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Clinical case report: management of a patient with extensive bone and soft tissue damage after a mine-blast injury

A. O. Zhernov, D. M. Sydorenko, H. H. Pipiia, I. O. Vorobei, A. O. Shelest

Municipal Non-Commercial Enterprise «Kyiv City Clinical Hospital of Emergency Medical Care»

✉ Artem Shelest: artemshel.98@gmail.com

A. O. Zhernov, http://orcid.org/0000-0001-5096-5220
D. M. Sydorenko, http://orcid.org/0009-0000-2995-1801
H. H. Pipiia, http://orcid.org/0009-0008-0232-4443
I. O. Vorobei, http://orcid.org/0009-0001-9954-6438
A. O. Shelest, http://orcid.org/0009-0005-3509-1437

Combat-related upper extremity trauma is one of the most frequent and severe categories of injuries in contemporary armed conflicts. Such injuries often cause extensive bone and soft tissue damage, impaired blood supply, infectious complications, and reduced limb mobility. In many cases, these problems require amputation, significantly diminishing patients' quality of life.

This report presents the clinical management of a 35-year-old patient who sustained a mine-blast injury. The injury resulted in combined chest and right upper limb trauma, including a humeral defect and extensive soft tissue damage. Treatment progressed in stages, following principles of damage-control surgery. Interventions included pleural cavity drainage, repeated surgical wound management, vacuum-assisted closure (VAC), and stabilization of bone structures. After the patient was stabilized, we performed a reconstructive procedure using a latissimus dorsi musculocutaneous flap on a vascular pedicle to close the soft tissue defect. Subsequently, the bone defect was reconstructed using a non-vascularized fibular autograft. This approach was chosen because of extensive cicatricial changes at the injury site. The comprehensive treatment facilitated limb salvage and enabled partial restoration of mobility by preserving the elbow joint and distal segment mobility.

This clinical case shows that, even in severe mine-blast upper extremity injuries with extensive tissue damage, reconstructive interventions can be an effective alternative to amputation. Success depends on individualized treatment planning, thorough infection control, and preservation of function in the distal segments of the limb.

Keywords
combat-related trauma, upper limb, mine-blast injury, humeral defect, reconstructive surgery, musculocutaneous flap, latissimus dorsi flap, bone grafting, limb salvage, amputation.

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Limb injuries constitute a major category of combat-related trauma in contemporary armed conflicts. Data from the wars in Iraq and Afghanistan indicate that more than 70 % of all combat injuries involve the limbs [1].

Gunshot and mine-blast injuries are often associated with open wounds and heavy wound contamination, which increase the risk of infectious complications [3, 12]. Additionally, limb fractures commonly occur with these injuries and further complicate treatment [1, 3].

Upper extremity injuries account for a substantial share of all extremity trauma and are often linked to soft tissue defects, bone injuries, and joint damage [1, 9]. Moreover, combined injuries to the shoulder joint and extensive tissue damage often cause severe functional impairment, requiring complex reconstructive procedures [3, 4, 9].

Vascular and nerve damage is critical in combat-related upper extremity trauma. Specifically, vascular injuries occur in 10–25 % of cases [4, 18], while peripheral nerve injuries are reported in 10–30 % of cases [13]. Together, these types of injuries strongly affect treatment and the potential for limb mobility restoration.

Amputations remain a major concern in combat-related trauma. Recent studies show an amputation

rate of about 6–7 % among wounded individuals [16]. Notably, severe mine-blast injuries are a primary cause of limb loss.

In the ongoing war in Ukraine, a similar trend is seen. Mine-blast injuries are rising and causing extensive tissue defects that require complex, staged treatments [3]. Reconstructive surgery has therefore become more important. It enables limb salvage and helps restore mobility [14, 17, 19].

The following clinical case exemplifies both the high prevalence of these injuries and the complexity associated with their management.

Clinical case

Patient: A 35-year-old male.

