



One year of treating patients with open fractures of the lower extremity in a new military trauma center in Korea: a case series

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Purpose: The Armed Forces Trauma Center of Korea was established in April 2022. This study was conducted to report our 1-year experience of treating soldiers with open fractures of the lower extremity.

Methods: In this case series, we reviewed the medical records of 51 Korean soldiers with open fractures of the lower extremity between April 2022 and March 2023 at a trauma center. We analyzed patients with Gustilo-Anderson type II and III fractures and reported the duration of transportation, injury mechanisms, injured sites, and associated injuries. We also presented laboratory findings, surgery types, intensive care unit stays, hospital stays, rehabilitation results, and reasons for psychiatric consultation. Additionally, we described patients' mode of transport.

Results: This study enrolled nine male patients who were between 21 and 26 years old. Six patients had type II and three had type III fractures. Transport from the accident scene to the emergency room ranged from 75 to 455 minutes, and from the emergency room to the operating room ranged from 35 to 200 minutes. Injury mechanisms included gunshot wounds, landmine explosions, grenade explosions, and entrapment by ship mooring ropes. One case had serious associated injuries (inhalation burn, open facial bone fractures, and hemothorax). No cases with serious blood loss or coagulopathies were found, but most cases had a significant elevation of creatinine kinase. Two patients underwent vascular reconstruction, whereas four patients received flap surgery. After rehabilitation, six patients could walk, one patient could move their joints actively, and two patients performed active assistive movement. Eight patients were referred to the psychiatry department due to suicidal attempts and posttraumatic stress disorder.

Conclusions: This study provides insights into how to improve treatment for patients with military trauma, as well as medical services such as the transport system, by revising treatment protocols and systematizing treatment.

Keywords: Military personnel; Degloving injuries; Leg injuries; Post-traumatic stress disorders

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INTRODUCTION

Background

Korea has been in a state of ceasefire for 70 years since the end of the Korean War in 1953. The Korean military maintains 500,000 soldiers, accounting for about 1% of the Korean population in the present day [1]. Accidents such as landmine explosions, gunshots, and falls during training can occur in the military. Lower extremity injuries are especially common in the military due to soldiers' training and exercise to maintain their physical condition. Patients with lower extremity injuries are usually hospitalized for a long time because their activity level is limited [2]. In addition, severe lower extremity injuries occasionally occur. Those with multiple severe injuries often show unstable vital signs and undergo repeated operations with considerable complications and psychological problems [3].

Objectives

The Armed Forces Trauma Center (AFTC; Seongnam, Korea) was established in April 2022. This study was conducted to report our 1-year experience of treating patients (soldiers) with open fractures of the lower extremity. In addition, the clinical processes of treating these patients were described in detail.

METHODS

Ethics statement

This study was approved by the Institutional Review Board of Armed Forces Capital Hospital (No. AFCH 2023-04-001). The requirement for informed consent was waived due to the retrospective nature of the study.

Study design

Data collection

In this observational study (case series), we reviewed the medical records of 51 Korean soldiers with open fractures of the lower extremity between April 2022 and March 2023 at a single trauma center.

Criteria and variables

After categorizing the severity using the Gustilo-Anderson classification, we analyzed patients with type II and III fractures (Fig. 1) [4]. The process of transporting patients was described as time elapsed from the accident scene to the emergency room (ER) and from the ER to the operating room (OR). We analyzed the pa-

tients' injury mechanisms, injured sites, types of surgery performed, associated injuries, and clinical processes. The injury mechanisms included gunshot wounds, landmine explosions, grenade explosions, being crushed under a vehicle wheel, being trapped by mooring ropes, and falls. We classified the injured sites as pelvis, thigh (femur), knee, calf (tibiofibular), ankle, and foot. The surgeries performed were bony fixation, vascular reconstruction, and performing flap. We also reported the associated injuries of these patients and calculated the Injury Severity Score (ISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS) for each case. We presented the initial laboratory findings upon arrival at the ER and clinical processes such as intensive care unit (ICU) stays, hospital stays, rehabilitation results, and reasons for referral to the psychiatry department for consultation.

