractures are the most prevalent, while posterior wall fractures are typically associated with higher-energy trauma (5,6). This distribution further supports the consistency of our findings with established patterns of frontal sinus fractures.

Evaluation of treatment modalities demonstrated that the vast majority of maxillofacial fractures were managed using ORIF, while closed reduction techniques were applied in a limited number of cases. This approach is consistent with current literature supporting ORIF as the preferred treatment modality

in displaced fractures (28). Cases managed with closed reduction in our series were well aligned with the conservative treatment indications described in the literature (10,28,29).

Study Limitations

The main limitations of this study include its retrospective design, potential incompleteness of medical records, and its single-centre nature. In addition, the lack of detailed data regarding trauma mechanisms limited a comprehensive analysis of the relationship between trauma energy and fracture patterns. Therefore, prospective multicenter studies with larger sample sizes are warranted to validate these findings further.

Conclusion

In conclusion, this study demonstrates that MFTs occur more frequently in young male patients, with assault and falls being among the leading etiological factors. Mandibular fractures represent the most commonly encountered bony injuries, underscoring the importance of appropriate surgical planning and stable fixation in clinical management. The findings of this study contribute to a better understanding of regional trauma patterns and etiological distributions. This study provides region-specific reference data for Samsun and neighboring regions and may contribute to the development of trauma management strategies in similar tertiary referral centers.

Ethical Approval: *This study was approved by the Samsun University Clinical Research Ethics Committee (approval no: 2022/10/6, date: October 19, 2022).*
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Concept: A.S., M.O.
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Data acquisition: A.S., B.B., C.A., D.Ö., İ.B.
Analysis and interpretation: İ.B., D.Ö., U.T.
Writing manuscript: A.S., M.O.
Critical revision of manuscript: A.S., M.O.
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