Midfacial Trauma: Epidemiological Trends, Localization Patterns and Psychological Consequences

Doctoral (PhD) Dissertation

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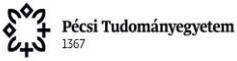

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List of Abbreviations

CT – Computed tomography
IES – Impact of Event Scale
EHS – Hungarian version of the Impact of Event Scale
OR – Odds ratio
CI – Confidence interval
PTSD – Post-traumatic stress disorder
ZM – Zygomaticomaxillary

1. Introduction

Maxillofacial traumatology is one of the most important fields of emergency and reconstructive surgery, dealing with the diagnosis and treatment of injuries of the facial skeleton. Midfacial fractures represent a particularly significant clinical problem, as numerous anatomically and functionally important structures are located in the midface region that are essential both from functional and aesthetic perspectives. These include the upper airways, elements of the masticatory system, orbital structures, and the bony framework determining facial aesthetics. Consequently, the consequences of such injuries may manifest not only as functional disturbances – such as visual impairment, diplopia or difficulties in mastication – but may also involve significant psychosocial effects.

In recent decades, the epidemiological pattern of facial trauma has undergone considerable changes worldwide. With the development of road safety measures, the proportion of high-energy traffic accidents has decreased in many countries, while low-energy trauma, particularly falls, has become increasingly important. This tendency is closely related to demographic changes observed in developed countries, most notably the gradual ageing of the population.

Geriatric trauma is now considered one of the key areas of emergency care. Injuries in elderly patients show several specific characteristics: deterioration

of bone quality, osteoporosis, multimorbidity and medical treatments – such as anticoagulant therapy – all influence the development and course of injuries. As a result of these factors, facial trauma in elderly patients often presents different patterns compared with younger populations.

However, the significance of midfacial fractures does not lie solely in physical injuries. The psychological consequences of trauma have received increasing attention in the scientific literature. Following injury, many patients may experience post-traumatic stress symptoms, anxiety or deterioration in quality of life. Visible facial injuries may represent a particularly strong psychological burden, as the face is one of the most important elements of personal identity and social communication.

The aim of the present doctoral dissertation was the comprehensive investigation of the epidemiological patterns, anatomical localization characteristics and psychological consequences of midfacial fractures. The research was based on three complementary study pillars: a large-scale epidemiological analysis of patient data, a CT-based localization study and a questionnaire-based psychological assessment.

2. Objectives

The main objective of the doctoral dissertation was the comprehensive investigation of the epidemiological, anatomical and psychological characteristics of midfacial fractures.

The research focused on three interrelated areas.

The first research pillar aimed to explore the epidemiological patterns of midfacial fractures in different age and sex groups. Particular attention was paid to trauma etiology, hospitalization patterns and associated injuries.

In the second pillar, the anatomical localization of fractures was analyzed using CT-based diagnostic data. The aim of this investigation was to determine how age, sex and trauma etiology influence the localization patterns of midfacial fractures.

The third research pillar focused on the psychological consequences of midfacial fractures. Within this framework, the occurrence and severity of post-traumatic stress symptoms were examined using a questionnaire-based method, with special attention to demographic and etiological factors.

3. Materials and Methods

The doctoral dissertation is based on three retrospective studies that complement each other in examining the epidemiological, anatomical and psychological characteristics of midfacial fractures.

Epidemiological study

A total of 957 patients with CT-confirmed midfacial fractures were included in the epidemiological analysis. The patients were treated at the Department of Oral and Maxillofacial Surgery of the University of Pécs.

During data collection, the following variables were recorded: age, sex, trauma etiology, hospitalization, associated injuries and dental status.

During statistical analysis, chi-square tests were applied to compare categorical variables. In order to examine the effect of individual risk factors, odds ratio (OR) calculations were performed with a 95% confidence interval.

