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A Case report

Replacement of a Femoral Defect Affected by Post-Traumatic Osteomyelitis with a Non-Vascularized Fibular Autograft: a Case Report

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Abstract

Replacement of extensive defects of tubular bones against the background of osteomyelitis remains an urgent problem today. The existing methods of replacing such defects by the method of bilocal osteosynthesis with the Ilizarov apparatus or the use of a free fibular autograft are not always applicable.

We present a clinical case of the use of a combined Masquelet's induced membrane technique with bone autoplasty by fibular graft and the use of the Ilizarov frame. A 33-year-old patient was injured in December 2015 as a result of a traffic accident. Subsequently, the development of osteomyelitis has been noted. As a result of surgery and the course of osteomyelitis, there was formed an extensive femoral defect of up to 9.5 cm. Next, the first stage of a two-stage surgical treatment was performed – Sequestrnecrectomy, remounting of the Ilizarov frame, installation of a temporary cement spacer with an antibiotic into the formed bone defect of the right femur using the Masquelet technique. After 4 months, the second stage of surgical treatment was performed – Free autograft of a fragment of the fibula in order to replace a bone defect of the right femur.

In order to stimulate and improve the reparative and integrative processes of the bone autograft, PRP therapy was performed 10 months after the last surgery. 21 months after the second stage of surgical treatment, the consolidation of a free fragment of the fibula was established with the help of an X-ray, and the Ilizarov frame was dismantled. 48 months after the second stage of the surgery, the functional condition is satisfactory, the patient moves with a full support load on the right lower limb. In the presented clinical case, the combination of Masquelet technique, free fibular autograft and osteosynthesis by Ilizarov frame allowed to achieve satisfactory functional results.

Key words: *Ilizarov frame, bone defect, reconstruction, free bone autograft, Masquelet, induced membrane.*

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Introduction

In the event of post-traumatic osteomyelitis of long tubular bones, one of the stages of surgical treatment is the rehabilitation and resection of the infected bone area, as well as the removal of sequestered bone fragments. The estimated volume of sequestrectomy is determined by the Cierny-Mader anatomical classification [1]. After sequestrnecrectomy, cases of bone defects are not uncommon. Bone defects of more than 6 cm are most often replaced using the Ilizarov frame by bilocal distraction osteosynthesis, or by bone transplantation [2-4]. Currently, one of the most effective methods of treating patients with post-traumatic bone defects is the combined method of distraction osteosynthesis according to Ilizarov using the Masquelet technique [1,5-7]. The first stage of treatment is radical resection, sequestrectomy of the affected area. Further, the second stage of treatment is the implantation of a cement spacer similar to the diameter of adjacent bones in accordance with the size of the bone defect to form an induced membrane technique (IMT) using the Masquelete technique. Thus, based on literature, it is known that IMT has proven itself as a way of restoring bone tissue, preventing bone graft resorption and plays an important role in revascularization and consolidation of bone structure [6].

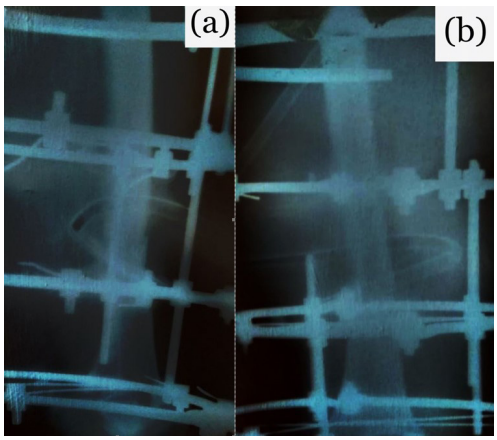
In this clinical case, we present our first two-stage autograft of the fibula in femoral defect with the use of distraction osteosynthesis by Ilizarov and Masqulet technique. This method is preferable for the replacement of defects of tubular bones over 6.0 cm. in the long course of post-traumatic osteomyelitis affected by chronic osteomyelitis [8,9].

