THE ROLE OF ULTRASOUND THERAPY IN THE DIAGNOSIS AND TREATMENT OF TRAUMATIC INJURIES

Abstract. Traumatic injuries, such as muscle, ligament, tendon and joint injuries, pose serious challenges to the physical health and active lifestyle of a significant number of people. This problem is central to overall well-being and can affect various aspects of life. Traumatic injuries can lead to pain, restricted movement and functional limitations. Damage to the integrity of muscles, ligaments and tendons can significantly affect strength, flexibility and coordination. Often, such injuries can cause chronic problems that affect overall physical health. Ultrasound is a non-traumatic medical examination method that uses high-frequency sound waves to create real-time images of internal organs and tissues. The procedure is based on the reflection of sound waves from the body structures and their
registration with the help of a special device - an ultrasound scanner. Ultrasound is widely used in various fields of medicine to visualise internal organs, blood vessels, soft tissues and structures such as muscles or joints. This method is an effective and safe diagnostic tool, allowing doctors to obtain detailed images to make a diagnosis and monitor a patient's condition. Ultrasound therapy is a significant treatment for traumatic injuries, using high-frequency sound waves to therapeutically affect tissue. This review explores the use of ultrasound therapy in the context of traumatic injury treatment, including its effectiveness in reducing pain, promoting inflammation, stimulating blood circulation and accelerating tissue healing. The basic mechanisms of action of ultrasound are discussed, as well as the benefits and limitations of its use. The results of important clinical trials and prospects for the development of ultrasound therapy in modern medical practice to optimise the treatment of traumatic injuries are highlighted.

Keywords: traumatic injuries, ultrasound, ultrasound therapy, treatment, muscles, joints.

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РОЛЬ УЛЬТРАЗВУКОВОЇ ТЕРАПІЇ ДЛЯ ДІАГНОСТИКИ ТА ЛІКУВАННЯ ТРАВМАТИЧНИХ УШКОДЖЕНЬ

Анотація. Травматичні ушкодження, такі як пошкодження м'язів, зв'язок, сухожиль і суглобів, створюють серйозні виклики для фізичного здоров'я та активного способу життя значної кількості осіб. Ця проблема займає центральне місце в контексті загального добробуту і може впливати на різні аспекти життя. Травматичні ушкодження можуть призвести до болю, обмеження руху та функціональних обмежень. Порушення цілісності м'язів, зв'язок і сухожиль можуть суттєво впливати на силу, гнучкість і координацію рухів. Нерідко такі ушкодження можуть викликати хронічні проблеми, які впливають на загальний стан фізичного здоров'я. Ультразвукове дослідження — це нетравматичний метод медичного обстеження, який використовує високочастотні звукові хвилі для створення зображень внутрішніх органів та тканин у реальному часі. Процедура базується на відбиванні звукових хвиль від структур організму та їхньому реєструванні за допомогою спеціального апарату — ультразвукового сканера. Ультразвукове дослідження широко використовується в різних галузях медицини для візуалізації внутрішніх органів, судин, м'яких тканин та структур, таких як м'язи чи суглоби. Цей метод є ефективним і безпечним засобом діагностики, дозволяючи лікарям отримувати детальні зображення для встановлення діагнозу та контролю за станом пацієнта. Ультразвукова терапія є значущим методом лікування травматичних ушкоджень, використовуючи високочастотні звукові хвилі для терапевтичного впливу на тканини. Цей огляд обстежує застосування ультразвукової терапії в контексті лікування травматичних ушкоджень, включаючи її ефективність у зменшенні болю, сприянні зменшенню запалення, стимуляції кровообігу та прискорені процеси зцілення тканин. Розглядаються основні механізми дії ультразвуку, а також переваги та обмеження його застосування. Висвітлюються результати важливих клінічних досліджень та перспективи розвитку ультразвукової терапії в сучасній медичній практиці для оптимізації процесу лікування травматичних ушкоджень.

Ключові слова: травматичні ушкодження, ультразвук, ультразвукова терапія, лікування, м'язи, суглоби.

