Clinical case
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Treatment outcome in a patient with knee joint infection developed after arthroscopic plasty of the anterior cruciate ligament

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Abstract

Introduction Knee joint infection (septic arthritis) is a rare but severe postoperative complication. With the increasing number of primary and revision arthroscopic surgeries on large joints performed annually, the incidence of infectious complications has also grown.

The **aim** of this study is to present the outcome of a successful two-stage treatment of a female patient with knee joint infection caused by methicillin-resistant Staphylococcus epidermidis after arthroscopic anterior cruciate ligament reconstruction.

Materials and Methods A 22-year-old female patient diagnosed with chronic posttraumatic osteomyelitis of the right femur and tibia, arthritis of the right knee following reconstruction of the anterior cruciate ligament (ACL) of the right knee. Her medical records stated several failures of debridement surgeries. The first stage involved joint debridement, removal of the infected ACL graft, and filling of the bone defects with bone cement containing antibacterial agents. In the second stage, the bone cement was removed, the bone defects were filled with allograft bone chips, and ACL reconstruction was performed using the peroneus longus tendon. Clinical, instrumental, and functional evaluations of treatment effectiveness were performed.

Results The treatment managed to control the infection. Remission of the infection was achieved, and function of the affected limb was restored. The follow-up period was two years.

Discussion There are few publications in the Russian medical literature on the treatment of infection after arthroscopic surgery on large joints. This clinical case demonstrates a positive outcome in infection resolution after ACL reconstruction with forced ligament removal following failures of debridement procedures.

Conclusion The choice of treatment strategy was based on the patient's medical history and desired needs. The management of knee infection that developed after ACL reconstruction included appropriately selected and administered antibiotic therapy and the necessary number of timely surgical interventions. This optimally chosen approach ultimately resulted in good outcome.

Keywords: clinical case, revision arthroscopy, ACL reconstruction, bone grafting, infection, two-stage revision, osteomyelitis, MRSE

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INTRODUCTION

Knee joint infection (septic arthritis) is a rare but a severe postoperative complication. In the general population, infectious complications after surgical arthroscopic interventions occur with a frequency of 0.14–1.8 % [1]. The causative agents of infection are commonly coagulase-negative staphylococci and *Staphylococcus aureus* [2, 3, 4]. Young patients, those receiving corticosteroid injections, those with a history of diabetes mellitus, and patients with concomitant surgical interventions are at a higher risk of knee joint infection [5, 6, 7]. Some researchers claim that the incidence of infectious complications is higher if harmstring muscle tendons are chosen for grafting [8]. Late presentation of patients or delayed initiation of treatment threatens to results in such outcomes of infectious arthritis as cartilage detachment, its thinning, osteoarthritis, and osteomyelitis [9].

Diagnosis of infection after anterior cruciate ligament (ACL) reconstruction is based on the patient's history, physical examination, laboratory parameters, and synovial fluid study after joint aspiration. Clinically, septic arthritis is characterized by soft tissue swelling, hyperemia, localized fever, pain, and dysfunction of the affected joint along with non-healing postoperative wounds. Laboratory diagnosis includes tests for serum markers and intra-articular material (synovial fluid and tissue samples obtained intraoperatively) [5].

Many orthopedic surgeons initially prefer procedures that preserve the ligament graft: staged arthroscopies, debridement, and antibiotic therapy [1, 2, 10, 11]. However, if such treatment is ineffective or a therapy-resistant pathogen is identified, joint debridement includes removal of the graft and its fixing implants, due to the ability of microorganisms to adhere to the surface of elements implanted into the joint [6, 12].

Our study presents a clinical case of a patient with infectious complications following ACL reconstruction. A distinctive feature of this case is the filling of the bone canals with a cement spacer containing an antibiotic and the subsequent bone grafting of those canals after spacer removal. The authors of a similar clinical case report used cement spacers in the form of beads placed into the joint cavity [9].

Purpose of this study is to present the outcome of a successful two-stage treatment of a female patient with knee joint infection caused by methicillin-resistant Staphylococcus epidermidis after arthroscopic anterior cruciate ligament reconstruction.

MATERIAL AND METHODS

A 22-year-old female patient was admitted to the Bone and Joint Infection Clinic of the Ilizarov National Medical Research Center of Traumatology and Orthopedics with complaints of pulsating pain in the right knee joint at night and instability of the right knee joint.

Diagnosis: Chronic post-traumatic osteomyelitis of the right femur and tibia; arthritis of the right knee joint; condition after ACL reconstruction of the right knee joint (Fig. 1).

