Case Report
https://doi.org/10.23934/2223-9022-2021-10-3-575-581

Autotransplantation of Flaps in the Treatment of Peri-Implant Infection After Osteosynthesis (Analysis of Clinical Observations)

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SUMMARY Unfortunately, suppuration of a postoperative wound remains the most frequent complication of surgical intervention. If suppuration is located superficially, within the subcutaneous fat, it can be successfully managed with minimal functional losses. The clinical course is significantly complicated if the focus of infection is located under the skin, in the thickness of the muscles, in the fracture zone. In the case of suppuration in the area of osteosynthesis, the complication may become critical.

Such a complication is a serious condition that requires multi-stage complex and sometimes multidisciplinary treatment.

The conditions for a successful outcome in this pathology are the minimum period from the moment of suppuration, active surgical tactics, stability of the implant, and good vascularization of the surrounding soft tissues.

Active surgical tactics involves the opening and sanitation of purulent foci, leaks, recesses. Staged necrectomies are inevitable companions of surgical treatment and can cause the formation of defects in the skin, subcutaneous tissue, and muscles.

The resulting soft tissue defect leads to exposure of the bone and plate. Removal of the metal fixator becomes inevitable.

Only the closure of the defect with a complex of tissues based on free vascularized composite grafts can radically solve the problem.

The article presents two clinical observations of deep wound infection after bone osteosynthesis, where autotransplantation of a vascularized flap was used. The use of this technique made it possible to achieve suppression of infection, wound healing by primary intention, to create conditions for consolidation of the fracture, restoration of function and preservation of the limb as a whole.

Keywords: deep wound infection, plate osteosyntesis

For citation Ganiyev RR, Nevedrov AV, Valiyeva RI, Zadneprovsky NN, Ivanov PA, Lazarev MP, et al. Autotransplantation of Flaps in the Treatment of Peri-Implant Infection After Osteosynthesis (Analysis of Clinical Observations). *Russian Sklifosovsky Journal of Emergency Medical Care.* 2021;10(3):575–581. https://doi.org/10.23934/2223-9022-2021-10-3-575-581 (in Russ.)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments, sponsorship The study has no sponsorship

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RATIONALE

According to various data, the incidence of deep wound infection after bone osteosynthesis ranges from 5% to 12%. This complication requires a long-term treatment (up to 68 days) and is associated with a significant mortality in the older age group of patients. According to Kappler data, it makes 14.6% [1]. But in 15% of cases, success fails to be achieved, despite a multi-stage treatment [2].

The factors involved in the infection development include microbial contamination of the fracture zone during trauma, during surgical intervention, and in the postoperative period due to impaired wound healing [3]. An important role is assigned to the mechanism of injury: high-energy exposure leads to extensive damage to the skin, muscles, local microcirculation disorders, and the occurrence of secondary necrosis. The implant presence contributes to the development of inflammation — it reduces the microbial count required for the infection development by several orders of magnitude [4].

The spectrum of microorganisms that cause peri-implant infection is very diverse. According to the literature, the most prevalent are Staphylococcus aureus (30%), coagulase-negative Staphylococci (22%), and gram-negative bacilli (10%). In most cases, there are associations of microorganisms [5].

The leading role in the treatment of peri-implant infection is assigned to a radical surgical debridement, and cleansing of the fracture area. It is important that the removal of affected non-viable tissues is possible only surgically, together with the placement of a flushing system for the wound irrigation with large volumes of antiseptic solutions. A secondary role is assigned to antibacterial therapy, which is associated with the microorganism resistance [5].

The critical period of treatment for peri-implant suppuration is 14 days. In cases where it is not possible to cope with the infection for a longer period of time, it is necessary to remove the metal fixator [3].

An important factor is the status of local blood circulation and microcirculation. Good blood supply creates the prerequisites for successfully striving against the developed inflammation. If there are signs of impaired wound healing and soft tissue defects, the flap autografting is necessary [6].

This paper presents clinical case reports on successful treatment for severe peri-implant infection using microsurgical autotransplantation of soft tissue complexes.

Clinical Case Report 1

Patient K., 45 years old. He was injured in a traffic accident. The ambulance team delivered him to N.V Sklifosovsky Research Institute for Emergency Medicine. A closed fracture of the proximal metaepiphyses of both shin bones of the left leg was diagnosed. After a brief preoperative preparation, a temporary hip-shin core fixation device was applied (Fig. 1).