Statement of the problem. Traumatic injuries to muscles, ligaments, tendons and joints are a serious challenge to the physical health and active lifestyle of many people [1]. Regardless of the source of the injury, such as sporting events, work duties or everyday activities, these injuries can lead to pain, restrictions in movement and a significant reduction in quality of life [2]. In this regard, the development of effective treatments is becoming a critical challenge for the medical community [3].
Muscle injuries are an important aspect of traumatology and sports medicine, representing a significant number of cases in the field of traumatic injuries. These injuries can be the result of spontaneous, unforeseen events or they can be the result of excessive physical activity, insufficient stretching before physical activity or adverse environmental conditions [4]. It is important to recognise that muscle injuries can range in severity from mild strains to serious tears that require immediate intervention and effective treatment [5].

Types of muscle lesions [6, 7, 8]:

**Sprain:** This is a mild muscle injury that occurs as a result of excessive stretching. It is mainly accompanied by pain and mild restriction of movement.
- **Symptoms:** Pain, swelling and possible limited movement in the affected area.
- **Causes:** Improper opening before physical activity, insufficient warm-up and excessive stretching.

**Tear:** This form of injury involves partial or complete tearing of muscle fibres. It causes pain, swelling and may require medical attention for recovery.
- **Symptoms:** Acute pain, possible tearing sound, swelling and loss of functionality.
- **Causes:** Sudden movement or transition from rest to intense activity, heavy load.

**Muscle contusions:** These are serious injuries to muscle fibres that can occur during intense physical activity. It requires competent treatment and rehabilitation.
- **Symptoms:** Pain, swelling, sometimes redness or pallor of the affected area.
- **Causes:** Muscle damage due to impact, fall or improper movement.

**General type of injury (muscle contusion):**
- **Symptoms:** Pain, swelling, possible bruising in the affected area.
- **Causes:** A direct blow to the muscles as a result of contact play or a hit.

**Overstrain syndrome (overload):**
- **Symptoms:** Pain, fatigue, possible trigger points.
- **Causes:** Excessive training volume, insufficient rest, monotonous loads.

**Tendonitis (inflammation of the tendon):**
- **Symptoms:** Pain on movement, swelling, sometimes redness in the affected area.
- **Causes:** Excessive load on the tendon, mechanical stimuli, injuries.

Summing up all types of injuries, we can highlight what they have in common: pain, swelling, limited mobility, muscle spasms, possible muscle haematoma, reduced functionality, and the risk of chronic complications and possible recurrence [9]. The treatment of this pathology has been going on for hundreds of years, and in addition to the already known techniques such as PRP, MsC, physiotherapy, pharmacological options and surgical treatments, we would like to consider such a treatment method as ultrasound therapy as a treatment for muscle damage.
Traumatic joint injuries are a common type of injury that can occur as a result of various situations, such as accidents, sports injuries, falls or other accidents. These injuries can affect different parts of the joint, including bone, cartilage, tendons, ligaments and related tissues. Below are some common traumatic joint injuries [10, 11, 12]:

**Dislocation:** This is a condition in which the bones of a joint lose their normal anatomical relationship. Dislocations can occur as a result of injury or joint malfunction.

**Tears:** Tears in tendons, ligaments or muscles due to injury or excessive strain can lead to pain, inflammation and limited mobility.

**Subluxation:** This is a condition where the bones of a joint do not fully move out of their connected position, but are still out of alignment. It can be accompanied by pain and joint deformity.

**Contusion:** Bumps or blows to the joint area can lead to contusions, which can be accompanied by pain, swelling and limited mobility.

**Post-traumatic arthritis:** Traumatic injuries can lead to damage to the joint surfaces and contribute to the development of arthritis in the future.

