

Digital Amputations Due To Upper Extremity Injuries: A Retrospective Analysis of Patients Presenting To The Emergency Department

Üst Ekstremitte Yaralanmalarına Bağlı Gelişen Dijital Amputasyonlar: Acil Servise Başvuran Hastaların Geriye Dönük Analizi

Fatma ÇAKMAK¹, Sinem DOĞRUYOL², Mehmet Akif ÇAKMAK³

ABSTRACT

This study aimed to examine the characteristics of traumatic minor digital amputations in patients presenting to the emergency department, who were candidates for replantation and revascularization and to discuss the clinical outcomes of these patients. Upper extremity total/subtotal amputation cases presenting to Private Erzurum Buhara Hospital emergency department between January 1, 2018, and January 1, 2021, were retrospectively evaluated. The demographic characteristics, occupational status, etiology and type of injury, localization and level of injury, time to arrive at hospital and undergo surgery, length of hospital stay, and survival outcomes were recorded for a total of 134 patients. Of the patients, 88.1% were male, and the mean age was 36.45±20.87 years. Injuries were most commonly seen in those working in agriculture, at a rate of 61.4%. The most common injury type was avulsion (45.5%). The most common specific cause (16.4%) was related to throttle belt use. The mean time from the time of injury to arrival at the emergency department was calculated as 2.51±1.88 hours. It was found that, the survival rate was 71.6% for all the patients and 75.9% for the pediatric patients alone. In conclusion, it is found that the survival rate was higher in guillotine type injuries and in pediatric patients. It is determined that different mechanisms were involved in the etiology of these minor digital amputation cases due to the geographical region where the study was conducted. It is consider that it can be a guide for informing people working in agriculture in this region, and thus reducing the incidence of similar traumas.

Keywords: Digital amputation, Replantation, Revascularization

ÖZ

Bu çalışmada amacı acil serviste değerlendirilip replantasyon ve revaskülarizasyona aday olmuş travmatik minör dijital ampütasyon hastalarına ait özellikleri ve bu hastaların klinik sonuçlarını incelemektir. 01.01.2018 ile 01.01.2021 tarihleri arasında Özel Erzurum Buhara Hastanesi acil servise başvuran üst ekstremitte total/subtotal ampütasyon olguları retrospektif olarak incelendi. 134 hastaya ait demografik özellikler, çalışma durumu, yaralanma etyolojisi ve tipi, yaralanmanın lokalizasyonu ve seviyesi, hastaneye ulaşma ve operasyona alınma süreleri, hastanede kalış süreleri ve survival durumlarına dair sonuçlar kayıt altına alınmıştır. Hastaların %88,1'i erkekti ve ortalama yaş 36,45±20,87 idi. En çok yaralanma %61,4 oranıyla tarım alanında çalışanlarda görülmüştü. En sık yaralanma tipi avülsiyon tipi yaralanma (%45,5) idi. En sık spesifik neden (%16,4) patos kayışı yaralanmasıydı. Yaralanma zamanı ile acil servise ulaşma zamanları arasındaki ortalama süre 2,51 ± 1,88 saat olarak hesaplandı. Survival oranları tüm hastalar için %71,6, sadece çocuk hastalar için ise %75,9 şeklinde tespit edilmiştir. Sonuçta giyotin tipi yaralanmaların ve çocuk hastalarda survival oranlarının daha yüksek olduğu görüldü. Çalışmamızın geçtiği coğrafi bölge itibarıyla, minör dijital ampütasyon vakalarımızın etyolojisinde farklı mekanizmaların devreye girdiğini tespit edildi. Bu durumun, bölgede tarım alanında çalışan halkın bilgilendirilmesi ve böylelikle travmaların azaltılması konusunda yol gösterici olabileceğini düşünülmektedir.