Diagnosis: Blast trauma (11.07.2025). The patient sustained a penetrating through-and-through gunshot wound to the right chest with lung injury (S2, S6). A gunshot fracture of the right 4th rib. Right-sided hemopneumothorax. Pneumomediastinum. Lung contusion. A multi-fragment fracture of the right scapula with bone defect (articular surface and body) and fragment displacement. A defect of the lateral 1/3 of the right clavicle. A through-and-through gunshot shrapnel wound of the right upper limb with fracture of the humerus, and bone (involving the head and diaphysis extending to the border of the middle and lower thirds) and soft tissue defects (Fig. 1).

Anamnesis: The injury was sustained on 11.07.2025 as a result of an explosive event. During medical evacuation, interventions included drainage of the right pleural cavity using the Bülau technique, primary surgical management and sealing of chest wounds, primary surgical management of the right upper limb wound, and application of external fixation to the right upper limb.

Upon hospitalization, the patient's condition was critical. Reduced consciousness (Glasgow Coma Scale 14–15), further pharmacological sedation. Diminished right-sided breath sounds, pleural drainage, SpO_2 93–99 % while using supplemental oxygen. Pleural drainage – up to 200 ml of hemorrhagic pleural fluid. Unstable hemodynamics (blood pressure 90/70 mm Hg, heart rate 74–92/min). Laboratory findings: anemia, elevated creatinine, and increased lactate levels.

To further characterize the injuries, a computed tomography scan was performed (12.07.2025): a right-sided pneumothorax, a right lung contusion, pneumomediastinum, multifragmentary fractures of the right scapula and humerus with a diaphyseal defect, multiple metallic foreign bodies, and subcutaneous emphysema.

Radiological assessment revealed a substantial defect involving the humerus, scapula, and the acromial end of the clavicle (Fig. 2).

The patient was in the intensive care unit from 12.07.2025 to 04.08.2025.

Given the severity of the injuries and elevated risk of infectious complications, a staged treatment approach was implemented: serial surgical wound management (12.07, 13.07, 14.07, 15.07, 21.07), application of an external fixation device to the right