Ultrasound therapy (UST), employing a cutting-edge device emitting ultrasonic waves across varying frequencies, represents a contemporary approach to stimulate the recovery processes within the body. These ultrasonic waves induce compression and stretching of tissues, fostering therapeutic benefits. The treatment strategically utilizes different frequency ranges: lower frequencies for deep tissues and higher frequencies for superficial, inflamed tissues [13]. This frequency adjustment allows specialists to target specific areas, avoiding interference with healthy organs and tissues. The impact of ultrasound on the body manifests through three primary mechanisms: physicochemical, mechanical, and thermal [14]. Notably, the mechanical effect is paramount, generating tissue micro-vibrations and delivering a massage-like sensation to areas challenging to access manually. The thermal effect contributes positively to blood vessels, while physicochemical processes activate redox reactions and the synthesis of bioactive compounds. Ultrasound therapy offers a non-invasive avenue for enhancing the body's natural healing capabilities. The precise customization of frequencies allows clinicians to craft tailored treatment plans, optimizing therapeutic outcomes while ensuring the well-being of surrounding healthy tissues. This contemporary technology stands at the forefront of physiotherapeutic interventions, blending science and innovation to promote holistic healing [15, 16, 17].

Ultrasound therapy, a widely used modality in physiotherapy, has proven to be an effective and non-invasive approach in the treatment of various injuries. This therapeutic technique harnesses the power of ultrasound waves to penetrate deep into tissues, promoting healing and providing relief from pain and inflammation. Here's a closer look at how ultrasound therapy is employed for injury treatment [18, 19]:
1. Mechanism of Action:
   Deep Tissue Penetration: Ultrasound waves travel deep into injured tissues, reaching muscles, tendons, and ligaments.
   Micro-massage Effect: The mechanical vibrations caused by ultrasound create a micro-massage effect at the cellular level, promoting blood circulation.

2. Accelerated Healing:
   Increased Blood Flow: Ultrasound therapy enhances blood flow to the injured area, delivering oxygen and nutrients essential for tissue repair.
   Stimulation of Fibroblasts: Fibroblasts, responsible for collagen production, are activated, aiding in the healing process.

3. Reduction of Inflammation:
   Cavitation Effect: Ultrasound induces cavitation, which helps in the dispersion of inflammatory substances and accelerates the reduction of swelling.
   Improved Lymphatic Drainage: The therapy assists in draining excess fluid and waste products, diminishing inflammation.

4. Pain Management:
   Endorphin Release: Ultrasound therapy stimulates the release of endorphins, the body's natural painkillers.
   Nerve Conduction Modulation: It can modulate nerve conduction, reducing pain signals from the affected area.

5. Targeted Application:
   Focused Treatment: Ultrasound can be precisely directed to the injured site, allowing for a concentrated therapeutic impact.
   Adjustable Parameters: Therapists can customize the frequency and intensity of ultrasound waves based on the specific needs of the injury.

6. Types of Injuries Treated:
   Muscle Strains and Tears: Ultrasound therapy aids in the healing of damaged muscle fibers.
   Tendonitis: It can reduce inflammation in tendons and promote their recovery.
   Ligament Injuries: Ultrasound contributes to the rehabilitation of ligaments, supporting their strength and flexibility.
   Contusions and Bruises: The therapy helps in resolving hematomas and accelerating the healing of contused tissues.

7. Precautions and Considerations:
   Professional Supervision: Ultrasound therapy should be administered by qualified healthcare professionals.
   Contraindications: Certain conditions, such as cancerous tissues or pregnancy, may require caution or avoidance of ultrasound therapy.

Ultrasound therapy stands as a valuable tool in the comprehensive treatment of injuries, providing a safe and efficient means to enhance the natural healing processes within the body. However, individual responses may vary, and
consultation with a healthcare professional is essential for a tailored and effective treatment plan.

8. Combination with Other Methods:
   Physiotherapy: Ultrasound therapy is often combined with other physiotherapy modalities for maximum effect.
   Massage and Rehabilitation: Combined use with massage and physical rehabilitation can improve treatment outcomes.

**Analysis of the latest research and publications.** Ultrasound and ultrasound therapy have been subjects of extensive research, with recent studies shedding light on their applications, efficacy, and advancements in various medical fields.

**The aim of this article:** studying the method of ultrasound as a diagnostic method and the potential of treatment with ultrasound therapy.

