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Case report

# Differentiated approach to the treatment of patients with consequences of multiple localization hematogenous osteomyelitis (Clinical case)

Yuriy E. Garkavenko[1, 2], Nikolay M. Belokrylov[3]

[1] H. Turner National Medical Research Center for Children's Orthopedics and Trauma Surgery, Saint Petersburg, Russia;
[2] North-Western State Medical University named after I.I. Mechnikov, Saint Petersburg, Russia;
[3] Regional Children's Clinical Hospital, Perm, Russia

***BACKGROUND:*** Treatment of children after hematogenous osteomyelitis is a serious problem that requires a comprehensive solution, particularly with regard to cases of multiple lesions of the musculoskeletal system, when the task of stabilizing, restoring, and maintaining the function of the affected joints is of primary importance, followed by the restoration of the length and correction of the shape of the affected limb segments. At the same time, damage to the metaepiphyseal growth zones of long bones during the child's growth causes relapses of the deformity, which necessitates staged and differentiated treatment.

***CLINICAL CASE:*** The paper describes a clinical case of a patient with a history of postpartum epiphyseal disseminated osteomyelitis with lesions of the hip, left knee, left elbow, and right radiocarpal joints. After a septicemic condition, damage to the heads and necks of the femoral bones resulted in high pathological hip dislocations. Hip arthroplasty was performed consecutively to the patient at the age of 7 and 8 years, using demineralized osteocartilaginous allografts which shortened osteotomies of the femoral bones. At the age of 13 years old, lengthening of the left femur with correction of the axis of the lower limb affected segment was performed. A satisfactory clinical result was obtained.

***DISCUSSION:*** Many authors refrain from using organ-preserving surgical aids, or are unable to use them, in pathological hip dislocations, relying on early arthroplasty. However, the service life of a native joint and an endoprosthesis necessitates searching for ways to extend the functional suitability of a native musculoskeletal system, especially during the period of a child's growth. That is why the use of organ-preserving interventions in children with the consequences of osteomyelitis is advisable even from these considerations. The lower limb length can also be restored due to the affected femur and is advisable without loss of stability in the previously operated hip joint, provided that it is surgically or conservatively unloaded.

***CONCLUSIONS:*** Hip arthroplasty using demineralized osteocartilaginous allografts is the method of choice in pediatric patients with destructive pathological hip dislocations after osteomyelitis, in order to restore and preserve the joint function. An individual rehabilitation program should be chosen taking into account not only the deformities, but also the adaptation of the affected segment to the conditions of its functioning. With full functional adaptation of the limb deformed segment, its correction is not of primary importance and inappropriate in some cases.

**Keywords:** osteomyelitis; pathological high hip dislocation; umbilical sepsis; arthroplasty; organ-preserving interventions on the hip joint; demineralized osteocartilaginous allograft; knee joint deformity; femur shortening.

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Клинический случай

# Дифференцированный подход к лечению пациентов с последствиями гематогенного остеомиелита множественной локализации (клиническое наблюдение)

Ю.Е. Гаркавенко[1, 2], Н.М. Белокрылов[3]

[1] Национальный медицинский исследовательский центр детской травматологии и ортопедии им. Г.И. Турнера, Санкт-Петербург, Россия;
[2] Северо-Западный государственный медицинский университет имени И.И. Мечникова, Санкт-Петербург, Россия;
[3] Краевая детская клиническая больница, Пермь, Россия

***Обоснование.*** Лечение детей после перенесенного гематогенного остеомиелита представляет серьезную проблему, подразумевающую комплексное решение. Особенно это касается случаев множественного поражения опорно-двигательного аппарата, когда на первый план выступает задача стабилизации, восстановления и сохранения функции пораженных суставов, а на второй — восстановление длины и коррекция формы пораженных сегментов конечностей. При этом поражение метаэпифизарных зон роста длинных костей в процессе роста ребенка вызывает рецидивы деформации, что приводит к необходимости осуществления этапного и дифференцированного лечения.

***Клиническое наблюдение.*** В работе описано клиническое наблюдение за больным, перенесшим послеродовой эпифизарный диссеминированный остеомиелит с поражением тазобедренных, левого коленного, левого локтевого и правого лучезапястного суставов. После септического состояния сформировались высокие патологические вывихи бедер в результате поражения головок и шеек бедренных костей. Последовательно в 7- и 8-летнем возрасте больному выполнена артропластика тазобедренных суставов с применением деминерализованных костно-хрящевых аллотрансплантатов, укорачивающих остеотомий бедренных костей. В возрасте 13 лет проведено удлинение левого бедра с коррекцией оси пораженного сегмента нижней конечности. Получен удовлетворительный клинический результат.

