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Research Article

Traumatic Amputations in Military Personnel: From The Perspective of Forensic Medicine

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Abstract

Aim: Traumatic amputations are devastating injuries that occur suddenly and unexpectedly, resulting in the loss of a body part. This study was aimed at evaluating cases of traumatic amputations from a medico-legal perspective.
Material and Method: The forensic reports prepared by the Department of Forensic Medicine, Gülhane Training and Research Hospital (fka; Gülhane Military Medical Academy), between January 1, 2011, and December 31, 2014 were examined retrospectively and the cases who had traumatic amputations analyzed in depth.
Results: All of the cases (n=72) were male, and the mean age at the time of the injury was 24.2 (±4.3) years. Almost all the cases (97.2%) were soldiers. It was determined that the most common cause of trauma among all cases was work accident (51.5%), followed by explosion injuries (26.4%). Traumatic amputations were mostly seen in the upper extremity (83.3%), followed by lower the extremity (12.5%) and both upper and lower extremities (4.2%). The most common cause of upper extremity amputations was work accidents, while lower extremity amputations were mostly caused by blast injuries. While 58.3% of the amputations were minor (fingers only), 41.7% were major. It was determined that psychiatric disorders developed in 19.4% of the cases after traumatic amputation.
Conclusion: Traumatic amputations are among the issues that need to be carefully examined because they occur especially at the young age group and cause disabilities in the affected people. It is necessary to reduce trauma, which is one of the important causes of amputations, to take precautions by using personal protective equipment, and to not neglect treatment and follow-up. The majority of patients in developing nations, like Türkiye, struggle to receive pre-hospital care, which proves to be a major challenge for trauma care, especially in military cases. It is of great importance that psychiatric follow-up of people is carried out in the early and late periods after amputation and that social support and appropriate treatments are not neglected.

Keywords: Amputation, trauma, forensic medicine, military personnel

INTRODUCTION

The word “amputation” means a total or partial removal of any organ in the form of a protrusion of the body (especially the extremities) by surgery. While the etiology of amputation may be alterable depending on the cultural and geopolitical conditions of countries, the most common causes are diseases, traffic accidents, occupational-work accidents, and combat-related injuries like gunshot injuries and explosions (1-5).

Approximately 185,000 amputations are performed annually in the United States, and it is reported that 16% of these are related to trauma (6-8). Traumatic amputation is one of the most disturbing and devastating wounds of conflict. It occurs suddenly and unexpectedly, and there is not any adaptation time, contrary to the disease-related amputations. Therefore, traumatic amputees need complete health care services, including psychological support.

The purpose of this retrospective study was to analyze the forensic cases with traumatic amputation (s) who applied to the Gülhane Training and Research Hospital (fka: Gülhane Military Medical Academy), and reveal the characteristics of military amputees and traumatic extremity amputations among military personnel.

MATERIAL AND METHOD

The forensic reports prepared by the Gülhane Training and Research Hospital (Gülhane Military Medical Academy),

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between January 1, 2011, and December 31, 2014, were examined retrospectively. The cases who had traumatic amputation (s) were analyzed in detail, including the parameters like age and sex of amputees, the etiology of amputation, amputation levels, replantation operations, life-threatening situations due to amputation, the disability of extremities due to amputation, and psychiatric disorders due to amputation.

The data obtained from the cases were analyzed with Microsoft Office-Excel 2010 and IBM SPSS Statistics version 23.0 (IBM SPSS Statistics for Windows, IBM Corp, Armonk, New York, USA). Descriptive statistics included number (%) and mean standard deviation for continuous variables.

Ethics committee approval is received for this research from Ethics Committee of Gülhane Military Medical Academy (05.05.2015, 08/227).

RESULTS

There were a total of 2472 forensic reports in four years, and 72 (2.9%) of the cases had traumatic amputation(s). The cases were sent to the Department of Forensic Medicine to prepare forensic reports for extremity disability ratio calculation (n=54, 75%), action for compensation (n=10, 13.9%), criminal action (n=6, 8.3%), and the Turkish Armed Forces Assistance Fund Law (n=2, 28%).

