



# Evaluation of Clinical and Cost Analysis of Patients Applying to the Emergency Service with Extensor Tendon Incision in the Upper Extremity

## Üst Ekstremitte Ekstansör Tendon Kesisi ile Acil Servise Başvuran Hastaların Klinik ve Maliyet Analizinin Değerlendirilmesi

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### Abstract

**Aim:** Hand trauma is common in emergency departments, with approximately 20% of regional traumas involving hand injuries. Extensor tendon lacerations, often caused by sharp objects, are frequently encountered but may be overlooked, leading to significant morbidity. This study aims to retrospectively review cases of extensor tendon lacerations in the upper extremities to highlight the importance of thorough evaluation and management in the emergency department.

**Material and Method:** A single-center retrospective study included 114 patients presenting to the emergency department with extensor tendon lacerations. Data on patient demographics, injury characteristics, treatment, complications, and costs were collected and analyzed. Statistical analysis was performed using SPSS version 26.0.

**Results:** The majority of patients were male adults, with sharp objects such as knives being the most common cause of injury. Extensor tendon repairs were predominantly performed in the emergency department, with complications observed in 14.9% of cases. The mean cost of treatment was \$255.97. Factors influencing the decision to perform repair in the operating room included patient age, injury characteristics, and associated injuries.

**Conclusion:** Extensor tendon lacerations in the upper extremities represent a significant burden in emergency departments. Our findings emphasize the importance of thorough evaluation and timely management to prevent missed diagnoses and optimize patient outcomes. Repairing extensor tendon injuries in the emergency department can be cost-effective and efficient, but careful consideration of patient and injury factors is necessary to determine the most appropriate treatment setting.

**Keywords:** Cost analysis, extensor tendon incision, upper extremities

### Öz

**Amaç:** El travması acil servislere sık başvuru nedenleri arasındadır. Bölgesel travmaların yaklaşık %20'si el yaralanmalarını içermektedir. Genellikle keskin nesnelere neden olduğu ekstansör tendon kesileri sık karşılaşılan ancak gözden kaçabilen, ciddi morbiditeye yol açabilen yaralanmalardır. Bu çalışma, acil serviste kapsamlı değerlendirme ve yönetimin önemini vurgulamak için üst ekstremitelerdeki ekstansör tendon kesisi vakalarını retrospektif olarak gözden geçirmeyi amaçlamaktadır.

**Gereç ve Yöntem:** Ekstansör tendon kesisi nedeniyle acil servise başvuran 114 hasta tek merkezli retrospektif olarak çalışmaya dahil edildi. Hasta demografisi, yaralanma özellikleri, tedavi, komplikasyonlar ve maliyetlere ilişkin veriler toplandı ve analiz edildi. İstatistiksel analiz SPSS 26.0 versiyonu kullanılarak yapıldı.

**Bulgular:** Hastaların çoğunluğu yetişkin erkekti ve yaralanmaların en yaygın nedeni bıçak gibi keskin nesnelereydi. Ekstansör tendon onarımları ağırlıklı olarak acil serviste yapıldı ve vakaların %14,9'unda komplikasyon görüldü. Ortalama tedavi maliyeti 255,97 dolardı. Ameliyathanede onarım yapma kararını etkileyen faktörler arasında hastanın yaşı, yaralanma özellikleri ve ilişkili yaralanmalar yer alıyordu.

**Sonuç:** Üst ekstremitedeki ekstansör tendon kesileri acil servislere önemli bir yük oluşturmaktadır. Bulgularımız, gözden kaçan tanıları önlemek ve hasta sonuçlarını optimize etmek için kapsamlı değerlendirme ve zamanında yönetimin önemini vurgulamaktadır. Acil serviste ekstansör tendon yaralanmalarının onarılması uygun maliyetli ve verimli olabilir, ancak en uygun tedavi ortamının belirlenmesi için hasta ve yaralanma faktörlerinin dikkatli bir şekilde değerlendirilmesi gereklidir.