Processes for responding to military trauma patients

Transportation system for trauma patients in the Korean military

Almost all military servicepersons who require transportation to a hospital are immediately reported to the Medical Emergency Operation Center (MEOC) under the Korean Armed Forces Medical Command (Fig. 2). The MEOC offers on-site counseling and treatment, determines the appropriate hospital (military or civilian) for patients, and prepares a transport strategy using military or civilian vehicles or helicopters. Among them, patients with traumatic injuries requiring surgical or intensive management are usually transported to the AFTC after discussion with the MEOC.

Fig. 3. shows the field triage protocol for trauma patients. Patients with minor injuries are transported to military hospitals under corps. Ultra-emergency patients who have an unstable airway, severe shock, and traumatic arrest (Fig. 4) are transported to the nearest military hospital for initial resuscitation. The helicopters depart at the same time, and then patients are re-transported

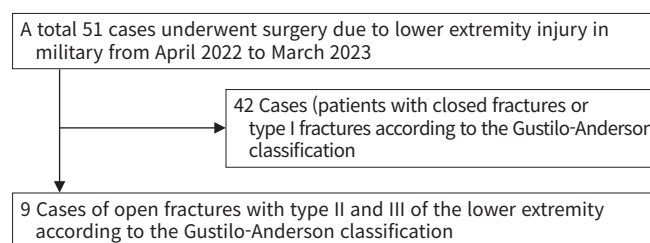


Fig. 1. Flow diagram of the patient selection and exclusion process.



Fig. 2. The Medical Emergency Operation Center under the Korean Armed Forces Medical Command.

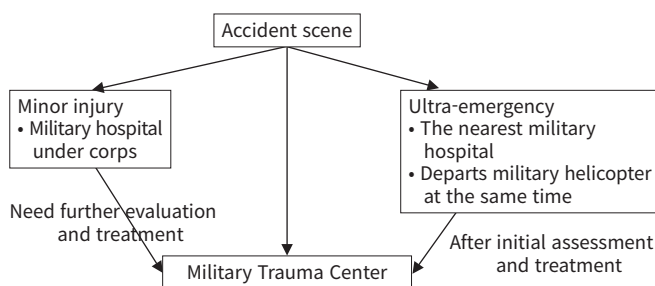


Fig. 3. Field triage protocol in the Korean military.

Transport to the nearest military hospital for resuscitation, with the helicopter department for re-transport to the Armed Forces Trauma Center (Seongnam, Korea) at the same time		
Unstable airway • GCS score: ≤ 9 • AVPU: unresponsive	Severe shock • SBP: <70 mmHg • Capillary refill time: >2 sec	Traumatic arrest

Fig. 4. Field triage protocol: ultra-emergency. The Medical Emergency Operation Center evaluates patients' severity and decides where to direct them. GCS, Glasgow Coma Scale; AVPU, alert, voice, pain, unresponsive; SBP, systolic blood pressure.

to the AFTC after resuscitation. Exceptionally, by the MEOC decision, patients are sometimes transported to the nearest civilian trauma center. Patients with major injuries (Fig. 5) are also transported to the AFTC.

AFTC workforce and building structure

A total of 11 trauma surgeons work in the AFTC. Four are military officers, six are civilians who were dispatched from a cooperative hospital, and one is a civilian surgeon employed by the military. This center is part of the biggest military hospital in Korea, with 666 beds and 130 doctors (excluding residents). Physicians affiliated with this military hospital support the AFTC, including

Transport to Armed Forces Trauma Center (Seongnam, Korea)	
Major	Minor
Penetrating injury: head, neck, torso, proximal part of elbow, or knee	High-risk traffic accident: rollover of vehicle, bounce out of the car, expiration of fellow passenger
Suspected fracture or depressed fracture of skull	Pedestrian: traffic accident by car or motorcycle
Suspected spinal injury with motor or sensory disturbance	Fall from more than 3 m
Two or more fractures of humerus or femur	Trauma-related burn
Crashed, degloved, mangled, pulseless extremity	Definitive loss of consciousness
Amputation of proximal part of wrist or ankle	Decision of on-site physician in charge or MEOC
SBP: <90 mmHg	
Heart rate $>$ SBP	
GCS score: <6	
Respiratory rate: <10 or 29 breaths/min	

