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ORIGINAL ARTICLE

Lower extremity impairments from a forensic medicine perspective: A descriptive study

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Abstract

This study examines disability and incapacity assessments and forensic medical processes related to lower extremity fractures. Reports prepared by the Forensic Medicine Council, Faculty of Medicine, Afyonkarahisar Health Sciences University, between 2022 and 2024 were retrospectively analyzed. As a result of the forensic medical evaluation, 1.89% of the cases (n=13) were excluded due to the inability to establish a causal relationship between the injury and the accident, 1.31% (n=9) were excluded due to previous injuries in the same region, and 1.31% (n=9) showed simulated findings. The Forensic Medicine Board reports prepared on the cases included in the study were evaluated within the scope of the 'Regulation on Disability Assessment for Adults' (*in Turkish: Erişkinler* İçin *Engellilik Değerlendirmesi Hakkında Yönetmelik*) rates. Of the 649 cases included in the study, 70.9% were male, and the most common cause of injury was traffic accidents (98.6%; n=640). The average disability rate in all cases was found to be 9.86% (SD=7.856) [11.59 (SD=8.965) for surgically treated cases, and 7.14 (SD=4.505) for conservatively treated cases]. It was observed that upper extremity injuries (22.8%) frequently accompanied lower extremity injuries. In orthopedic examination, joint motion restriction was more common with femur fractures, and leg length discrepancy was more frequently observed with femur, tibia, and multiple lower extremity fractures ($p<0.05$). No significant difference was found between atrophy and fracture sites. In forensic medical impairment assessments, establishing causality and accurately determining disability rates and recovery processes are crucial in legal proceedings.

Keywords: Lower extremity fractures, forensic medicine, impairment, traffic accidents

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Introduction

Lower extremity fractures are common orthopedic traumas that significantly affect patients' quality of life [1]. These fractures typically occur as a result of high-energy trauma (traffic accidents, falls, sports injuries) or low-energy osteoporotic fractures [2]. Anatomically, the most commonly fractured bones in the lower extremity are the femur, tibia, and fibula [3]. The recovery process varies depending on the location and type of the fracture, as well as the patient's overall health condition. In cases where conservative treatment is applied, recovery typically takes around 8-12 weeks, while in cases requiring surgical intervention, it can range from 3 to 6 months [4].

Lower extremity fractures are important in forensic medicine, as it is crucial to assess the mechanism of the trauma, whether the fracture occurred due to external factors such as an accident or assault, and the extent of the violence the individual was subjected to [5]. Biomechanical analyses and radiological examinations play a critical role in determining the etiology of the fracture [6]. On the other hand, the loss of workforce, recovery time, and disability/impairment caused by the fracture can directly affect the course of criminal and legal cases. Disabilities and impairments resulting from lower extremity fractures vary depending on the location of the fracture, the presence of joint involvement, the healing process, and functional loss [7]. In lower extremity disability assessments, limitations in hip, knee, ankle, and toe joint range of motion (ROM), muscle atrophy, and limb length discrepancy are significant subcategories. The ratios obtained from the assessment not only indicate the loss of workforce and decreased quality of life but also determine the amount of compensation to be awarded [8,9].

In the study, while conducting a descriptive analysis of lower extremity fractures, accompanying injuries to other parts of the body from a forensic perspective, variations in disability rates according to the types of fractures, and the impact of trauma-induced workforce loss and functional limitations on legal and forensic processes have been evaluated. Additionally, the relationship between disability rates and the methods of fracture treatment (surgical versus non-surgical) has been examined.

Materials and Methods

The study was conducted as part of the Scientific Research Methods project by third-year students of the Faculty of Medicine at Afyonkarahisar Health Sciences University, within the Department of Forensic Medicine. A total of 689 cases evaluated for disability and incapacity due to lower extremity injuries by the Forensic Medicine Council between January 1, 2022, and December 31, 2024, were retrospectively analyzed. 13 cases (1.89%) were excluded due to the inability to establish a clear causal relationship between the injury and the incident, and nine cases (1.31%) were excluded due to a prior history of injury to the same lower extremity region on different dates. Additionally, nine cases (1.31%) were excluded based on the forensic assessment indicating suspected simulation during examination. The reports of the included cases were analyzed for sociodemographic data, type of incident, fracture location, presence of accompanying pathologies, surgical history and disability rate. Disability ratings were assigned in accordance with the Regulation on Disability Assessment for Adults (*in Turkish: Erişkinler* İçin *Engellilik Değerlendirmesi Hakkında Yönetmelik*) [10], the national legal framework governing the evaluation of permanent impairments in adults. As the study period included the post-pandemic phase, disruptions in healthcare services prevented the evaluation of physical therapy processes within the scope of this study.