Anahtar Kelimeler: Parmak ampütasyonu, Replantasyon, Revaskülarizasyon

Prior to commencing the study, ethical approval was obtained from the Clinical Research Ethics Committee of Erzurum Regional Training and Research Hospital (E-37732058-514.99).

¹ Uzm. Dr. Fatma ÇAKMAK, Acil Tıp, Erzurum Özel Buhara Hastanesi Acil Servis, e-posta: dr.fatmacakmak@gmail.com , ORCID: 0000-0002-5770-3554

² Uzm. Dr. Sinem DOĞRUYOL, Acil Tıp, İstanbul Haydarpaşa Numune Eğitim ve Araştırma Hastanesi Acil Servis, e-posta: dogruyolsinem@gmail.com , ORCID: 0000-0002-6949-7233

³ Uzm. Dr. Mehmet Akif ÇAKMAK, Plastik Cerrahi, Erzurum Özel Buhara Hastanesi, Plastik Rekonstruktif ve Estetik Cerrahi Erzurum, e-posta: makifcakmak@gmail.com , ORCID: :0000-0001-7828-040X

İletişim / Corresponding Author:
e-posta/e-mail:

Yazar Adı SOYADI Fatma ÇAKMAK
Yazar e-mail adresi dr.fatmacakmak@gmail.com

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INTRODUCTION

Limb losses due to upper extremity traumas are serious disabilities that affect both the social and work lives of individuals. With the microsurgical techniques developing since the 1960s, the loss of limb and function has been minimized, and replantation and revascularization attempts have been widely adopted across the world.¹

Trauma-related digital injuries constitute nearly 1% of all trauma cases, and the first place of application for these cases is almost always the emergency services.² In such traumatic amputations, a part or all of the extremity is detached from a certain level due to the effect of trauma. Replantation and revascularization are surgical interventions performed to restore the function of an amputated body part. Upper extremity amputations are evaluated in two categories as major and minor.³ Injuries distal to the wrist level are considered as minor

amputations and digital amputations are also in this category. Thumb amputation, multiple digit amputation, and all digital amputations in pediatric patients are indications for digital replantation. Many factors, such as patient age, comorbid diseases, type of trauma, and ischemia duration play a role in the success of replantation and affect survival outcomes.⁴

Emergency departments are of critical importance in detecting finger injuries with indications for replantation and revascularization, shortening the ischemia time, and undertaking patient referral and management. This study aimed to examine the characteristics of traumatic minor digital amputations in patients presenting to the emergency department, who were candidates for replantation and revascularization and to discuss the clinical outcomes of these patients.

MATERIAL AND METHOD

Upper extremity total/subtotal amputation cases presenting to Erzurum Private Buhara Hospital emergency service between January 1, 2018, and January 1, 2021, were retrospectively evaluated, and those with digital injuries who underwent replantation and revascularization were included in the study. Patients who were referred to a different center and those with missing data in the hospital registry system were excluded from the study. 36 patients were excluded due to missing data.

The patients' demographic characteristics, occupation status, etiology and type of injury, localization and level of injury, time to arrive at hospital and undergo surgery, length of hospital stay, and survival outcomes were recorded. In the presence of multiple digit injuries, the phalanx level of the injury was considered when specifying the injury level. After collecting the data of all the patients, pediatric patients were evaluated separately as a subgroup. Early survival, i.e., functional and circulatory stability within two weeks, was taken as the

basis for the patients' postoperative survival status.

Ethical considerations

Prior to commencing the study, ethical approval was obtained from the Clinical Research Ethics Committee of Erzurum Regional Training and Research Hospital (E-37732058-514.99).

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences for Windows, v. 20.0 (SPSS, Chicago, IL, USA). The conformity of continuous variable data to the normal distribution was evaluated with the Shapiro-Wilk test. Since continuous variables related to time were normally distributed, Student's t-test was used when comparing the differences in these variables between the two groups. Percentage and numerical values were given for categorical variables and mean \pm standard deviation values for continuous variables. The Pearson chi-square test was conducted to compare categorical

variables. As the significance level, $p < 0.05$ was taken as a basis when presenting the results.