Fig. 5. Field triage protocol: major injury. The Medical Emergency Operation Center (MEOC) evaluates patients' severity and decides where to direct them. SBP, systolic blood pressure; GCS, Glasgow Coma Scale.

surgeons (thoracic, orthopedic, plastic, vascular, hepatobiliary, and neurosurgeons), interventionists, anesthesiologists, cardiologists, pulmonologists, neurologists, physiatrists, psychiatrists, and so on.

The AFTC is a three-story building with a helipad on the roof, which is designated as the shortest distance by foot (Fig. 6A). The ground floor includes a trauma ER with two resuscitation rooms (Fig. 6B), a computed tomography (CT) room, a magnetic resonance room, and an intervention room. The first floor includes offices and educational rooms. The second floor includes a trauma OR (Fig. 6C), a general ward for trauma patients with 60 beds, and a trauma ICU (TICU) with 20 beds (Fig. 6D).

AFTC treatment protocols

One or more trauma surgeons are on duty all the times in the AFTC. Trauma surgeons respond to patients' arrival at the trauma ER, apply critical care in the TICU, participate in surgery, and operate the trauma general ward. When the MEOC contacts the AFTC trauma team leader (a trauma surgeon) for patient transportation, the team leader decides whether to accept the patient, and then whether to activate the trauma team following standard criteria (Fig. 7). The trauma team consists of trauma surgeons (including the trauma team leader), trauma ER nurses, emergency medical technicians, radiology technicians, and security guards. The trauma team leader can also call for additional staff affiliated with the supporting military hospital, such as surgeons from other departments, anesthesiologists, and interventionists.



Fig. 6. The Armed Forces Trauma Center (Seongnam, Korea). (A) Three-story building with a helipad on the roof, which is designated as the shortest line of foot. (B) The ground floor includes two resuscitation rooms in trauma emergency room. (C, D) The second floor includes a trauma operation room and a trauma intensive care unit.

Trauma team activation criteria
Systolic blood pressure: <90 mmHg
Arrest state (or ROSC state), tracheal intubation required or intubated state
Initial GCS score: ≤12
Unstable pelvic fracture, two or more fractures in long bones, or amputation/near-amputation above elbow/knee
Penetrating injury of cervix, thorax, abdomen, and above elbow/knee
Fall from more than 3 m
Traffic accident
Driver or passenger: bounced out of the car
Pedestrian: torso crushed under vehicle
Three or more patients arrived at trauma emergency room simultaneously
Trauma team leader's decision

Fig. 7. Trauma team activation criteria. ROSC, return of spontaneous circulation; GCS, Glasgow Coma Scale.

When trauma patients arrive at the AFTC, trauma surgeons assess and resuscitate them if needed, together with trained nurses assigned to the trauma ER. They then discuss the treatment plan with supporting staff members. In the trauma ER, protocols are in place for CT scans, transfusion, laboratory studies, and performing necessary procedures.

RESULTS

Table 1 shows the transportation processes of patients from the accident site to the AFTC ER, along with their demographics. This study included nine male patients aged between 21 and 26 years old. Five patients were transported directly to the AFTC (cases 1, 2, 4, 5, 7), and four patients (cases 3, 6, 8, 9) were transferred to the center through another hospital. Military trauma patients can be transported in four ways: military helicopter, military ambulance, public helicopter, public ambulance. In this study, four patients were transported by military helicopter, four patients by military ambulance, and one patient by public helicopter. The time it took to transport patients from the accident scene to the AFTC ER ranged from 75 minutes (case 4) to 455

minutes (case 9), and from the ER to the OR ranged from 35 minutes (case 4) to 200 minutes (case 6). Cases that went through another hospital (cases 4, 6, 8, 9) took more time to transport. Among them, military-specific injuries included gunshot wounds (cases 1, 3), landmine explosions (cases 2, 5) (**Fig. 8A–C**), a grenade explosion (case 4), and entrapment by a war-ship's mooring ropes (case 7) (**Fig. 8D–F**). The foot was the most common site of injury, and only one patient (case 4) had serious associated injuries (namely, an inhalation burn, open facial bone fractures, and hemopneumothorax with multiple rib fractures). Systolic blood pressure, ISS, Revised Trauma Score, and TRISS were not unusually low except in one case (case 4).

