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Directions Of Rehabilitation of Patients Who Have Suffered Injuries of The Musculoskeletal System

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ABSTRACT

The paper studies the directions of rehabilitation of patients who have suffered injuries of the musculoskeletal system. The author notes that rehabilitation of patients after injuries of the musculoskeletal system is a complex and multifaceted process that includes many approaches and techniques. Each patient has his own individual picture of the damage, so the approach to his treatment and rehabilitation should be individual and comprehensive. Modern rehabilitation methods, such as virtual reality, robotics, transcranial magnetic stimulation, Internet of Things technologies, stem cells and three-dimensional printing, provide new opportunities for effective rehabilitation of patients after injuries of the musculoskeletal system. However, it is important to remember that each of these methods has its advantages and disadvantages, and the choice of method should be based on the individual characteristics of the patient. In addition, psychological support and support of the relatives are equally important components of the rehabilitation process. It must be remembered that the process of recovery after injury of the musculoskeletal system can be long and difficult, and the support of others can significantly improve the quality of life of the patient and speed up the rehabilitation process.

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INTRODUCTION

Rehabilitation of patients who have suffered a musculoskeletal injury is an important part of the treatment process and allows patients to restore their motor function faster and more efficiently, as well as return to normal life. It includes a comprehensive approach that includes physical, psychological, social and professional rehabilitation [1].

After an injury of the musculoskeletal system, rehabilitation plays an important role in restoring body functions and improving the quality of life of the patient. There are many approaches and methods of rehabilitation, ranging from physiotherapy and therapeutic gymnastics, and ending with the use of the latest technologies, such as virtual reality, robotics, transcranial magnetic stimulation, stem cells, three-dimensional printing and artificial intelligence. Each of these methods can be effective in certain cases, and the choice of a specific rehabilitation strategy depends on many factors, including the nature of the injury, the age of the patient, concomitant diseases and many others.

However, in addition to the technical aspects of rehabilitation, there are other problems that can affect the success of the recovery process. Some of these problems include psychological difficulties that the patient may have, such as depression, anxiety, fear of repeated injuries, problems with self-esteem, alienation, etc. Such problems can be especially significant in the case of long-term rehabilitation and require support and attention from medical personnel [2].

Rehabilitation of patients who have suffered an injury of the musculoskeletal system is a long process that requires a comprehensive approach and individual selection of treatment and recovery methods. Modern rehabilitation methods, such as virtual reality, robotics, transcranial magnetic stimulation, the use of stem cells and Internet of Things and 3D printing technologies, allow to improve the results of treatment and reduce the rehabilitation time.

In general, rehabilitation of patients after injuries of the musculoskeletal system is a complex and multifaceted process that requires careful planning and the use of innovative technologies and treatment methods. It is important to remember that each patient is individual, and his rehabilitation should be carried out in accordance with his needs and capabilities.

MATERIALS AND METHODS

When writing the paper, Russian and foreign sources on the research topic were analyzed, analytical and comparative research methods were also applied.

RESULTS

Musculoskeletal injuries are injuries that can affect bones, joints, muscles, ligaments, tendons and other structures that help support the body, provide movement and protect internal organs. The characteristics of such injuries may vary depending on their type, location and severity. Some common characteristics of musculoskeletal injuries may include:
- pain and discomfort in the area of injury;
- swelling and inflammation of the tissues around the damaged area;
- restriction of movement or inability to perform it;
- bruises, hemorrhages or bleeding in the area of injury;
- deformity or curvature of bones or joints;
- crunching, grinding or clicking when moving the damaged area;
- violation of blood circulation or nerve supply to the damaged area;
- loss of sensitivity or paralysis if nerves are damaged [3].

Typical injuries of the musculoskeletal system may include bone fractures, dislocations and sprains of ligaments and muscles, joint injuries, tendon injuries, etc. When assessing the characteristics of an injury, it is important to take into account not only the type of injury, but also the location of its localization, severity and general condition of the patient.