**Anahtar Kelimeler:** Maliyet analizi, ekstansör tendon kesisi, üst ekstremitte



## INTRODUCTION

Hands are highly vulnerable to trauma in our daily lives and can be easily traumatized. Emergency department visits with hand trauma constitute approximately 20% of all regional traumas.<sup>[1,2]</sup> In a study conducted in the literature with hand trauma cases, it was reported that approximately 82% of the cases had soft tissue injuries.<sup>[3]</sup> In another literature study, in a series of 50 272 hand injury cases, 35% of the injuries were simple injuries, and 5% of the same cases had tendon injuries.<sup>[4]</sup>

It has been reported that the most common etiology of hand injuries is sharps injuries.<sup>[3-5]</sup> In the literature, it has been reported that the most common sharp-piercing instruments used in hand injuries are knives and glass, while the fingers are the most commonly injured part of the hand.<sup>[3,4]</sup>

There are many epidemiologic studies on hand injuries in the literature. However, few studies in the literature draw attention to the level of deep structures being affected or overlooked, even in tiny incisions in the emergency department. The most common reason for missing deep injuries despite a small incision area is the lack of adequate examination. In such injuries, the observer makes a quick decision due to the small size of the injury and does not make the necessary assessment.<sup>[6]</sup> Although these injuries are not life-threatening, they can lead to severe morbidities. These types of injuries deserve the necessary attention due to the complexity of the hand structure and the long rehabilitation process in these patients. Therefore, we should make the necessary evaluation and elaborate the examination of deep lacerations in the upper extremities, especially in the hand and wrist.

In this study, we aimed to conduct a retrospective review of patients admitted to the emergency department with lacerations of the extensor tendons in the upper extremities and draw attention to extensor tendon lacerations in the emergency department.

## MATERIAL AND METHOD

### Study Design and Setting

Our study is a single-center and retrospective study. Our hospital is one of the largest tertiary care hospitals in the region, with 1400 daily emergency department visits, and all critical interventions can be performed.

An emergency medicine specialist and an orthopedic specialist conducted our study. Our study was performed according to the review guidelines for retrospective studies in emergency medicine summarized by Kaji et al.<sup>[7]</sup>

### Patient Selection

Our study was performed on patients who presented to the emergency department with upper extremity trauma and were found to have extensor tendon lacerations after evaluation. Routine treatment and follow-up were performed immediately after admission.

The study included 114 patients. Patients with incomplete data, patients who were not considered to have extensor tendon laceration, patients who had repeated admissions to our centers, and patients with total or partial limb amputation were excluded from the study.

Ethics committee approval was obtained from the Clinical Ethics Committee of our 3rd Level Training and Research Hospital (dated 10/08/2021 with the Ethics Committee No. KAEK/2021.05.88), and the study was started.

### Data Sources

Our study scanned the database of our hospital's automation system and patient files to identify the cases. ICD codes "S66, S66.2, S66.3, S66.4, S66.5, S66.7, S66.8, S69.7, S69.8, and S69.9" were used for the extensor tendon of the upper extremity. Only the first admissions of patients with repeated admissions were included among the patients included in the study.

### Data Collection

A study data form was created to collect and standardize the data in our study. This form systematized data collection and facilitated the identification of cases with missing data.

In our study, 114 patients who presented to the emergency department with upper extremity trauma between 01/01/2022 and 01/01/2023 with extensor tendon incision were included. The etiology of trauma, the time elapsed between the onset of trauma and admission, the name and localization of the extensor tendons, whether the incision was partial or complete, the place of intervention (emergency department or operating room), complications, and cost analysis parameters were examined and recorded in the previously created study data form.

In our study, emergency and orthopedic specialists with at least three years of experience in the field evaluated extensor tendon incisions.

Loss of flexion due to extensor tendon contraction after repair, loss of flexion and extension due to adhesions, and weakened grip in the patients were considered complications.

### Outcome Measures

The primary outcome of our study was to draw attention to extensor tendon laceration, which can be seen in patients presenting to the emergency department with upper extremity trauma. As a secondary outcome, we aimed to evaluate the follow-up, complications, and costs in cases with extensor tendon incisions and to contribute to the literature with our results.

### Statistical Analysis

Data were analyzed with SPSS Package Program version 26.0. Number, percentage, mean, standard deviation, median, minimum, maximum, median, minimum, and maximum were used to present descriptive data. The Kolmogorov-

Smirnov Test evaluated the suitability of the data for using thermal distribution. In univariate analysis, median (IQR) values were given for continuous variables not showing normal distribution, and mean ( $\pm$ standard deviation) values were given for continuous variables showing normal distribution. Pearson Chi-Square Test was used to analyze categorical variables. Fisher's Exact Test was used in the presence of less than five variables in categorical variables. The T-test was used to compare two independent numerical data.

$p < 0.05$  was accepted as the level of statistical significance.

