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Comparison of injury cases presented to the department of forensic medicine at gaziantep university between 2017 and 2021 according to three different evaluation guidelines

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Abstract

It was aimed to evaluate forensic cases involving permanent dysfunction or loss of sensory or organ function due to trauma between 2017 and 2021 and compare impairment levels across the American Medical Association (AMA) Guide, the Turkish Penal Code (TPC) Injury Guide, and the 2008 Regulation on the Determination of Loss of Working Capacity and Professional Earning Power (2008 ÇMKG). A retrospective review of 126 forensic cases referred to the Department of Forensic Medicine at Gaziantep University was conducted. Cases were evaluated based on gender, age, trauma mechanism, time of admission, surgical history, affected anatomical region, life-threatening status, and fracture severity. Each case was assessed and categorized according to the TPC Injury Guide, 2008 ÇMKG, and AMA Guide. Kappa statistics were used to assess concordance among scales. Of the 126 cases, 88.1% were male (mean age: 40.5±16.9 years). The most common trauma causes were traffic accidents (34.9%) and firearm injuries (27%). Eye injuries (27%) were the most frequent among isolated injuries. Significant statistical discordance was observed between the TPC Injury Guide and the other two regulations, particularly in assessing eye, abdominal, and auditory injuries (Kappa < 0.1), whereas strong concordance was found between the AMA Guide and 2008 ÇMKG (Kappa > 0.9). The TPC Injury Guide lacks consistency with internationally accepted assessment methods and requires structural revision. Integrating anatomical and functional criteria and aligning with validated international scales like the AMA Guide will enhance forensic accuracy. The 2008 ÇMKG Regulation, although used in civil law contexts, is outdated and insufficient for modern forensic applications.

Keywords: Forensic medicine, AMA guide, Turkish Penal Code, functional loss, injury classification, sensory dysfunction

Introduction

The integrity of the human body is protected as a fundamental human right in virtually every legal system worldwide. In Turkey, this principle is enshrined in Article 17 of the Constitution, which guarantees the right to protect and develop one's material and spiritual existence and explicitly prohibits non-consensual bodily interventions outside medical necessity and legal provisions [1]. Consequently, injuries that impair bodily integrity are not only medical conditions but also judicial matters with profound implications for criminal and civil law.

In the adjudication of crimes involving bodily harm, determining the severity and consequences of the injury is pivotal. Whether an injury results in temporary discomfort or permanent functional loss plays a key role in defining the legal classification of the act, the severity of the penalty, and the rights of the victim for compensation [2,3]. Forensic physicians are often called upon to evaluate the nature and consequences of such injuries and to provide expert opinions that form the basis for legal decisions. However, the tools and criteria used for these evaluations vary across jurisdictions and lack standardization within national practice [4].

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In Turkey, forensic evaluations related to injuries are predominantly conducted based on the "Guide for the Forensic Assessment of Injury Crimes Defined in the Turkish Penal Code (TPC Injury Guide)", which attempts to interpret the provisions of Article 87 of the Turkish Penal Code concerning qualified injuries. Supplementary tools include the "Regulation on the Determination of Loss of Working Power and Professional Earning Capacity in Working Life (2008 ÇMKG)", which is primarily used for civil and compensation-related cases. Internationally, however, particularly in the United States, forensic evaluations frequently refer to the "American Medical Association (AMA) Guides to the Evaluation of Permanent Impairment", which offers a standardized approach for estimating whole-person impairment using anatomical and functional criteria [5-9].

Despite the availability of these frameworks, challenges remain in ensuring consistency and objectivity in forensic assessments. The TPC Injury Guide, while legally recognized, lacks the detailed anatomical and functional breakdown found in the AMA Guide [10]. Conversely, the AMA Guide is not officially endorsed in Turkish forensic medicine practice, and its use varies across institutions. The 2008 ÇMKG Regulation, though often used as a fallback in forensic assessments, is outdated and was originally developed for occupational disability determinations rather than medico-legal evaluations [11].

This disparity among assessment tools can lead to significant variability in impairment ratings and legal outcomes. A person evaluated as having permanent impairment under one system may receive a lower or even no impairment rating under another, which can affect judicial consistency, victim compensation, and the fairness of criminal sentencing.