Table 2 displays the initial laboratory findings upon arrival at the ER. No cases with serious blood loss (hemoglobin, <7.0 g/dL) or coagulopathies were found. Most cases showed a significant elevation of creatinine kinase (316–2,876 IU/L), except for cases 3 and 5, which were within normal range.

Table 3 shows the operative methods used. The patients in cases 4 and 7 underwent vascular reconstruction, and the patients in cases 2, 4, 5, and 7 received external fixation during their initial surgery. The patients in cases 4, 5, 7, and 8 underwent flap surgery.

Table 4 shows hospitalization-related variables. Case 4, a patient with multiple injuries, remained in the ICU for 169 days due to requiring long-term ventilator care and management of serious infections. Patients who required rehabilitation for an extended period were hospitalized for more than 16 weeks (cases 1, 2, 4, 5, 7, 8, 9). The results of rehabilitation were as follows: the patients in cases 1, 2, 3, 6, 8, and 9 were able to walk; the patient in case 5 was able to perform active joint movements; and the patients in cases 4 and 7 were able to perform active assistive joint movements. Eight patients in this study required referral to the psychiatry department. Four of these patients had suicidal ideation; those patients had injuries caused by suicide attempts (cases 3, 4, 8, and 9). Their suicidal ideation were addressed following the accidents. All eight patients had posttraumatic stress disorder (PTSD).

Table 1. Patients' transportation processes and characteristics

Case no.	Age (yr)	Sex	Transferred from another hospital	Mode of transport	Elapsed time (min)		Injury mechanism	Injured site	Severity ^{a)}	Associated injury	SBP (mmHg)	ISS	RTS	TRISS (%)
					From accident site to AFTC	From ER to OR								
1	22	Male	No	Military ambulance	305	85	Gunshot	Foot	II	None	124	4	7.550	98.40
2	22	Male	No	Military helicopter	115	80	Landmine explosion	Ankle, foot	II	Multiple lacerations	144	5	7.841	99.58
3	26	Male	Military hospital	Military helicopter	120	75	Gunshot	Foot	II	None	162	4	7.841	99.28
4	24	Male	No	Military helicopter	75	35	Grenade explosion	Foot, bilateral	IIIc	Inhalation burn, open facial bone fractures, hemopneumothorax with multiple rib fractures	96	50	7.841	84.74
5	23	Male	No	Military helicopter	85	40	Landmine explosion	Ankle, foot	IIIb	None	114	4	7.841	99.61
6	21	Male	Civilian hospital	Military ambulance	405	200	Crushed by under vehicle wheel	Foot	II	None	143	4	7.841	99.61
7	25	Male	No	Public helicopter	135	70	Trapped by mooring ropes	Calf (tibio-fibular)	IIIc	Rib fracture, multiple lacerations	83	11	7.108	98.76
8	23	Male	Civilian hospital	Military ambulance	390	70	Fall	Thigh (femur), ankle, foot	II	Multiple lacerations	115	10	7.841	99.12
9	21	Male	Civilian hospital	Military ambulance	455	90	Fall	Foot	II	Lumbar spine compression fracture	120	13	7.841	99.19

AFTC, Armed Forces Trauma Center; ER, emergency room; OR, operation room; SBP, systolic blood pressure; ISS, Injury Severity Score; RTS, Revised Trauma Score; TRISS, Trauma and Injury Severity Score.

^{a)}Gustilo-Anderson classification.