Medical history 2010: right knee injury, ACL injury, arthroscopic ACL replacement; June 2016: re-injury, therapeutic and diagnostic arthroscopy with medial

Fig. 1 AP and lateral radiographs of the right knee joint

meniscus resection; June 2021: right knee injury with ACL graft damage; July 2021: repeated arthroscopic medial meniscus resection and revision ACL replacement, postoperative purulent arthritis. August 2021: knee drainage.

Local status Skin condition: no wounds or fistulas; moderate swelling of the right knee joint; local hyperemia and hyperthermia of the skin. The anterior drawer symptom was positive. Lachman test was positive. Gait characteristics: walks with support on crutches. Orthopedic status: no shortening. Peripheral vascular pulse: pulsation on the dorsalis pedis artery was palpable on both lower extremities. Joint movements of the affected limb: flexion-extension contracture of the right knee joint (flexion/extension — 110/170°). Functional state of the right knee joint: 19.5 points (according to KSS), 40 points (according to Lysholm).

Results of laboratory tests Mild anemia (Hb 98 g/L), elevated ESR (61 mm/h) and CRP (6.7 mg/L). A puncture of the right hip joint revealed growth of Staphylococcus epidermidis, MRSE 10^3 CFU/ml.

The intervention at our clinic was performed in December 2021.

Fist treatment stage Right knee joint revision; ACL graft removal; debridement; ultrasound wound cavitation; defect reconstruction with vancomycin-impregnated bone cement (Fig. 2). Intraoperative microbiological tests revealed MRSE 103 CFU/ml. Intraoperative blood loss was 100 ml; no blood transfusion was performed. The wound healed by primary intention. The drain was removed on the third postoperative day.

Fig. 2 AP and lateral radiographs of the right knee joint after the first treatment stage

After each stage of the surgical treatment, a two-week course of etiotropic antibacterial therapy with vancomycin 1.0 g twice daily and meropenem 1.0 g three times daily was administered in the hospital; a four-week course of moxifloxacin 400 mg once daily and co-trimoxazole 480 mg three times daily was administered during the outpatient period. The patient was advised to use crutches while walking, with limited weight-bearing on the operated limb.

Three months after the first stage of treatment, a diagnostic puncture of the right knee joint was performed; no growth of the pathogen was detected. Hematological parameters were: mild anemia (Hb 107 g/L), acute-phase reactants of inflammation within normal limits (ESR 2.0 mm/hour and CRP 1.6 mg/L).

In March 2022 the ***second treatment stage*** was performed: revision of the right knee joint; spacer removal; debridement of the right femur and tibia; ultrasound cavitation of the wound; plastic surgery of the femur and tibia defects with allograft material with the addition of vancomycin; open reconstruction of the ACL of the right knee joint using an autograft (Fig. 3).

Intraoperative blood loss was 150 ml; no blood transfusion was performed. Intraoperative microbiological tests revealed no pathogen growth. The patient received restorative treatment; mobilization was initiated on the second postoperative day with the assistance of a physical therapist. The drain was removed on the third postoperative day. The wound healed by primary intention.

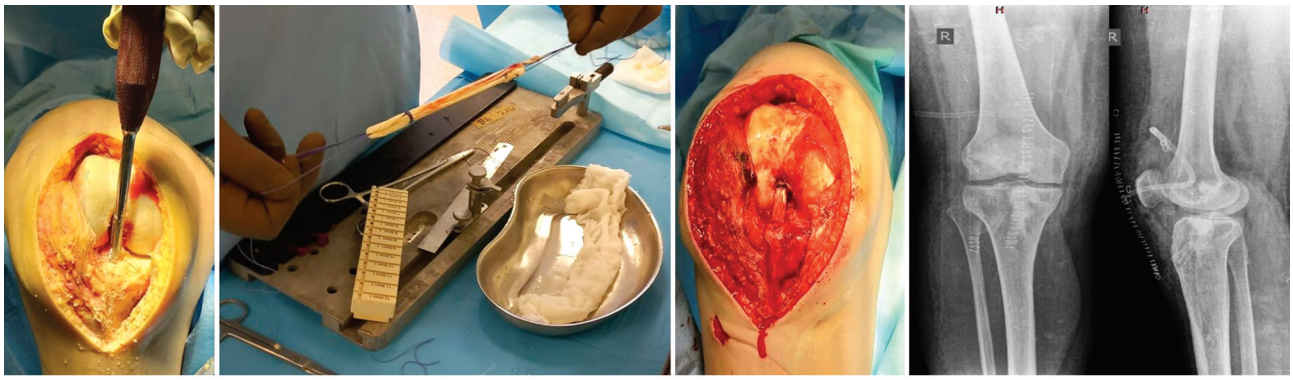

Fig. 3 The second stage of treatment: (a) plastic surgery of bone defects of the femur and tibia with allobone chips; (b) preparation of the ACL autograft from the tendon of m. peroneus longus dexter (length, 10 cm; diameter, 8 mm); (c) fixation of the ACL autograft in the femoral and tibial canals with fixation implants; (d) radiographs of the right knee joint in the frontal and lateral projections after the second stage of treatment