***Обсуждение.*** Многие авторы при патологических вывихах бедер воздерживаются или не имеют возможности использовать органосохраняющие хирургические пособия, полагаясь на раннее эндопротезирование. Однако сроки службы собственного сустава и эндопротеза заставляют искать пути продления функциональной пригодности собственного опорно-двигательного аппарата, особенно в период роста ребенка. Именно поэтому применение органосохраняющих вмешательств у детей с последствиями остеомиелита целесообразно даже из этих соображений. Восстановление длины нижней конечности за счет пораженного бедра также возможно и целесообразно без потери стабильности в ранее оперированном тазобедренном суставе при условии его оперативной или консервативной разгрузки.

***Заключение.*** Артропластика тазобедренных суставов с использованием деминерализованных костно-хрящевых аллотрансплантатов является методом выбора у детей с деструктивными патологическими вывихами бедер после перенесенного остеомиелита с целью восстановления и сохранения функции суставов. Выбор индивидуальной программы реабилитации следует осуществлять с учетом не только деформаций, но и адаптации пораженного сегмента к условиям его функционирования. При полной функциональной адаптации деформированного сегмента конечности его коррекция представляется не первостепенной и в ряде случаев нецелесообразной.

**Ключевые слова:** остеомиелит; патологический высокий вывих бедра; пупочный сепсис; артропластика; органосохраняющие вмешательства на тазобедренном суставе; деминерализованный костно-хрящевой аллотрансплантат; деформация коленного сустава; укорочение бедра.

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ЭКО•ВЕКТОР

## BACKGROUND

The treatment of children with a history of hematogenous osteomyelitis represents a serious problem that requires a comprehensive solution [1, 2]. This is certainly true in early severe forms of epiphyseal osteomyelitis with bone epiphyseal and metaepiphyseal growth zone destruction, which leads to various deformities in the further growth process of the child and limb segment shortening [3, 4]. A deep infection in a hip joint lesion often causes osteolysis of the femoral proximal metaepiphysis, and normal joint function becomes impossible due to the femoral head and neck destruction. Pathological hip dislocation is an outcome of such conditions [5].

The organ-sparing surgical interventions for such severe orthopedic defects are not almost discussed by international literature. Starting from adolescence, early arthroplasty in these cases is usually used [6]. However, the philosophy of the organ-sparing approach suggests that the conditions for restoring the support capacity of the joints in pediatric patients after epiphysis osteolysis should be created by modeling or the maximum possible restoration of the supporting bone areas [7, 8]. The search for such methods continues. These problems have been solved at the H.I. Turner National Medical Research Center for Children's Orthopedics and Trauma Surgery for >30 years using original technologies based on the use of demineralized bone and cartilage allografts. Experience has been accumulated in the use of these methods in bilateral pathological hip dislocations [9, 10]. The problem of preserving and prolonging the life of the patient's joint is newly discovered; however, it persists because new orthopedic disorders, shortening, and deformities of limb segments may occur in the growth process and development of a child, and the degree of joint stability may change [10, 11].

International authors mainly focus on early and accurate osteomyelitis diagnostics, which leads to decreased hazardous complications, which the reality is recognized by all experts [12–18]. However, despite the expansion of indications for early hip arthroplasty in pediatric patients [6], the relevance of the organ-sparing approach is extremely high and undeniable, including the preservation of support using own tissues, staged solution of issues of biomechanical favorability, and functional adaptation of the child in the growth process. Additionally, international authors point out the importance and possibility of using the greater trochanter in pediatric patients, the Ilizarov apparatus, to maintain the stability and functionality of the hip joint when using organ-sparing techniques, and the need to develop a flexible treatment approach for such patients. However, such reports are rare [19–22]. The available literature from international authors did not reveal the use of demineralized allografts to create a supporting remodeled surface of the femur after the lysis of its articular surface. All authors support the relevance of a holistic approach to patient treatments, but the solutions can be very diverse, and the complexity of choosing the surgical treatment approach remains indisputable. Multiple, multi-level growth zone lesions of the bones after osteomyelitis necessitates the staged orthopedic correction. Here, we present the treatment of a patient with severe consequences of osteomyelitis.