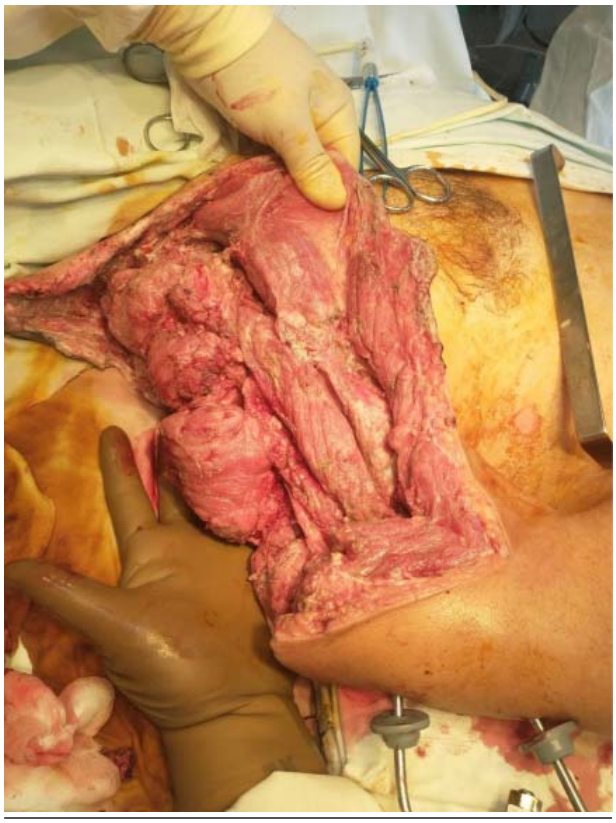

Figure 1. **Clinical presentation of the defect on admission**

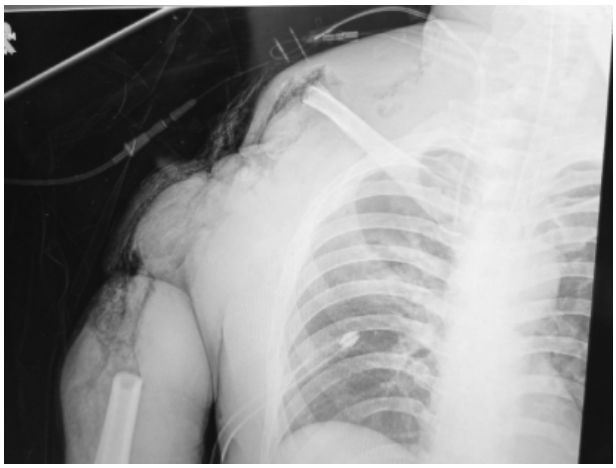

Figure 2. **Clinical presentation of the bone and soft tissue defect on admission**

upper limb using the shoulder–forearm–pelvis configuration (14.07), VAC-therapy and wound revision with ligation of a branch of the right brachial artery (24.07).

Once the patient's general condition stabilized, a reconstructive intervention was planned (Fig. 3).

On 28.07.2025, the reconstructive stage of treatment was conducted, representing a pivotal intervention in this case. Due to the extensive soft tissue and humeral bone defects, a cement spacer was implanted. Subsequently, bridge-like fixation of the distal third of the right humerus was achieved using a titanium plate (Fig. 4).

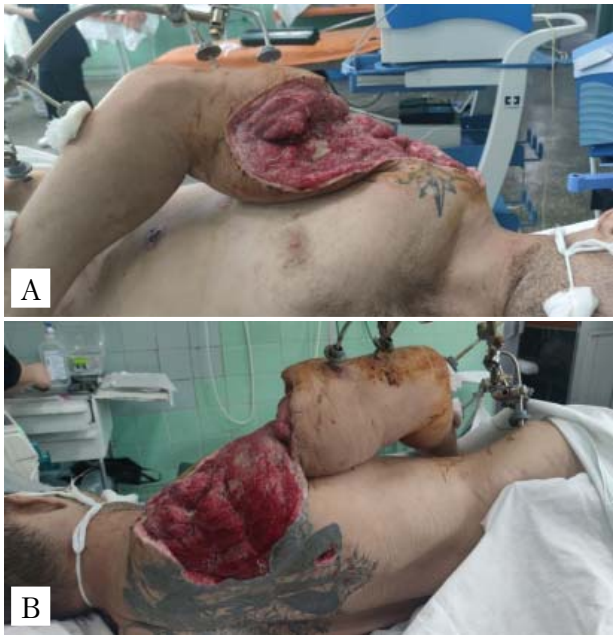

Figure 3. **Frontal (A) and posterior (B) view of the defect before the final reconstructive procedure**

Closure of the soft tissue defect was achieved using a musculocutaneous flap incorporating the latissimus dorsi muscle (m. latissimus dorsi) on its vascular pedicle (a. et v. thoracodorsalis), a technique commonly employed for large shoulder defects. This approach ensured reliable vascularization of the flap and complete wound closure, thereby further facilitating subsequent healing.

This stage was critical, as it not only addressed the tissue defect but also salvaged the limb and established the foundation for functional restoration (Fig. 5).

On 27.08.2025, autodermoplasty of the residual wound surfaces of the right shoulder area was performed.

During treatment, the wound's microbial spectrum shifted from primary contaminants (*Enterobacter* spp., *Escherichia coli*, *Enterococcus faecalis*) to nosocomial organisms (*Acinetobacter baumannii*, *Pseudomonas aeruginosa*). In response to these microbiological findings, antibacterial therapy was modified to include imipenem/cilastatin (04.08–14.08.2025), metronidazole (12.08–16.08.2025), followed by escalation to colistin (16.08–01.09.2025).