**Presentation of the main material.** The healing process of muscle tissue is a complex and well-organised mechanism that involves several phases and the interaction of various cells and molecules [20, 21, 22]. Here is a general overview of how muscle injuries heal:

**Inflammatory Phase:**
Damage and release of blood: After an injury, the blood vessels in the muscles can rupture, resulting in the release of blood into the tissues.
Inflammation and Phagocytosis: Inflammatory mediators (chemicals) attract white blood cells, especially phagocytes, which remove excess cells and detritus from the affected area.

**Proliferative Phase:**
Proliferation of fibroblasts: Fibroblasts identified during inflammation begin to proliferate and synthesise collagen, the main protein of muscle tissue structure.
Formation of a New Tissue Matrix: Fibroblasts form a new matrix that establishes the structure and elasticity of the tissue.

**Remodelling Phase:**
Redesign of the tissue: The collagen fibres are redesigned to increase their strength and adapt to the functional load.

End of the Process: The remodelling process can last from several weeks to several months, depending on the severity of the injury and the speed of healing.

**Rehabilitation and Return to Activity:**
Physiotherapy and training: After basic muscle tissue repair, physiotherapy and systematic training can help return to full functionality and strength.

**Important Factors Affecting Healing:**
Age: Healing may take longer in older patients.
Nutrition and Hydration: Providing the body with sufficient nutrients and fluids is important for effective healing.
Lifestyle: Negative factors such as alcohol consumption and smoking can slow down the healing process.
It is important to keep in mind that the speed and quality of healing can vary considerably depending on the individual, proper management of the injury and the provision of appropriate medical care.

**Factors affecting the speed and quality of healing:**

- **Type of Injury:** The size, depth and nature of the injury can affect the length of the healing process. Complex injuries may take longer to heal.
- **Body Capacity:** Healing can be complicated if you have a chronic illness or immune disorder.
- **Treatment and Rehabilitation:** Appropriate medical intervention, physiotherapy and rehabilitation activities play an important role in promoting effective healing.

**Other Recovery Factors:**

- **Physiotherapy techniques:** Complementary techniques such as ultrasound therapy, massage and stimulation can improve circulation and speed up healing.
- **Blood Flow:** Effective blood flow to the affected area is key to providing sufficient oxygen and nutrients.
- **Psychological state:** The patient's mental state can affect healing, as stress and anxiety can contribute to the release of inflammatory substances.

**Importance of Individual Approach:**

Everybody is unique and therefore an individualised approach to managing injury and healing is important. Patients should work with medical and physiotherapy professionals to develop a treatment plan that addresses their specific needs and injury characteristics.

The use of ultrasound (US) is proving to be of great importance in the diagnosis of joint and tendon injuries [23]. This method, which uses high-frequency sounds to create images of internal structures, provides a detailed and real-time visual representation of tissues. Ultrasound makes it possible to accurately diagnose lesions, determine the extent of damage to joints, ligaments and tendons, and identify the causes of pain. Its importance is manifested in the ability to provide information about structural changes in tissues, which helps the doctor determine the optimal treatment plan. In addition, ultrasound is an effective means of monitoring the effectiveness of treatment and restoring joint functionality after injuries or surgical interventions. Its non-invasiveness and safety make it an important tool for objective examination of tissue condition without the need for surgical procedures. To summarise, the use of ultrasound in the diagnosis of joint and tendon injuries is a key element in the rapid and accurate identification of lesions, development of a treatment plan and restoration of optimal joint functionality [24, 25].

The authors Juerd Wijntjes and Nens van Alfen (2021) argue that muscle ultrasound is an important tool in clinical and research settings, recognised for its value and reliability [26]. However, to date, it has not yet been able to fully realise its potential in the diagnosis of neuromuscular diseases. They reviewed the...
opportunities and challenges of muscle ultrasound as a diagnostic tool and biomarker, and discussed the challenges that hinder its widespread implementation. It is analysed that simpler scoring systems and deep learning algorithms can help overcome limitations in the interpretation of visual images caused by the inexperience of users. It is noted that quantitative muscle ultrasound provides the most sensitive results, but requires reference values for specific equipment [27]. The creation of special muscle ultrasound and artificial intelligence systems is expected to facilitate image interpretation. It is noted that the inclusion of muscle and nerve ultrasound in curricula and guidelines will facilitate its widespread use in practice. The review calls for unlocking the full potential of muscle ultrasound in the future.