RESULTS AND DISCUSSION

The data of 134 patients were included in this study were analyzed. It was determined that replantation and revascularization attempts were undertaken for a total of 173 fingers. The male patients constituted 88.1% of the sample, and the mean age was calculated as 36.45 ± 20.87 years. Table 1 presents the baseline characteristics of all the patients. When the type of work was examined in trauma-related injuries among manual laborers, it was determined that the most injuries occurred in those working in agriculture at a rate of 61.4%. The most common type of injury was avulsion (45.5%). The type of injury was compared between the manual laborers and unemployed/retired patients. Although many different causes were involved in the etiology of injuries, the most common specific cause was injury due to throttle belt use, which was observed in 22 patients (16.4%). It was determined that the throttle belt caused both avulsion (81.5%) and crush (18.5%) injuries ($p = 0.000$). This was followed by injuries caused by sharp objects, such as a chainsaw (12.7%), spiral device (12%), and ax (9.7%). Crush-type injuries were more common in manual laborers while guillotine injuries caused digital injuries more frequently in those who were unemployed/retired. The difference between these two groups was statistically significant ($p = 0.000$). When the distribution of injury types was compared between the men and women, there was no statistically significant difference ($p = 0.134$). Other clinical and anatomical features of digital injuries are shown in Table 2.

Table 1. Baseline Characteristics Of The Patients Undergoing Replantation And Revascularization

	All patients (n = 134)
Age (mean \pm SD, years)	36.45 \pm 20.87

Table 1 (Continue). Baseline Characteristics of The Patients Undergoing Replantation and Revascularization

Sex (%)	
Male	118 (88,1%)
Female	16 (11,9%)
Occupational status (%)	
Working (manual laborer)	
Agriculture	35 (26,1%)
Industry/manufacturing	22 (16,4%)
Unemployed/retired	54 (40,3%)
Pediatric	23 (16,2%)

It was found that 29 (21.6%) of the 134 patients exposed to trauma were pediatric patients. The mean age of the pediatric patients was 6.83 ± 3.31 years. The most common injury type in this group was crush injuries (44.8%), and there was no significant difference in the distribution of injury types between the pediatric and other patients ($p = 0.279$).

Table 2. Clinical And Anatomical Features Of Digital Injuries

All patients (n = 134)	
Injury type (%)	
Avulsion	61 (45,5%)
Crush	41 (30,6%)
Sharp/guillotine	24 (17,9%)
Multimodal	8 (6,0%)
Affected limb side (%)	
Right	82 (61,2%)
Left	52 (38,8%)

Table 2 (Continue). Clinical and Anatomical Features of Digital Injuries

Type of affected finger (%)	
Thumb	19 (11,1%)
Index	43 (24,9%)
Middle	43 (24,9%)
Ring	48 (27,7%)
Little	20 (11,6%)
Number of affected fingers (%)	
Two fingers	9 (6,7%)
More than two fingers	14(10,4%)
Level of minor amputation (%)	
Distal phalanx	48 (35,8%)
Middle phalanx	41 (30,6%)
Proximal phalanx	45 (33,6%)
Time to hospital (mean ±SD, hours)	2,51 ± 1,88
Time to surgery (mean ± SD, minutes)	54,59 ± 30,78
Early outcome (survival rate) (%)	96 (71,6%)
Hospital stay (mean ± SD, days)	6,08 ± 2,44

Concerning the anatomical features of digital injuries, the frequencies of right-hand injuries, especially fourth finger injuries were high (Table 2). It was determined that the frequency of right-hand injuries in manual laborers (71.9%) was higher than in unemployed/retired patients (53.7%), but the difference was not statistically significant ($p = 0.089$). Digital injuries were mostly seen at the distal phalanx level (35.8%). The frequency of injuries at the distal phalanx level was higher in the pediatric group than in the adults (44.8%). However, no statistically significant difference was found in the anatomical level of digital injuries according to the patient being an adult or child ($p = 0.109$).