Injuries of the musculoskeletal system can be of various types, depending on which structures were damaged [4]. Here are some of the most common types of musculoskeletal injuries:

- fractures are a complete or partial violation of the integrity of the bone. They can be open or closed, displaced or unbiased, and can lead to various complications, such as hemorrhages, connective tissue damage, infections, and others.;

- dislocations are the exit of articular surfaces from the normal position, which can lead to sprains or ruptures of ligaments, as well as damage to surrounding tissues and nerves;

- sprains and ruptures of ligaments and muscles are injuries that can occur with strong stretching or improper movement. They can be mild or severe and can lead to pain, swelling and restricted movement;

- contusions are injuries that occur with a strong impact or compression of tissues, which can lead to hemorrhages, damage to muscles and joints;

- tendon injuries are injuries that can occur with repetitive movements, overloads or injury. They can lead to pain, swelling and restricted movement;

- joint injuries are injuries that can affect various structures of the joint, such as cartilage, bones, ligaments and muscles. They can lead to pain, swelling, restricted movement and impaired joint function [5].

Injuries of the thoracic spine are injuries that occur in the chest area and can lead to a violation of the function of the thoracic spine, damage to the lungs and other organs.

Injuries of the lumbar spine are injuries that occur in the lumbar region and can lead to impaired function of the lumbar spine, pain syndromes, impaired function of internal organs, etc.

Pelvic injuries are injuries that occur in the pelvic region and can lead to fractures of the pelvic bones, damage to the bladder, intestines and other organs, as well as to impaired function of the lower extremities.

Upper limb injuries are injuries that occur in the shoulder girdle, arm, elbow and forearm. They can lead to fractures, sprains, ruptures of ligaments and muscles, as well as to impaired function of the arm and shoulder.

Injuries of the lower extremities are injuries that occur in the pelvis, hip, knee, shin and foot. They can lead to fractures, sprains, ruptures of ligaments and muscles, as well as to impaired leg and foot function [6].

In addition, injuries of the musculoskeletal system can be classified according to other characteristics, such as severity, mechanism of injury, etc.

Musculoskeletal injuries can be classified by severity based on how badly the musculoskeletal system is damaged and how much they affect the general condition of the patient. Here are some of the most common types of musculoskeletal injuries, classified by severity:

- minor injuries are injuries that usually do not require special treatment and go away on their own in a short time. These may be bruises, sprains, small wounds, etc.;

– moderate injuries are injuries that require treatment and may restrict the patient's movement for a while. These can be bone fractures, sprains, severe bruises, etc.;

– severe injuries are injuries that pose a threat to the patient's life and require immediate medical intervention. These may be fractures of large bones, damage to internal organs, hemorrhages, etc.;

– critical injuries are injuries that can lead to the death of the patient if immediate medical care is not provided. These can be head injuries, spinal injuries, severe bleeding, etc. [7].

In addition, the severity of the injury can be assessed on a scale of traumatic severity, such as ISS (Injury Severity Score) or RTS (Revised Trauma Score). These scales take into account various parameters, such as blood pressure, pulse, breathing, level of consciousness, the presence of fractures, etc., and help determine the severity of the injury and the need for medical care.

Approaches to the treatment of musculoskeletal injuries may vary depending on the characteristics and severity of a particular injury. There are general approaches that can be used in the treatment of injuries of the musculoskeletal system:

– non-drug methods. First of all, with injuries of the musculoskeletal system, rest of the damaged area is necessary.

For some types of injuries, special devices (such as plaster casts) may be used to prevent further damage. Physiotherapy techniques such as massage, exercises and therapeutic gymnastics can also be used to speed up the healing process.;

– medicinal treatment. Medications can be used to reduce pain and inflammation. These may be nonsteroidal anti-inflammatory drugs, analgesics, muscle relaxants, chondroprotectors and other medications, depending on the type and severity of the injury;

– surgical treatment. Some musculoskeletal injuries may require surgical intervention, especially if they have caused a serious fracture or damage to internal structures such as ligaments, tendons and muscles;

– rehabilitation. After an injury, a lengthy rehabilitation process may be required to return the affected area to normal and restore full functionality. This may include physical therapy, exercise, and other methods to bring the affected area back to normal;

– prevention of repeated injuries. It is important to take measures to prevent repeated injuries, as they can slow down the healing process and even lead to additional damage. This may include the use of protective devices (such as helmets and knee pads), proper training in exercise techniques, the elimination of risk factors such as unsafe working conditions or sporting events, as well as weight control and a healthy lifestyle;

– surgical treatment: In some cases, surgical treatment may be required, such as reconstruction of ligaments, tendons or muscles. Surgical treatment may also be necessary to correct deformities, restore normal anatomy and relieve stress from the damaged area.;

– psychological support. Injuries to the musculoskeletal system can lead to psychological consequences, such as depression, anxiety and post-traumatic stress syndrome. Therefore, it is important to provide patients with psychological support to help them cope with the emotional consequences of trauma [8].