Description of the clinical case

The patient, a female, 33 years old, was injured in December 2015 as a result of a traffic accident. Patient was hospitalized in an emergency with a diagnosis of "Open multi-splintered fracture of the right femur with displacement of bone fragments." Primary surgical treatment of the wound of the right thigh was performed in the in-patient unit of the interregional traumatology department of a district hospital where skeletal traction was applied, followed by the imposition of an external fixation device of the right thigh. In the post-surgery period, there were noted infiltration, edema of soft tissues, fluctuation and diastasis of fragments of the right femur in the area of surgery (Picture 1).

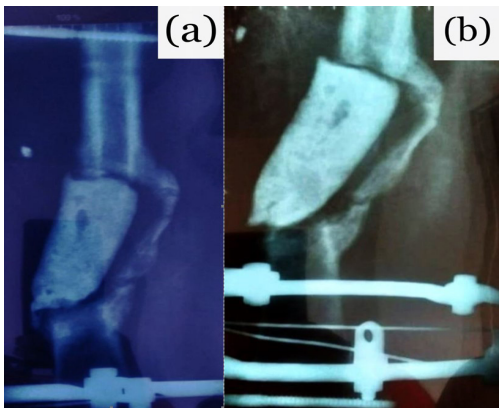
Picture 1 - X-ray picture of the right femur in a direct projection. Diastasis of fragments of the right femur can be visualized

Due to the complications that have arisen, the patient was urgently transferred to a regional hospital, where they performed an autopsy of a suppurated hematoma, sequestration necrectomy, resection of the osteomyelitic focus of the middle third of the thigh and osteosynthesis of the Ilizarov frame of the right thigh (Picture 2). Further, after discharge, the patient noted periodic functioning of the fistula wound in the middle third of the right thigh.



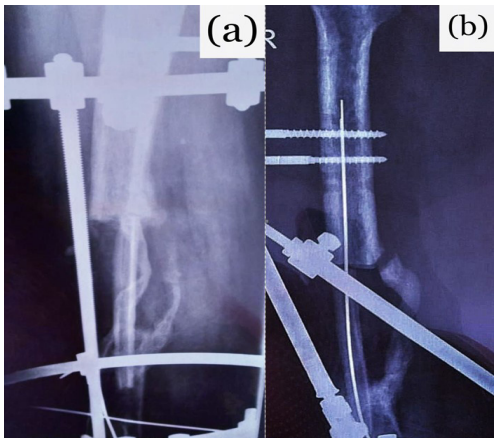
Picture 2 - X-ray picture of the right femur in a straight (a) and lateral (b) projection after sequestrnecrectomy, resection of the osteomyelitic focus of the middle third of the thigh and osteosynthesis by the Ilizarov frame of the right thigh

In August 2016, the first stage of surgical treatment "Remounting of the Ilizarov frame of the right femur, sequestrnecrectomy, filling of the bone defect of the femur with bone cement with an antibiotic according to the Masquelet technique" was performed within the Injuries and Combustiology Consequences Department of the NSCTO named after Academician N.D. Batpenov" (Picture 3).



Picture 3 - X-ray picture of the right femur in a straight (a) and lateral (b) projection after remounting of the Ilizarov frame of the right femur, sequestrnecrectomy, filling of the bone defect of the femur with bone cement with an antibiotic using the Masquelet technique, ossification of the periosteum on the medial surface

In January 2017, after a preliminary X-ray radiography of the right thigh with a measuring ruler in two projections, the second stage of surgical treatment was carried out to assess the size of the defect.



Picture 4 - X-ray picture of the right femur in a straight (a) and lateral (b) projection after free autograft of a fibular fragment in order to replace a bone defect of the right femur. Intramedullary osteosynthesis of an autograft with a spoke. Dismantling of the Ilizarov frame of the right thigh

The primary tactics of the surgery involved laying the graft, intramedullary osteosynthesis with a spoke and the imposition of arterial and venous anastomoses on the feeding leg of the bone graft, but due to the severity of the primary injury and early surgery, the patient developed extensive scarring of soft tissues, there were no vessels of the required diameter and collaterals, and the attempt to impose an anastomosis was not possible.

