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REHABILITATION STRATEGIES FOR PATIENTS WITH SARCOMAS: A LITERATURE REVIEW

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ABSTRACT

Relevance: *Due to modern treatment methods, sarcoma patients' survival rate is increasing. Rehabilitation helps to minimize physical and functional limitations caused by aggressive therapy, improves mental health, and promotes social and professional adaptation. Since sarcoma predominantly affects working-age people, rehabilitation plays a key role in restoring body functions, improving the quality of life, and reintegrating patients into society.*

The study aimed to *analyze the scientific literature on modern approaches to rehabilitating sarcoma patients.*

Methods: *A search and selection of articles were conducted in the Pubmed, Web of Science, Scopus, and RSCI databases using the main keywords and phrases: «orthopedic oncology,» «sarcoma,» «rehabilitation,» and «rehabilitation strategies.» The review included articles published within the last 10 years relevant to the topic. Case reports, correspondence, letters, and studies not conducted on humans were excluded from the review.*

Results: *The article presents data on selecting the most effective rehabilitation technologies for sarcoma patients and provides arguments for implementing new approaches and methods into clinical practice. Rehabilitation is divided into several main types: medical (which involves physiotherapy, the use of medications, etc.), physical (based on the restoration of the range of motor functions, coordination, and strength), psychological (includes work on the patient's psycho-emotional state), social (implies the patient's return to social activity, assistance in the adaptation period), rehabilitation using modern technologies (assistance from robotic systems, computer simulation of augmented virtual reality, the use of smartwatches and fitness bracelets).*

Individually selected and adapted rehabilitation concepts within a multidisciplinary and interdisciplinary setting are essential for optimizing function in patients with sarcoma.

Conclusion: *Rehabilitation of patients with sarcoma is not only a medical but also a social task. Successful recovery of patients contributes to their full return to active life, which is of critical social importance.*

Keywords: *sarcoma, rehabilitation, multidisciplinary approach, modern rehabilitation technologies.*

Introduction: Currently, sarcomas account for about 1% of all malignant neoplasms in adults and 15% in children and adolescents. Sarcomas are characterized by rapid growth, propensity to metastasize, and high risk of recurrence, which complicates prognosis and requires regular follow-up. Treatment of sarcomas often involves surgery, including amputations or extensive resections, as well as the use of chemotherapy, radiation, and beam therapy, which is often accompanied by serious physical and psychological consequences that significantly reduce the quality of life of patients and require special attention.

According to the Kazakh Research Institute of Oncology and Radiology (hereinafter referred to as KazNIIOIR, Almaty, Kazakhstan), in 2023, the incidence of sarcomas amounted to 0.9% of all malignant neoplasms. There were 1,250 new cases, of which 60% were soft tissue sarcomas and 40% were bone sarcomas [1].

The most common sarcomas are osteosarcoma, chondrosarcoma, and Ewing sarcoma. The five-year survival rate varies depending on the type of sarcoma and the stage of the disease: in the early stages, the survival rate can reach 70-80%, while in advanced stages it decreases to 20-30% [2, 3].

Modern treatment methods, such as targeted therapies and improved surgical approaches, help improve the survival of patients with sarcomas but increase the number of patients requiring long-term rehabilitation [3, 4].

Motor difficulties, chronic and phantom pain, and psychological disorders, including depression and anxiety, may occur after treatment. Since sarcomas most often occur in working-age people, rehabilitation plays a key role in restoring body function, improving quality of life, and minimizing the effects of aggressive treatment.

Numerous studies have confirmed the need for restorative treatment immediately after surgery in orthopedic oncologic patients. Lack of timely comprehensive rehabilitation often leads to unsatisfactory functional

outcomes. Full rehabilitation significantly improves functional performance. Regardless of the nature of the surgical intervention (including mutilation), the patient's functional activity level is a key factor affecting quality of life. Among the main tasks of rehabilitation of sarcoma patients are their early activation, contributing to the stabilization of hemodynamics, and prevention of cardiopulmonary, thrombotic, and other postoperative complications, including those caused by prolonged immobilization. Moreover, rehabilitation is aimed at preparing patients for upright posture and learning to walk. After organ-preserving surgeries in orthopedic oncology, there is a significant association between mobility limitation in the operated joints, functional indices, and quality of life of patients [5-9].

Rehabilitation of cancer patients should begin as early as possible and continue throughout life.

The study aimed to analyze the scientific literature on modern approaches to rehabilitating sarcoma patients.

Materials and Methods: The search and selection of articles in Pubmed, Web of Science, Scopus, and RINC databases by main keywords and word combinations were carried out: "orthopedic oncology," "sarcoma," "rehabilitation," and "rehabilitation strategies." The review included articles no more than 10 years old that were relevant to the subject of this review. Case reports, correspondence, letters, and studies not conducted on humans were excluded from the review.

