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Prognostic Factors in the Management of Earthquake-Related Soft Tissue Injuries: A Single-Center Experience

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ABSTRACT

Objective: There is limited evidence for the early and rapid assessment of earthquake-related soft tissue injuries. This research examined parameters that can be utilized to identify the prognosis of patients with these injuries.

Materials and Methods: This retrospective study was conducted at Erciyes University. Patients injured in the Kahramanmaraş-centered earthquake in Türkiye in 2023 were enrolled. The effect of injury types, trauma, and injury severity scores (TRISS), and specific laboratory values of the patients at the time of application on the success of soft tissue reconstruction was investigated.

Results: A total of 61 patients were enrolled in the study. The median TRISS scores were 98.35 in Group 1, 88.20 in Group 2, and 57.35 in Group 3. The TRISS scores exhibited statistically significant differences between the groups. The TRISS score of Group 3 was found to be significantly lower than those of Groups 1 and 2 ($p<0.001$, $p<0.011$, respectively). Prolongation of the time spent under the wreckage and elevated TRISS scores were correlated with an increase in the number of injury debridements, a decrease in injury closure success, an increase in the frequency of Acinetobacter baumanii reproduction, an increase in the need for amputation, an increase in mortality, and hospitalization costs ($p<0.05$).

Conclusion: In the early and rapid assessment of earthquake-related soft tissue injuries, the time spent under the wreckage and the TRISS score were crucial parameters in determining the prognosis. The parameters mentioned above may guide the management of patients with earthquake-related soft tissue injuries.

Keywords: Earthquake, disaster, crush injury, injury assessment, trauma score.

INTRODUCTION

Earthquakes, which can emerge suddenly without any precursor and destroy thousands of human lives within hours, are a devastating natural disaster for humankind. Earthquakes occur in the Earth's lithosphere, and those with a Richter severity of 7 and above may seriously cause loss of property and life.[1,2] It is known that more than 750,000 people lost their lives in the earthquakes that occurred between 1998 and 2017, and more than 125 million people were affected by these disasters around the world.[3]

On February 6, 2023, two major earthquakes occurred in the south of Türkiye, affecting 11 provinces and neighboring cities of Syria. The magnitudes of these earthquakes, occurring 9 hours apart, were 7.8 and 7.5 according to the Richter scale. Due to both the magnitude of the earthquakes and the shallow earthquake focal length (<10 km), enormous damage occurred in an area of 350,000 km^2 (Fig. 1). After these earthquakes, the United Nations (UN) health agency declared the earthquake in Türkiye as a "3rd Degree Emergency."[4] Throughout the earthquake and the following days, the air temperature was between +4 °C and -5 °C, and the losses increased due to severe damage to the infrastructure in the settlements. Approximately 50,000 deaths were reported after these earthquakes.[5]

Earthquakes may cause severe soft tissue injuries due to collapse or a rigid body impact.[6–8] Moreover, local injury in these patients may be accompanied by a systemic metabolic stress response and a suppressed immune system response due to being under the rubble for a long time.[9,10] Nevertheless, the injuries in these patients are likely to become complicated due to contamination.[11,12] Despite a certain amount of evidence in the literature for the urgent or orthopedic assessment of earthquake-related trauma patients,[13–15] there is no study for the early and rapid evaluation of earthquake-related soft tissue injuries.

This research examined the factors affecting the prognosis of patients who applied to our clinic following the earthquake on February 6, 2023, and had earthquake-related soft tissue injuries. For this purpose, the association between the success of soft tissue injury management and the time under the wreckage, laboratory findings at the time of application to the emergency department, trauma scores, duration of hospitalization, necessity for psychiatric support, and treatment costs were evaluated.

MATERIALS AND METHODS

The study was designed retrospectively and descriptively for patients injured in the earthquake on February 6, 2023, who were admitted to the Erciyes University Plastic, Reconstructive, and Aesthetic Surgery Clinic. The local institutional review committee approved the study and waived the requirement for informed consent due to the study design. The protocol number of the ethics approval by Erciyes University's Ethics Committee was 2023/685. The study complied with international ethical guidelines for human research, such as the Declaration of Helsinki.