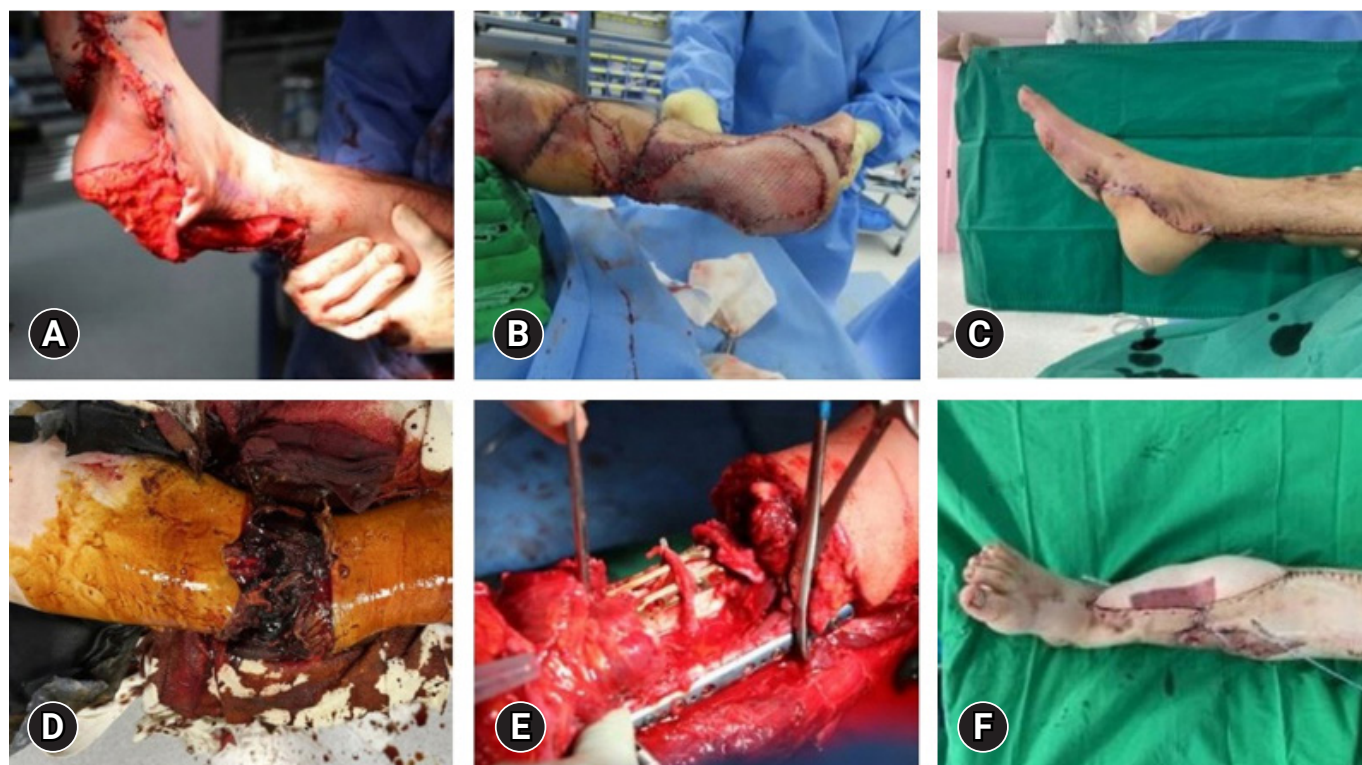


Fig. 8. Images of cases 5 and 7. (A–C) Case 5. (A) Injury causing by entrapment by mooring ropes of warship. (B) Fixation during the first surgery. (C) After performing flap surgery. (D–F) Case 7. (D) Leg injury causing by entrapment by mooring ropes of warship. (E) Fixation. (F) After performing flap surgery.