Given these inconsistencies, there is a growing need to systematically compare the classifications and impairment ratings derived from these different systems. Such a comparison can help identify areas of discordance, highlight the limitations of currently used tools, and guide revisions toward a unified and scientifically grounded assessment framework for forensic medicine in Turkey.

The aim of this study is to retrospectively analyze forensic cases with permanent dysfunction or loss in at least one sensory or organ system and to compare the outcomes of three key impairment evaluation frameworks: the TPC Injury Guide, the 2008 ÇMKG Regulation, and the AMA Impairment Guide.

Material and Methods

Study Design

The study was approved by the Ethics Committee of the Gaziantep University Clinical Research Ethics Committee (Decision No: 29/12/2021; No: 2021/413). This study aimed to evaluate how permanent functional impairments were assessed in cases referred to the Department of Forensic Medicine, Faculty of Medicine, Gaziantep University between 2017 and 2021 due to trauma, in which an expert opinion was issued indicating permanent weakening or loss of function in a sensory or organ system. Specifically, the study sought to compare impairment assessments based on the American Medical Association (AMA) Guides to the Evaluation of Permanent Impairment with two national frameworks currently in use: the "Forensic Evaluation Guide for Injury Crimes Defined in the Turkish Penal Code" and the "Regulation on the Determination of Loss of Working Capacity and Professional Earning Power." The goal was to discuss potential standardization of impairment evaluation practices.

This research was designed as a retrospective archival review. It included cases referred to the Department of Forensic Medicine between 2017 and 2021 due to trauma, in which forensic reports were prepared indicating permanent weakening or loss of function in a sensory or organ system. Data were obtained from forensic reports and the hospital information system.

A total of 126 cases that met the inclusion criteria were included in the study. The following variables were collected retrospectively: sex, age at the time of the incident, type of incident, time elapsed between the incident and forensic evaluation, referring center, nature and anatomical localization of the injury, history of surgical intervention, presence of life-threatening conditions, presence and severity of bone fractures, and the degree of impairment based on the "2008 Regulation on the Determination of Loss of Working Capacity and Professional Earning Power." All impairments were re-evaluated using the 5th edition of the American Medical Association (AMA) Guides to the Evaluation of Permanent Impairment to determine new proportional impairment ratings.

Statistical Analysis

Normality of data distribution was assessed using the Shapiro–Wilk test. For comparison of numerical variables between two independent groups, Student's t-test or the Mann–Whitney U test was used, depending on the distribution. For comparisons among more than two groups, one-way ANOVA or the Kruskal–Wallis test was applied as appropriate. Kappa statistics were used to evaluate the agreement between impairment classification systems (see Table 7). Relationships between categorical variables were analyzed using the Chi-square test, and Bonferroni correction was applied in subgroup analyses to adjust for multiple comparisons. All statistical analyses were performed using SPSS for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). A p-value < 0.05 was considered statistically significant.

Results

A total of 126 forensic cases meeting the inclusion criteria were evaluated in this study. The mean age of the study population was 40.5±16.9 years. The majority of cases were in the 20–29 age group (23.8%), followed by the 30–39 age group (18.3%) and the 40–49 age group (16.7%). Children aged 0–9 years constituted

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the smallest portion of the sample (3.2%). Individuals aged 10–19 accounted for 14.3% of the cases, while those in the 50–59 and 60+ age groups represented 10.3% and 13.5%, respectively. These findings indicate that young and middle-aged adults, particularly those between 20 and 39 years of age, were the most frequently affected by trauma resulting in permanent sensory or organ dysfunction.

The analysis of injury mechanisms revealed that traffic accidents were the most common cause of trauma, accounting for 34.9% (n = 44) of cases. Firearm-related injuries followed closely, comprising 27.0% (n = 34) of the total. Occupational injuries were observed in 9.5% (n = 12) of the cases, while sharp or blunt trauma constituted 5.6% (n = 7). Physical assault was reported in 8.7% (n = 11) of cases. The remaining 14.3% (n = 18) were categorized under other mechanisms.

Regarding the time interval between trauma and forensic evaluation, the majority of cases (45.2%, n = 57) were assessed within the first year following the incident. Evaluations conducted 1–2 years after trauma accounted for 25.0% (n = 32) of the cases, while 15.9% (n = 20) and 13.5% (n = 17) were evaluated within 2–3 years and after 3 years, respectively. In terms of surgical intervention, a vast majority of patients (97.6%, n = 123) had undergone at least one surgical procedure related to their injury, whereas only 2.4% (n = 3) did not require surgery.

