

**Transposition of the pedicled radial forearm flap to reconstruct an electrical  
burn defect of the hand**

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*According to statistics, from 9 to 15 patients with electrical injury or electrical burn were annually admitted to the Burn Center of N.V. Sklifosovsky Research Institute for Emergency Medicine in the period from 2012 to 2015 that made about 1.5% of the total number of patients. The electrical injury, being a most severe and socially devastating injury, requires using combined therapies, applying the techniques of plastic and reconstructive microsurgery. The Burn Center specialists have developed up-to-date reconstructive techniques to quickly and efficiently treat tissue defects, including those after electrical burns.*

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According to world statistics, electrical injury occurs in 1-2.5% of all types of trauma, and makes about 0.2% of all industrial accidents; and the deaths have been recorded in 2-3% of electrical injury cases which significantly exceeds mortality from other types of trauma [1-4].

High-voltage exposure is characterized by unpredictable spreading of electric current in the tissue; meanwhile, it is known that the tissue with the lowest resistance is the most affected. Dry skin can carry the electric current marks only, but muscles,

fatty tissue, fascial compartments may be irreversibly damaged, and that determines the characteristics of the electric current distribution and the entailed unpredictable extent of tissue damage [5].

The ability to salvage the limb and to restore its function after an electrical accident depends on the severity of the primary lesion and also on the complications inevitably developing in restrained treatment tactics:

- Infectious complications;
- Compartment syndrome;
- Impaired main blood flow and tissue blood supply;
- Exposure of vulnerable functional structures after necrectomy;
- Occurrence of secondary necrosis.

The increasing intoxication can greatly reduce the chances for the limb salvage, and even for saving the patient life [6, 7].

The most important problems in electrical burns include the difficulties to reliably assess the damage extent and to make the decision on the timing and extent of surgery. For example, in an apparently safe blood circulation in the muscles, their innervation may be irreversibly impaired, or necrosis may develop in one or more muscle groups. An uncertain depth and extent of irreversible tissue damage in circumstances of the visible skin integrity makes even more difficult the choice of surgical approach and the scope of intervention. As a rule, the course of the intervention is determined by intraoperative findings. In turn, the possible (and sometimes inevitable) postoperative secondary necroses dictate the need for choosing new tactics.

Electrical burn makes a challenge for burn surgeons, but in some cases one can get impressive results if the Burn Unit has in its arsenal the techniques of plastic and reconstructive surgery, microsurgery.

**Case report.** Patient K., 64 years old was diagnosed with a IV-degree electrical injury (as a result of exposure to 3000 V) of the right hand dorsum (Fig. 1).



**Fig. 1. A deep electrical burn of the hand dorsum**

On day 2 after the injury, he underwent a surgical necrectomy of the soft tissue on the right hand dorsum. The devitalized skin and tissue were removed. The fatty tissue necrosis was found extending over 3 cm from the visible margins of the wound. Necrotized dorsal interosseous muscles of the hand were removed, as were the peritendineum of the extensor muscles of long fingers, for up to 7 cm (Fig. 2).



**Fig. 2. Soft tissue defect of the hand after necrectomy**

The nonviable tendons deprived of sheaths were retained in the wound. We did not perform a primary closure of the soft tissue defect as we anticipated the need to

remove the secondary necroses in case of their formation that is typical for electrical burns.

Using traditional solutions and ointments is known to lead to either dehydration, mummification of tendons, or to their maceration and infection, saying in other words, to an irreversible damage of the structure, thus precluding the possibility of revitalization and retaining the functions. In order to prevent such adverse effects, we took a decision to use vacuum dressings with *Locus* coating for the wound treatment (Fig. 3). *Locus* is a two-component polyurethane foam coating commonly used to treat wounds; but we have proposed a method of combining this porous and elastic material with open cells in a vacuum system. Our experience has demonstrated that *Locus* is not embedded in tissues, it can be easily separated from them, and has good drainage properties that would best fulfill the task of cleansing the wound and draining the fluid that, when infected, can damage the tendon.



**Fig. 3. Hand with *Locus* coating and the installed vacuum system**

The environment created in the vacuum dressing is highly moisturized due to the wound discharge; this moisture is rapidly evacuated that does not allow pathogens to actively develop on the wound surface. The existing moist environment is physiologically favorable and helps to keep the tendon structure safe; and at a total

cleansing of the wound it makes possible to cover the tendon with well-perfused tissue, to achieve the tendon revascularization, and to restore the function. The dressings were changed every 3 days.

The complete wound cleansing and the closure of subcutaneous "pockets" were achieved for 14 days. The tendon structure appeared well-preserved and suitable for a closure with a vascularized flap (Fig. 4).



**Fig. 4. Right upper extremity: fasciocutaneous flap is designed showing the vascular fascicle plane and the access to the site of positioning the vascular pedicle of the flap**

After the flap and its pedicle consisting of the radial artery and concomitant veins have been mobilized (maintaining the retrograde arterial blood flow), the flap transposition was performed (Fig. 5).





**Fig. 5. The stage of flap placement and fixation on the wound of the hand. The vascular pedicle is visible**

Long-term results at 6 weeks after the injury included a completely restored valuable skin dorsum of the hand; and the independent blood supply to the flap contributed to the revascularization of tendons, and the prevention of infectious complications (Fig. 6).



**Figure 6. Full range of motion in the hand and its fingers.**

## CONCLUSION

Electrical burns of functionally important body areas pose challenging diagnostic and therapeutic tasks for combustiologists, and the solution of those tasks aims at achieving the main goal that is a speedy recovery of functions and ensuring an aesthetic appearance.

The use of wound preparation and wound surgical treatment techniques, including those of plastic and reconstructive microsurgery, contribute to a rapid and efficient repair of tissue defects and the restoration of the hand function.

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