## CLINICAL CASE

Patient P., aged 14 years, who had a history of disseminated hematogenous osteomyelitis in the neonatal period, with lesions of the hip, left knee, left elbow, and right radiocarpal joints, was conservatively under our follow-up. Active surgical aids were not provided to the child after birth, and he was treated. At the age of 3 years, an unsuccessful attempt was made at the primary healthcare facility to close the femoral bone reduction with adductor muscle tenotomy and subsequent Vilensky splint treatment due to the formation of pathological hip dislocations. Stabilization of the hip joints was not achieved due to the developed femoral head and neck lysis.

The child was admitted to the H.I. Turner National Medical Research Center for Children's Orthopedics and Trauma Surgery at the age of 6 years. He underwent surgical interventions to stabilize the hip joints, with an interval of 1.5 years. Therefore, in 2014 and 2015, hip arthroplasty was successively performed using demineralized bone and cartilage allografts. Concurrently, shortening detorsion osteotomies of the femoral bones were performed for joint decompression (Fig. 1).

Regular rehabilitation measures in the postoperative period and the long term enabled stability maintenance and satisfactory hip joint function to date (Fig. 2).

Concurrently, other anatomical and functional disorders of the affected limb segments appeared in the growth process, namely, left femur shortening and left femur and tibia antecurvation deformity, which imitates knee joint flexion contracture, as well as left elbow joint varus deformity (2020) (Fig. 3).

Deformities 1, 2, and 3 required surgical correction. However, the patient was left-handed and the adaptation level to the left elbow joint work was very high. He is a prize-winner of the Russian championship and winner and prize-winner of many other All-Russian wheelchair tennis competitions in doubles and singles. Hence, we refrained from offering him a correction of the varus deformity of the left upper limb in the absence of complaints, at least at present time.

In this situation, lameness, leg size discrepancy, axial deformity, pelvic torsion during walking, and limited left knee joint extension became an indication for staged surgical treatment. The hip joints retained full extension with free

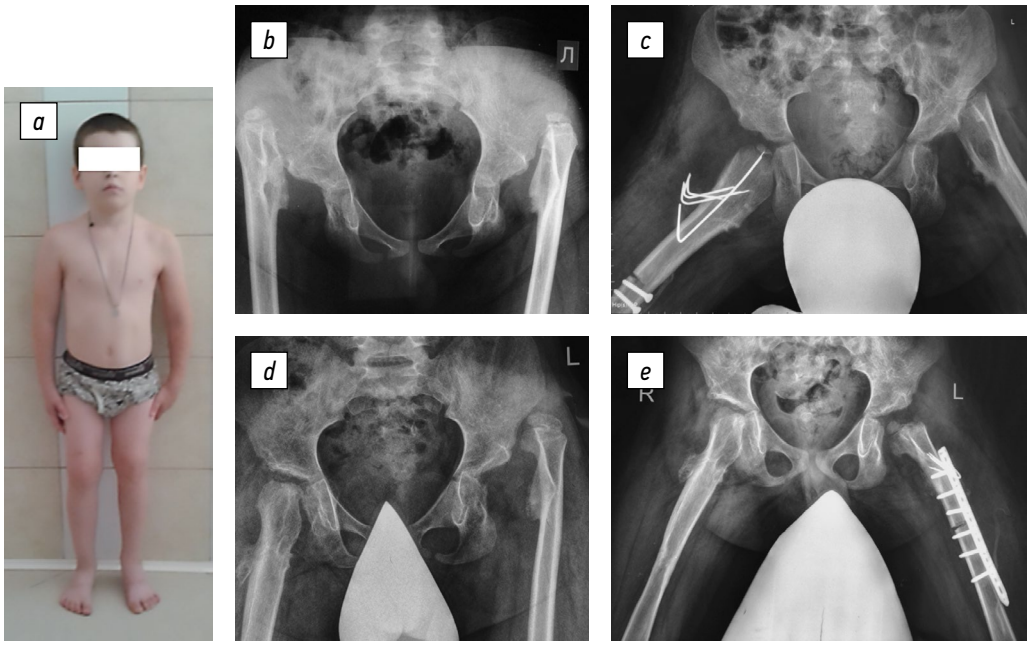


**Fig. 1.** Appearance of the patient (*a*) and hip joint radiographs before (*b*) and at their surgical stabilization stages (*c–e*)