In terms of anatomical distribution, eye injuries were the most common, observed in 27.0% (n = 34) of cases, followed closely by lower extremity injuries at 24.6% (n = 31). Injuries to the upper extremity and abdomen were equally represented, each accounting for 13.5% (n = 17) of the total. Ear injuries constituted 3.2% (n = 4), while combined injuries involving multiple anatomical regions were present in 4.0% (n = 5). Less frequently affected regions included the oral-maxillofacial area, central nervous system, vertebrae, and urogenital system, each comprising 2.4% (n = 3) of cases. Other anatomical sites were affected in 4.8% (n = 6).

Relationship between injury region and life-threatening condition were shown in table 1. The relationship between injury region and life-threatening conditions was statistically significant in certain anatomical areas. Abdominal injuries were most strongly associated with life-threatening outcomes, with all 17 cases classified as such (p = 0.001). Upper extremity injuries also showed a statistically significant association with life-threatening status (p = 0.043), with 6 out of 22 cases presenting as life-threatening. While a high number of eye injuries (n = 14) were classified as life-threatening, the association did not reach statistical significance (p = 0.07). Similarly, central nervous system (CNS) injuries (p = 0.066) and urogenital system injuries (p = 0.129) approached significance but did not meet the threshold. No significant relationships were found for lower extremity, oral-maxillofacial, vertebral, or ear injuries (Table 1.).

Table 1. Relationship between injury region and life-threatening condition

Injury Region	Life-Threatening Yes (n)	Life-Threatening No (n)	p-value
Upper extremity	6	16	0.043
Lower extremity	19	18	0.512
Combined injury	0	1	0.346
Eye	14	26	0.070
Ear	4	2	0.316
Abdomen	17	0	0.001
Oral-maxillofacial	2	2	0.897
CNS	5	1	0.066
Vertebra	1	2	0.635
Urogenital system	4	1	0.129
Other	3	2	0.547

CNS: Central nervous system

Relationship between anatomical region and fracture severity were shown in table 2.

Fracture severity was categorized as Mild (score 1), Moderate (scores 2–3), and Severe (scores 4–6) based on their impact on vital functions, as defined in the Guide for Forensic Evaluation of Injury Crimes in the Turkish Penal Code (TPC Injury Guide). Severe fractures (score 4–6) were most frequently observed in lower extremity injuries, with 33 cases showing high fracture severity (p = 0.001). Similarly, upper extremity injuries demonstrated a significant correlation, with 11 severe cases and 9 moderate fractures (p = 0.001). Eye injuries also showed a significant relationship with fracture severity (p = 0.001), despite 25 cases presenting without fractures, suggesting a dual pattern of ocular trauma either involving severe damage or no fracture at all. Abdominal injuries (p = 0.033) and CNS-related injuries (p = 0.023) also demonstrated statistically significant associations, primarily in the severe category. No significant relationships were observed in combined, ear, oral-maxillofacial, vertebral, urogenital, or other injuries (Table 2.).

Table 2. Relationship between anatomical region and fracture severity

Injury Region	No Fracture (n)	Mild (1)	Moderate (2–3))	Severe (4–6)	p-value
Upper extremity	2	0	9	11	0.001
Lower extremity	2	0	2	33	0.001
Combined injury	0	0	0	1	0.807
Eye	25	2	4	9	0.001
Ear	1	0	1	4	0.779
Abdomen	11	0	0	6	0.033
Oral-maxillofacial	1	0	0	3	0.757
CNS	2	1	1	2	0.023
Vertebra	0	0	0	3	0.395
Urogenital system	2	0	0	3	0.833
Other	1	0	1	3	0.868

CNS: Central nervous system

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Kappa agreement levels between TPC Injury Guide, AMA, and 2008 ÇMKG for each region were shown in table 3. The strongest agreement was observed between the AMA Guide and the 2008 ÇMKG Regulation, particularly for eye (κ = 0.942), ear (κ = 0.896), and abdominal injuries (κ = 0.901). In contrast, the TPC Injury Guide showed poor agreement with both the AMA Guide and the 2008 ÇMKG Regulation in these regions, with Kappa values below 0.1 for eye, ear, and abdominal injuries. Notably, the highest concordance between TPC Injury Guide and AMA was found in lower extremity (κ = 0.826) and upper extremity injuries (κ = 0.756), where more objective, function-based assessments are typically applied. The lowest overall agreement across all three systems was observed in urogenital and "other" injury categories (Table 3.).