KEY MESSAGES

- In the initial and expeditious evaluation of earthquake-related soft tissue injuries, the duration spent beneath the wreckage and the TRISS score were pivotal parameters in establishing the prognosis.
- Prolonging the time spent under the wreckage effectively develops antibiotic-resistant injuries, reduces the success of injury closure, and increases hospitalization costs.
- It is worth noting that elevated levels of procalcitonin and myoglobin, which are laboratory values commonly encountered in the emergency department, are associated with an unfavorable prognosis.

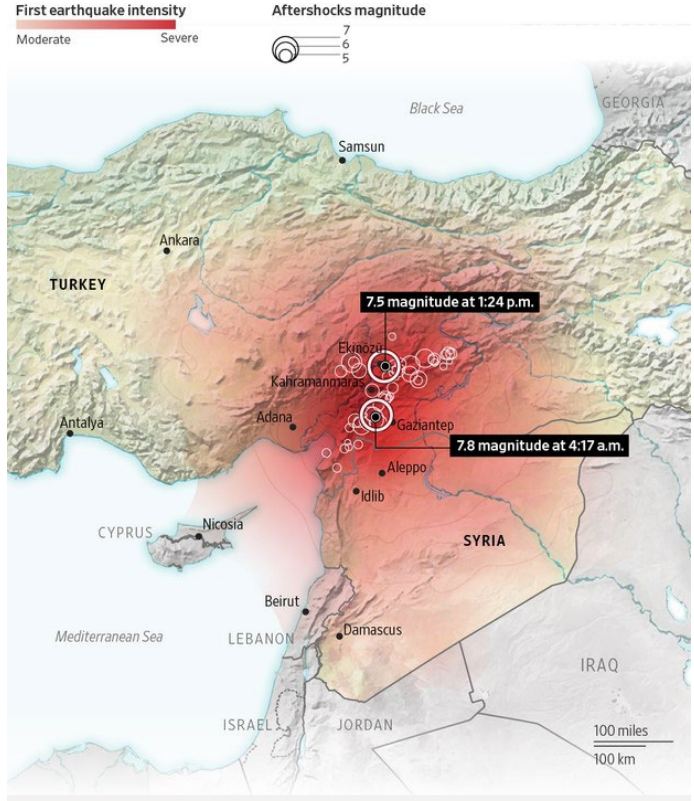

Figure 1. A map showing the epicentre and affected area of the earthquake.

Table 1. Demographic and clinical characteristics of the patients who participated in the study

Variables	Total (n=61)
Age (years), (IQR)	24 (12–48)
Gender (female), n (%)	27 (44.3)
Comorbidity (number of patients), n (%)	11 (18)
Hypertension	5 (8.2)
Asthma	3 (4.9)
Diabetes	2 (3.3)
Malignancy	2 (3.3)
Depression	2 (3.3)
Number of injuries in the head and neck area, n (%)	
1 injury	16 (26.2)
2 injuries	7 (11.5)
3 injuries	1 (1.6)
Number of injuries in the upper extremity region, n (%)	
1 injury	12 (19.7)
2 injuries	4 (6.6)
Number of injuries in the body area, n (%)	
1 injury	14 (23.0)
Number of injuries in the lower extremity region, n (%)	
1 injury	25 (41.0)
2 injuries	14 (23.0)
3 injuries	2 (3.3)
4 injuries	2 (3.3)
Patients followed-up in intensive care unit, n (%)	28 (45.9)
Duration of hospitalization in intensive care unit (days), (IQR)	7.50 (4.00–25.00)
Patient requiring psychiatric support, n (%)	31 (50.8)
Duration of hospitalization (days), (IQR)	17.00 (8.25–40.00)
Hospitalization cost (USD), (IQR)	836.70 (385.71–3221.14)

IQR: Interquartile range; USD; United States Dollar; Values are shown as n (%) or median (1st–3rd quartiles).

Age, gender, comorbidities, and injury characteristics (abrasion, laceration, crush, frostbite, avulsion, gangrene, burn, amputation, and fracture injuries) of the patients who participated in the research were examined. The patients were divided into three groups:

1. Patients who need amputation-free reconstruction
2. Patients who require amputation-requiring reconstruction
3. Patients who did not survive (Exitus).