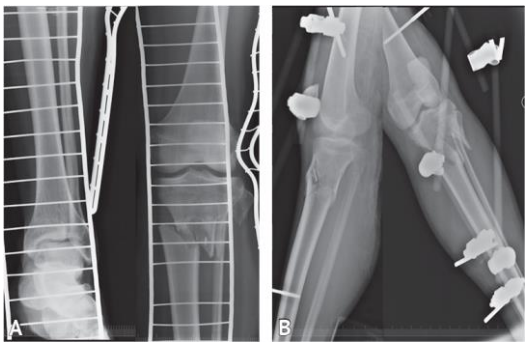

Fig. 1. X-rays of the left lower extremity of patient K. A - upon admission; B - after the installation of the external fixation device (EFD)

After the skin condition normalized and edema reduced on day 7 after admission, an open reposition, osteosynthesis with a blocked plate for the proximal tibia was performed. On day 5 after surgery, a pyo-hemorrhagic discharge from the wound was observed. In the operating room, the wound edges were separated, necrectomy was performed, and the purulent focus was cleaned. The wound was left open; local treatment with ointment dressings was performed in combination with vacuum therapy. The wound discharge culture revealed the growth of Staphylococcus aureus.

As a result, the patient developed a soft tissue defect on the medial surface on the upper third of the left lower leg, with the plate and a part of necrotic bone being exposed (Fig. 2).

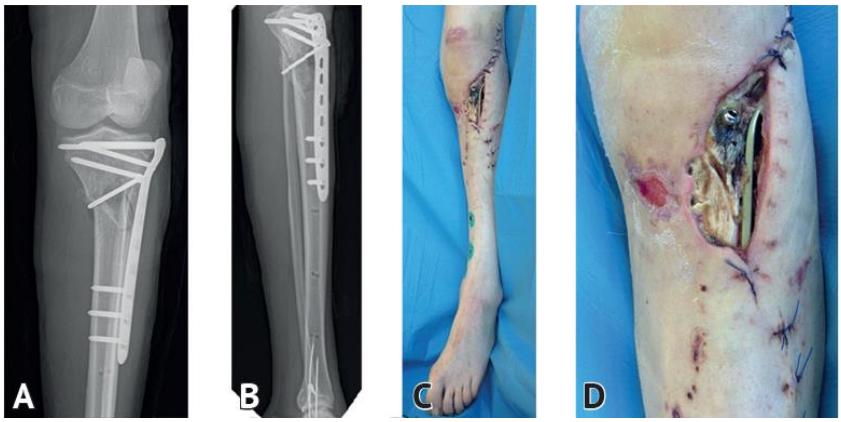

Fig. 2. X-rays of the patient's left lower leg after osteosynthesis of the fracture of the proximal tibial metaepiphysis (A, B). View of the patient's left lower leg 10 days after osteosynthesis (C, D)

On day 13 after osteosynthesis, osteonecrectomy and decortication of the left tibia were performed. The resulting bone defect was replaced with a vancomycin-impregnated cement spacer. The soft tissue defect was replaced with a musculocutaneous flap tailored from the lateral head of the calf muscle. Drainage of the space under the flap was performed by using Redon technique. The fixator device was not removed. In the postoperative period, antibacterial therapy was performed with Ciprofloxacin 500 mg twice a day intravenously. Drains were removed on the 5th day, 2 days after the exudate ceased to discharge from the drains. The donor sites after the flap removal were healed by primary tension (Fig. 3).

Fig. 3. X-rays of the patient's left lower leg after osteonecrectomy, replacement of the bone defect with a spacer (A). View of the limb after replacement of the soft tissue defect in the upper third of the leg with a musculocutaneous flap from the lateral head of the gastrocnemius muscle on the vascular pedicle (B)

The patient was discharged from hospital in a satisfactory condition for outpatient follow-up treatment. Walking with crutches was allowed, but without support on the left lower limb.