Statistical evaluations were conducted using SPSS (Statistical Package for the Social Sciences) version 21.0 software (IBM, USA). Continuous variables were presented as mean ± standard deviation, and categorical variables were presented as frequency and percentage. The Shapiro-Wilk test was used to assess the normality of data. For data not meeting the assumptions of parametric tests, Mann-Whitney U and Kruskal-Wallis tests were used. The Chi-square test was used for categorical variables. A statistical significance level of $p<0.05$ was considered at a 95% confidence interval in all analyses.

Ethical approval for this study was obtained from the Afyonkarahisar Health Sciences University Non-Interventional Scientific Research Ethics Committee with the decision dated 03.01.2025, and the approval number 2025/1. The study was conducted in accordance with the Helsinki Declaration.

Results

A total of 649 cases were included in the study, all of which were evaluated for disability due to lower extremity injuries by the Forensic Medicine Council at Afyonkarahisar Health Sciences University. The average age of the cases at the time of presentation was 35.53 (SD=17.408), and the average age at the time of the incident was 32.56 (SD=17.431). Regarding the gender distribution of the cases, 70.9% (n=458) were male, and 29.1% (n=191) were female. In the majority of cases (98.6%; n=640), the cause of injury was traffic accidents. One of the other cases was an assault and eight were work-related accidents. When fractures in the lower extremity were analyzed by region, the most common fractures were multiple fractures, followed by tibia and pelvis fractures (Figure 1).

It was observed that 61.2% (n=397) of the cases received surgical treatment. More than half of the cases (54.9%; n=356) presented with injuries solely related to the lower extremity. In the analysis of injuries involving more than one anatomical region, the most common concomitant injury with lower extremity trauma was upper extremity injury [22.5% (n=66)], followed by skin lesions [16.7% (n=49)], head and neck trauma [15.4% (n=45)], thoracic injuries [8.9% (n=26)], vertebral and spinal cord injuries [7.5% (n=22)], and abdominal trauma in 2 cases [0.7%]. In 28.3% of the cases (n=83), lower extremity injuries were accompanied by trauma to multiple anatomical regions.

In the analysis of the treatment methods for fractures, it was found that multiple fractures, tibia, and femur fractures were treated surgically at significantly higher rates compared to other fractures (p<0.05) (Table 1).

When evaluating the disability assessment for lower extremity fractures, significant clinical findings such as ROM restrictions, leg length discrepancies, and atrophy were analyzed. It was found that ROM restrictions were more common with femur fractures, and leg length discrepancies were more frequently observed in femur, tibia, and multiple lower extremity fractures (p<0.05). No significant differences were observed between atrophy and fracture regions (Table 2).

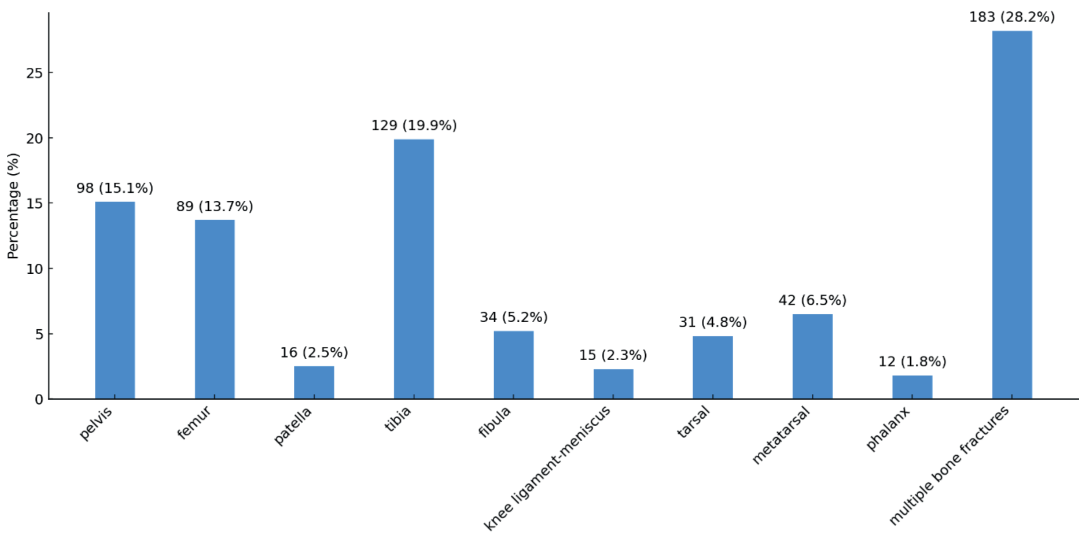

Figure 1. Regional distribution of pathologies affecting the lower extremities.