Table 3. Kappa agreement levels between TPC Guide, AMA, and 2008 ÇMKG for each region

Injury Region	TPC Guide vs AMA (Kappa)	TPC Guide vs 2008 ÇMKG (Kappa)	AMA vs 2008 ÇMKG (Kappa)
Upper extremity	0.756	0.337	0.439
Lower extremity	0.826	0.623	0.688
Eye	0.01	0.005	0.942
Ear	0.024	0.031	0.896
Abdomen	0.058	0.062	0.901
Oral-maxillofacial	0.337	0.215	0.618
CNS	0.341	0.295	0.770
Vertebra	0.511	0.473	0.682
Urogenital system	0.215	0.200	0.605
Other	0.189	0.175	0.588

TPC: Turkish Penal Code Forensic Medicine Guide; AMA: American Medical Association Guide; 2008 ÇMKG: 2008 Regulation on Determination of Loss of Earing Capacity; CNS: Central nervous system

The relationship between time elapsed since trauma and the classification of forensic opinion demonstrated statistically significant patterns in several anatomical regions. Eye injuries evaluated within the first-year post-trauma were significantly more likely to be classified as "functional loss" (p = 0.014). In contrast, injuries to the lower extremity (p = 0.036) and upper extremity (p = 0.045) assessed between 1–2 years after trauma were more commonly classified as "functional weakening,". Abdominal injuries evaluated after more than three years were associated with a classification of "functional loss" (p = 0.041). Although not reaching statistical significance, other injuries assessed 2–3 years post-trauma also tended toward a classification of functional weakening (p = 0.062).

Discussion

In this retrospective analysis, we examined the compatibility and consistency of three commonly used impairment assessment frameworks—namely the TPC Injury Guide, the 2008 ÇMKG, and the AMA Guides—in trauma cases that resulted in permanent sensory or organ dysfunction. Our findings reveal a striking variability between these classification systems, particularly in injuries involving complex anatomical and functional structures such as the eyes, ears, and abdominal organs.

The dominance of male patients in our cohort (88.1%) aligns with prior epidemiological studies that associate higher trauma exposure with occupational and behavioral risk profiles in men. For example, Hosukler et al. reported a male predominance of 84% in forensic injury evaluations related to occupational trauma [12]. Similarly, Pekoz et al. found that road traffic accidents disproportionately involved young males, constituting over 70% of their cohort [13].

Our study's identification of eye injuries as the most common isolated injury site echoes the findings of Levine et al., who reported that ocular trauma is not only frequent in assault and firearm-related injuries but also leads to permanent visual loss in a significant proportion of cases [14]. However, our most striking result lies in the lack of agreement between TPC Guide and AMA classifications for eye injuries, where the kappa coefficient was found to be <0.01. This finding supports Artar et al., who argued that the TPC Guide lacks the clinical granularity required to properly assess functional sensory loss, particularly in organ systems such as vision and hearing [15].

In contrast, lower extremity injuries demonstrated substantial concordance across all three systems. This likely stems from the objective nature of orthopedic impairment scoring, which is quantitatively defined in terms of joint mobility, muscle strength, and radiological evidence. This observation is consistent with the reports of Melhorn et al., who found high inter-rater agreement when using AMA-based scoring in extremity trauma cases [16].

Despite its widespread usage in Turkey, the TPC Guide has been criticized for its lack of standardized assessment criteria. Unlike the AMA Guide, which utilizes precise functional definitions and region-specific algorithms, the TPC Guide relies on broad legal language and subjective interpretation. Uygun et al. highlighted that the current version of the TPC Guide does not offer sufficient direction for calculating degrees of permanent disability, resulting in inconsistencies among forensic practitioners [17].