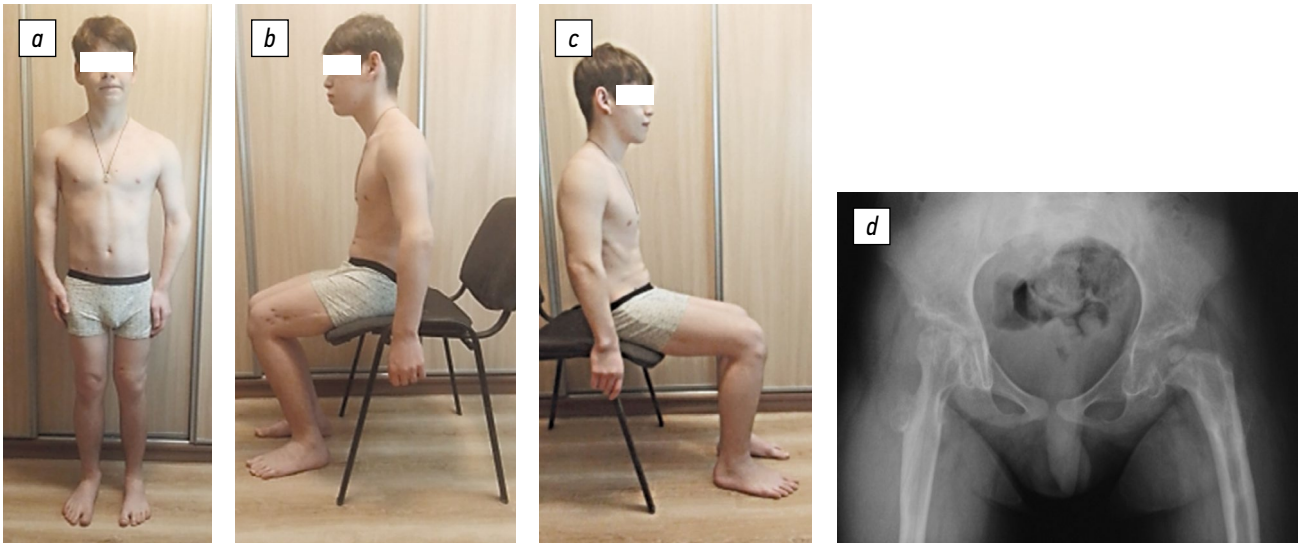


**Fig. 2.** Appearance of the patient (*a–c*) and hip joint radiograph (*d*) after hip joint stabilization and left femur lengthening (2021)

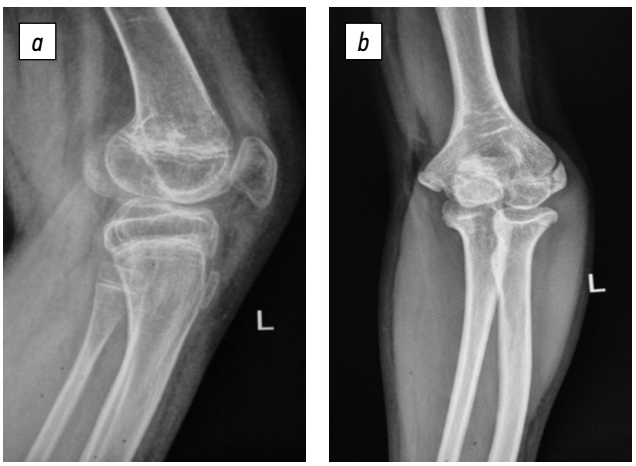


**Fig. 3.** Left knee (*a*) and elbow (*b*) joint deformities at the treatment stage

flexion of up to 90°, abduction possibility of 25°–30°, and total rotation on each side of 15°–20° before the last surgical correction of the left femur in its distal part. The support ability of the left knee joint was reduced due to the rigid restriction of the extension within 15°, flexion of 30°, and an external rotational positioning of the left lower limb. A corrective detorsion-varus extensor osteotomy with fixation using the Ilizarov apparatus was performed in February 2021 to restore the left lower limb length and eliminate the left femur deformity in its lower third. Additionally, the hip joint was fixed with an apparatus to maintain stability and ensure unloading of the left hip joint at the time of distraction and for 4 weeks after its completion (Fig. 4). The load on the operated lower limb was permitted the next day postoperatively. The total left femur elongation was 4 cm along with deformity correction.