Results: Rehabilitation in orthopedic oncology is a branch of medicine that continues to improve in line with advances in cancer science.

This article summarizes the existing literature on sarcoma rehabilitation and provides a comprehensive review of the effects of various rehabilitation interventions that can be used as a basis for individualized rehabilitation in clinical practice.

It is important to note that the number of scientific studies on sarcoma patients' rehabilitation is small.

In recent years, there has been increased recognition of the importance of rehabilitation in optimizing function in sarcoma patients [10]. Rehabilitation should be comprehensive [11]. A multidisciplinary rehabilitation team may include a physical therapist, nurse, occupational therapist, speech therapist, orthopedist, prosthetist, social worker, psychologist, and dietitian [12]. Although people may not need all these services, they should be available wherever cancer care is provided.

A multidisciplinary rehabilitation plan can help minimize symptoms and sequellae that adversely affect a patient's function and quality of life, including chemotherapy-induced pain, peripheral neuropathy, radiation fibrosis, activity limitations after surgical removal, amputation, bowel and bladder dysfunction, and lymphedema.

Rehabilitation prior to cancer treatment, known as pre-rehabilitation, may help to increase tolerance to toxic and harmful side effects [13]. And while pre-rehabilitation can potentially improve chemotherapy tolerance, a key component of pre-treatment rehabilitation is patient counseling. If a choice must be made between limb salvage and amputation, patients should be fully informed of the advantages and disadvantages of each procedure, including potential functional deficits.

Immediately after surgery, patients can benefit from inpatient rehabilitation.

Patients who undergo amputation due to sarcoma have been shown to make significant progress during inpatient rehabilitation compared to a control group with a dysvascular lesion, with the majority being discharged home [14]. The goal of rehabilitation at this stage is primarily to strengthen the patient and provide adaptive equipment and strategies to address functional deficits for a safe discharge home. It includes physiotherapy, medication, physical therapy (PT), massage, ultrasound therapy and electrophoresis. It is known that physical therapy is characterized by certain criteria such as frequency, intensity, and type (e.g., strengthening, endurance, and functional exercises) [15]. Exercises affect functional impairment by improving balance, muscle strength, and endurance, relieving cancer-related fatigue, and enhancing physical abilities [16]. It is believed that exercises increase patients' self-confidence and stabilize psychological well-being. When choosing this rehabilitation, patients face several limitations, such as a limited number of specialized centers, especially in remote regions, and a lack of qualified specialists with experience in working with cancer patients. It was essential to recall individual limitations, which can significantly limit the choice of rehabilitation methods.

For cancer patients, psychological problems begin at the time of diagnosis, so the earlier psychological rehabilitation begins, the better it will be for the patient and his/her family members.

A mental health professional with expertise in functional loss and chronic illness is an invaluable member of the interdisciplinary team for many cancer patients. Cancer diagnosis and treatment can be a traumatic experience that patients tolerate differently, and patients undergoing sarcoma treatment are at increased risk of developing anxiety, depression, and adjustment disorders associated with grief from the loss of a limb [17].

This is true for all stages of the disease, including survival. In addition, patients with sarcoma are at increased risk of suicide [18].

Psychological support programs may include individual and group therapy with psychologists and psychotherapists [19, 20].

One of the important rehabilitation aspects is the return to an active social life, which includes vocational rehabilitation programs to help patients return to work or school [21], help with social adjustment, devel-

opment of social skills, and support in returning to an active life.

Helping patients return to school and work is also vital for restoring quality of life after sarcoma treatment. Returning to ordinary activities can improve the sense of well-being. Children and adolescents may require individualized learning plans in the short term after returning to school. For adults, perceptions of the employer's work environment are particularly important, and doctors play a crucial role in guiding any necessary changes in the workplace [22]. The patient's expected job duties should be listed, and guidelines should be provided for activities that can and cannot be performed. Any return to school or work after significant cancer treatment should be gradual and flexible, creating an opportunity for the patient to adjust to normal routines.

Not everyone can undergo inpatient rehabilitation, as not all hospitals, especially in remote regions, provide rehabilitation for cancer patients. Telemedicine has allowed online consultations with doctors, prescribing PT programs, and monitoring their implementation [11].

The telerehabilitation system allows a patient to consult with doctors and rehabilitate from any place with internet access. It also helps to save money and time to reach a rehabilitation center or hospital.

The development of modern medical technologies has allowed for the improvement of not only the methods of sarcoma treatment but also the methods of sarcoma patients' rehabilitation. Innovative methods accelerate recovery, improve accuracy in diagnosing complications, and improve patients' quality of life.