Marco Becciolini et al. (2019) describe that athletes frequently suffer injuries to the proximal hamstring, especially the long myotensin junction, during eccentric contractions [28]. This illustrated article presents the use of ultrasound to image the typical anatomy of the muscle, tendon and bone complex of the proximal hamstring. In addition, ultrasound findings associated with traumatic injuries and tendinopathies in patients are highlighted.

Antonia S Caldwell et al. (2023) note that dynamic musculoskeletal ultrasound is an important diagnostic tool that allows healthcare professionals to observe soft tissue structures in different ranges of motion, helping to identify pathologies that may not be detected by other imaging modalities [29]. The skilful use of this method enables doctors to properly recommend such examinations to patients. This article discusses the various indications for dynamic ultrasound imaging, including conditions such as slipped ribs, muscle hernias, hip dislocation, and peroneal tendon pathology. The examination techniques and expected findings associated with common pathologies in each of these anatomical locations are discussed.

By considering all of these aspects, optimal conditions can be provided for effective and complete healing of muscle tissue after an injury. Diagnosing muscle injuries begins with a thorough collection of trauma history, followed by a clinical examination involving the inspection and palpation of the affected muscles, as well as assessing the function of damaged muscles both without external resistance and with its presence [30]. The diagnosis is easily established when a typical history of contusion or muscle strain is accompanied by objective signs of swelling and/or ecchymosis distal to the site of injury. Clinically diagnosing small hematomas located deep within the muscular belly can be challenging, but imaging methods such as ultrasound (US), computed tomography (CT), or magnetic resonance imaging (MRI) offer valuable tools for more precise verification and determination of the damage. Ultrasound is traditionally considered the method of choice for clinical diagnosis of muscle injuries due to its relative cost-effectiveness [31]. However, it has a clear limitation: it heavily depends on the radiologist's experience, and consequently, MRI has recently replaced ultrasound in visualizing many
musculoskeletal disorders. Especially concerning muscle injuries, MRI can accurately confirm/exclude the presence of muscle trauma and provides a highly detailed characterization of the damage, sometimes being considered somewhat more sensitive [32]. In conclusion, it can be stated that clinical diagnosis of muscle trauma is generally sufficient in most cases, but ultrasound can be considered an effective first-line tool when a more precise characterization of the injury is required. Magnetic resonance imaging, on the other hand, should be preferred if there is a clear discrepancy between the patient's symptoms, the physician's findings, and/or the results of ultrasound, especially in injuries near and/or in the inguinal region or near the musculotendinous junction (MTJ), where MRI has demonstrated its superiority over ultrasound.

Ultrasound therapy in the treatment of muscle injuries is justified by a number of significant advantages. It is defined by its high efficiency and low risk of side effects. The use of this method allows for deep penetration of ultrasound waves into muscle tissue, which ensures treatment at the level of the damaged areas. This is important because it helps to target the affected areas and accelerates the recovery process.

Additionally, ultrasound therapy helps to improve blood circulation, which is important for delivering oxygen and nutrients to injured muscles [33]. This method is also known for its ability to reduce inflammation and pain due to the effects of cavitation and modulation of nerve excitability.

It is difficult to overestimate the role of ultrasound therapy in stimulating the activity of fibroblasts, which are responsible for the production of collagen and other components of the intercellular matrix. This contributes not only to effective healing, but also to strengthening muscles and maintaining their structure. One of the key advantages of ultrasound therapy is its non-invasiveness and safety. It does not require surgery, and therefore does not carry the risk of surgical complications. This makes it an attractive option for a wide range of patients, especially those seeking minimally invasive treatments [34]. Ultrasound therapy also provides the ability to fine-tune the treatment parameters to take into account the individual characteristics of each patient and the type of injury. This contributes to a more effective and personalised approach to rehabilitation. All in all, ultrasound therapy stands out as an effective, safe and individualised method of treating muscle injuries, which promotes rapid recovery and improved tissue function.