### RESULTS

Of the 114 patients in our study, 55.3% were male, and the mean age was  $33.46 \pm 11.70$  years. 11.4% of the patients were children, and 88.6% were adults. The most common mechanism of injury was sharps injury, with a rate of 75.4%, and the most common object causing injury was a knife (49.1%). The patients presented to the emergency department after a mean of  $2.43 \pm 1.72$  hours of trauma. It was seen that the most common extremity direction of trauma was right (55.3%), the most common injury site was the metacarpal region with 36.0% ( $n=41$ ), and the mean wound size was  $3.00 \pm 1.70$  cm. It was learned that 20.2% of the cases were injured due to work accidents. While 74.6% of these cases had complete (total) tendon laceration, 25.4% had incomplete (partial) tendon laceration. The bone fracture was associated with tendon incision in 12.3% of these cases; nerve injury was associated with tendon incision in 7.9%, and arterial injury in 13.2%. Tendon repair was performed in the emergency department in 67.5% of the cases, while in 32.5%, the repair was planned in the operating room. Complications were seen in 14.9% of cases. The mean cost of the cases was  $\$255.97 \pm 83.50$  (Table 1).

It was questioned whether the injured extremity was dominant or not. It was seen that 53.6% ( $n=61$ ) of these patients had a dominant hand injury.

Posttraumatic evaluation of the patients was performed, and then trauma-directed treatment was planned. Among these patients, repair was planned in the operating room because pediatric patients were noncompliant with the physician during repair ( $p=0.022$ ), the injury area was not suitable for evaluation and repair in the emergency department in patients with a long admission time after injury ( $p=0.024$ ), patients with high injury size ( $p=0.030$ ), and patients with forearm injuries required additional dissection to find tendon ends and had additional injuries ( $p=0.016$ ). In addition, repair was performed in the emergency department in partial tendon incisions because it was more feasible. After all, the tendon ends could be seen ( $p=0.043$ ). However, in addition to all these factors, the cost of tendon repair in the operating room was significantly higher than in the emergency department (Table 2).

**Table 1 Evaluation of demographic and clinical data of the patients**

Parameter	n (%) / Mean $\pm$ SD
Age (years)	33.46 $\pm$ 11.70
Gender	
Woman	51 (44.7)
Male	63 (55.3)
Age Group	
Child	13 (11.4)
Adult	101 (88.6)
Direction of Injured Extremity	
Right	63 (55.3)
Left	51 (44.7)
Time between injury and application (hours)	2.43 $\pm$ 1.72
Injury Mechanism	
Sharps Injury	86 (75.4)
Blunt Trauma	28 (24.6)
Wound Size (cm)	3.00 $\pm$ 1.70
Type of Injury	
Blunt Trauma	28 (24.6)
Knife Cut	56 (49.1)
Glass Cut	24 (21.1)
Other	6 (5.3)
Injury Localization	
Finger	29 (25.4)
metacarpal	41 (36.0)
Wrist	14 (12.3)
forearm	30 (26.3)
Work accident situation	
None	91 (79.8)
There is	23 (20.2)
Tendon Incision Type	
Complete /Total	85 (74.6)
Incomplete / Partial	29 (25.4)
Place of intervention	
Emergency room	77 (67.5)
Operating room	37 (32.5)
Additional Injury	
None	76 (66.7)
Bone Fracture	14 (12.3)
Nerve Injury	9 (7.9)
Artery Injury	15 (13.2)
Complication	
None	97 (85.1)
There is	17 (14.9)
Cost (\$)	255.97 $\pm$ 83.50

**Table 2 Examination of the factors affecting whether the cases were repaired in the emergency department or in the operating room**

Parameter	Place of intervention		p
	Emergency Department (n=77) n (%) / Mean±SD	Operating room (n=37) n (%) / Mean±SD	
Age (years)	33.54±11.52	33.26±1.52	0.466
Gender			
Woman	38 (74.5)	13 (25.5)	0.278
Male	41 (65.1)	22 (34.9)	
Age Group			
Child	5 (38.5)	8 (61.5)	0.022
Adult	72 (71.3)	29 (28.7)	
Direction of Injured Extremity			
Right	46 (73.0)	17 (27.0)	0.339
Left	33 (64.7)	18 (35.3)	
Time between injury and application (hours)	2.19±1.25	2.97±2.41	0.024
Injury Mechanism			
Sharps Injury	60 (69.8)	26 (30.2)	0.849
Blunt Trauma	19 (67.9)	9 (32.1)	
Wound Size (cm)	2.77±1.60	3.49±1.88	0.030
Type of Injury			
Blunt Trauma	19 (67.9)	9 (32.1)	0.701
Knife Cut	40 (71.4)	16 (28.6)	
Glass Cut	17 (70.8)	7 (29.2)	
Other	3 (50.0)	3 (50.0)	
Injury Localization			
Finger	25 (32.5)	4 (10.8)	0.001
metacarpal	32 (41.6)	9 (24.3)	
Wrist	6 (7.8)	8 (24.3)	
forearm	14 (18.2)	16 (43.2)	
Work accident situation			
None	65 (71.4)	26 (28.6)	0.327
There is	14 (60.9)	9 (39.1)	
Tendon Incision Type			
Complete /Total	53 (62.4)	32 (37.6)	0.043
Incomplete / Partial	24 (82.8)	5 (17.2)	
Additional Injury			
None	58 (76.3)	18 (48.6)	0.016
Bone Fracture	7 (9.1)	7 (18.9)	
Nerve Injury	4 (5.2)	5 (13.5)	
Artery Injury	8 (10.4)	7 (18.9)	
Complication			
None	69 (71.1)	28 (28.9)	0.310
There is	10 (58.8)	7 (41.2)	
Cost (\$)	212.87±47.80	353.26±62.23	<0.001