FOLLOW-PUS AND THE OUTCOME

At a two-year follow-up, no evidence of exacerbation of the purulent inflammatory process was detected. No instability in the knee joint was observed (anterior drawer sign, posterior drawer sign, and the Lachman test were negative), and inflammatory markers were within normal limits (ESR — 21 mm/hour; CRP — 3 mg/L). The functional status of the right knee joint was 77 points according to the KSS, 69 points according to the Lysholm (Fig. 4).

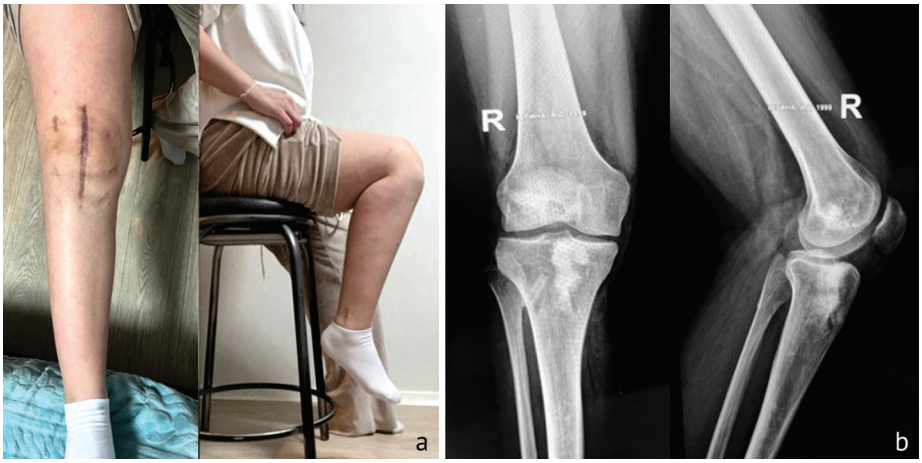

Fig. 4 The outcome two years after the treatment: (a) photo demonstrating the function of the limb; (b) radiographs of the right knee joint in the frontal and lateral projections

The outcome of the treatment was arrest of infection in the right knee joint and recovery of limb function. The patient is satisfied with the treatment results, no longer uses additional support devices, and returned to her daily work activities.

DISCUSSION

Septic arthritis after ACL reconstruction increases the risk of rapid knee joint destruction. Infectious complications after this surgical procedure occur with a frequency of 0.1 % to 1.7 % in the general population [2]. Timely diagnosis and appropriate patient management are key components of successful treatment and the prevention of early and significant deterioration of the joint. Despite the increasing incidence of this problem, there is no consensus on treatment strategies.

Arthroscopy provides easy access to the joint, adequate debridement, shorter postoperative recovery time and physiological lavage under pressure [13], and also enables to determine the stage of joint

destruction. According to the classification proposed by the German scientist A. Gaechter [14], four stages of joint damage are distinguished: stage I is joint effusion, redness of the synovial membrane and possible petechial bleeding; stage II is severe inflammation, fibrinous deposits and pus in the knee; stage III is thickening of the synovial membrane and multiple pockets due to adhesions; stage IV is aggressive pannus with infiltration into the cartilage, possibly undermining the cartilage, radiographic signs of subchondral osteolysis and possible bone erosions and cysts [5, 15].

During the initial arthroscopic evaluation and debridement, it is necessary to assess the integrity and viability of the graft, evaluate its tension, and perform an anterior drawer test. If the test is positive the viability of the graft poses doubts, and debridement arthroscopy with extensive lavage and complete synovectomy should be performed [2, 3, 4]. Upon completion of the procedure, a closed drainage system is installed and the knee joint is immobilized for a short period.