In general, the treatment of injuries of the musculoskeletal system should be comprehensive and individually tailored for each patient, taking into account the characteristics of the injury and its severity, as well as the general health of the patient and his needs for rehabilitation [9].

Rehabilitation of patients with injuries of the musculoskeletal system is aimed at improving the functional state and restoring damaged tissues, as well as reducing pain and restoring the quality of life.

The main directions of rehabilitation of patients with injuries of the musculoskeletal system include:

- physiotherapy that is a complex of therapeutic procedures, including physical exercises, massage, electrotherapy, laser therapy and other methods aimed at improving blood circulation, reducing swelling and pain, as well as restoring motor functions;

– therapeutic gymnastics. Specially selected exercises help strengthen muscles, joints and ligaments, restore coordination of movements, improve flexibility and maintain proper posture;

– orthopedic products. Restorative treatment may require the use of orthopedic products such as corsets, orthoses, bandages or crutches that support damaged joints or restrict movement to protect them.;

– drug therapy. Medications such as anti-inflammatory and painkillers can help reduce swelling, reduce pain and facilitate the rehabilitation process.;

– psychological support. Recovery from injury can be difficult for the patient both physically and emotionally. Psychological support can help the patient cope with the emotional consequences of trauma, increase motivation for treatment and improve the results of rehabilitation;

– professional rehabilitation. When restoring motor functions, the participation of specialists may be required, such as physiotherapists, occupational therapists or sports specialists who will help the patient to restore working capacity.

Physiotherapy is one of the most important methods of treatment and rehabilitation for injuries of the musculoskeletal system. This is a complex of therapeutic procedures, including physical exercises, massage,

electrotherapy, laser therapy and other methods aimed at improving blood circulation, reducing swelling and pain, as well as restoring motor functions [10].

Depending on the nature and location of the injury, the physiotherapist can offer various methods of treatment. For example, the following methods of physiotherapy are often used for bone and joint injuries:

1. Exercise therapy. A set of exercises designed individually for each patient helps to strengthen muscles, improve flexibility and maintain proper posture. This allows you to restore the functions of the musculoskeletal system.

2. Massage. Massage improves blood circulation and metabolism in tissues, and also reduces pain. It can be carried out both manually and with the use of special devices.

3. Electrotherapy. Electrical impulses can help reduce pain, reduce swelling and accelerate tissue regeneration. This method may include the use of low and medium frequency currents, ultrasound and other methods.

4. Laser therapy. Laser radiation can help improve blood circulation, accelerate wound healing and tissue regeneration. This method can also be used to relieve pain and reduce swelling.

5. Individual and group classes. Conducting classes in a group or individually under the supervision of a specialist helps patients improve motor skills and coordination of movements, as well as increase self-confidence [11].

Physiotherapy for injuries of the musculoskeletal system can be prescribed both at the treatment stage and at the rehabilitation stage. It is important to remember that each case of injury is individual, and for each patient, a complex of physiotherapy procedures can be developed, taking into account his condition and the nature of the injury.

It is also worth noting that physiotherapy should be carried out under the supervision of a specialist and only after consultation with an orthopedic or traumatologist. An improperly selected set of exercises or procedures can cause more harm than good [12].

In addition, it is important to understand that physiotherapy is only one of the components of treatment and rehabilitation for injuries of the musculoskeletal system. It should be supplemented by other methods, such as drug therapy, surgery, psychological support, etc. Only an integrated approach to treatment and rehabilitation allows you to achieve the best results.

Therapeutic gymnastics is one of the main methods of rehabilitation for injuries of the musculoskeletal system. It is aimed at restoring motor activity and reducing pain, strengthening muscles, improving blood circulation and overall body tone.