Table 2. Initial laboratory findings in the emergency room

Case no.	WBC ($10^3/\mu\text{L}$)	Hemoglobin (g/dL)	Platelet ($10^3/\mu\text{L}$)	Prothrombin time (INR)	Lactate (mmol/L)	Creatinine kinase (IU/L)
1	17.59	13.2	261	1.01	1.5	348
2	10.17	12.5	228	1.15	1.8	316
3	6.73	13.5	361	1.00	1.4	99
4	42.99	11.3	295	1.17	9.0	2,836
5	13.29	12.3	167	1.08	4.8	93
6	11.19	15.3	268	1.03	1.1	690
7	9.55	9.6	60	1.32	3.9	572
8	23.33	13.3	247	1.11	3.2	1,039
9	18.11	11.9	215	1.15	1.7	759

WBC, white blood cell; INR, international normalized ratio.

DISCUSSION

Transportation processes

When a patient with traumatic injuries (or other serious illness) occurs, the military tries to choose the fastest transportation method. Helicopters are very useful for the military because military camps are scattered throughout the country. However, helicopter operations are limited by inclement weather, including

rainy, snowy, severely windy, and foggy conditions. Additionally, military helicopters are not able to operate near the ceasefire line, since it could cause military tension. When it is difficult for the MEOC to operate a helicopter and when they suspect that a patient's injury is serious, they arrange transportation to a nearby military or civilian hospital. After evaluation and (if needed) resuscitation, MEOC discusses the situation with AFTC medical staff and decides whether to transfer the patient to the AFTC.

Table 3. Operative methods

Case	Open fractured site	Cause of injury	Vascular reconstruction	External fixation during initial surgery	Internal fixation	Flap
1	Right foot	Gunshot wound	No	No	Yes	No
2	Left ankle and foot	Landmine explosion	No	Yes	Yes	No
3	Left foot	Gunshot wound	No	No	Yes	No
4	Both feet	Grenade explosion	Yes (PTA, right)	Yes	Yes	Yes
5	Right ankle and foot	Landmine explosion	No	Yes	Yes	Yes
6	Left foot	Crushed under vehicle wheel	No	No	Yes	No
7	Right calf (tibiofibular)	Trapped by warship's mooring ropes	Yes (ATA)	Yes	Yes	Yes
8	Left thigh (femur), ankle, and foot	Fall	No	No	Yes	Yes (foot)
9	Right foot	Fall	No	No	Yes	No

PTA, posterior tibial artery; ATA, anterior tibial artery.

Table 4. Hospitalization-related variables

Case no.	Length of stay (day)		Results of rehabilitation	Reason for psychiatric consultation
	Intensive care unit	Hospital ^{a)}		
1	13	216	Able to walk	PTSD
2	4	243	Able to walk	PTSD
3	4	46	Able to walk	Suicide attempt, PTSD
4	169	335	Active assistive joint movement	Suicide attempt, PTSD
5	29	>271 ^{b)}	Active joint movement	PTSD
6	0	70	Able to walk	None
7	13	>181 ^{b)}	Active assistive joint movement	PTSD
8	13	>132 ^{b)}	Able to walk	Suicide attempts, PTSD
9	11	130	Able to walk	Suicide attempts, PTSD

PTSD, posttraumatic stress disorder.

^{a)}Hospital stays were recorded until August 20, 2023. ^{b)}Still hospitalized.

Characteristics of military trauma

Several cases in this study included military-specific injuries unusual in civilian society, such as gunshot wounds, landmine explosions, grenade explosions, and entrapment by a warship's mooring ropes. Additionally, there were cases of military-specific injuries caused by pinching a foot between a cannon and a cannonball, crashing a parachute, and falling from a military helicopter. These cases occurred during the study period but were excluded since they involved closed fractures of the lower extremity. Crashing injuries caused by heavy military equipment, such as moving tanks, cannons, helicopters, and warships, should be taken seriously. In addition, the medical staff of a military trauma center should understand the characteristics of various weapons. For example, even blank cartridge shot can cause severe injury due to the gunpowder blast and projectile gas [5,6]. Grenade explosions can cause whole-body injury by countless fragments with burns, including to the airway [7].