Most authors do not limit themselves to a single operation; the average number of arthroscopies is 2.8 (minimum one, maximum five operations) [10, 12, 13, 16]. During staged salvage arthroscopies, surgeons decide to remove the ligament and fixators. Preservation or removal of the graft is still a controversial issue and depends on preference, experience and expert opinion [17]. In some cases, the cause of recurrent infection is probably the formation of biofilm, and removal of the graft and all materials may lead to successful results in terms of infection control [17]. In addition, one of the factors that is crucial for graft viability is early diagnosis, since the patients diagnosed more than seven days after the onset of symptoms frequently undergo graft removal [18]. In this case, all fixators should be removed, and canal debridement is performed within healthy tissues. This operation can be performed either arthroscopically or by arthrotomy [2].

In cases of widened canals, bone grafting is actively used in aseptic revisions. According to an analysis of 460 repeated ACL reconstructions, bone plasty simultaneously with graft placement was performed in 3 % of cases, while 9 % of cases required staged treatment with defect compensation at the first stage and revision grafting at the second [19]. After graft removal, bone canals must be treated, since the risk of further spread of infection is extremely high [2, 16]. In our opinion, filling of femoral and tibial canals with a spacer containing an antibacterial agent provides better infection control in patients before subsequent reimplantation. In our case, the canals were filled with a spacer containing an antibiotic, while antibiotic beads are usually used which are placed into the joint cavity arthroscopically or openly during the debridement stage and removed during ligament reconstruction [20]. In the presented clinical case, due to a long history of septic arthritis, the presence of severe multidrug-resistant microflora, and the need to place a spacer containing an antibiotic in the bone canals, a decision was made to opt for open surgery. A study by Osti et al. confirms that in such cases, arthroscopic techniques should be avoided and arthrotomy should be the preferred [21].

Along with surgical intervention, a long course of etiotropic therapy (antibiotic therapy) is mandatory [7]. Parenteral administration of an antibiotic active against the most common microorganisms (Staphylococcus aureus and coagulase-negative staphylococcus) should be started immediately after receiving the results of microorganism culture from the knee joint puncture. To achieve clinical efficacy, a combination of antibiotics is recommended, the choice of which should be based on the microorganism and following consultation with a clinical pharmacologist [5]. A generally accepted combination is third-generation cephalosporins and vancomycin/gentamicin. However, the latter are used with caution due to their nephro- and ototoxicity. The course of antibiotics starts with intravenous administration for three to four weeks, followed by a switch to oral drugs [2, 16].

The second surgical intervention for ligament reimplantation is recommended to be delayed and performed six to eight months after the initial surgery [5]. However, a properly and timely first stage, absence of pathogen growth in the knee joint puncture specimen, and normal inflammatory parameters, as in the presented clinical case, allow for an earlier second stage to reduce the patient's recovery time [22].

In the early postoperative period, the limb is fixed in a brace at 175° extension. Rehabilitation measures start from the following day after surgery, aimed at relieving pain and swelling, increasing the range of passive and active motion, and strengthening the quadriceps femoris. The primary goal is to increase the load on the limb and enable walking without additional support [23].

Functionally, patients can return to work and daily life, as evidenced by the increased scores on the IKSSS and Lysholm scales in the clinical case presented. We compared our functional results with those of international surgeons. Gille's study recorded scores of 63.9 on the Lysholm scale and 63 on the IKSSS scale [15]. It should be noted that the final results in our clinical case are in no way inferior to the average values in the available international literature. Arrest of infection and joint stabilization improved the patient's quality of life, and in the long term, this should reduce the rate of gonarthrosis progression.

The strengths of this study include the originality of the technique, which nevertheless adheres to the general paradigm for treating patients with infectious complications, and a long-term treatment outcome. The use of this technique in the treatment of a single patient is undoubtedly a limitation of the study level of evidence.

CONCLUSION

This clinical case demonstrates a successful personalized approach to treating patients with infection following ACL reconstruction. The choice of treatment strategy was based on the patient's medical history and desired needs. Optimal management, including appropriately selected and administered antibiotic therapy and timely surgical interventions, ultimately resulted in a good outcome.

Conflict of interests *The authors declare neither obvious nor potential conflicts of interest related to the publication of this article.*

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Ethical statement *The study was approved by the ethics committee of the Federal State Budgetary Institution Ilizarov National Medical Research Center of Traumatology and Orthopedics of the Ministry of Health of the Russian Federation (protocol No. 1 (76) dated November 29, 2024) and was conducted in accordance with the ethical standards of the Helsinki Declaration developed by the World Medical Association "Ethical Principles for Medical Research Involving Human Subjects" with the amendments of 2000.*

Informed consent *The patient gave voluntary written consent to participation in the study and publication of its results.*

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