The mean time from the time of injury to arrival at the emergency department was calculated as 2.51 ± 1.88 hours, and the mean time from consultation to surgery was 54.59 ± 30.78 minutes. The early replantation and revascularization survival rate was 71.6% for all the patients and 75.9% for the pediatric patients alone. The early survival rate was found to be higher in patients with a shorter time to arrive at the emergency department and undergo surgery, but no statistically significant result was found in terms of numerical data ($p = 0.868$ and $p = 0.266$, respectively).

The relationship between the type of injury and survival rate was also examined. The highest survival rate was found in guillotine injuries (87.5%). This was followed by multimodal (75.0%), avulsion (70.5%), and crush (63.4%) injuries. There was no significant difference between the injury types in terms of the survival rate ($p = 0.219$).

There are many factors that affect the success of replantation and revascularization in amputations due to digital injuries. Emergency medicine clinicians should be able to determine which patient is a suitable candidate for surgery at the time of presentation and should make clear decisions in the referral and management of these patients. In the current study, it is aimed to contribute to the literature by guiding emergency clinicians in this process. For this purpose, it has been retrospectively analyzed the characteristics of traumatic minor digital amputations in patients that presented to the emergency department and were evaluated as candidates for replantation and revascularization and discussed the clinical outcomes of these patients.

Digital amputation injuries mostly affect young-adult men and are usually caused by jobs involving tool use.⁵ Similarly, in this study, the majority of cases were young or middle-aged men. The rates of employed and unemployed patients were similar, and the frequency of tool-related injuries was noticeably higher in both groups. In the literature, it has been stated that in digital

injuries related to tool use, patients are most frequently injured with a chainsaw.⁶ In this study, it was found that the most common tool causing injury was the throttle belt. Our study differs from the literature in terms of both the presence of a rare etiology and the higher incidence of agriculture-related injuries in our sample.

In this study, the most frequently affected digit due to injury was the fourth finger, which is similar to the findings reported by Struckmann et al.⁷ This digit being more open to trauma has been associated with it also being the ring finger and the ring being stuck-attached to an object, resulting in injuries.⁸

In the literature examining upper extremity injuries, there are variable data concerning the frequency of injury mechanisms, and it has been stated that clean-cut and crush injuries are more common than avulsion injuries.⁹ In a study examining the relationship between the type of injury and survival, the survival rate of guillotine injuries was reported to be 96%, which was statistically significantly higher compared to crush and avulsion injuries.¹⁰ In this study, unlike the literature, the most

common injury type was avulsion. The survival rate was higher in guillotine injuries compared to the remaining injury types.

In a study in which non-work-related finger amputations were compiled from the literature, it was stated that children aged five years and younger were at high risk for amputations.¹¹ The mean age of the pediatric patients in our study was around 6 years. In a meta-analysis of digital replantation survival rates, Ma et al. reported this rate to be lower in children than in adults.¹⁰ In contrast, the survival rate of our pediatric replantation cases was higher compared to the adult patients. Digital injuries in pediatric patients are mostly associated with domestic accidents, which can be reduced by taking appropriate precautions.

In two different studies, the success rates of replantation and revascularization in patients with complete avulsion and amputation in digital injuries were reported to be 78% and 86%.^{11,12} In our study, the replantation and revascularization survival rate was determined as 71.6%, which was very close to the values reported in the literature.

CONCLUSION AND RECOMMENDATIONS

It is determined that the survival rate was higher in guillotine type injuries and pediatric patients. It is also found that different mechanisms were involved in the etiology of our minor digital amputation cases compared to the literature due to the

geographical region where it is conducted the study. It is considered that our findings can be a guide for informing people working in agriculture in this region, and thus reducing traumas.

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