Robotic systems are now used to restore motor activity in patients after amputation or major surgery. For example, exoskeletons [23, 24] help patients with limited mobility strengthen muscles and learn to control prosthetic limbs and robotic simulators such as Lokomat et al. are used to restore gait and coordination.

3D technology is gradually introduced into rehabilitation. 3D printing is increasingly used to create customized prostheses and orthoses, which is especially important for patients with non-standard anatomy after tumor resection [20, 25].

Virtual reality technologies help rehabilitate motor functions, improve the skill of using a bionic prosthesis, and relieve pain. For example, virtual reality training helps patients restore motor function through interactive exercises [11, 26].

Rehabilitation methods currently include the use of modern technology, such as the use of fitness bracelets and smart watches to monitor vital signs and activity levels.

The implementation of artificial intelligence tools is actively promoted to analyze patient data, modify the rehabilitation plan according to the needs, and create personalized treatment programs based on the patient's clinical data [14].

Discussion: Integration of a multidisciplinary approach is one of the important modern approaches in rehabilitation. A multidisciplinary team is required for more effective rehabilitation, especially for oncological diseases. Oncologists, surgeons, rehabilitation therapists, physical therapists, psychologists, and social workers can be considered the main specialists of the team. The teamwork of these specialists is based primarily on the construction of an individualized rehabilitation plan.

Rehabilitation of patients with limb sarcomas is challenging, and the approach varies depending on the choice of surgical procedure as well as potentially associated medical complications [27]. Therefore, finding a way to adapt to a new life situation and return to work is a complex but important task for both the individual and society. It is also well known that rehabilitation needs after treatment vary considerably from one person to another [22].

An individualized rehabilitation plan is necessary to consider the patient's characteristics, such as the type and localization of sarcoma, the amount and nature of treatment received, age, gender, physical and psychological condition, allowing creation of the rehabilitation plan according to the patient's individual needs. This approach will allow for tracking the progress, making adjustments, and providing better rehabilitation.

Despite significant advances and modern medical technology, the rehabilitation field has limitations. The high cost of equipment such as exoskeletons and robotic systems limits availability. Specially trained specialists must effectively use technology; their training requires separate costs. Not all patients, especially older patients, can adapt to new technologies and rehabilitation methods. Ensuring that all the necessary specialists are available in one place is not always possible. Overloading the patient with various recommendations and procedures and possible contradictions in the approaches of different specialists can reduce the effectiveness of rehabilitation. Problems with integrating methods and the time dependency of organizing appointments and coordinating treatment can also slow patient recovery, making a multidisciplinary approach challenging in some situations.

In modern Kazakhstan, ensuring effective rehabilitation and improving palliative care for cancer patients is one of the objectives of the Comprehensive Plan to Combat Cancer in the Republic of Kazakhstan for 2023-2027 [28]. In this regard, introducing modern, proven practices in the system of rehabilitation of sarcoma patients in Kazakhstan is one of the important steps for the successful recovery of patients and ensuring a full quality of life.

The health of the working-age population is of great importance to society. Therefore, rehabilitation of sarcoma patients, which affects a predominantly working-age population, is not only a medical but also a social challenge. Successful recovery is an opportunity for

patients to return to an active life and reintegrate back into society.

Conclusion: Data on the complex rehabilitation measures for sarcomas are insufficient in the literature. The gap between rehabilitation studies and practice requires further action focused on disseminating and implementing available research findings. This review deepens the knowledge base by providing a comprehensive analysis of the effectiveness of these interventions.

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АҢДАТПА

САРКОМАСЫ БАР ПАЦИЕНТТЕРГЕ АРНАЛҒАН РЕАБИЛИТАЦИЯ СТРАТЕГИЯЛАРЫ: ӘДЕБИЕТТЕРГЕ ШОЛУ

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Өзектілігі: *Заманауи емдеу әдістерінің арқасында саркомасы бар науқастардың өмір сүру деңгейі артады. Реабилитация агрессивті терапиядан туындаған физикалық және функционалдық шектеулерді азайтуға көмектеседі, психикалық денсаулықты жақсартады, әлеуметтік және кәсіби бейімделуге ықпал етеді. Саркома көбінесе еңбекке қабілетті жастағы адамдарға әсер ететінін ескере отырып, реабилитация дене функцияларын қалпына келтіруде, өмір сапасын жақсартуда және қоғамға оралуда шешуші рөл атқарады.*

Зерттеудің мақсаты *саркомасы бар науқастарды реабилитацияның заманауи тәсілдері туралы ғылыми әдебиеттерді талдау болып табылады.*