Picture 5 - X-ray picture of the right femur in direct projection after sequestrationrectomy, dismantling of the Ilizarov frame of the right thigh

Surgery was performed in the following volume: "Removal of a cement spacer, free non-vascularized autograft of a fibular fragment in order to replace a bone defect of the right femur. Intramedullary osteosynthesis of an autograft with a spoke. Pre-installation of the Ilizarov frame of the right thigh" (Picture 4).

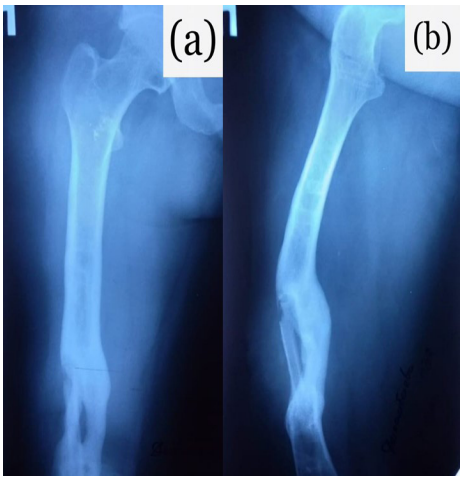
No complications were observed in the early post-surgery period. Post-surgery wounds healed by primary tension 14 days after surgery.

In November 2017, in order to stimulate and improve the reparative and integrative processes of the bone autograft of the right femur, PRP therapy was applied on an outpatient basis to the site of the implanted graft.

In November 2018, the Ilizarov frame of the right thigh was dismantled (Picture 5).

48 months after the surgery, the functional condition of the operated limb is satisfactory (Picture 6). The patient moves without external means of support with a full axial load on the limb.

The authors obtained a written informed consent of the patient for the dissemination of medical information.



Picture 6 - A control X-ray picture of the right thigh in 2 projections 48 months after the dismantling of the Ilizarov frame. Hypertrophy of the graft is visualized, ossification of the remainder of the medial part of the periosteum in the area of the femoral defect. In the lateral projection, the recurve deformation of the right femur is visualized. The axis of the lower limb is preserved

Discussion

Replacement of extensive defects of tubular bones remains an urgent problem at the present time. Existing methods of replacing extensive defects of tubular bones have a number of limitations that do not allow using them as a monomethod in the presence of osteomyelitis [2].

Thus, the use of bone allograft has such advantages as the absence of a donor site wound and virtually "unlimited" graft volume. At the same time, the main disadvantages of this method are the limited use of allografts affected by osteomyelitis, preservation of the risk of transmission of vector-borne diseases, variable osteoinductive properties, the high cost of allografts, which did not allow applying them in our case. [2,16,17].

The existing induced membrane technique or Masquelet is the method of choice against the background of osteomyelitis as in our clinical case. The possibility of filling in extensive defects, the use of both external and internal fixation of the bone and the low cost allows active use of the presented method. The disadvantages of the Masquelet technique are the need to use a two-stage defect replacement technique and a long reconstructive period when using an external fixation device (9 months on average) [2,16].

After the introduction of the technique of fibular graft transplantation on the vascular pedicle, the advantages of this method became obvious. The reconstruction time of a large defect has significantly decreased compared to the use of Ilizarov technique or Masquelet technique, and the possibility of graft hypertrophy, which will allow maintaining a higher load on the limb. The disadvantages of the presented technique are the presence of a donor site wound, the need to possess microsurgical skills and the availability of microsurgical instruments [2]. Free transplantation of a vascularized fibular graft in one stage in the presence of osteomyelitis was described by Sun Y. and co-authors. In this study, a vascularized fibular graft was transplanted immediately after the rehabilitation of the infection focus. Graft consolidation occurred in an average of 4.5 months, full axial load became possible in an average of 9 months. No cases of osteomyelitis recurrence were observed during 26 months of follow-up [10].