Signs of fracture consolidation were seen on X-ray films 5 months after osteosynthesis. The cement spacer was removed and the defect was bone grafted with an autograft tailored from the iliac crest at 7 months after the injury. The patient was allowed to walk with full support on the injured limb. The patient returned to work 12

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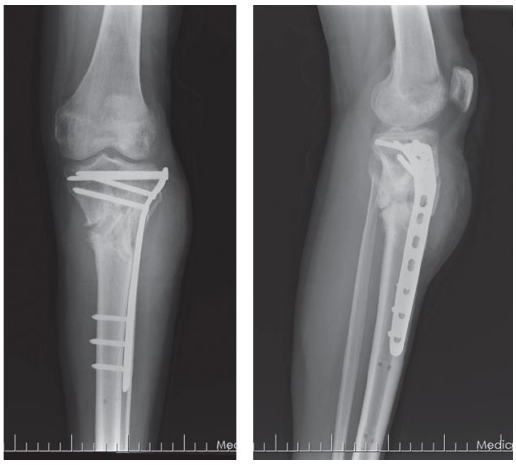

Fig. 4. X-rays of the patient's left lower leg after removal of the cement spacer, replacement of the bone defect with an autograft of the iliac crest

Clinical Case Report 2

Patient N., 34 years old, was admitted to N.V.Sklifosovsky Research Institute for Emergency Medicine on a planned basis with the diagnosis: "A non-union fracture of the lower third of the left tibia after osteosynthesis with a plate. Chronic osteomyelitis, late peri-implant infection, soft tissue defect in the left ankle joint".

Six months before admission, she had been injuried injured in an accident and sustained a closed fracture of the distal metaepiphyses of both bones of the left lower leg. In another medical institution, osteosynthesis with plates was performed (Fig. 5).

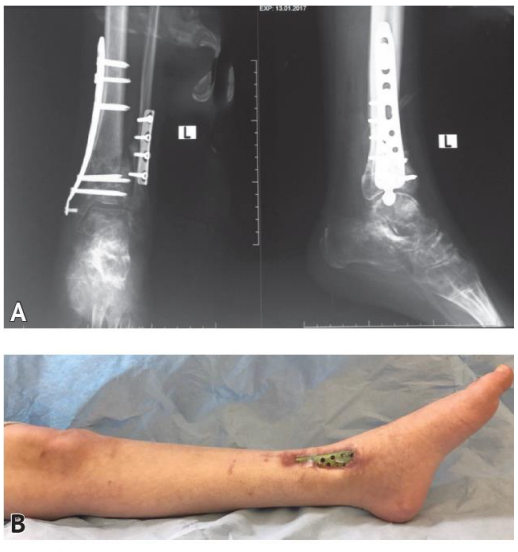

Fig. 5. X-rays of patient N. upon admission (A). The patient's left lower leg on admission (B)

On the inner surface of the left shin, there was a skin defect of 6 x 4 cm, with scanty discharge. The edges of the skin were rigid with cicatricial changes. The bottom of the wound was a plate.

Escherichia coli sensitive to Ciprofloxacin was detected in the cultures of the wound discharge. On day 3 after admission, the revision, secondary surgical debridement of the wound, the removal of plates from the distal metaepiphysis of the tibia and fibula, and the ankle joint arthrodesis in the Ilizarov apparatus were performed. Transarticular pin fixation was preformed (Fig. 6).

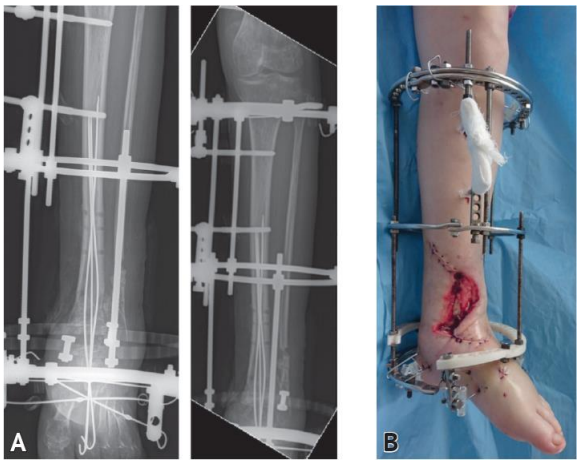

Fig. 6. X-rays of the left lower leg after arthrodesis of the ankle joint in the Ilizarov apparatus (A). Patient N.'s left lower leg after surgical debridement, removal of plates, arthrodesis of the ankle joint. The left lower leg after secondary surgical treatment, removal of the plate, arthrodesis of the left ankle joint in the Ilizarov apparatus (B)

In the postoperative period, a course of antibacterial therapy with Ciprofloxacin 500 mg twice a day intravenously was administered. Local wound treatment with ointment dressings was performed for 5 days. Next, the soft tissue defect was replaced with a distally attached gastrocnemius skin-fascial flap with an additional venous anastomosis. The donor sites after flap removal were healed by primary tension. There were no signs of wound infection. The patient was discharged for outpatient treatment (Fig. 7).