Localization study

The localization analysis included data from 115 patients with CT-confirmed midfacial fractures. The anatomical localization of fractures was analyzed in detail with particular attention to the following regions:

- zygoma
- zygomaticomaxillary complex
- maxillary walls
- orbital wall (blow-out fractures)
- alveolar process
- frontal bone
- Le Fort fractures

Patients were classified into a total of 12 subgroups based on age, sex and trauma etiology. Differences between subgroups were analyzed using Pearson's chi-square test and the Fisher–Freeman–Halton test.

Psychological study

A total of 116 patients were included in the psychological study. To evaluate post-traumatic stress symptoms, the Hungarian adaptation of the Impact of Event Scale (IES), the Impact of Event Scale Hungarian version (EHS), was used.

The EHS contains two main subscales: the intrusion and avoidance dimensions.

The following variables were examined during the analysis:

- age
- sex
- trauma etiology
- hospitalization

Correlation analyses and group comparisons were performed during statistical evaluation.

4. Results

4.1 Epidemiological results

The retrospective epidemiological analysis included a total of 957 patients with CT-confirmed midfacial fractures. Detailed evaluation of the patient cohort revealed clear age-related differences in trauma etiology, injury mechanisms and clinical management patterns.

When analyzing trauma etiology, it was observed that in the younger population high-energy trauma, particularly traffic accidents and interpersonal violence, represented the most frequent causes of injury. In contrast, falls dominated as the main etiological factor among elderly patients.

In the ≥65 age group nearly 90% of midfacial fractures occurred as a consequence of falls, which represents a marked epidemiological difference compared with younger patients. Odds ratio calculations demonstrated that the probability of fall-related midfacial fractures was significantly higher in the elderly population than in younger individuals.

Sex-based analysis revealed further characteristic differences. In younger age groups male patients predominated, which is consistent with the well-known epidemiology of high-energy trauma. In contrast, a higher proportion of female patients was observed in the elderly population. This can partly be explained by demographic factors, such as the longer life expectancy of women, and partly by the higher incidence of falls among elderly individuals.

Elderly women represented a particularly vulnerable group with regard to fall-related facial trauma. The combination of female sex and advanced age appeared as a synergistic risk factor in statistical analyses.

The investigation of hospitalization patterns also revealed important clinical differences. High-energy trauma, such as traffic accidents, required hospital admission significantly more frequently and was often associated with additional injuries such as cranial or limb trauma. In contrast, low-energy fall-related injuries frequently resulted in isolated midfacial fractures that could often be managed in an outpatient setting.

The analysis of associated injuries demonstrated that polytrauma and multimorbidity were more frequent among elderly patients, highlighting the importance of multidisciplinary management.

Overall, the results of the epidemiological study indicate that the pattern of midfacial fractures differs significantly according to age, and that falls among elderly individuals represent an increasingly dominant etiological factor.

4.2 Localization results

The CT-based localization analysis included 115 patients with detailed imaging data available for precise anatomical evaluation of midfacial fractures.

Based on the overall data, the most frequent fracture locations were:

- the zygoma
- the maxillary walls
- the zygomaticomaxillary complex

These regions represent biomechanically vulnerable structures of the midface that are particularly susceptible to lateral or anterolateral forces.

Age-based analysis demonstrated significant differences in anatomical fracture patterns. Among elderly patients isolated maxillary wall fractures predominated, typically resulting from low-energy trauma such as falls.

In contrast, younger patients more frequently presented with complex injuries, including fractures of the zygomaticomaxillary complex and orbital blow-out fractures, which are generally associated with higher-energy trauma mechanisms.

Classical Le Fort fractures proved to be relatively rare in the examined population. This finding suggests that the traditional Le Fort classification system may have limited applicability in modern trauma epidemiology, where low-energy injuries are increasingly prevalent.

Subgroup analyses classified patients into 12 different groups based on age, sex and trauma etiology. Statistical evaluation demonstrated that age had a significant effect on fracture localization, while sex and etiology primarily influenced injury type and complexity.

Overall, the localization study clearly showed that the anatomical patterns of midfacial fractures are closely related to both the mechanism of trauma and age-related characteristics.