## DISCUSSION

Deep injuries in the upper extremities are often overlooked and may cause significant morbidity and loss of function in these cases. Although clinical evaluations and diagnostic information regarding tendon and other soft tissue (nerve, vessel, etc.) injuries are frequently described in the literature, many tendon injuries are still overlooked.<sup>[8,9]</sup> In addition, the clinician frequently overlooks arterial injuries due to the double arterial blood supply to the forearm and hand.

In our study, 11.4% of the cases were pediatric patients under the age of 18 years. It was observed that extensor tendon injuries in these patients were repaired in the operating room at a higher rate due to their incompatibility with the physician and agitation during repair. A comparison could not be made because of the need for similar study data.

When the gender distribution of patients with extensor tendon incision was analyzed, it was found that male patients were more common. Broback et al. found a male gender preponderance in their study.<sup>[10]</sup> In the study by Angermann and Lohmann, the male/female ratio was 2/1.<sup>[5]</sup> In our study, this ratio was significantly lower than in the literature. We think that this is because many patients were referred to our hospital from the surrounding regions, and these regions are primarily rural areas; women are exposed to injuries as much as men because they are doing active daily work (cooking, cutting wood, pruning, etc.).

There is a consensus in the literature that injuries occur equally in the dominant or non-dominant hand.<sup>[11-14]</sup> In our study, the approximately equal incidence of injury in the dominant and non-dominant hand was similar to the literature.

Although there are many different types of injuries, the literature has reported that the highest rate of injuries is with glass.<sup>[3,5]</sup> In addition, Singer and Maloon reported that the most common injury was with a knife.<sup>[15]</sup> Our study observed that the most common injury was with a knife, as in the study of Singer and Maloon. We think that this is again due to the high proportion of women in our study and the high risk of knife injuries in daily housework.

Singer and Maloon reported that proximal finger level was the most common extensor tendon injury.<sup>[3-5,15]</sup> In a similar study, it was reported that the most common extensor tendon injury was at the level of the proximal and middle finger joints and that there were approximately equal injuries in these two regions. Turker et al. reported that the most common extensor tendon injury was in the metacarpal region.<sup>[16]</sup> Similarly, Meyer et al. reported that extensor tendon injuries were most common in the metacarpal region.<sup>[17]</sup> Our study observed the highest injury rate in the metacarpal region. The extensor tendons in the metacarpal region are more superficial and frequently exposed to injuries.

In our study, extensor tendon repairs were performed in the emergency department in 67.5% of the cases. This situation has some advantages and disadvantages.<sup>[18,19]</sup> Repair in the emergency department is advantageous for rapid treatment

and discharge. In addition, it will not cause unnecessary surgical preparation and operating room intensity for patients. On the other hand, it will cause overcrowding in the emergency department, which is a disadvantage. In addition, it is seen that repair in the emergency room is more cost-effective than repair in the operating room. As far as we know, there are no similar studies in the literature on this subject, and our study is pioneering in cost analysis.

### Limitations of Study

The first limitation of the study was the difference in the number of pediatric and adult patients since randomized patients were included. In addition, patients with extensor tendon incisions diagnosed with different ICD 10 codes were not included in the study. However, our study results will not show significant variability due to these limitations.

### CONCLUSION

We presented general information about extensor tendon incisions in patients admitted to the emergency department with upper extremity trauma and wanted to draw attention to this issue. In these cases, a detailed examination of the patient for extensor tendon incision will prevent the tendon incision from being missed. In addition, improving the conditions in the emergency department regarding tendon repairs will prevent unnecessary operating room intensity and reduce costs.

### ETHICAL DECLARATIONS

**Ethics Committee Approval:** Ethics committee approval was obtained from the Clinical Ethics Committee of our 3rd Level Training and Research Hospital (dated 10/08/2021 with the Ethics Committee No. KAEK/2021.05.88), and the study was started.

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

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