All of the amputees were male, with the mean age at injury date being 24.2 (±4.3) years, ranging from 20 to 35 years. Almost all cases were military personnel (n=70, 97.2%) and the ranks of the cases were as follows: 53 (73.6%) private, 10 (13.9%) specialist sergeant, 3 (4.2%) noncommissioned officer, 4 (5.6%) commissioned officer, and 2 (2.8%) civilian. Traumatic amputation mostly occurred in May (n=11, 15.3%) and in the spring season (n=25, 34.7%). The seasonal evaluation of the traumatic amputation rate of incidence is stated in Figure 1.

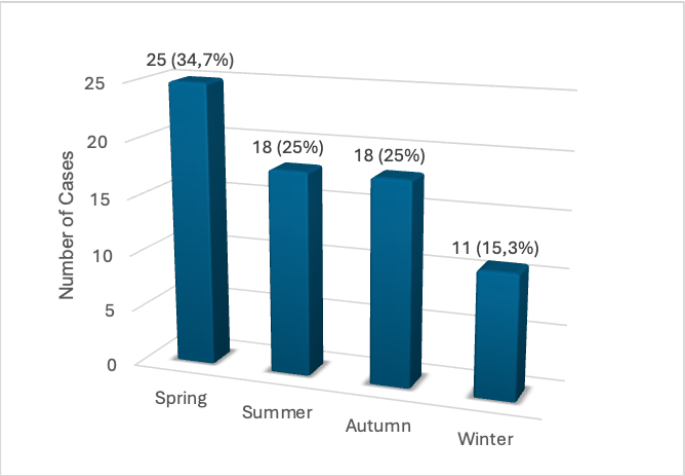

Figure 1. Seasonal evaluation of traumatic amputation rate of incidence

Amputations due to work-related (occupational) injuries were the most common cause of traumatic amputations (n=37, 51.4%), followed by explosion injuries (n=19, 26.4%) and gunshot injuries (n=9, 12.5%). Among the work-related injury group, jamming of body parts (in the door, gun mechanism, etc.) accounted for 21 cases, and machine accidents (lawn mower, meat grinder, etc.) accounted for 16 cases. The distribution of causes of amputations and amputation levels is stated in Table 1.

Sixty-four (88.9%) cases had amputation of one extremity (upper or lower), while 8 (11.1%) cases had multiple extremity amputations. Six (8.3%) cases had amputations involving two extremities, and 2 (2.8%) cases had amputations involving three extremities (Table 1).

Traumatic amputation was mostly seen in the upper extremity (n=60, 83.3%), followed by the lower extremity (n=9, 12.5%) and both upper and lower extremities (n=3, 4.2%). There was no difference in the number of amputees between the right and left upper extremities; besides, amputation was more frequently seen at the left lower extremity than the right lower extremity. Also, there were 4 (5.6%) cases with bilateral upper extremity amputations and 1 (1.4%) case with bilateral lower extremity amputations (Table 1).

Work-related (occupational) injuries (n=35, 62.5%) were the most common cause of traumatic upper extremity amputations, followed by explosion injuries (n=9, 15.2%) and gunshot injuries (n=6, 11.7%). Among lower extremity amputations, explosion injuries and work-related injuries (each n=3, 37.5%) were the most common cause. And also explosion injuries (n=7, 87.5%) were the most common cause of multiple extremity amputations.

"Toes and fingers (digits)" are considered as minor amputations, while "any upper level of metacarpophalangeal/metatarsophalangeal articulation" is considered as major amputations (i.e., partial hand/foot, wrist, trans-radial, elbow, trans-humeral, shoulder, hip, trans-femoral, knee, trans-tibial, ankle). In this research, of the 72 amputees, 42 (58.3%) had minor amputations (only fingers and/or toes) and 30 (41.7%) had major amputations. While isolated partial hand amputations (n=11, 36.6%) were the most common among the major amputations, finger amputations (n=39, 54.2%) were the most common among the minor amputations (Table 1 and 2).

Partial hand amputation was the most frequent amputation level among all trauma types, except electrical injuries and traffic accidents. The traumatic cause was explosion wounds in 3 cases, who had both upper and lower extremity amputations (Table 2).

There were a total of 110 amputations among 54 partial hand amputees, and the left hand (n=29, 53.7%) was more dominant than the right hand (n=25, 46.3%). Of the 54 amputees who had partial hand amputations, 34 (62.9%) had only one finger involving amputations, while 20 (37.1%) had more than one finger amputations. Distal phalanges level (30.9%), metacarpophalangeal joint level (17.3%), and proximal phalanges level (15.4%) were the most frequent amputation levels. The distribution of amputation levels and amputation numbers of 54 partial hand amputees is stated in Table 3.