The principles of therapeutic gymnastics for injuries of the musculoskeletal system are as follows:

– gradual increase in the load. You should start with light exercises, gradually increasing their intensity and duration;

– variety of exercises. To restore the musculoskeletal system, it is important to deal with all its components: muscles, ligaments, joints and bones;

– taking into account the individual characteristics of the patient. Each patient has their own characteristics and needs, so the set of exercises should be individually selected by a physiotherapist;

– timeliness of classes. Therapeutic gymnastics should be carried out at every stage of rehabilitation – from the very beginning to full recovery. [13].

It is important to note that therapeutic gymnastics should be carried out under the supervision of a doctor and a physiotherapist, since depending on the injury and its severity, an individual set of exercises can vary significantly.

Orthopedic products are special devices that are used to support and protect the musculoskeletal system during rehabilitation for injuries. They help to reduce pain, accelerate the recovery process, and improve the quality of life of patients.

During rehabilitation for injuries of the musculoskeletal system, the following products can be used:

- orthoses for joints. These are special devices that are put on the damaged joint to fix and support it. They can be used for injuries of the knee joint, ankle joint, elbow joint and others;

– corsets and belts for the spine. These products are used in spinal injuries to provide support and stabilization of the spine;

– orthopedic insoles. They are used to correct gait, reduce pressure on certain areas of the foot and improve cushioning when walking;

– prosthetics. In case of loss of a limb or part of it, special prostheses are used to help patients maintain their mobility and quality of life.;

– pillows for various parts of the body. They are used to reduce pressure on damaged areas of the body, improve blood circulation and reduce pain [14].

Orthopedic products should be selected and prescribed by an orthopedic or rehabilitologist based on the individual characteristics of the patient and the characteristics of the injury. When using orthopedic products, it is important to follow all the doctor's recommendations, put them on correctly and use them in accordance with the instructions, so as not to cause additional harm to health.

Drug therapy is one of the important components of the rehabilitation process for injuries of the musculoskeletal system. It may include the use of the following groups of medicines:

– anti-inflammatory drugs. These medications can reduce inflammation in the tissues, reduce swelling and pain. Examples of such drugs: nonsteroidal anti-inflammatory drugs (for example, diclofenac, ibuprofen), glucocorticosteroids (for

example, prednisone);

- painkillers. They are used to reduce pain. Depending on the intensity of the pain, drugs of various groups can be used, from simple analgesics (for example, paracetamol) to potent analgesics;

– muscle relaxants. They are used to reduce muscle tension and spasms. Examples of such drugs: tizanidine, baclofen;

– drugs to accelerate the healing of bones and tissues. They contribute to the accelerated formation of new tissue and healing of damage. Examples of such drugs: calcium, vitamin D, drugs containing growth factors;

– drugs for the prevention of infections. They are used to prevent the occurrence of infectious complications during treatment;

– vitamins and minerals. They help to improve the general condition of the patient and speed up the recovery process. For example, vitamin C, calcium, magnesium [15].

Medication treatment should be carried out under the supervision of a doctor and in accordance with the individual characteristics of each patient. The duration and dosage of drugs also depend on the nature of the injury, its severity and the stage of treatment.

Psychological support is an important component of rehabilitation for injuries of the musculoskeletal system. Injuries can have a significant negative effect on the psychological state of the patient, causing depression, anxiety, fear and even post-traumatic stress syndrome. Therefore, it is important to provide patients not only with medical care, but also with psychological support.

Psychological support includes various types of assistance aimed at improving the mental state of the patient. Patients can seek help from a psychologist who will provide them with professional support and help in solving psychological problems arising as a result of trauma.

A complex of psychotherapeutic measures aimed at the treatment of various psychological disorders. With injuries of the musculoskeletal system, psychotherapy can help patients cope with depression, anxiety, phobias and other psychological problems.

Group classes help patients communicate with other people who are going through similar difficulties, and find support and understanding [16].

Physical exercises and sports can help patients improve their psychological state, improve mood and reduce stress levels. Relaxation techniques such as meditation, yoga, and breathing exercises can help patients cope with stress and anxiety.

Psychological support helps patients overcome emotional and psychological difficulties associated with injury of the musculoskeletal system and improve the quality of life.

Professional rehabilitation is an important stage in the process of restoring the functions of the musculoskeletal system after injuries. It includes a set of measures aimed at returning the patient to professional activity and social adaptation [17].