Interestingly, the 2008 ÇMKG Regulation, although originally developed for social security and occupational capacity evaluations, showed moderate to substantial agreement with the AMA Guide in most anatomical regions. Demirci et al. suggest that while the 2008 Regulation is outdated in several respects, its numeric structure allows for better alignment with international frameworks compared to the text-heavy TPC Guide [5].

A significant secondary observation in our study was the effect of time elapsed since trauma on forensic opinion. For example, eye injuries were more likely to be classified as "functional loss" within the first-year post-injury, likely due to early stabilization of visual deficits. Conversely, lower extremity injuries were

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often deemed "functionally weakened" when evaluations occurred 1–2 years after trauma, consistent with the natural course of orthopedic rehabilitation. These findings reflect those of Dogan et al., who emphasize that impairment ratings may vary significantly depending on the timing of the medicolegal assessment [18].

Compared to previous studies, our methodology offers a more comprehensive and structured evaluation of forensic impairment ratings across three distinct legal frameworks. For example, Rondinelli et al. [9] emphasized the standardized algorithms and anatomical specificity provided by the AMA Guides, which we adopted for re-evaluating all cases in this study. Our work expands on this by simultaneously assessing the concordance with two additional national tools, thus revealing discrepancies not previously quantified at this scale. Furthermore, while Levine et al. [14] detailed the visual consequences of firearm-related orbital injuries through individual case observations, our analysis builds upon such clinical descriptions by quantitatively classifying ocular injuries across different regulatory schemes. This allows for objective insight into the limitations of non-standardized assessments in vision-related trauma.

The study by Artar et al. [15] criticized the TPC Injury Guide's general lack of anatomical clarity. Our findings corroborate and extend these concerns by statistically demonstrating extremely low inter-framework agreement (Kappa < 0.1) in injuries requiring sensory-functional assessment. By comparing the discriminative capacity of each system, especially in functionally complex regions like the eye and ear, our study adds measurable data to previously qualitative critiques. In contrast to prior research limited to either clinical outcomes or legal classifications, this study combines both forensic and functional assessment to highlight the shortcomings of traditional legal tools and proposes a data-driven path for regulatory improvement.

From a forensic policy standpoint, the findings of our study highlight the urgent need for the implementation of a unified, function-based impairment assessment system at the national level, especially in the context of criminal trials. Such a system should be grounded in internationally validated tools—particularly relevant sections of the AMA Guides to the Evaluation of Permanent Impairment—and should provide region-specific anatomical criteria to ensure precision and consistency. Moreover, it must emphasize objective and reproducible functional evaluation methods, such as visual field testing or mobility scoring, to enhance reliability. To remain clinically and legally relevant, this framework should also be subject to regular revision in line with medical advances and evolving legal standards. Our results clearly demonstrate that the continued exclusive reliance on the TPC Guide is inadequate for contemporary forensic practice, as it may lead to inconsistent sentencing outcomes and disparities in compensation evaluations due to its lack of functional and anatomical specificity.

One of the key strengths of this study is its comprehensive comparison across three widely used assessment systems within a well-defined trauma cohort. To our knowledge, few studies in Turkey have directly quantified the agreement between these tools across multiple anatomical regions using Kappa statistics. However, the study has several limitations. First, the retrospective nature of data collection may introduce bias due to incomplete or inconsistent documentation. Second, we did not perform inter-rater reliability analysis between different forensic assessors. Finally, while the AMA Guide was used as a reference, its full integration into Turkish legal practice is currently lacking.

Conclusion

In conclusion, this study demonstrated that significant inconsistencies exist among the three primary forensic impairment assessment frameworks used in Turkey. The TPC Injury Guide, despite its legal foundation, lacks anatomical and functional specificity, resulting in poor agreement with internationally accepted standards such as the AMA Guide. In contrast, the 2008 ÇMKG Regulation, though originally intended for occupational assessments and now outdated in several respects, showed relatively strong concordance with the AMA-based evaluations due to its structured and numerical format. These findings underscore the necessity of revising national forensic assessment tools to enhance clarity, consistency, and legal validity. The integration of detailed functional metrics and region-specific criteria—drawing from international references like the AMA Guide—into a hybrid model that also respects national legal terminology appears to be the most practical path forward for advancing forensic medicine in Turkey.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study was approved by the Ethics Committee of the Gaziantep University Clinical Research Ethics Committee (Decision No: 29/12/2021; No: 2021/413).

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