Trauma and Injury Severity Scores (TRISS) at the time of admission to the emergency department, duration of stay under the wreckage, laboratory values at the time of admission to the emergency department, number of injuries, number of surgical interventions, injury infections, period of antibiotic treatment, antibiotic resistance, intensive care needs, number of hospitalization days, psychiatric support needs, and total costs to the health system of all three patient groups were compared.

Statistical Analysis

The normality of the data was assessed using histograms, Q-Q plots, and the Shapiro-Wilk test. The Levene test was employed to evaluate variance homogeneity. Descriptive statistics are presented as mean±standard deviation, median,

Table 2. Laboratory results of the patients at the time of admission to the hospital

Variables	Total (n=61)	Group			p
		Group 1 (n=50)	Group 2 (n=5)	Group 3 (n=6)	
Procalcitonin (ng/L), (IQR)	1.17 (0.20–10.80)	0.89 (0.20–5.93)[a]	13.60 (0.39–15.40)[a]	64.50 (3.44–100.00)[b]	0.007*
GFR (mL/min/1.73 m^2), (IQR)	74.00 (29.00–126.00)	90.50 (34.25–126.00)[a]	54.00 (20.50–93.00)[ab]	17.50 (12.25–33.50)[b]	0.006*
CRP(mg/L), (IQR)	60.00 (25.50–96.00)	57.90 (19.73–93.13)	89.00 (57.20–143.50)	78.25 (48.75–117.00)	0.224
CK-MB (IU/L), (IQR)	121.00 (43.30–330.50)	103.00 (37.98–279.75)	152.00 (51.00–902.00)	920.00 (101.05–21792.75)	0.116
Myoglobin (ng/mL), (IQR)	1133.00 (286.00–9166.25)	783.00 (175.50–2386.50)[a]	4667.00 (1067.00–73290.50)[b]	24755.00 (1245.25–79429.25)[b]	0.011*
Prealbumin (mg/dL), (IQR)	7.93 (5.72–13.52)	7.65 (5.36–13.60)	7.21 (2.42–7.93)	9.85 (7.06–15.85)	0.347

GFR: Glomerular filtration rate; CRP: C-reactive protein; CK-MB: Creatine kinase-myocardial band. Values are shown as median (1st–3rd quartiles). The similarities of the measurements between the groups are shown with the same letter, whereas the differences between the groups are shown with different letters. *Indicates a statistically significant difference.

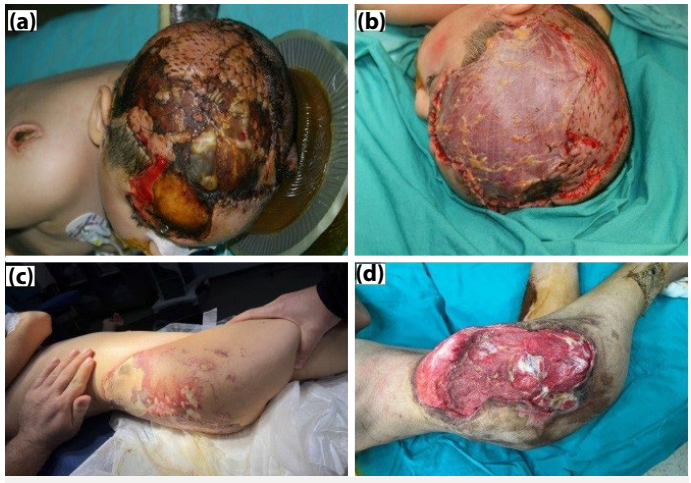

Figure 2. Examples of patients injured in the earthquake. **(a)** A 4-year-old male patient was reconstructed with a partial-thickness skin graft after 96 hours under the rubble; however, graft lysis occurred. **(b)** Intraoperative appearance of the defect following reconstruction with a free latissimus dorsi muscle flap. **(c)** A 13-year-old female patient sustained a crush injury in the right lumbar and right gluteal region after 48 hours under the wreckage. **(d)** Necrosis and infection reached deep muscle groups after debridement.

and interquartile range (IQR), or frequency (percentage). Kruskal-Wallis tests were utilized for between-group comparisons. Multiple comparisons were conducted using the Dunn-Bonferroni test. The relationship between variables was analyzed using Spearman correlation analysis. Data analysis was performed using TURCOSA statistical software. A significance level of $p<0.05$ was considered statistically significant.