The main tasks of professional rehabilitation are:

- determination of the professional suitability of the patient after injury. For this purpose, special examinations and tests are carried out, which allow us to assess the physical and psychological capabilities of a person;

– determining the necessary changes in the working environment and work organization to ensure the safety and convenience of the patient;

– developing an individual program of professional rehabilitation, which includes physical therapy, massage, physiotherapy, medication treatment, the use of orthopedic products and other methods of restorative treatment;

– conducting training programs and trainings aimed at developing the skills necessary to work in new conditions;

– providing psychological support to the patient during the period of professional rehabilitation;

– organization of control over the recovery process and conducting periodic examinations to assess the effectiveness of vocational rehabilitation [18].

Professional rehabilitation is an important stage in the process of restoring the functions of the musculoskeletal system after injuries. It helps the patient to return to normal life and work, and also prevents possible complications and recurrence of injuries.

DISCUSSION

Despite the constant improvement of methods and approaches to the rehabilitation of patients after injuries of the musculoskeletal system, there are still some problems that may arise in the process of restoring the health and functionality of the patient.

One of the main problems is the duration of the rehabilitation process. Recovery from injury can take a significant amount of time, which can lead to deterioration of the patient's physical and psychological condition. In addition, some patients may experience limitations in daily life, including work, which can lead to social isolation and depression[19].

Another problem may be limited access to the qualified medical care. Some regions may not have enough rehabilitation specialists or the necessary equipment, which may complicate the patient's recovery process.

A lack of funding may also be an important problem. Some types of rehabilitation, such as physical therapy or the use of orthopedic products, can be expensive. This may limit patients' access to the necessary care and slow down their recovery process.

Finally, another problem may be a lack of motivation on the part of the patient. A long rehabilitation process can cause

fatigue and frustration in some patients, which can lead to a lack of motivation to continue treatment. In this case, psychological support and motivation from family, friends and rehabilitation specialists is important [20].

Another problem may be lack of resources and limited access to rehabilitation services. Some patients may have limited access to qualified medical professionals and rehabilitation facilities due to distance or economic factors.

Social support in the rehabilitation process is also important. Some patients may face social isolation, job loss, or deterioration of relationships with loved ones due to trauma. Psychological support and assistance in adapting to changed conditions can be important factors in the successful rehabilitation of patients [21].

Finally, some patients may face complications and consequences after injury, such as chronic pain, impaired motor functions, post-traumatic stress syndrome, and others. Solving these problems may require long and thorough treatment, as well as close cooperation between medical specialists of various profiles.

In general, rehabilitation of patients after injuries of the musculoskeletal system may face a number of problems, but in most cases these problems can be solved with the help of modern methods of treatment and rehabilitation, as well as social support and attention from others.

Another problem of rehabilitation of patients after injuries of the musculoskeletal system is insufficient funding and unavailability of qualified care in some regions. Another important factor is the social adaptation of patients after injury, especially in cases where injury has caused disability [22].

In addition, many patients face the problem of lack of motivation and discipline in the rehabilitation process. Recovery after injury of the musculoskeletal system requires constant work and perseverance, and many patients have difficulties in following the treatment regimen and following the recommendations of doctors and rehabilitologists.

Also, some patients may experience side effects of medications used in the rehabilitation process, which may make their recovery more difficult. For example, some drugs can cause nausea, dizziness, allergic reactions and other undesirable effects.

Accordingly, rehabilitation of patients after injuries of the musculoskeletal system is a complex process that requires an individual approach and comprehensive treatment. Despite some problems, modern methods of treatment and rehabilitation allow achieving good results and help patients to return to active life after injury [23].

Modern methods of rehabilitation of patients after injuries of the musculoskeletal system may include the use of new technologies and approaches. Some of them are:

- Virtual reality (VR) is a technology that creates the illusion of being in another place or environment, and can be used for training and recovery of movements after injury;

- robotics is the use of robots and devices that can help patients restore movement and functionality, improve coordination and strengthen muscles;

- Transcranial magnetic stimulation (TMS) is a technique that uses a magnetic field to stimulate nerve cells in the brain. It can be used to improve functions and reduce pain after injury;

- Using Internet of Things (IoT) technologies and portable devices - this may include monitoring physical activity levels, heart rate and other factors that can help patients track their progress and receive personalized feedback;

- using stem cells - this may include stem cell transplantation to regenerate damaged tissues and accelerate the healing process;

- the use of three-dimensional printing - this can be used to create individual prostheses and orthoses that can be more precisely adapted to the specific injury and the needs of the patient;

- The use of artificial intelligence (AI) - this may include the use of machine learning algorithms to analyze large amounts of data related to musculoskeletal injuries and to determine the best approach to treatment and rehabilitation.