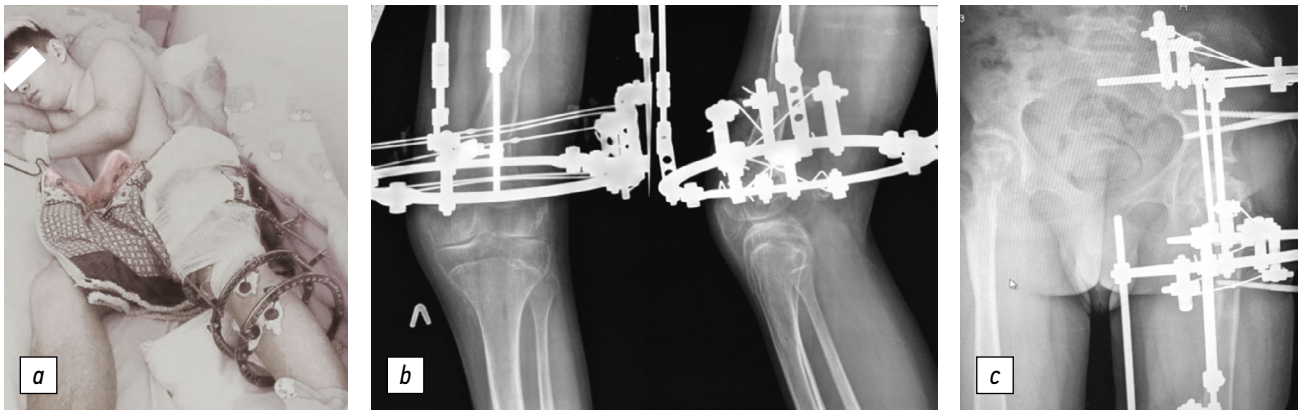


**Fig. 4.** Photograph of the patient (*a*) and left knee (*b*) and hip (*c*) joint radiograph at the stage of left femur lengthening

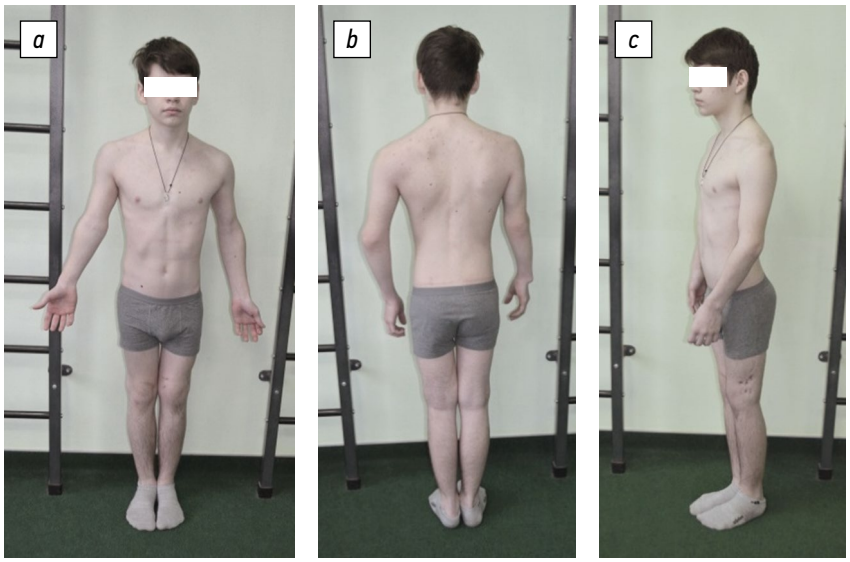


**Fig. 5.** Photographs of the patient (*a–c*) after the treatment completion. The length of the left lower limb was restored, and the left knee joint deformity was corrected

The difference in the length of the lower limbs was eliminated because of surgical intervention, and the patient was able to fully extend the knee joint. Pelvic torsion and static spinal deformity were eliminated. The patient continues rehabilitation and is satisfied with the result (Fig. 5).