Replantation operation was performed only on 4 (5.6%) of the amputees: left second and third proximal phalanges level in 1 case, right third mid phalanges level in 1 case, and right elbow level in 2 cases. There were eburnation and movement restriction sequels at the distal levels of replantation in replanted amputees.

Eighteen (25%) amputees overcame a life-threatening situation due to amputation injury, and 14 (19.4%) amputees had a psychiatric disorder after trauma. The distribution of psychiatric disorders after traumatic amputation is stated at Figure 2. The rate of psychiatric disorders was found to be 15.6% (n=13) in upper extremity amputations, 28.2% (n=11) in lower extremity amputations, and 50% (n=2) in both extremity (upper and lower) amputations. The incidence of psychiatric disorders after traumatic amputation was most frequently observed in explosion injuries (37.2%) and gunshot injuries (28.6%).

While the rate of psychiatric disorders was 29.8% (n=17) in major amputations, this rate was only 13% (n=9) in minor amputations. It was determined that the most common type of psychiatric disorder in both types of amputations was anxiety disorder.

Twenty-four (33.3%) amputees had a continuous failure of extremity function, while 22 (30.6%) amputees had a loss of extremity function due to amputation.

Table 1. The distribution of amputation causes and amputation levels of the amputees

	Explosion injuries	Work-related injuries	Gunshot injuries	Electricity injuries	Stab wounds	Traffic Accident	Total (%)
Upper extremity amputations							
Fingers	4	28	4	-	2	1	39 (54.2)
Partial hand	4	5	2	-	-	-	11 (15.3)
Wrist disarticulation	1	-	-	-	-	-	1 (1.4)
Trans-radial (below elbow)	-	-	-	1	-	-	1 (1.4)
Elbow disarticulation	-	2	-	-	-	-	2 (2.8)
Trans-humeral	-	-	-	-	-	2	2 (2.8)
Shoulder disarticulation	-	-	-	-	-	-	-
Subtotal upper extremity							56 (77.7)
Lower extremity amputations							
Toes	-	1	1	-	-	-	2 (2.8)
Partial foot (below ankle)	-	-	-	-	-	-	0
Ankle disarticulation	-	-	-	-	-	-	0
Trans-tibial (below knee)	2	-	1	1	-	-	4 (5.6)
Knee disarticulation	-	-	-	-	-	-	0
Trans-femoral (above knee)	-	-	1	-	-	-	1 (1.4)
Hip disarticulation	1	-	-	-	-	-	1 (1.4)
Subtotal lower extremity							8 (11.1)
Multiple extremity amputations							
Fingers + trans-femoral	2	-	-	-	-	-	2 (2.8)
Partial hand + partial foot	1	-	-	-	-	-	1 (1.4)
Knee disarticulation + trans-tibial	1	-	-	-	-	-	1 (1.4)
Bilateral hand fingers	-	1	-	-	-	-	1 (1.4)
Bilateral wrist disarticulation	3	-	-	-	-	-	3 (4.2)
Subtotal multiple extremity							8 (11.1)
Grand total (%)	**19 (26.4)**	**37 (51.4)**	**9 (12.5)**	**2 (2.8)**	**2 (2.8)**	**3 (4.2)**	**72 (100)**

Table 2. Extremity distributions of amputations

Amputation region	Number of cases	(%)
Right upper extremity	28	38.9
Left upper extremity	28	38.9
Bilateral upper extremity	4	5.6
Right lower extremity	1	1.4
Left lower extremity	7	9.7
Bilateral lower extremity	1	1.4
Upper and lower extremity	3	4.2
Total	**72**	**100**

Table 3. Amputation levels and numbers of 54 partial hand amputees

	Carpal bones	CMC joint	Metacarpal bones	MCP joint	Proximal phalanges	PIP joint	Mid phalanges	DIP joint	Distal phalanges	Total
Right hand	2	1	5	7	9	10	4	5	14	57
Left hand	-	1	3	12	8	1	6	2	20	53
Total (%)	2 (1.8)	2 (1.8)	8 (7.3)	19 (17.3)	17 (15.4)	11 (10)	10 (9.1)	7 (6.4)	34 (30.9)	110 (100)

CMC: Carpometacarpal, MCP: Metacarpophalangeal, PIP: Proximal Interphalangeal, DIP: Distal Interphalangeal

DISCUSSION

Amputations can be evaluated in two ways: traumatic and non-traumatic. Non-traumatic amputations depend on diseases (diabetes mellitus, peripheral vascular disease, malignancy, etc.) and frequently performed surgery treatment at hospitals. This kind of amputation is more acceptable for patients because they are preplanned operations, and patients have knowledge about their disease. But, on the contrary, traumatic amputations occur suddenly, without going through a pre-loss adaptation phase, and are the most severe injuries for a person, both physically and psychologically.