Table 1. Relationship between lower extremity trauma region and surgical history.

	Orthopedic Treatment Type		
	Conservative n (%)	Surgical n (%)	Total
Pelvic fracture	57 (58.2)	41 (41.8)	98
Femur fracture	10 (11.2)	**79 (88.8)***	89
Patella fracture	11 (68.8)	5 (31.3)	16
Tibia fracture	38 (29.5)	**91 (70.5)***	129
Fibula fracture	22 (64.7)	12 (35.3)	34
Tarsal bone fractures	20 (64.5)	11 (35.5)	31
Metatarsal fracture	32 (76.2)	10 (23.8)	42
Phalanx fracture	8 (66.7)	4 (33.3)	12
Knee ligament-meniscus injury	10 (66.7)	5 (33.3)	15
Multiple fractures	44 (24)	**139 (76)***	183
Total	252 (38.8)	397 (61.2)	649

Row percentages are given.

*p<0,05

Table 2. Relationship between lower extremity trauma region and findings of ROM limitation, atrophy, and limb length discrepancy.

	ROM Limitation		Thigh or Calf Atrophy		Lower Extremity Length Discrepancy	
	Absent n (%)	Present n (%)	Absent n (%)	Present n (%)	Absent n (%)	Present n (%)
Pelvis fracture	26 (26.5)	72 (73.5)	88 (89.8)	10 (10.2)	58 (59.2)	40 (40.8)
Femur fracture	14 (15.7)	**75 (84.3)***	69 (77.5)	20 (22.5)	16 (18)	**73 (82.0)***
Patella fracture	6 (37.5)	10 (62.5)	11 (68.8)	5 (31.3)	13 (81.3)	3 (18.8)
Tibia fracture	25 (19.4)	104 (80.6)	98 (76)	31 (24)	43 (33.3)	**86 (66.7)***
Fibula fracture	5 (14.7)	29 (85.3)	27 (79.4)	7 (20.6)	22 (64.7)	12 (35.3)
Tarsal bone fractures	8 (25.8)	23 (74.2)	29 (93.5)	2 (6.5)	26 (83.9)	5 (16.1)
Metatarsal fracture	33 (78.6)	9 (21.4)	41 (97.6)	1 (2.4)	42 (100)	-
Phalanx fracture	11 (91.7)	1 (8.3)	12 (100)	-	12 (100)	-
Knee ligament - meniscus injury	3 (20)	12 (80)	14 (93.3)	1 (6.7)	15 (100)	-
Multiple fractures	38 (20.8)	145 (79.2)	141 (77)	42 (23)	62 (33.9)	**121 (66.1)***
Total	169 (26)	480 (74)	530 (81.7)	119 (18.3)	309 (47.6)	340 (52.4)

Row percentages are given.

*p<0,05

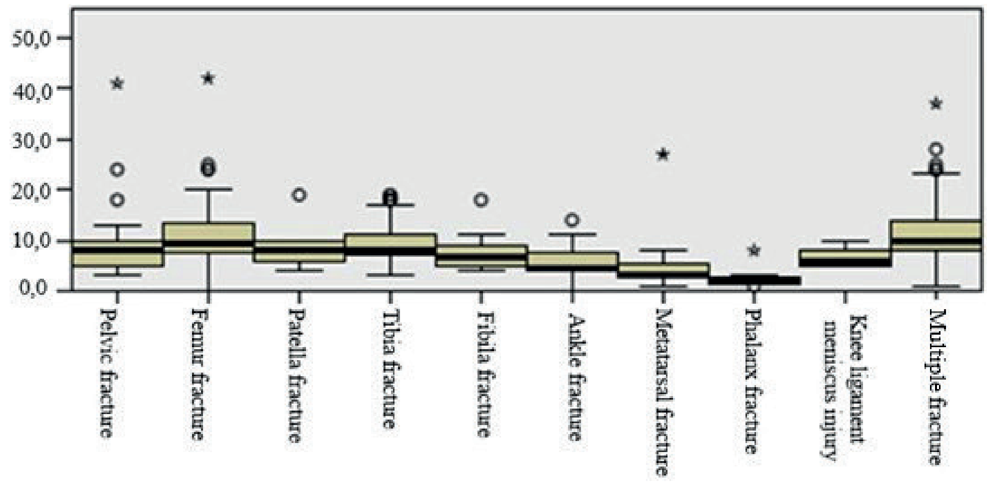

Figure 2. Relationship between lower extremity fracture region and disability rates (Kruskal-Wallis test, *p*<0.001).