## DISCUSSION

Treatment of patients with multiple joint lesions after osteomyelitis continues during the child's growth [3, 11, 23]. Over time, the patient may require hip arthroplasty [6]. However, the service life of the patient's joint and endoprosthesis should be commensurate with the duration of the functional activity of a person and his life. Therefore, organ-preserving interventions are performed [7–10, 19, 21–23].

Femur lengthening is possible while maintaining the stability of the affected hip joint after organ-sparing interventions [8, 10]. An important prerequisite, in this case, is the creation of the joint decompression during the distraction, which in turn ensures its stability. The variant of maintaining stability in the affected hip joint presented in the clinical case should not be taken as a dogmatic assertion. There are other well-established variants of joint decompression during femur lengthening, in particular, tibial cuff traction in the position of moderate lower limb abduction [23]. Another segment (tibia) for restoring the lower limb length may be limited by ankle joint contracture and the patient's unwillingness to obtain a different knee joint level position after elongation. Notably, intervention on an unaffected segment in the postoperative period can lead to complications, which can occur in anyone, and another affected segment of the lower limb is undesirable.

At present, the amplitude of flexion in the hip joints reaches 90°, with abduction amplitude of 25°–30° and rotational movements of 15°–20° in a patient with full extension. Full extension of the tibia was restored, but the limitation of the left knee joint flexion amplitude (0/0/45°) persists, and the rehabilitation process continues. The patient is favorable

from the point of view of orthopedic rehabilitation prospects, as he is an athlete, and set his mind on a good functional result. Currently, the biomechanical axis of the lower extremities has been restored, and the physiologically favorable range of motion in all large joints of the upper and lower extremities has been preserved. Confidently, the patient will preserve a state of good functional compensation for a long time as the growth is completed.

## CONCLUSION

Hip arthroplasty, using demineralized bone and cartilage allografts to restore and preserve joint function, is the method of choice in pediatric patients with destructive pathological hip dislocations after osteomyelitis.

Unloading the affected hip joint in the process of hip lengthening, as well as in subsequent rehabilitation, maintain its stability and satisfactory functional characteristics for a long time.

An individual rehabilitation program should be chosen, considering not only the existing deformities but also the affected segment and the conditions of its functioning. Correction is not paramount in the case of complete functional adaptation of the deformed limb segment and is inappropriate in some cases.

## ADDITIONAL INFORMATION

**Funding.** The study had no external funding

**Conflict of interest.** The authors declare no conflict of interest.

**Ethical considerations.** The patient's parents agreed to conduct the study and publish the patient's treatment data and results.

**Author contributions.** *Yu.E. Garkavenko* created the study concept and design, analyzed the data, processed the material, edited the manuscript, performed surgical treatment of the patient, and determined the approach of the child's treatment at further stages. *N.M. Belokrylov* analyzed the data, processed the material, analyzed the literature sources, wrote the manuscript, performed femur correction and lengthening, as well as staged surgical and conservative rehabilitation of the pediatric patient.

All authors made a significant contribution to the study and article preparation, as well as read and approved the final version before its publication.

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## AUTHOR INFORMATION

**Yuriy E. Garkavenko**, MD, PhD, Dr. Sci. (Med.);
ORCID: https://orcid.org/0000-0001-9661-8718;
Scopus Author ID: 57193271892; eLibrary SPIN: 7546-3080;
e-mail: yurijgarkavenko@mail.ru

*** Nikolay M. Belokrylov**, MD, PhD, Dr. Sci. (Med.),
Assistant Professor, Honored Doctor of Russian Federation;
address: 17a Bauman str., Perm, 614066, Russia;
ORCID: https://orcid.org/0000-0002-9359-034X;
eLibrary SPIN: 7649-8548; e-mail: belokrylov1958@mail.ru

## ОБ АВТОРАХ

**Юрий Евгеньевич Гаркавенко**, д-р мед. наук;
ORCID: https://orcid.org/0000-0001-9661-8718;
Scopus Author ID: 57193271892; eLibrary SPIN: 7546-3080;
e-mail: yurijgarkavenko@mail.ru

*** Николай Михайлович Белокрылов**, д-р мед. наук, доцент, заслуженный врач РФ;
адрес: Россия, 614066, Пермь, ул. Баумана, д. 17а;
ORCID: https://orcid.org/0000-0002-9359-034X;
eLibrary SPIN: 7649-8548; e-mail: belokrylov1958@mail.ru

* Corresponding author / Автор, ответственный за переписку