No case of serious blood loss (hemoglobin, <7.0 g/dL) and coagulopathy was observed in this study because military medical officers were able to control bleeding well at the accident scenes. Additionally, the AFTC ICU, which is separated into single-occupancy rooms, could help patients maintain a comfortable state and enable monitoring of possible self-injury and abnormal behaviors. Patients with suicidal attempts or a concerning level of PTSD who require repeated surgery are admitted to the ICU until ready for a closed psychiatric ward or until their psychiatric problems become less concerning.

Treatment strategies for open fractures in lower extremities

Trauma patients should be considered in two aspects: (1) the severity of the injured site; and (2) possible life-threatening associated injuries. Aspects of the military context contribute to fractures in many patients. This is natural because soldiers undergo high-intensity training, exercise regularly, and often participate in

hazardous tasks such as landmine removal. Most patients experience minor injuries, but some cases are very serious, such as limb injuries with degloving, severe associated injuries, or both [8,9]. Many cases involve injuries from which patients find it difficult to achieve a full recovery. The treatment of these patients requires a strategy consisting of several steps.

The first step is to decide whether to salvage or sacrifice the injured leg. Trying to salvage the injured limb may require repeated operations, cause serious complications (such as infection, thrombosis, and chronic pain), impose a huge financial burden, and delay rehabilitation. For many patients with severe leg injuries, amputation might be a better option [10,11]. Patients admitted to the AFTC have their medical expenses covered by the military, and most soldiers, such as military officers and sergeants who suffered disabilities from accidents on duty, can keep their jobs postinjury and are paid during the treatment period. Therefore, we tried our best to salvage the leg in each case, since we could focus on saving the leg without worrying about time or cost [12]. In this study, no cases involved amputation of a lower limb.

The second step is to manage concurrent injuries that could have adverse effects. Life-threatening injuries such as those affecting the brain, heart, lungs, liver, and large vessels are treated with priority.

The third step is to perform surgery. OR decisions were made according to the injury mechanism, injured site, general condition, and the surgeon's experience, including their skill level [13,14]. During operations, surgeons must solve problems such as vascular reconstruction, muscle repairing, and overlapping skin defects. The most crucial point for surgeons is planning. Surgeons should plan what may be feasible, up to a certain limit of reconstruction, if the injury is too serious to permit a full recovery. In particular, landmine explosions can cause serious internal injuries that make it difficult to reconstruct vascular structures and create flaps for covering defective tissue. We tried to salvage limbs as much as possible, since most patients in this study were young, otherwise healthy soldiers.

The fourth step is to perform rehabilitation, which may take a long time [15,16]. The timing for initiating rehabilitation depends on many factors such as how the fracture heals, the fixation method, and how related ligaments heal. The rehabilitation process typically begins with restrictive weight bearing, followed by a range of motion evaluation, continuous passive motion, and finally muscle strengthening exercises [17]. Appropriate pain control is needed across the rehabilitation period. Moreover, addressing psychological problems is the most difficult part of re-

covery [18–20]. Many patients have PTSD, and a psychiatrist's active involvement is required if the cause of injury is self-harm or a suicidal attempt. In conclusion, management of lower extremity injuries requires complex processes. This study has shown our experiences and management policy for lower extremity injuries in a new military trauma center, which could be useful for other trauma centers that manage lower extremity injuries.

Strengths and limitations

The strengths of this study include its analysis of data based on a specialized transporting system and treatment strategies for military trauma patients. We were able to observe the entire period of treatment from initial ER management to rehabilitation. However, this study has several limitations. First, the volume of the data was small because the AFTC was established only 1 year ago. Second, it is difficult to evaluate the relevance of intensive care, since there was only one case (case 4) with life-threatening associated injuries.

Conclusions

This study showed the experiences of treatment in patients with lower extremity injuries in the military. We hope that the study may help improve treatment in patients with military trauma, as well as improve military medical services such as the transport system, in order to revise treatment protocols and systematize treatment during hospitalization.