Pharmacological management included infusion-transfusion support (erythrocytes, fresh frozen

Figure 4. **Bridge-like fixation of the humerus with a titanium plate with the placement of a cement spacer**

Figure 5. **Our patient at 3 months after spacer installation and reconstruction with a musculocutaneous flap**

Figure 6. **Free fibular autograft**

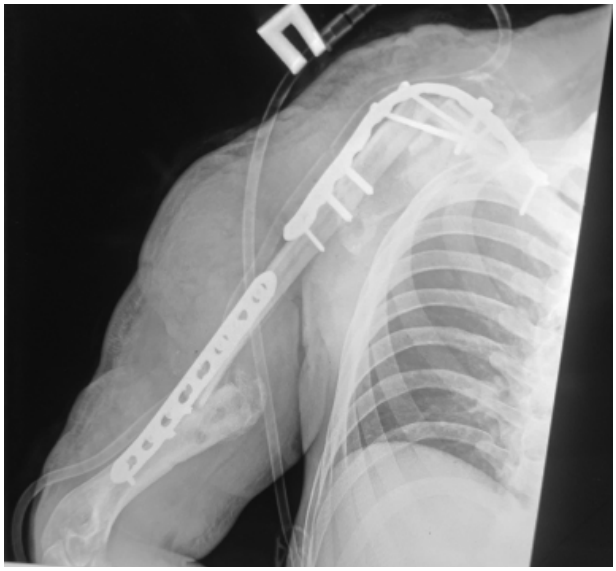

Figure 7. **Clinical presentation after reconstruction with a fibular autograft and metal osteosynthesis**

Figure 8. **Our patient on the 3rd day after bone grafting**

plasma), analgesia (morphine), anticoagulant therapy (enoxaparin), and symptomatic treatment.

Due to the severity of the injuries, infectious complications, and compromised blood supply, amputation of the right upper limb was initially considered, consistent with standard management of severe extremity trauma [11, 16]. However, the chosen staged surgical approach utilizing reconstructive techniques enabled limb salvage and established conditions for subsequent functional recovery.

The patient was transferred to the next stage of treatment and rehabilitation on 15.09.2025 in a stable condition.

The patient was referred for reconstructive surgery to address the humeral defect. Initially, a custom titanium implant was planned, but three manufacturers declined to produce it due to the complexity of the case. As a result, bone grafting with an autograft was selected. On 08.04.2026, surgery involved the removal of the cement spacer and reconstruction of the humeral defect with a free fibular autograft (Fig. 6).

Reconstructive surgery was performed using a non-vascularized fibular autograft because of extensive cicatricial changes at the injury site and the absence of vessels suitable for microvascular anastomosis.

During metal osteosynthesis, the proximal fibula was fixed with a titanium plate at a 95° angle, and the distal fibula was fused to the residual humerus in a functionally optimal position, considering the existing elbow joint contracture (Fig. 7).

Initially, closure of the wound in the clavicular region above the titanium plate was not feasible; therefore, a reconstructive procedure was performed using a latissimus dorsi musculocutaneous flap (Fig. 8).

Discussion

Recent studies indicate that combat-related upper extremity injuries are among the most challenging to manage, especially when both bone and soft tissue defects are present [1, 8]. These injuries are frequently associated with a high risk of infectious complications and often require limb amputation [11, 12].

Contemporary treatment strategies employ staged surgical management guided by damage-control principles. This approach stabilizes the patient's condition and facilitates subsequent interventions [12, 14]. The reconstructive stage is critical for restoring anatomical integrity and limb mobility [14, 17, 19].

In cases of severe limb injury, the decision between amputation and limb salvage remains a subject of active debate in surgical practice. Amputation may expedite stabilization and reduce the duration of treatment and associated complications.

Conversely, reconstructive approaches may salvage the limb and yield superior functional outcomes in comparable cases [7, 15, 17].

The presented case involved multiple complicating factors, including a substantial bone defect, extensive soft tissue damage, infectious complications, and a risk of impaired blood supply. In similar scenarios, amputation is frequently discussed in the literature as a viable treatment option [11, 16]. Nevertheless, in this case, the potential to preserve function in the distal segments of the limb was the decisive factor in selecting the treatment strategy. As a result, a reconstructive surgery was preferred.