RESULTS

Sixty-one patients were admitted to our clinic due to earthquake-related soft tissue injuries. Of the patients, 44.3% were female, 55.7% were male, and the median age was 24 years (IQR: 12–48). Of these patients, 11 (18%) had a comorbid disease, and the most prevalent comorbidity was hypertension (5 patients, 8%). The patients' median hospitalization duration was 17 days (IQR: 8.3–40). The number of patients in Group 1 was 50 (82%), in Group 2 was 5 (8.2%), and in Group 3 was 6 (9.8%). The median cost to the insurance system was $836 (IQR: $385–3221) (Table 1).

The most frequent soft tissue injuries due to the earthquake were in the lower extremity (43 injuries) at 70%, head-neck (24 injuries) at 39%, upper extremity (16 injuries) at 26%, and body (14 injuries) at 22%. As a reconstruction method, 17 injuries were reconstructed with flaps, 30 with grafts, 34 with secondary healing, and 48 injuries with primary suture. Six injuries required amputation. Complications affecting the success of reconstruction included flap necrosis in 3 injuries, graft lysis in 9, and injury infection in 16 (Fig. 2). All patients in Groups 1 and 2 were discharged following reconstruction.

The median time under the wreckage was 10 hours (IQR: 1–160) in Group 1, 72 hours (IQR: 11–100) in Group 2, and 30 hours (IQR: 8–80) in Group 3. There was no statistically significant difference between the groups concerning the period spent under the wreckage (p=0.37). The median TRISS scores of the patients throughout admission to the hospital were 98.35 (92.78–99.00) in Group 1, 88.20 (52.23–94.03) in Group 2, and 57.35 (12.25–72.18) in Group 3 (Fig. 3). The TRISS scores were statistically significant between the groups, and the TRISS score of Group 3 was significantly lower than those of Groups 1 and 2, respectively; p<0.001, p=0.011.

The median C-reactive protein (CRP) values of the patients during admission to the emergency department were 60 mg/L (IQR: 25.50–96.00), procalcitonin values were 1.17 ng/L (IQR: 80.20–10.80), and creatine kinase-MB (CK-MB) values were 121.00 IU/L (IQR: 43.30–330.50). The median myoglobin value was calculated to be 1133 ng/mL (IQR: 286.00–9166.25), prealbumin to be 8.84 mg/dL (IQR: 5.72–13.52), and the mean glomerular filtration rate (GFR) to be 74.00 mL/min/1.73 m^2 (IQR: 29.00–126.00) (Table 2). The procalcitonin value of Group 3 was statistically higher than Groups 1 and 2 (p=0.007), and the GFR value was significantly lower than Group 1 (p=0.006), but it was not significantly different compared to Group 2. The myoglobin value of Group 1 was statistically lower than Groups 2 and 3 (p=0.011). No statistically significant difference was noted between the groups regarding CRP, CK-MB, and prealbumin (p=0.224, p=0.116, p=0.322, respectively).

Twenty-eight patients required intensive care, 19 of whom were in Group 1, 3 in Group 2, and 6 in Group 3. Thirty-eight (62.3%) patients had crush injuries, and 16 (26.2%) of them had crush syndrome and associated acute renal failure. Immediate dialysis was required in 10 (16.4%) of the patients developing acute renal failure.

At least one injury of 55 (90.2%) patients throughout hospitalization required injury debridement. Empirical antibiotics were initiated in all patients undergoing debridement. The median empirical antibiotic period was calculated to be 6.00 days (2.25–11.00). Empirical antibiotic preference was cefazolin in 18 (29.5%) patients, ampicillin-sulbactam in 13 (21.3%) patients, cipro-flagyl in 10 (16.4%) patients, clindamycin-cefotaxime in 9 (14.8%) patients, and vancomycin in 6 (9.8%) patients. In the course of treatment, at least one microorganism was detected in 16 (26.2%) patients, polymicrobial reproduction in 7 (11.5%) patients, and bacteremia in 4 (6%) patients. In 16 (26.2%) patients, a surgical area infection emerged within an average of 6 days, and at least one pathogen was isolated. The most frequently isolated pathogen was Acinetobacter baumanii, which was found in 10 patients, and all were multidrug-resistant (MDR). Klebsiella pneumoniae (70% MDR) was isolated in 7 patients, Pseudomonas aeruginosa (20% MDR) in 5 patients, Escherichia coli in 3 patients, and Enterococcus in 5 patients (Fig. 4). A statistically significant difference was found when comparing the time spent under the wreckage between patients with MDR growth and those without growth (p=0.021).