The etiology of amputation varies between countries and cities depending on cultural and geopolitical characteristics. In the United States, vascular diseases (Diabetes Mellitus, etc.) are the most frequent cause of amputations (9), while trauma is seen as the most frequent cause in Türkiye (1,3). To our knowledge, this is the first study that determines traumatic amputations among military personnel in Türkiye.

Military personnel are always at risk of trauma due to difficult conditions like conflicts, training, etc. This can also cause traumatic amputations. In this research, we examined 2472 forensic case reports of military personnel retrospectively and determined that 72 (2.9%) of them had traumatic amputation (s).

It is known that traumas and traumatic amputations are frequently seen in young men. All of our cases were male and in young age groups similar to the other studies (4) (1,2,10-14). It is thought that the fact that the cases in our study were mostly in the young age group and all were men was because all the cases included in the study were military personnel. This is consistent with the fact that traumatic amputations are generally caused by occupational injuries, especially in the military, heavy labor, when machinery is involved, and in youths and males.

When the etiology of traumatic amputations is examined, it varies depending on factors such as profession (civilian/security force), development level of the countries, terrorism, war, public order in the country, and the existence of a developed health system. While the majority of injuries, especially in the presence of war, are caused by explosions, outside of war, other causes other than explosions are more effective (15). When the literature was examined, although there were differences in the rates, it was seen that work accidents and explosions were the most common causes of amputations (1,3,16,13). The most common causes of traumatic amputation in our study were work-related injuries (51.4%) and explosion injuries (26,4%). The frequent occurrence of terrorist acts and military operations in our country between the years of the study led to an increase in explosions and explosion-related amputations. In addition, the study mainly involved soldiers, who often work with heavy machinery and are exposed to trauma-inducing scenarios like explosions; it was determined that work accidents and explosions were the leading causes of traumatic amputations.

Although amputations vary depending on the cause of trauma, they are mostly in only one extremity (upper or lower) in literature (2,17). In our study, most of the cases (88.9%) had amputation in only one extremity (upper or lower), while 11.1% had amputation in multiple (more than one) extremities. We were unable to locate any research on amputations involving only one or multiple limbs. The etiology of the trauma, the severity of the injury, and the affected body part are all factors that contribute to the number of extremities involved in traumatic amputations. Although primarily associated with severe trauma such as terrorist bombings and land mines, it can also develop in a singular extremity from relatively minor injuries like those sustained in work or traffic accidents. Since people injured in these minor injuries are focused on protecting themselves, it is thought that they try to protect their uninjured extremities to avoid amputation. We think that the fact that work-related injuries were the most common in the cases in our study caused amputations to occur mostly in only one extremity.

Although amputations occur in various parts of the body, they often occur in the upper extremity. In the study of Barmparas et al., it was reported that amputations were more common in the upper extremity (58.9%) (11). Similarly, other studies have found that traumatic amputations are most common in the upper extremity (68.6%) (17,18). In our study, it was determined that the majority of amputations (83.3%) were in the upper extremity, consistent with the literature. People frequently use their upper extremities in their daily lives. Especially in work accidents, traumas are frequently seen in the upper extremities, especially the fingers, and as a result, amputations occur. We think that the most common cause of trauma in our study is work-related, which causes upper extremity amputations to occur more frequently.

The most frequently affected areas by trauma are the distal parts of our body. In studies evaluating upper extremity amputations, it was reported that amputations were most frequently seen in the fingers (19,20). In a study conducted on American soldiers injured in Afghanistan and Iraq, it was

determined that amputations occurred more frequently at the distal ends of the body, upper extremity amputations were more common below the elbow, and lower extremity amputations were more common below the knee (21). Similar results were obtained in the study of Melcer T et al. (22). In our study, similar to the literature, it was determined that amputations were most common in the fingers of the upper extremity (54.2%, n=39) and in the distal parts of the lower extremity. This is just because people use their distal extremities for work or battle, and they get hurt frequently at distal extremities.