In general, modern methods of rehabilitation of patients after injuries of the musculoskeletal system are aimed at using individual and integrated approaches. Let's look at them in more detail.

The use of virtual reality (VR) technologies in the rehabilitation of patients with musculoskeletal injuries is one of the modern methods that can significantly improve the effectiveness of treatment and reduce recovery time.

VR technology allows you to create artificial environments in which the patient can engage in special exercises and games aimed at restoring the functions of the musculoskeletal system. Such trainings are conducted in a controlled environment where the patient can focus on the task and improve coordination, balance and support.

The use of VR also allows patients to be transported into the virtual world, where they can engage in exercises and games that are entertaining in nature, which helps to improve the psychological state of the patient and increase motivation for rehabilitation. Also, VR technology can be used to simulate real life situations that help patients cope with problems in everyday life, such as climbing stairs, walking on uneven surfaces, and others. This allows patients to learn new skills and prepare for real situations.

Thus, the use of virtual reality technologies in the rehabilitation of patients with musculoskeletal injuries can significantly increase the effectiveness of treatment, reduce recovery time and improve the quality of life of patients.

The use of robotics in the rehabilitation of patients with musculoskeletal injuries is one of the modern methods that can significantly improve the results of treatment and speed up the

recovery process.

Robotics in medicine is used to improve the motor skills of patients after injuries of the musculoskeletal system. Exoskeleton robots help restore movement in the limbs, which is especially important for people with paralysis or after strokes. The exoskeleton allows you to increase the range of motion in the joints, reduce muscle spasticity, increase muscle strength and endurance, and also facilitate the walking process.

In addition, robotics can be used for various types of training, for example, balancing, coordination of movements, improving posture, as well as for teaching patients the correct movements when performing everyday tasks.

One of the most promising directions in the application of robotics is the use of robotic prostheses. This allows patients who have lost limbs to restore their motor functions and return to normal life. However, despite all the advantages, the use of robotics in the rehabilitation of patients with musculoskeletal injuries is an expensive and not always affordable method of treatment. In addition, special training and qualifications are required to work with robots, as well as the availability of appropriate equipment.

Transcranial magnetic stimulation (TMS) is a method in which an electromagnetic field is used to stimulate the nervous tissue of the brain. It is used to treat various disorders, including rehabilitation of patients after injuries of the musculoskeletal system.

TMS can be useful in the treatment of pain, muscle spasms, paralysis and other neurological disorders associated with injuries of the musculoskeletal system. The method is used as an alternative or supplement to other methods of treatment, such as drug therapy and physiotherapy.

TMS can be applied in various forms, including superficial and deep stimulation. It can be used to stimulate the motor and sensory areas of the brain. The application of the method can improve muscle strength, improve sensitivity and restore limb function. One of the advantages of TMS is its safety, but the method is not suitable for all patients, and some side effects are possible, such as headache and discomfort during the procedure. It can also be expensive and not accessible to all patients.

In general, TMS is a promising method of rehabilitation for patients with injuries of the musculoskeletal system, but its use should be individual and under the supervision of specialists.

Internet of Things (IoT) technologies can play an important role in the rehabilitation process of patients with musculoskeletal injuries. For example, IoT sensors can be used to monitor a patient's physical activity and collect data on his condition, which allows individualizing a rehabilitation program.

With the help of IoT, it is also possible to create a patient regime management system that will automatically adjust the dosage of medications and exercise regimens depending on the data on his condition. This can significantly improve the effectiveness and safety of rehabilitation. In addition, IoT can be used to monitor the environment, for example, to detect obstacles in the patient's path or to determine the optimal temperature and humidity in the rehabilitation room.

Thus, IoT technologies can significantly improve the rehabilitation process of patients with musculoskeletal injuries, providing an individual and effective approach to treatment.

The use of stem cells in the rehabilitation of patients with musculoskeletal injuries is one of the promising areas in medicine. Stem cells can differentiate into various types of tissues, including bone and cartilage, which makes them a potentially important tool in regenerative medicine.