4.3 Psychological results

The aim of the psychological study was to explore the mental consequences of midfacial fractures. A total of 116 patients participated in the investigation and completed the Hungarian adaptation of the Impact of Event Scale (EHS).

The scale evaluates post-traumatic stress symptoms along two principal dimensions: intrusion and avoidance.

The results indicated that approximately one-third of the patients showed clinically relevant PTSD symptoms. This finding suggests that midfacial fractures may have not only physical but also significant psychological consequences.

Analysis of demographic factors revealed that female patients achieved higher scores on both the intrusion and avoidance subscales, indicating increased psychological vulnerability.

Age also played an important role in psychological reactions. Younger patients demonstrated higher intrusion scores, suggesting that the psychological processing of trauma may be more intense in this age group.

Examination of etiological factors revealed that violent trauma, such as interpersonal assault, was associated with higher PTSD scores. Hospitalization also showed a significant relationship with psychological burden, which may be explained by the severity of injuries and the longer recovery period.

Statistical analyses demonstrated a significant correlation between the intrusion and avoidance subscales, which is consistent with established psychological models of PTSD.

Overall, the findings indicate that the psychological consequences of midfacial fractures are clinically relevant and should be considered during comprehensive patient care.

5. Novel Scientific Findings5. Novel Scientific Findings

1. The dominant role of falls in old age can be demonstrated in the epidemiology of midfacial fractures.
   The retrospective analysis performed on a large patient cohort demonstrated that the etiological distribution of midfacial fractures differs significantly according to age. In the ≥65 age group, the vast majority of cases occurred as a consequence of falls, which proved to be the dominant causative factor of facial trauma in elderly patients. This finding is consistent with international epidemiological trends observed in ageing populations and highlights that the etiological structure of facial trauma has undergone substantial changes over recent decades.

2. The risk of fall-related midfacial fractures is significantly higher among patients aged ≥65 years.
   Based on odds ratio calculations, the likelihood of midfacial fractures resulting from falls was significantly higher in the elderly population compared with younger patients. Age appeared as an independent risk factor in the statistical analyses, indicating that the mechanisms leading to facial trauma in the geriatric population differ from those observed in younger individuals.

3. Elderly women represent a particularly vulnerable group regarding fall-related facial trauma.
   Sex-based analysis revealed that in the older age group the proportion of female patients was higher, and fall-related midfacial fractures occurred particularly frequently among elderly women. The combination of female sex and advanced age appears to increase the risk of facial trauma in a synergistic manner, which may partly be explained by demographic factors and partly by age-related changes in bone quality.

4. Age has a significant influence on the localization patterns of midfacial fractures.
   The CT-based localization analysis demonstrated that the anatomical distribution of fractures shows significant differences depending on age. In elderly patients, isolated low-energy injuries predominated, whereas younger patients more frequently presented with complex fracture patterns. This indicates that trauma energy and mechanism play a decisive role in determining the anatomical localization of fractures.

5. Isolated maxillary wall fractures are primarily associated with low-energy trauma.
   The anatomical analysis revealed that the majority of isolated maxillary wall fractures occurred as a consequence of falls and were considerably more frequent among elderly patients. This observation supports the assumption that low-energy trauma results in characteristic fracture patterns within the midfacial region.

6. Classical Le Fort fractures occur relatively rarely within modern trauma etiological patterns.
   Within the examined patient cohort, classical Le Fort fractures were relatively uncommon. This suggests that the traditional Le Fort classification system is primarily suitable for describing high-energy trauma. In the context of the increasing dominance of low-energy injuries, modern facial trauma epidemiology results in different fracture patterns.

7. The Impact of Event Scale proved to be a reliable instrument for assessing the psychological status of patients with midfacial fractures.
   During the psychological investigation, the Hungarian version of the Impact of Event Scale demonstrated appropriate internal consistency and proved suitable for evaluating post-traumatic stress symptoms in patients with facial trauma. The significant correlations observed between the intrusion and avoidance subscales further support the reliability and clinical applicability of the questionnaire.