Amputations can be at different levels, major or minor, depending on the etiology of the trauma and the severity of the injury. When the literature is evaluated, there are differences regarding the level of traumatic amputations. These differences vary depending on the country where the study is conducted, the level of development of the health system, and the presence of war, such as the profession (civilian/security force). In a study conducted on American soldiers injured in Afghanistan and Iraq, it has been stated that the majority of traumatic amputations are major amputations, and this situation is caused by severe trauma such as terrorist bombings and antipersonnel land mines (23). In the study conducted by Dillingham et al. among civilians, it was reported that the most common amputations were minor amputations (70.1%), and among them, finger amputations (52.7%) were the most common. It was determined that the most common major amputation was hand amputation (11.5%) (18). In our study, 58.3% of the cases had minor amputations and were frequently seen in the fingers. In general, minor amputations are most common in civilians and non-traumatic amputations, while major amputations are common in military personnel at different rates. Amputations due to diseases (diabetes, cardiovascular diseases, etc.) are mostly in the distal parts, while in traumatic amputations, this situation varies according to the etiology of trauma. For example, major amputations are seen in high-energy traumas such as terrorist bombings and antipersonnel land mines, while minor amputations are more common in work-related traumatic amputations. Although the cases in our study were military personnel, the frequency of work-related traumatic amputations in the etiology of trauma explains the minority of amputations. In this case, we think that the presence of military doctors and the experience of military hospitals in this field are also effective, and the major level is prevented.

Amputations have not only physical but also psychological effects on people. The level of these effects may vary depending on the personality characteristics of the victim and the severity of the amputations. Many researchers reported that traumatic amputations are typically equated with the loss of a spouse, loss of one's perception of wholeness, symbolic castration, and even death (24) (25). In the study of Çopuroğlu et al., it was determined that 36% of the cases had psychiatric complaints in the early period after amputation, and post-traumatic stress disorder occurred in 77.2% in the late period (26). In a study conducted on military cases, it was reported that 38.3% of the cases had psychiatric complaints after traumatic amputation, and among these, post-traumatic stress disorder was the most common (17.9%) (27). Similar studies have also reported that there are varying rates of psychiatric complaints after amputation, and post-traumatic stress disorder is the most common among them (28,29). In our study, it was determined that an accompanying psychiatric disorder occurred in 19.4% (n=14) of the injuries resulting in amputation, and among these, anxiety disorder was the most common. In addition, it was determined that psychiatric disorders were more common in lower extremity amputations, and as the number of amputations increased, the rate of psychiatric disorders also increased. In a study conducted on war victims, it was found that patients with amputations were more frequently examined in psychiatric outpatient clinics, and psychiatric disorders were more common, especially in lower extremity amputations (22). Amputations are known to cause social discomfort and body image anxiety. This leads to activity limitation and psychiatric disorders such as post-traumatic stress disorder, depression, and anxiety. Since lower extremity amputations cause more social discomfort, psychiatric disorders were more common than upper extremity amputations. Similarly, we think that increasing the number of amputations causes psychiatric disorders for the same reason.

CONCLUSION

Trauma is one of the important causes of amputations. Traumatic amputations are among the issues that need to be carefully examined because they occur especially in the young age group and cause disabilities in the affected people. It is known that traumatic amputations are more common in soldiers and security forces, where situations such as explosions and gunshot wounds occur frequently in terrorist acts in our country and around the world. Amputations occur in the extremities and often in the distal regions, and this leads to significant effects on the person's post-event life. It is necessary to reduce trauma, which is one of the important causes of amputations, to take precautions by using personal protective equipment, and to not neglect treatment and follow-up. Trainings should be provided on common causes of trauma (work-related injury, explosion, etc.) to prevent the occurrence of amputations.

The majority of patients in developing nations, like Türkiye, struggle to receive pre-hospital care, which proves to be a major challenge for trauma care, especially in military cases. The prevention of amputations relies heavily on proper prehospital first aid interventions. Simple first aid information and training are essential for soldiers who often encounter traumatic amputations.

Psychological injuries may also occur in people with severe traumatic injuries such as amputation. Developing psychological injuries leads to significant effects on a person's life. It is of great importance that psychiatric follow-up of people is carried out in the early and late periods after amputation and that social support and appropriate treatments are not neglected.

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