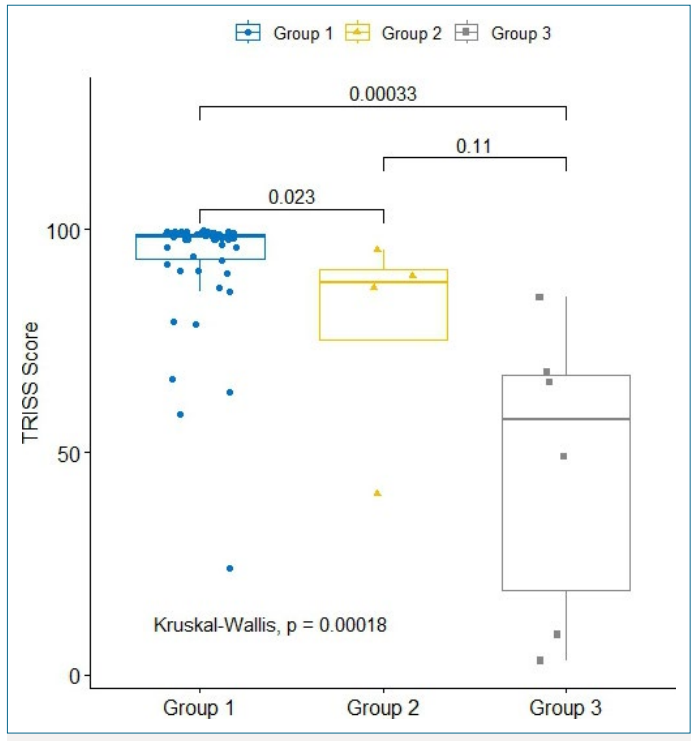

Figure 3. The association between TRISS scores of the patients injured in the earthquake and the patient groups.

Thirty-one patients required psychiatric consultation. Twenty-seven patients (54%) in Group 1 and 4 patients (80%) in Group 2 required psychiatric support.

A correlation was noted between the prolongation of the time spent under the wreckage and various parameters. Firstly, a positive, moderate, and significant relationship was detected between prolonging the time under the wreckage and the duration of hospitalization and hospitalization costs (p<0.01). Moreover, prolonging the period under the wreckage was associated with a increase in the number of injury debridements and a decrease in the success of injury closure (p<0.05). There was a negative, moderate, and significant relationship between them. Again, CRP and myoglobin values were higher in these patients during admission to the hospital (p<0.01). There was a positive, moderate, and significant relationship between them. Finally, there was a positive, moderate, and significant relationship between the prolongation of the time under the wreckage and MDR Acinetobacter growth in the injury area (p<0.01) (Table 3).

Table 3. Correlation matrix between duration under the wreckage and other variables

Variables	Duration of being under the wreckage
Age	-0.096
Hospitalization cost	0.398*
Duration of hospitalization in ICU	0.232
Duration of hospitalization	0.439*
Number of debridements	0.318*
Injury closure success	-0.333*
Empirical antibiotic period	0.066
CRP	0.334*
Procalcitonin	0.101
CK-MB	0.242
Myoglobin	0.377*
TRISS score	-0.150
Prealbumin	0.039
Creatinine-GFR	-0.125
Acinetobacter baumanii (MDR)	0.366*

ICU: Intensive care unit; CRP: C-reactive protein; CK-MB: Creatine kinase-myocardial band; TRISS: Trauma and Injury Severity Scores; GFR: Glomerular filtration rate; MDR: Multiple drug resistance. *Indicates a statistically significant difference.