The use of a non-vascularized fibular graft was described in a study by Tang Y.-W. and Lin K.-C. as the second stage of surgical treatment. In 25 out of 27 cases, graft consolidation was achieved. On average, after 7.8 months (6-11 months), patients returned to their daily activity. Graft hypertrophy was described in 15 cases two years after surgery [11]. Also in the study, Siyi Liu and co-authors evaluated the functional results in patients with non-vascularized and vascularized grafts according to the MSTS scale (Musculoskeletal Tumor Society) there was no significant difference between non-vascularized and vascularized grafts [16].

The methods of bilocal and polylocal osteosynthesis make it possible to eliminate extensive bone defects and can be used when other methods of reconstruction are ineffective [12,13]. A systematic review of C. Papakostidis and co-authors showed the effectiveness of the Ilizarov method of distraction osteogenesis, in addition, the use of the Ilizarov frame reduced the risk of infection against osteomyelitis. The authors also describe the frequency of repeated fractures – 5%, neurovascular complications – 2.2% and amputations – 2.9% in this study [5].

Due to the course of chronic osteomyelitis in the case described by us, it was not possible to use a bone allograft, a non-vascularized or vascularized fibular graft to replace the defect in one stage. Since the femur was already fixed by the Ilizarov frame, it was decided not to change the fixation method due to unsatisfactory results when using intramedullary rods on the background of osteomyelitis [14,15]. It was decided to use the Masquelet technique as the first stage for the formation of an induced membrane and for the purpose of local therapy of osteomyelitis. Taking into account the persistent remission of osteomyelitis after the first stage of surgery, the patient underwent replacement of the defect with a fibular graft on the vascular pedicle. Despite the impossibility of applying vascular anastomosis in this clinical case, the necessary clinical results were achieved.

Conclusion

The combination of Masquelet technique and free bone grafting with fibular graft with Ilizarov fixation has shown its effectiveness against the background of chronic osteomyelitis. In this clinical case, we represent a patient with a femoral defect up to 9.5 cm. affected by chronic osteomyelitis. The graft was fully integrated into the femur, hypertrophy of the graft occurred, ossification of the remainder of the medial part of the periosteum in the area of the femoral defect. A full axial load on the operated limb became possible, the patient returned to her daily activity.

Conflict of interest. The authors declare that there is no conflict of interest.

Contribution of the authors. Performing surgery, conceptualization – S.B.; Performing surgery, methodology – Zh.R.; Performing surgery, writing (review and editing) – A.D.; Performing surgery, verification – R.A.; Performing surgery – A.M.; Writing (review and editing) – A.K.; Writing (original draft paper) – A.A.; Writing (original draft paper) – A.B.; Writing (original draft paper) – Y. A.

All authors have read, agreed with the final version of the manuscript and signed the copyright transfer form.

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Посттравматикалық остеомиелиттен зардап шеккен феморальды ақауды тамырлы емес фибулярлы автотрансплантатпен ауыстыру: клиникалық жағдай

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Түйіндеме

Остеомиелит фонында түтік тәрізді сүйектердің кең ақауларын ауыстыру бүгінгі күннің өзекті мәселесі болып қала береді. Мұндай ақауларды Илизаров аппаратымен билокальды остеосинтез арқылы немесе бос фибулярлы автотрансплантацияны қолдану арқылы ауыстырудың қолданыстағы әдістері әрқашан қолданыла бермейді.