8. Midfacial fractures may be associated with significant psychological consequences.
   The results of the psychological study indicated that a considerable proportion of the examined patients exhibited post-traumatic stress symptoms. Higher scores were observed particularly among younger patients and individuals who had experienced violent trauma, suggesting that the psychological processing of trauma may vary depending on demographic and etiological factors.

6. Conclusions

The results of the doctoral dissertation indicate that the epidemiology of midfacial fractures has undergone significant changes in recent decades. With increasing age, the etiological pattern changes considerably: while high-energy trauma such as traffic accidents or interpersonal violence remains predominant among younger patients, falls become the dominant injury mechanism in elderly populations.

The dominance of falls in the elderly population represents new clinical and preventive challenges for healthcare systems. The findings emphasize the

importance of fall-prevention strategies, recognition of geriatric risk factors and improvement of environmental safety.

Localization studies demonstrated that anatomical fracture patterns are closely related to trauma mechanisms and age-related characteristics. Low-energy trauma in elderly patients typically results in isolated fractures, whereas younger individuals more frequently sustain complex fracture patterns.

The clinical relevance of the classical Le Fort classification may be limited in the context of modern trauma patterns, as many low-energy injuries do not fit into the traditional classification system. This underlines the importance of modern imaging techniques, particularly CT-based diagnostics, in the precise anatomical evaluation of midfacial fractures.

The psychological investigation revealed that midfacial fractures may have significant psychological consequences. The relatively frequent occurrence of post-traumatic stress symptoms indicates that psychological factors should also be considered in the management of maxillofacial trauma.

Overall, the results of the dissertation contribute to a better understanding of the epidemiological, anatomical and psychological characteristics of midfacial fractures and may support the development of improved diagnostic, preventive and therapeutic strategies.

7. Publications forming the basis of the dissertation

1. Orsi E, Makszin L, Nyárády Z, Olasz L, Szalma J. Age-Related Patterns of Midfacial Fractures in a Hungarian Population: A Single-Center Retrospective Study. *Journal of Clinical Medicine.* 2025;14(15):5396. (Q1, Impact Factor 2,9)
2. Orsi E, Makszin L, Birkás B, Olasz L, Szalma J. Poszttraumás stressztünetek előfordulása középarctörést szenvedett betegek körében: retrospektív, kérdőíves vizsgálat. *Orvosi Hetilap.* 2025;166(45):1786-1792. (Q3, Impact Factor 0,9)
3. Orsi E, Makszin L, Nyárády Z, Olasz L, Szalma J. Arcközéptörések lokalizációs mintázatai életkor, nem és etiológia szerint: retrospektív intézményi vizsgálat. *Fül-Orr-Gégegyógyászat.* 2025;71(3):137-141. (Hungarian journal, not indexed with a WoS Impact Factor)

8. Other publications related to the topic

Nyárády Z, Orsi E, Nagy K, Olasz L, Nyárády J. Transgingival lag-screw osteosynthesis of alveolar process fracture. *International Journal of Oral and Maxillofacial Surgery.* 2010;39(8):779-782. (Q1, Impact Factor 2,7)

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In: Radnai M, Fazekas A *Fogászat.* Budapest: Medicina Könyvkiadó; 2019.
pp. 189-195. (book chapter)

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10. Curriculum vitae

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Education
2004 – Medical Doctor (MD)
University of Pécs Faculty of Medicine
Qualification: cum laude
Specialization
2012 – Specialist in Oral and Maxillofacial Surgery
Qualification: excellent

Language skills
English – intermediate state language examination
German – advanced state language examination

Workplace
2004–
University of Pécs Clinical Centre
Department of Dentistry and Oral and Maxillofacial Surgery
Professional memberships
Hungarian Association of Oral and Maxillofacial Surgery

Teaching activity
Participation in the maxillofacial residency training program at the University of Pécs.
Regular supervision and evaluation of final thesis works of graduating students.
Teaching dental and medical students in Hungarian, English and German in the field of oral and maxillofacial surgery.

Regional professional supervision
Performance of regional supervisory duties in the field of oral surgery.