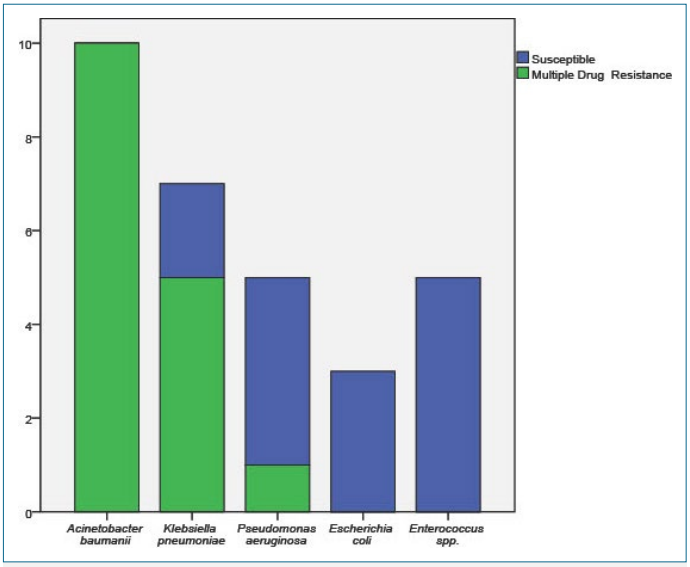

Figure 4. Factors isolated from the injury site culture and multiple drug resistance (MDR) status.

DISCUSSION

In natural disasters such as earthquakes, which can cause severe destruction in a brief time, it is essential to conduct clinical management accurately and to establish the priorities to be given in treatment. Therefore, predicting the clinical course and prognosis of patients with many earthquake-related soft tissue traumas rapidly and accurately may guide the healthcare team in determining the best treatment and efficient utilization of resources.

Kayseri has become one of the reference centers due to its proximity to the earthquake region. Following the earthquake, 647 patients were admitted to the emergency department of our university, and 61 of these patients were closely monitored by our personnel due to soft tissue trauma.

Scorings that determine trauma patients' survival probability are commonly utilized in modern emergency service practice. Hence, the TRISS scoring system has become almost standard.[16,17] The TRISS scoring system is a comprehensive scale considering variables such as the Revised Trauma Score (RTS), the Injury Severity Score (ISS), trauma type, and the patient's age.[18] Studies in the literature reveal that the TRISS score is superior to other trauma scores in identifying the patient's prognosis. Orhon et al.[19] reported that the TRISS score was superior to other trauma scores in determining the duration of hospitalization in the intensive care unit and the requirement for mechanical ventilators in their research on 633 patients who applied to the emergency department. Similarly, in Güneytepe, they suggested that the TRISS scoring system was more efficient than other trauma scores in predicting mortality in elderly trauma cases.[20] In our research, TRISS scores were lower in Group 3 compared to the other two groups, and the patients deceased without soft tissue reconstruction.

In earthquake-related soft tissue traumas, physiological changes develop due to crush syndrome and prolonged metabolic stress. Muscle necrosis, hypovolemic shock, hyperkalemia, and acute renal injury, particularly in crush syndrome, might be the cause of mortality.[21] In their study, Dönmez et al.[22] reported severe crush syndrome and acute renal injury due to rhabdomyolysis in 20 children following the Marmara earthquake. Accordingly, Shimazu et al.[23] emphasized the significance of fluid therapy in managing 14 patients who developed crush syndrome after the Hanjin-Awaji earthquake. In our research, as the period spent under the wreckage prolonged, the patients' myoglobin, a product of muscle destruction, elevated, GFR values decreased, and these factors were found to be associated with a poor prognosis, such as the need for amputation or exitus in soft tissue trauma.

One of the acute phase reactants enhancing trauma-associated tissue destruction and infections is procalcitonin. In their study on severe trauma patients, Billeter et al.[24] stated that

procalcitonin levels were a valuable biomarker in foreseeing the occurrence of septic infections. Sakran et al.[25] reported that procalcitonin values of ≥5 ng/mL measured on the second day in trauma patients were related to increased mortality. In our study, procalcitonin values in Group 3 were significantly higher compared to the other groups, and this outcome was evaluated according to the literature. Conversely, the procalcitonin value was noted to be ineffective in predicting the requirement for amputation.