Application of a latissimus dorsi musculocutaneous flap, combined with stabilization of the bone defect, provided effective wound closure and established conditions for further functional restoration. This approach aligns with current principles of reconstructive surgery [14, 17].

A subsequent reconstructive stage to replace the bone defect was necessary. A custom implant was considered but not used due to manufacturing constraints, so fibular autoplasty was chosen. Cicatricial changes prevented the use of a vascularized graft and complicated the reconstruction, highlighting the complexity of such cases.

Conclusions

This clinical case illustrates that, even in severe mine-blast upper extremity injuries with extensive bone and soft tissue damage, a staged reconstructive approach can be an effective alternative to amputation. This approach facilitates limb salvage with partial functional restoration. The use of modern reconstructive techniques–especially vascularized musculocutaneous flaps and bone grafting–enables adequate defect closure and tissue stabilization. These methods also help establish conditions for further functional recovery. Key factors for successful outcomes include individualized treatment planning, staged surgical interventions, prompt infection management, and preservation of function in the distal segments of the limb.

Declaration of interests

The authors have no conflicts of interest to declare.

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Authors contributions

A. O. Zhernov: work concept, design, surgical treatment of the patient, critical review of the manuscript; D. M. Sydorenko: critical review of the manuscript; H. H. Pipiia: surgical treatment of the patient, critical review of the manuscript; I. O. Vorobei: data collection and surgical management of the patient; A. O. Shelest: data collection and analysis, surgical treatment of the patient, writing the manuscript.

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Клінічний випадок лікування пацієнта з масивним дефектом м'яких і кісткових тканин після мінно-вибухової травми

А. О. Жернов, Д. М. Сидоренко, Г. Г. Піпія, І. О. Воробей, А. О. Шелест

КНП «Київська міська клінічна лікарня швидкої медичної допомоги»

У сучасних умовах збройних конфліктів бойова травма верхніх кінцівок залишається однією з найчастіших і водночас найскладніших категорій ушкоджень. Такі поранення нерідко супроводжуються значними дефектами кісткової та м'яких тканин, порушенням кровопостачання, інфекційними ускладненнями й суттєвим зниженням функції кінцівки. У багатьох випадках це призводить до необхідності виконання ампутації, що має значний вплив на якість життя пацієнтів.

Представлено клінічний випадок лікування пацієнта віком 35 років із мінно-вибуховою травмою — поєднане ушкодження органів грудної клітки та правої верхньої кінцівки з формуванням дефекту плечової кістки й масивного дефекту м'яких тканин. Лікування проводили поетапно із застосуванням принципів хірургії контролю пошкоджень. Воно передбачало дренування плевральної порожнини, багаторазові хірургічні обробки ран, терапію ран негативним тиском та стабілізацію кісткових структур. Після досягнення стабілізації стану пацієнта виконано реконструктивне втручання з використанням шкірно-м'язового клаптя найширшого м'яза спини на судинній ніжці, що дало змогу закрити дефект м'яких тканин. Наступним етапом проведено реконструкцію кісткового дефекту із застосуванням автотрансплантата малогомілкової кістки без судинної ніжки, що було зумовлено виразними рубцевими змінами в зоні ушкодження. Проведене комплексне лікування дало змогу зберегти кінцівку й досягти часткового відновлення її функції за рахунок збереження рухів у ліктьовому суглобі та дистальних відділах.

Представлений клінічний випадок демонструє, що навіть при тяжких мінно-вибухових ушкодженнях верхньої кінцівки зі значними дефектами тканин реконструктивні втручання можна розглядати як ефективну альтернативу ампутації за умови індивідуального підходу, ретельного контролю інфекційного процесу та збереження функції дистальних відділів кінцівки.

Ключові слова: бойова травма, верхня кінцівка, мінно-вибухова травма, дефект плечової кістки, реконструктивна хірургія, шкірно-м'язовий клапоть, клапоть найширшого м'яза спини, кісткова пластика, збереження кінцівки, ампутація.

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