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Мультиmodalний підхід при реконструкції вогнепальних дефектів м'яких тканин передпліччя та зап'ястка

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Case report of multimodal approach during reconstruction of gunshot defects the soft tissue of the forearm and wrist

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According to the literature, gunshot extremities wounds are most frequent among combat trauma and affect up to 62.2% of the patients. The total rate of gunshot upper extremities wounds is high too – near of 25.7% [1], in particular during local military conflicts. Provision of effective medical tactics allow to return the serviceman to service and expand the reserve of experienced personnel in Armed Forces.

The forearm–hand area has a high functional value. It contains a large number of mobile anatomical elements, the complex structure of connective tissue, vascular and nervous structures. In this regard, the treatment of damage to this area is a significant clinical problem that requires a long and hard work. At the same time, active surgical tactics to accelerate the restoration of anatomical – functional integrity of the upper extremity [1–9] is necessary, as the complexity and fragility of the anatomical structure cause significant limitation of hand function even due to minor, at first glance, scarring.

Currently, the aim of our work is improvement of patients management for injured with gunshot defects of soft tissues on forearm and hand at all levels of medical care in the medical service of Ukrainian Armed Forces, by consistently performing the preparatory period (cleaning the wound and support of viability surrounding tissues); staged surgical treatments using of additional technologies (NPWT, US cavitation) and the final stage (surgical reconstruction) with preoperative planning with usage of dynamic digital thermography and CDM US for identification of vascular structures and select the best option for surgical reconstruction.

A 37 years old servicemen of Ukrainian Armed Forces without previous history of chronic diseases, traumas and surgery presented to our department.

He was injured on 10th March–2020 (0 day) at 09:30 a.m. during a combat mission. His combat injury was caused by an anti–tank guided missile system and involved the right wrist and forearm. In addition to his hand injury, he suffered from a thorax and abdominal trauma.

He was delivered to a field hospital, where he received surgery (debridement of gunshot wounds; thoracentesis, drainage of the right pleural cavity; diagnostic peritoneal lavage; cystostomy; imposition of the device of external fixation "forearm and wrist" on the right upper extremity). After stabilization (2nd day) of the general condition, he has been evacuated to a regional hospital of medical support for continuing treatment. For reconstructive surgery, the patients was referred to the Military Medical Clinical Center of Southern region on the 16th day with the diagnosis of: Explosive injury (from 10–March–2020). Infected postoperative wounds of the left thigh. Extensive infected gunshot wounds of the right elbow joint, flexion, and extension surface of the radial – wrist joint of the right forearm with a defect of 5 metacarpal, triangular, hooked bones with the presence of multiple foreign bodies (metal fragments). Phlegmon of the left thigh and left leg. Mild posthemorrhagic anemia (Hb 92 g/l). View of wounds are presented on *Fig.1*.

Due to the soft–tissue infections in the area of gunshot wounds, we have performed a few preparation surgeries:

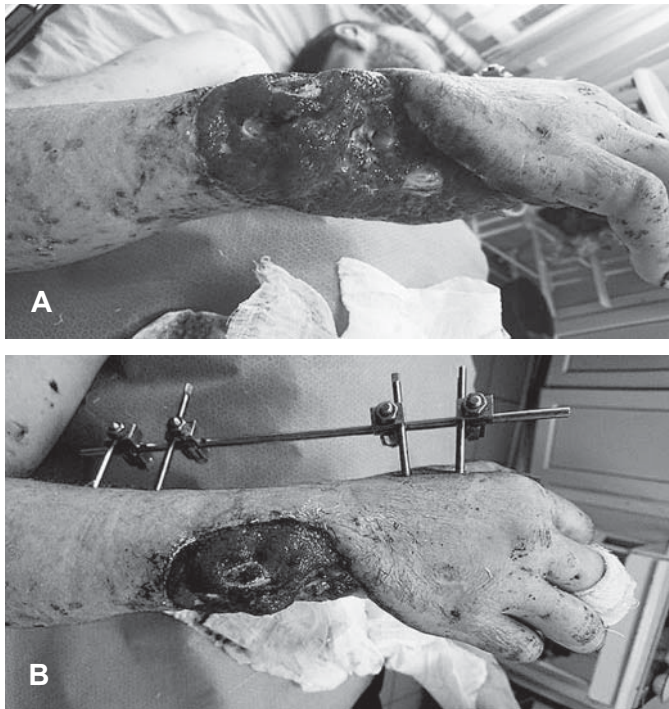


Fig. 1.
 View of the wound of the right forearm, 16th day after injury
 (A- flexor surface; B- extensor surface).



Fig. 2.
 View of the wound preparation with usage of NPWT-system
 (36th day after injury)/

07-Apr-20 (29th day after injury): debridement of wounds of the elbow joint of the right forearm and the medial surface of the radial – carpal joint. Ultrasound cavitation of wounds. Autodermoplasty. Installation of a controlled negative pressure system.

10-Apr-20 (32nd day after injury): Removed of the NPWT system. Debridement wounds of the flexor surface of the radial–carpal joint. Ultrasound cavitation of the wound. Removed of the external fixing device.

14-Apr-20 (36th day): A second look at wounds of the flexor surface of the radial–carpal joint. US cavitation.