Soft tissue damage, which results from prolonged time under the wreckage following significant traumas such as earthquakes, increases the need for surgical interventions and more empirical antibiotics.[26] Chen et al.[27] stated in their study that patients with infected injuries after the Wenchuan earthquake had longer periods under the wreckage compared to those without infection. Öncül et al., [28] in their retrospective study on 532 patients admitted to their hospitals following the 1999 Marmara earthquake, revealed that the average duration of being under the wreckage was 15.9 hours in patients with hospital-induced infections. Another factor that raises earthquake-related injury infection rates is the decrease in infection control measures due to the intense workload of healthcare professionals.[29,30] In our study, 16 (26.2%) patients had surgical site infections at the injury area, and the average duration of being under the wreckage for these patients was calculated to be 61 hours. Moreover, especially with gram-negative and polymicrobial agent isolation, MDR rates increase with the prolongation of the time under the wreckage. It would be appropriate to establish the empirical antibiotic preference by considering these factors, particularly in patients with a prolonged period under the wreckage.

One of the crucial prognostic factors that became prominent in our study was the duration of stay under the rubble. The prolongation of this duration reduced the success of reconstruction regardless of the requirement for amputation, and increased the number of surgical debridements as well as the costs of resistant infection and hospitalization. Given the complex damage mechanisms of the earthquake, it can be foreseen that these patients will require long-term follow-up at a multidisciplinary level.

CONCLUSION

It was observed that the TRISS score was substantial in determining the prognosis of patients with soft tissue trauma following earthquake trauma. Furthermore, it is noteworthy that procalcitonin and myglobulin, which are laboratory values in the emergency department, are associated with a poor prognosis. Lastly, prolonging the time under the wreckage is effective in developing antibiotic-resistant injury infections, decreasing injury closure success, and increasing hospitalization period and hospitalization costs.

Ethics Committee Approval: The Erciyes University Clinical Research Ethics Committee granted approval for this study (date: 25.10.2023, number: 2023/685).

Author Contributions: Concept – CAK, İÖ; Design – CAK; Supervision – CAK; Data Collection and/or Processing – VS, ZT, ASL, HD; Analysis and/or Interpretation – GZ, AC, HD; Literature Search – HD, ZT, DTK; Writing – HD, DTK; Critical Reviews – CAK.

Conflict of Interest: The authors have no conflict of interest to declare.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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REFERENCES

1. Gautschi OP, Cadosch D, Rajan G, Zellweger R. Earthquakes and trauma: review of triage and injury-specific, immediate care. Prehosp Disaster Med 2008; 23(2): 195–201. [CrossRef]
2. Gül MK, Ozmen S, Demirci E. After the 2023 earthquake in Turkiye: an assessment of post-earthquake psychological resilience in children and adolescents-a systematic review. J Clin Pract Res 2023; 45(6): 539–48. [CrossRef]
3. Ceferino L, Mitrani-Reiser J, Kiremidjian A, Deierlein G, Bambarйn C. Effective plans for hospital system response to earthquake emergencies. Nat Commun 2020; 11(1): 4325.
4. Ateş S, Erdem H. The earthquake in Türkiye and infectious disease concerns. New Microbes New Infect 2023; 52: 101127. [CrossRef]
5. Organization WH. Türkiye earthquake: external situation report no. 9: May 1–June 4 2023. Available from: URL: https://www.who.int/turkiye/publications/i/item/WHO-EURO-2023-7145-46911-70035. Accessed Aug 8, 2024.
6. Michaelson M. Crush injury and crush syndrome. World J Surg 1992; 16(5): 899–903. [CrossRef]
7. Long B, Liang SY, Gottlieb M. Crush injury and syndrome: A review for emergency clinicians. Am J Emerg Med 2023; 69: 180–7. [CrossRef]
8. Slater MS, Mullins RJ. Rhabdomyolysis and myoglobinuric renal failure in trauma and surgical patients: a review. J Am Coll Surg 1998; 186(6): 693–716. [CrossRef]
9. Spaggiari G, Setti M, Tagliavini S, Roli L, De Santis MC, Trenti T, et al. The hypothalamic-pituitary-adrenal and -thyroid axes activation lasting one year after an earthquake swarm: results from a big data analysis. J Endocrinol Invest 2021; 44(7): 1501–13. [CrossRef]