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Fig. 7. View of the left leg of patient N. after replacement of the soft tissue defect with a gastrocnemius fascial skin flap

The patient was allowed to walk with crutches, without support on the injured limb. Four weeks after surgery, the transarticular pins were removed. Six months after surgery, control X-ray revealed that arthrodesis was a success. The Ilizarov apparatus was dismantled, and the patient was allowed walking with full support on her left lower limb. The function of the lower extremities was restored, and the patient returned to work as a salesperson (Fig. 8).

Fig. 8. X-rays of patient N., arthrodesis is successful

DISCUSSION

Suppuration of the postoperative wound, with extensive necrosis, accompanied by the bone exposure in the area of the fracture and metal fixators, is a serious complication. It can negate all the efforts of the surgeon aimed at preserving the limb, induce disability and even lead to the patient's death.

The resulting skin defect over the bone structures requires being replaced with a full-fledged graft that is resistant to infection and provides reliable shelter for both the bone and the fixator.

The article presents two case reports of a successful treatment for deep peri-implant infection after bone osteosynthesis.

The differences in the tactics of surgical treatment of these patients are as follows.

In the first case, early peri-implant infection was detected, which may occur up to 14 days after the fixator placement. In such a complication, it is still possible to avoid the removal of the fixator device, provided that the focus is radically debrided and then closed with an adequately blood-supplied graft. Timely restoration of integument tissues is the key to successful treatment of such patients [7].

To restore the integrity of the bone, a two-stage method of treatment was resorted to: an antibiotic-impregnated cement spacer was used at the first stage; the second stage included bone grafting with an autograft tailored from the iliac crest. In order to restore the integumentary tissues, a graft was used made of a fragment of the gastrocnemius muscle on the vascular pedicle, which is a necessary condition [8]. The use of a flap located near the defect can significantly reduce the operation time [9]. With a sufficient supply of skin on the posterior surface of the lower leg, it is possible to form grafts of the desired size, without significant damage to the donor site.

According to available literature and based on our own experience, in cases of late peri-implant infection occurred, it is impossible to preserve the exposed metal fixator device, and its removal is necessary [10]. The second clinical case is a convincing illustration of this.

To preserve the limb support ability, arthrodesis of the destroyed ankle joint was performed with fixation in the Ilizarov apparatus.

The defect of the skin covering over the tibia was closed with a gastrocnemius skin-fascial flap on the distal pedicle.

In the above clinical cases, two types of grafts were used: skin-muscle and skin-fascial. From the point of skin the defect replacement, the goal was achieved in both cases.

The increase in the bloodstream in the operated area was most significant in the case of a transplanting a musculocutaneous graft. When a skin-fascial graft was transplanted, a less significant increase in the bloodstream was noted, as per scintigraphy results.

According to available experimental data, both types of grafts significantly reduce microbial contamination of the wound, but the musculocutaneous graft most significantly reduces the microbial count [11]. Some studies have demonstrated the ability of the graft muscle to accumulate an antibiotic, thereby increasing its concentration in the bone cavity [12].

Some authors note that stromal cells of muscle tissue have a higher osteogenic activity than cells of adipose tissue of skin-fascial flaps [13]. This has been confirmed by experimental studies that have demonstrated that fracture consolidation occurs faster when the defect is covered with muscle flaps compared that with skin-fascial flaps [14].

Meantime, there are studies showing similar efficacy of both the muscle and skin-fascial flaps in deep wound infection [15]. Clinical studies have also confirmed the efficacy of both methods for closing defects in patients with open fractures, provided that the wound is completely surgically debrided [16].

The advantages of using skin-fascial flaps include less damage to the donor site, less thickness in comparison with skin-muscle flaps. The latter provision is important, especially for areas with thin skin, such as the lower third of the lower leg. The best cosmetic effect in applying skin-fascial flaps with a full restoration of the skin is also rather important.

CONCLUSION

Deep peri-implant infection after bone osteosynthesis is one of the most difficult problems to solve at the junction of orthopedics, purulent surgery and plastic surgery.

The above described cases of early and late peri-implant infection have demonstrated that this problem can be successfully solved with the help of staged surgical treatments, local and systemic antibacterial therapy, and the transfer of vascularized tissue complexes (flaps). Restoration of the surrounding soft-tissue full-fledged in the presented cases was a key condition for the infection eradication, fracture union, and limb function recovery.

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Received on 16.07.2020

Review completed on 27.04.2021

Accepted on 29.06.2021