Stem cells can be used to regenerate damaged bone and cartilage tissue, which can speed up the recovery process after injury to the musculoskeletal system. Studies show that the injection of stem cells into damaged bone tissue promotes its rapid recovery and accelerates the healing of fractures. In addition, stem cells can be used to regenerate cartilage tissue, which can be useful for the treatment of knee injuries. However, the use of stem cells in the rehabilitation of musculoskeletal injuries is still at the research stage, and additional studies are needed to determine the effectiveness and safety of this method. In addition, stem cells may raise ethical questions related to their origin and use.

Thus, the use of stem cells in the rehabilitation of patients with musculoskeletal injuries is a promising direction in medicine, but requires further research and evaluation of efficacy and safety.

The use of three-dimensional printing in the rehabilitation of patients with musculoskeletal injuries is one of the modern approaches to the treatment and restoration of the functions of injured tissues and organs.

With the help of three-dimensional printing, it is possible to make individual implants, prostheses and orthoses that exactly correspond to the anatomical features of each patient. This makes it possible to improve the quality of treatment and speed up the recovery process, as well as reduce the risks of complications. For example, in case of injuries to bones and joints, three-dimensional printing can be used to manufacture individual implants that accurately repeat the shape and size of damaged bone structures. Also, three-dimensional printing can be used to create models of bones and joints to prepare surgeons for complex operations. In addition, three-dimensional printing can be used to create individual orthoses and prostheses, which makes it possible to achieve a more accurate fit and more effective restoration of the functions of damaged limbs.

Thus, the use of three-dimensional printing in the rehabilitation of patients with musculoskeletal injuries allows for more accurate and effective treatment, which is an important step in modern medicine.

The use of artificial intelligence (AI) in the rehabilitation of patients with musculoskeletal injuries can improve treatment

results and speed up the recovery process. Some of the possible applications of AI include:

- data analysis: machine learning algorithms can be used to process large amounts of data, such as clinical trial results and patient medical data, to identify patterns and predict treatment outcomes;

– selection of individual treatment: AI can be used to create a personalized treatment plan that will be optimal for each patient based on their unique characteristics;

– motion control: with the help of AI, it is possible to create motion control systems that can help patients with injuries of the musculoskeletal system restore motor functions and coordination;

–prosthetics: AI can be used to create intelligent prostheses that can adapt to the patient's needs and even predict their movements;

– assistance in solving diagnostic problems: AI can be used to support doctors in the process of diagnosis and selection of optimal treatment of patients with injuries of the musculoskeletal system.

In general, the use of artificial intelligence can significantly improve the rehabilitation process of patients with injuries of the musculoskeletal system, increase the effectiveness of treatment and reduce recovery time.

CONCLUSION

Rehabilitation of patients after injuries of the musculoskeletal system is a multidisciplinary task that requires an integrated approach. An important stage of rehabilitation is the elimination of pain syndrome, restoration of motor functions and normalization of the patient's psycho-emotional state.

Modern rehabilitation methods, such as physiotherapy, therapeutic gymnastics, the use of orthopedic products, drug therapy, psychological support, professional rehabilitation, the use of the latest virtual reality technologies, robotics, transcranial magnetic stimulation, Internet of Things technologies, stem cells, three-dimensional printing and artificial intelligence, can significantly accelerate and improve the patient's recovery process. However, during rehabilitation after injuries of the musculoskeletal system, some problems are possible, such as limited availability of some rehabilitation methods, the complexity of individual selection of a treatment program, high costs for some rehabilitation methods. Nevertheless, thanks to the development of medical technologies and the latest methods of rehabilitation, patients after injuries of the musculoskeletal system have a real opportunity to return to a full life. It is important that each patient receives an individual and comprehensive approach to treatment and rehabilitation after injury of the musculoskeletal system in order to achieve the best result.

In general, rehabilitation of patients after injuries of the musculoskeletal system is a complex but important process that requires an individual approach and a comprehensive methodology. Modern rehabilitation methods provide new opportunities for effective rehabilitation of patients, but it must be remembered that rehabilitation is a long process that requires patience and perseverance both for the patient and his relatives.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors contributed in reviewing the final version of this paper

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