Материалдары мен әдістері: *Pubmed, Web of Science, Scopus және РҒДИ дерекқорларында «онко-ортопедия», «саркома», «реабилитация», «реабилитация шаралары» сияқты негізгі түйінді сөздер мен сөз тіркестерін пайдаланып мақалаларды іздеу және таңдау жүргізілді. Шолу 10 жылдан аспайтын осы шолудың тақырыбына қатысты мақалаларды қамтыды. Бір реттік бақылау есептері, корреспонденциялар, хаттар және адамдарда жүргізілмеген зерттеулер шолуға қосылмаған.*

Нәтижелері: *Мақалада саркомасы бар науқастардың реабилитациясының ең тиімді технологияларын таңдауға қатысты деректер және жаңа тәсілдер мен әдістерді тәжірибеге енгізу бойынша ұсыныстарға қатысты дәлелдер келтірілді. Реабилитация бірнеше негізгі түрге бөлінеді: медициналық (физиотерапия жүргізу, дәрі-дәрмектер қолдану және т.б.), физикалық (қозғалыс функцияларын, үйлестіруді, күшті қалпына келтіруге негізделген), психологиялық (науқастың психоэмоционалдық жағдайымен жұмыс істеуді қамтиды), әлеуметтік (науқастың әлеуметтік белсенділікке оралуын, бейімделу кезеңінде көмек көрсетуді білдіреді), заманауи технологияларды пайдалану арқылы жүргізілетін реабилитация (роботтандырылған жүйелердің көмегі, толықтырылған виртуалды шындық компьютерлік симуляциясы, ақылды сағаттар мен фитнес-білезіктерді қолдану).*

Саркомасы бар науқастарда функцияны оңтайландыру үшін көпсалалы және пәнаралық тәсіл аясында жеке таңдалған және бейімделген реабилитация концепциялары маңызды рөл атқарады.

Қорытынды: *Саркомасы бар науқастардың реабилитациясы тек медициналық ғана емес, сонымен қатар әлеуметтік міндет болып табылады. Науқастардың табысты сауығуы олардың белсенді өмірге толық оралуына ықпал етеді, бұл жалпы қоғам үшін үлкен маңызға ие.*

Түйінді сөздер: *саркома, реабилитация, мультидисциплинарлық тәсіл, реабилитациядағы заманауи технологиялар.*

АННОТАЦИЯ

СТРАТЕГИИ РЕАБИЛИТАЦИИ ПАЦИЕНТОВ С САРКОМАМИ: ОБЗОР ЛИТЕРАТУРЫ

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Актуальность: *Благодаря современным методам лечения увеличивается выживаемость пациентов с саркомой. Реабилитация помогает минимизировать физические и функциональные ограничения, вызванные агрессивной терапией,*

улучшает психическое здоровье, способствует социальной и профессиональной адаптации. Учитывая, что саркома чаще всего приходится на людей трудоспособного возраста, реабилитация играет ключевую роль в восстановлении функций организма, улучшении качества жизни и возвращение в общество.

***Цель исследования** – анализ научных публикаций о современных подходах к реабилитации пациентов с саркомой.*

***Методы:** Был проведен поиск и отбор статей в базах данных Pubmed, Web of Science, Scopus, РИНЦ по основным ключевым словам и словосочетаниям: «онкоортопедия», «саркома», «реабилитация», «реабилитационные мероприятия». В обзор были включены статьи давностью не более 10 лет, относящиеся к тематике данного обзора. Отчеты о единичных наблюдениях, переписка, письма и исследования, не проводившиеся на людях, в обзор не включались.*

***Результаты:** В статье приведены данные касательно выбора наиболее эффективных технологий реабилитации больных с саркомой и приведены доводы относительно рекомендаций к внедрению в практику новых подходов и методов. Реабилитация подразделяется на несколько основных типов: медицинская (представляет собой проведение физиотерапии, применение медикаментов и др.), физическая (основана на восстановлении объёма двигательных функций, координации, силы), психологическая (включает работу над психоэмоциональным состоянием пациента), социальная (подразумевает возврат пациента к социальной активности, помощь в адаптационном периоде), реабилитация с использованием современных технологий (помощь роботизированных систем, компьютерной симуляции дополненной виртуальной реальности, использование умных часов и фитнес-браслетов).*

Индивидуально подобранные и адаптированные концепции реабилитации в рамках многопрофильной и междисциплинарной настройки имеют важное значения для оптимизации функции у пациентов с саркомой.

***Заключение:** Реабилитация пациентов с саркомой – не только медицинская, но и социальная задача. Успешное восстановление пациентов способствует их полноценному возвращению к активной жизни, что имеет большое значение для общества в целом.*

***Ключевые слова:** саркома, реабилитация, мультидисциплинарный подход, современные технологии в реабилитации.*

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