The result of preparation steps is a clean, actively granulating wound surface, ready for plastic closure (View of wound on Fig.2). Taking into account the etiology of the wound defect of soft tissues, its location, and anatomical structure, it was

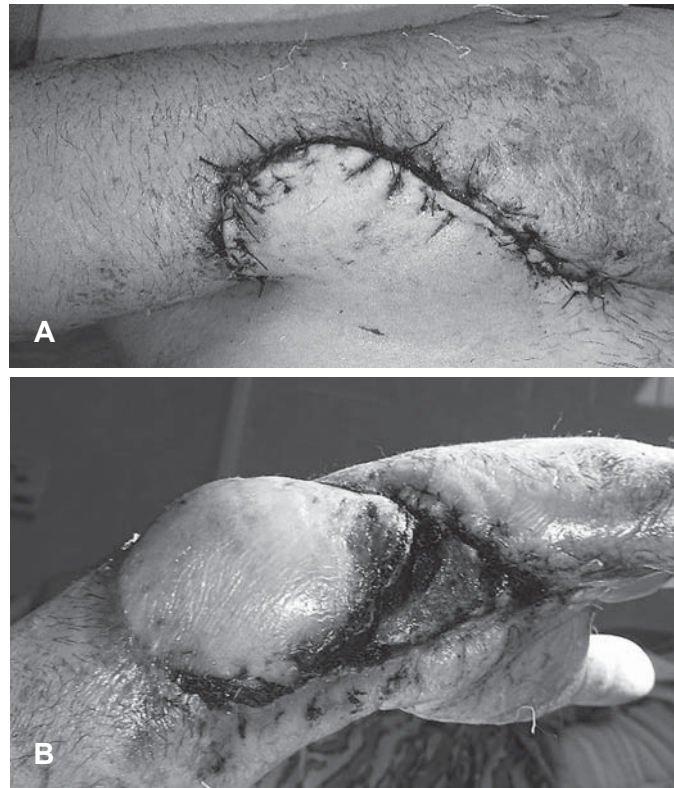


Fig. 3.
 View of wound after reconstruction
 (A – I stage of reconstruction, 39th day after injury;
 B – II stage of reconstruction, 72nd day after injury)

determined that the optimal method of reconstructive closure will be a plastic full–layer skin–subcutaneous flap from the anterior abdominal wall.

17-Apr-20 (39th day after injury) reconstructive surgery was performed: repeated surgical treatment of the right forearm and hand with a full–layer flap of the anterior abdominal wall. (Postoperative view are presenting on Fig. 3A)

In the postoperative period, daily dynamic thermographic and doppler control of perfusion properties of the vascular component of the flap and surrounding tissues of the right forearm and hand, the anterior abdominal were done.

After achieving a sufficient vascular collateralization of the periphery and adjacent areas of the soft tissues of the right forearm and hand (33 days after stage I, 72nd day after injury), we performed the second stage of classic Italian plastic of soft–tissue defect on the right hand and forearm with separation flap from the anterior abdominal wall, suturing of the wound of the anterior abdominal wall and adaptation of the flap in the area of the soft tissue defect. (Postoperative view are presenting on Fig. 3B)

On the third day after mobilization of the flap from the anterior abdominal wall, partial marginal necrosis of the superficial layers of the flap began. Conservative treatment was continued by changing aseptic dressings to form a clear zone of necrosis with demarcation.

11-Jun-20 (for 20 days after the 2nd stage of plastic surgery, 94th day after injury): To fully reconstruct the soft tissues

of the wound area and the maximum possible prevention of scar formation, we repeated the surgical wound treatment of the medial surface of the radial – wrist joint. US cavitation has been performed. Autodermoplasty of the necrosis zone of the flap has been performed.

The course of the postoperative period has been without signs of inflammation, complications and other adverse events. The transplant of the transplanted flap took place.

The wounded man was discharged from the hospital on 126th day after injury without signs of inflammation, restored structure of soft tissues and skin in the area of the gunshot wound in the phase of formation of norm trophic scars, without signs of contractures. After 1 month, at the end of the rehabilitation period, the wounded were recommended surgical restoration of the bone structures of the right radial–wrist joint, metacarpal bones. View on the finish of treatment are presenting on *Fig. 4*.

Despite the extensive experience in the history of wars for treatment of gunshot soft tissues defects, this problem remains still relevant for further study. This is due both to the high prevalence of such injuries and their high medical and social significance associated with quality of life and ability to work. The use of NPWT, US cavitation, color Doppler mapping, digital thermography greatly facilitates the work of the surgeon and improves its quality, allowing to take into account tissue angioarchitectonics and perfusion abilities of tissues. And although the use of new technologies is an important aspect that contributes to success in this matter, its basis has remained unchanged for a long time – it is a complete cleansing of the wound and achieving adequate tissue perfusion.

This case report shows that it is feasible to restore the structures of the soft tissues of the forearm and hand after a gunshot injury. It can be achieved through a multimodal screening, planning and a step–wise approach of surgical reconstruction.

The first phase, control of infection and inflammation, requires the rational use of antibiotics, the correction of deficits and the use of antiseptics. The second phase, reconstruction, should include dynamic preoperative planning, which involves choosing the method of reconstruction that will best help to restore the structure and function of the damaged area. During this phase, the flap modeling should be based on the clinical investigation of angio–architectonic properties of the donor site. We conclude that a stepwise approach and adequate, intensive postoperative care is necessary to receive an excellent functional recovery.



Fig. 4.
View of the wound before discharge from hospital
(126th day after injury).

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