The average disability rate in all cases was found to be 9.86% (SD=7.856). Among cases with isolated lower extremity injuries, the average disability rate was found to be 11.59 (SD=8.965) in those treated surgically, and 7.14 (SD=4.505) in those treated conservatively. A statistically significant difference was found between treatment methods for lower extremity fractures (U=29044, *p*<0.001).

In the study, a significant difference was found between the lower extremity fracture region and disability rates (*p*<0.001) (Figure 2).

Post-hoc analyses revealed that this difference was due to tibia, femur, and multiple lower extremity fractures. Similarly, a significant difference was found between recovery times and lower extremity fracture regions (*p*<0.001).

According to the obtained data, 38.8% of the cases (n=252) had physical therapy and rehabilitation referrals after completing orthopedic treatment, and of these cases, 59.1% (n=149) received physical therapy for more than 15 days.

Discussion

Lower extremity fractures, the treatment process, and anatomical and/or functional losses that occur after healing pose a significant public health issue [11]. In the context of this problem, which involves many different branches, the examination of forensic medical processes will also make important contributions. In this direction, cases diagnosed with lower extremity fractures that were referred to the Forensic Medicine Board were evaluated in this study.

One of the most common causes of such injuries is traffic accidents [12]. These accidents, which result in high-energy trauma, often lead to severe fractures in the lower extremity bones and can cause long-term functional losses. Similarly, in our study, it was observed that a significant portion of the cases referred to the Forensic Medicine Board with a diagnosis of lower extremity fracture were related to traffic accidents. In our study, the number of male cases was significantly higher, which is consistent with other studies conducted in regions with similar demographic structures [13,14]. The fact that male individuals are more active in the workforce, work in risky jobs, and are more frequently exposed to traffic accidents are among the main reasons for this difference. Similarly, a study in the literature reported that the average age of lower extremity fracture cases presenting to the emergency department was 35 [15]. Young-middle-aged men, especially those in the 30–40 age group, motor vehicle use, lifestyles associated with heavy physical activities, greater involvement in the workforce, and spending more time outdoors contribute to this age group being more frequently exposed to high-risk traumas and being more represented in fracture cases; this highlights that age is an important variable in trauma and fracture risk.

The analysis revealed a 28.2% prevalence of cases exhibiting fractures across multiple bones in the lower extremities. These cases are generally thought to be caused by high-energy trauma. In cases with a single bone fracture, the most commonly affected bones were the tibia, femur, and fibula. These findings also reveal the sensitivity of lower extremity anatomy to fractures depending on the severity and direction of the trauma. Similar results were obtained in the study conducted by Şenol and colleagues, which demonstrates the consistency of our findings with the literature [16].

In our study, disability rates were found to be significantly higher in patients who underwent surgical treatment compared to those treated with conservative methods. This finding is consistent with studies in the literature that report surgical intervention is more frequently preferred, especially in weight-bearing long bones such as the femur and tibia [17–20]. The decision to perform surgical treatment is generally based on multiple factors, including the type of fracture, its location, whether it is open or closed, its comminuted nature, and the patient's overall clinical condition. However, in some cases, particularly in comminuted and open fractures, the fixation materials used may negatively affect the healing process and increase the risk of infection, nonunion, and complications. Indeed, an increase in disability rates has been observed due to such complications. The main causes of permanent functional loss associated with lower extremity fractures include limb length differences, muscle atrophy, and joint movement restrictions. Such sequelae are more likely to occur in displaced and comminuted fractures due to the nature of the fracture, and they directly affect both the treatment process and the long-term functional outcome. When examining the relationship between length discrepancies in the lower extremities and fractures, it was found that femur fractures caused more length discrepancies compared to other bones. Similar results have been reported in orthopedic studies in the literature [21,22].