Маскеле индукцияланған қабықшасының перонеальды трансплантатпен сүйек аутопластикасымен біріктірілген әдістемесін қолданудың клиникалық жағдайы және Илизаров аппаратын қолдану көрсетілген. 2015 жылдың желтоқсан айында жол-көлік оқиғасы салдарынан 33 жастағы науқас зардап шекті. Кейіннен остеомиелиттің дамуы байқалады. Операция және остеомиелит ағымы нәтижесінде жамбас сүйегінің 9,5 см-ге дейін кең ақауы түзілді.Кейіннен екі кезеңді хирургиялық емдеудің бірінші кезеңі – секвестрэктомия, Илизаров аппаратын қайта орнату, монтаждау жүргізілді. оң жақ сан сүйегінің түзілген сүйек кемістігіне Maskelet әдісі бойынша антибиотикі бар уақытша цемент төсемі. 4 айдан кейін хирургиялық емдеудің екінші кезеңі орындалды - оң жақ сан сүйегінің сүйек ақауын ауыстыру үшін фибула фрагментінің еркін автотрансплантациясы. Сүйек аутотрансплантатының репаративті және интегративті процестерін ынталандыру және жақсарту мақсатында соңғы операциядан кейін 10 айдан кейін PRP терапиясы жасалды.

Хирургиялық емдеудің екінші кезеңінен кейін 21 айдан кейін рентген сәулесінің көмегімен фибуланың бос фрагментінің консолидациясы анықталды, Илизаров аппараты бөлшектелді. Операцияның екінші кезеңінен 48 айдан кейін функционалдық жағдайы қанағаттанарлық, оң жақ төменгі аяқ-қолында толық тірек жүктемемен қозғалады. Ұсынылған клиникалық жағдайда Маскелет техникасын, бос перонеальді автотрансплантацияны және Илизаров аппаратымен остеосинтезді біріктіру қанағаттанарлық функционалды нәтижелерге қол жеткізуге мүмкіндік берді.

Түйін сөздер: Илизаров аппараты, сүйек ақауы, реконструкция, бос сүйек аутотрансплантаты, маска, индукциялық мембрана.

Замещение дефекта бедренной кости, пораженного посттравматическим остеомиелитом, неваскуляризированным малоберцовым аутотрансплантатом: клинический случай

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Резюме

Замещение обширных дефектов трубчатых костей на фоне остеомиелита остается актуальной проблемой на сегодняшний день. Существующие способы замещения таких дефектов методом билокального остеосинтеза аппаратом Илизарова или применением свободного малоберцового аутотрансплантата не всегда применимы.

Представлен клинический случай применения комбинированной методики индуцированной мембраны Маскеле с костной аутопластикой малоберцовым трансплантатом и применением аппарата Илизарова. Больной 33-х лет получил травму в декабре 2015 года в результате дорожно-транспортного происшествия. В последующем отмечается развитие остеомиелита. В результате операции и течения остеомиелита образовался обширный дефект бедренной кости до 9,5 см. Далее выполнен первый этап двухэтапного хирургического лечения – секвестрнекрэктомия, перемонтаж аппарата Илизарова, установка временной цементной прокладки с антибиотиком в сформированный костный дефект правой бедренной кости по методике Маскелета. Через 4 мес выполнен второй этап оперативного лечения – Свободный аутотрансплантат фрагмента малоберцовой кости с целью замещения костного дефекта правой бедренной кости.

С целью стимуляции и улучшения репаративных и интегративных процессов костного аутотрансплантата через 10 мес после последней операции проводилась PRP-терапия. Через 21 месяц после второго этапа хирургического лечения с помощью рентгенографии установлена консолидация свободного фрагмента малоберцовой кости, демонтирован аппарат Илизарова. Через 48 мес после второго этапа операции функциональное состояние удовлетворительное, передвигается с полной опорной нагрузкой на правую нижнюю конечность. В представленном клиническом случае сочетание техники Маскелет, свободного малоберцового аутотрансплантата и остеосинтеза аппаратом Илизарова позволило добиться удовлетворительных функциональных результатов.

Ключевые слова: аппарат Илизарова, костный дефект, реконструкция, свободный костный аутотрансплантат, маскалет, индуцированная мембрана.