10. Relja B, Land WG. Damage-associated molecular patterns in trauma. Eur J Trauma Emerg Surg 2020; 46(4): 751–5.
11. Wuthisuthimethawee P, Lindquist SJ, Sandler N, Clavisi O, Korin S, Watters D, et al. Wound management in disaster settings. World J Surg 2015; 39(4): 842–53. [CrossRef]
12. Prasartritha T, Tungsiripat R, Warachit P. The revisit of 2004 tsunami in Thailand: characteristics of wounds. Int Wound J 2008; 5(1) :8–19. [CrossRef]
13. Liu S, He C. Related factors associated with earthquake inpatient mortality. Disaster Med Public Health Prep 2022; 16(1): 65–70. [CrossRef]
14. Hu H, Lai X, Tan C, Yao N, Yan L. Factors associated with in-patient mortality in the rapid assessment of adult earthquake trauma patients. Prehosp Disaster Med 2022; 37(3): 299–305. [CrossRef]
15. Bortolin M, Morelli I, Voskanyan A, Joyce NR, Ciottone GR. Earthquake-related orthopedic injuries in adult population: a systematic review. Prehosp Disaster Med 2017; 32(2): 201–8. [CrossRef]
16. Glance LG, Osler T. Beyond the major trauma outcome study: benchmarking performance using a national contemporary, population-based trauma registry. J Trauma 2001; 51(4): 725–7. [CrossRef]
17. Boyd CR, Tolson MA, Copes WS. Evaluating trauma care: the TRISS method. Trauma score and the injury severity score. J Trauma 1987; 27(4): 370–8. [CrossRef]
18. Schall LC, Potoka DA, Ford HR. A new method for estimating probability of survival in pediatric patients using revised TRISS methodology based on age-adjusted weights. J Trauma 2002; 52(2): 235–41. [CrossRef]
19. Orhon R, Eren SH, Karadayı S, Korkmaz I, Coşkun A, Eren M, et al. Comparison of trauma scores for predicting mortality and morbidity on trauma patients. Ulus Travma Acil Cerrahi Derg 2014; 20(4): 258–64. [CrossRef]
20. Güneytepe Üİ, Aydin ŞA, Gökgöz Ş Özgüç H, Ozakoğlu G, Aktaş H. The factors influencing the mortality in elderly trauma patients and scoring systems. Uludağ Üniversitesi Tıp Fakültesi Dergisi 2008; 34(1): 15–9.
21. Bosch X, Poch E, Grau JM. Rhabdomyolysis and acute kidney injury. N Engl J Med 2009; 361(1): 62–72. [CrossRef]
22. Dönmez O, Meral A, Yavuz M, Durmaz O. Crush syndrome of children in the Marmara Earthquake, Turkey. Pediatr Int 2001; 43(6): 678–82. [CrossRef]
23. Shimazu T, Yoshioka T, Nakata Y, Ishikawa K, Mizushima Y, Morimoto F, et al. Fluid resuscitation and systemic complications in crush syndrome: 14 Hanshin-Awaji earthquake patients. J Trauma 1997; 42(4): 641–6. [CrossRef]
24. Billeter A, Turina M, Seifert B, Mica L, Stocker R, Keel M. Early serum procalcitonin, interleukin-6, and 24-hour lactate clearance: useful indicators of septic infections in severely traumatized patients. World J Surg 2009; 33(3): 558–66. [CrossRef]
25. Sakran JV, Michetti CP, Sheridan MJ, Richmond R, Waked T, Aldaghlas T, et al. The utility of procalcitonin in critically ill trauma patients. J Trauma Acute Care Surg 2012; 73(2): 413–8; discussion 418. [CrossRef]
26. Kazancioglu R, Cagatay A, Calangu S, Korular D, Turkmen A, Aysuna N, et al. The characteristics of infections in crush syndrome. Clin Microbiol Infect 2002; 8(4): 202–6. [CrossRef]
27. Chen X, Zhong H, Fu P, Hu Z, Qin W, Tao Y. Infections in crush syndrome: a retrospective observational study after the Wenchuan earthquake. Emerg Med J 2011; 28(1): 14–7. [CrossRef]
28. Oncül O, Keskin O, Acar HV, Küçükardali Y, Evrenkaya R, Atasoyu EM, et al. Hospital-acquired infections following the 1999 Marmara earthquake. J Hosp Infect 2002; 51(1): 47–51. [CrossRef]
29. Orak Y, Orak F, Göçer S, Doganay M. Earthquake in Türkiye: impact on health services and infection threats. J Clin Pract Res 2023; 45(6): 549–57. [CrossRef]
30. Izumikawa K. Infection control after and during natural disaster. Acute Med Surg 2018; 6(1): 5–11. [CrossRef]