ARTICLE INFORMATION

Author contributions

Conceptualization: KL; Data curation: all authors; Formal analysis: JWK, KL; Investigation: all authors; Methodology: KL; Project administration: KL; Visualization: JWK, KL; Writing—original draft: JWK, KL; Writing—review & editing: all authors. All authors read and approved the final manuscript.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Data availability

Data analyzed in this study are available from the corresponding author upon reasonable request.

REFERENCES

1. Korean Ministry of National Defense. 2022 Defense white paper. Korean Ministry of National Defense; 2023.
2. Higgins TF, Klatt JB, Beals TC. Lower Extremity Assessment Project (LEAP): the best available evidence on limb-threatening lower extremity trauma. *Orthop Clin North Am* 2010;41: 233–9.
3. Balandiz H, Bolu A. Forensic mental health evaluations of military personnel with traumatic life event, in a university hospital in Ankara, Turkey. *J Forensic Leg Med* 2017;51:51–6.
4. Hu R, Ren YJ, Yan L, et al. Analysis of staged treatment for Gustilo Anderson IIIB/C open tibial fractures. *Indian J Orthop* 2018;52:411–7.
5. Lee H, Hwang K, Lee Y, Jeong SY. Survival of a blank cartridge gunshot injury to the soft palate in a soldier. *J Craniofac Surg* 2022;33:e573–6.
6. Kim HJ, Lee D, Lee K. Submandibular injury caused by the close-range firing of a military blank cartridge shot. *J Acute Care Surg* 2023;13:35–38.
7. Robson DC. Death from an anti-personnel grenade explosion. *J R Army Med Corps* 1983;129:115–6.
8. Dehouche N. The injury severity score: an operations perspective. *BMC Med Res Methodol* 2022;22:48.
9. Bothig R. TRISS: a method of assessment of the prognosis in multiple trauma patients. *Zentralbl Chir* 1991;116:831–44.
10. Okereke I, Abdelfatah E. Limb salvage versus amputation for the mangled extremity: factors affecting decision-making and outcomes. *Cureus* 2022;14:e28153.
11. McGowan SP, Fallahi AK. Degloving injuries. StatPearls Publishing; 2023.
12. Korean Ministry of National Defense; Korea Law Translation Center. Military Accident Compensation Act [Internet]. Korea Legislation Research Institute; 2023 [cited 2023 Jun 1]. Available from: https://elaw.klri.re.kr/eng_service/lawView.do?hseq=60445&lang=ENG
13. Xu Q, Zhu L, Wang G, et al. Application of cryopreserved autologous skin replantation in the treatment of degloving injury of limbs. *J Plast Reconstr Aesthet Surg* 2022;75:2387–440.
14. Yan H, Gao W, Li Z, et al. The management of degloving injury of lower extremities: technical refinement and classification. *J Trauma Acute Care Surg* 2013;74:604–10.
15. Kaya D, Guney-Deniz H, Sayaca C, Calik M, Doral MN. Effects on lower extremity neuromuscular control exercises on knee proprioception, muscle strength, and functional level in patients with ACL reconstruction. *Biomed Res Int* 2019;2019: 1694695.
16. McKeon PO, Fourchet F. Freeing the foot: integrating the foot core system into rehabilitation for lower extremity injuries. *Clin Sports Med* 2015;34:347–61.
17. Hoyt BW, Pavey GJ, Pasquina PF, Potter BK. Rehabilitation of lower extremity trauma: a review of principles and military perspective on future directions. *Curr Trauma Rep* 2015;1: 50–60.
18. Al Salman A, Khatiri MZ, Cremers T, Ring D, Thomas JE, Fatehi A. Difficult life events affect lower extremity illness. *Arch Orthop Trauma Surg* 2022;142:599–605.
19. Archer KR, Davidson CA, Alkhoury D, et al. Cognitive-behavioral-based physical therapy for improving recovery after traumatic orthopaedic lower extremity injury (CBPT-Trauma). *J Orthop Trauma* 2022;36:S1–7.
20. McCarthy ML, MacKenzie EJ, Edwin D, et al. Psychological distress associated with severe lower-limb injury. *J Bone Joint Surg Am* 2003;85:1689–97.