In our study, it was found that only approximately 40% of the cases received physical therapy and rehabilitation. This situation was interpreted as being influenced by the post-pandemic period and the disruptions in healthcare services during that time. This limitation in physical therapy and rehabilitation could potentially increase disability levels and hinder individuals' return to social life [23]. Furthermore, difficulties in accessing healthcare services exacerbate this situation. Especially during the pandemic, the restriction of treatment opportunities became a significant problem [24]. The low rate obtained in our study was evaluated in the context of the significant limitations of treatment opportunities during the Covid period, the possible effect of stay-at-home orders, and a reduction in service delivery due to patient overload in the post-pandemic period.

In the literature, it has been demonstrated that effective physical therapy and rehabilitation reduce issues such as walking difficulties, balance disorders, and joint motion limitations, and are associated with achieving independent mobility, higher physical function and performance, greater recovery perception, and a faster and higher return-to-work rate [25,26]. The relationship between injury findings and causality is of critical importance in forensic evaluations. This is because correctly determining causality ensures that compensation cases are resolved fairly and allows for the accurate calculation of disability rates. Clearly establishing the relationship between injury findings and the effects of trauma helps prevent incorrect medical evaluations and potential unjust compensation claims [27]. In this context, a correct causality analysis is a fundamental factor that increases the reliability and validity of forensic medical reports. Even small increases in rates can lead to significant compensation amounts, making the exclusion of simulation methods crucial [28].

In the context of this study, simulated findings were excluded to ensure the reliability of the data. In forensic medicine, simulation refers to the deliberate imitation or exaggeration of medical symptoms, typically for purposes such as obtaining unjust compensation, evading legal responsibility, or accessing unnecessary treatment. Such attempts not only distort clinical assessments but may also lead to unjust legal outcomes [29]. The detection of simulation cases is recognized as one of the fundamental responsibilities of forensic medicine experts; however, this process should not be limited to forensic medicine alone. Especially when patients intentionally exaggerate their current health conditions or present non-existent symptoms, this can directly impact the objectivity of forensic reports and the functioning of the justice system [30]. Therefore, the early detection and accurate assessment of simulation is a process that should be carried out through multidisciplinary collaboration not only by forensic medicine experts but also by physicians from related fields such as traumatology, orthopedics, psychiatry, and neurology. All physicians acting with this awareness will make significant contributions to both the fair decision-making in legal processes and the prevention of abuse of the healthcare system.

In recent years, the significant increase in material and moral compensation lawsuits filed after traffic accidents has seriously increased the workload in the field of forensic medicine. This situation clearly demonstrates that forensic medicine experts play a central role not only in medical but also in legal evaluations. In the assessment of trauma-related injuries, establishing the causal relationship between the type of incident (e.g., traffic accident, workplace accident, assault) and documented findings is of great importance for both the fair operation of compensation processes and the scientific basis of forensic reports. From this perspective, Forensic Medicine Boards provide a more comprehensive and causality-based analysis by considering critical elements such as the time of injury, the mechanism of injury, and the nature of the trauma, which are often overlooked by disability health boards [31]. This evaluation method not only protects individual rights but also supports the sustainability of trust in the justice system. Indeed, this approach has been explicitly emphasized in recent decisions of the Supreme Court of Appeals, reaffirming the decisive role of forensic medical board expert opinions in legal proceedings. In this regard, the evaluations of forensic medicine experts occupy a critical position in terms of both medical accuracy and legal fairness, and when supported by multidisciplinary cooperation, they yield stronger and more equitable results.

Conclusion

Lower extremity fractures are serious injuries that can have lasting effects on an individual's quality of life, daily activities, and occupational functioning. In our study, we found that traffic accidents were the most common cause of these fractures and that disability rates were higher in patients who underwent surgical intervention compared to those treated with conservative methods. These findings highlight the impact of fracture type and treatment method on long-term functional outcomes, while also emphasizing the critical importance of the rehabilitation process in terms of physical recovery and social integration. However, considering that only approximately 40% of the population in our study received physical therapy and rehabilitation services, it is thought that access issues in this area may contribute to higher disability rates. From a forensic medicine perspective, such injuries have not only medical but also legal consequences; the accurate determination of disability rates is of vital importance for the fair conduct of compensation processes. In this context, the accurate analysis of causal relationships, the exclusion of simulation cases, and the objective determination of the relationship between trauma and injury enhance the reliability of forensic reports. In the future, studies incorporating long-term follow-up data and addressing rehabilitation processes and permanent functional losses in greater detail are expected to provide a more robust foundation for both clinical and forensic medical evaluations.

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Conflict of interest

There are no conflicts of interest related to this study.

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