The study by Saraiva, H. H. (2014) analysed the mechanical properties of muscles that had been subjected to acute impact injury and treated with therapeutic ultrasound at 1 and 3 MHz [35]. The study used 40 rats, which were divided into four groups: a control group, a group with untreated muscle damage, and two groups with muscle damage that received therapeutic ultrasound at different frequencies. The muscle injury was caused by a blow to the calf muscle using an impactor. The treatment included one daily session of therapeutic ultrasound for six days. The
mechanical properties of the muscles were tested on a mechanical traction machine. The results of the study showed that the average values of mechanical properties in the groups of injured people who received therapeutic ultrasound were significantly higher than in the group of injured people without treatment. The use of therapeutic ultrasound resulted in an increase in muscle stiffness of approximately 38%. The overall conclusion of the study is that therapeutic ultrasound has a positive effect on the mechanical properties of injured muscles, bringing them closer to the level of the control group. However, there was no significant difference in mechanical properties between the groups treated with 1 MHz and 3 MHz ultrasound.

In their work, Kravchenko and Tereshchenko (2018) analysed modern ultrasound therapy devices used for the treatment of deforming ankle arthrosis and possible prospects for the use of these devices with elements of adaptive control during the procedure [36]. After analysing 11 ultrasound therapy devices, they offered them as a wide choice and provided a structural diagram of a modified adaptive ultrasound therapy device in which the output parameters are controlled by the state-dependent parameters of the patient's body, which provides improved control of the ultrasound therapy procedure.

In a study conducted by L Daniel Latt and colleagues in 2020, the focus was on exploring treatment options for plantar fasciitis, the primary cause of persistent heel pain in adults, affecting both active individuals and sedentary older adults [37]. The initial approach to addressing plantar fasciitis involves non-surgical methods such as modifying activities, using anti-inflammatory medications, engaging in calf muscle and plantar fascia stretching, and utilizing internal orthoses that elevate and cushion the heel. These non-invasive treatments have shown success in providing complete pain relief for 90% of patients, although the process may take 3-6 months. For those individuals whose symptoms persist even after a 6-month non-surgical regimen, the study suggests considering minimally invasive treatments or surgical intervention. Platelet-rich plasma injections and therapeutic ultrasound are explored as techniques to stimulate the body's natural healing response. PRP stands for Platelet-Rich Plasma. It is a medical treatment that involves drawing a small amount of the patient's blood and processing it to concentrate the platelets. Platelets contain growth factors and other proteins that play a crucial role in the body's natural healing process. The concentrated PRP is then injected into the affected area to stimulate tissue repair and regeneration [38, 39]. Corticosteroid injections, while offering temporary pain relief, come with potential drawbacks such as an increased risk of plantar fascia tearing and fatty tissue atrophy. The study highlights shockwave therapy and intense therapeutic ultrasound, specifically Extracorporeal Shock Wave Therapy (ESWT), as methods delivering low-frequency, high-energy acoustic waves to the plantar fascia. This induces microtrauma, activating reactions within the tissue that lead to regeneration, angiogenesis, increased blood flow, and improved nutrient delivery. Systematic reviews suggest that these therapies provide
satisfactory short-term pain relief and functional outcomes, including reduced morning and activity-related pain, as well as pain associated with walking. However, the long-term efficacy remains uncertain due to a lack of extended follow-up data. Notably, patients treated with ESWT demonstrated significant improvements in patient-reported outcome measures compared to those treated with corticosteroid injections.

Dongni Luo et al. (2022) conducted a meta-analysis on the effectiveness of ultrasound therapy in treating lateral epicondylitis, a common musculoskeletal disorder [40]. Thirteen studies involving 442 participants were analyzed, revealing a significant reduction in pain according to the VAS scale after ultrasound therapy. However, no statistically significant difference was found in grip strength between ultrasound therapy and control groups at various post-treatment time points. The study concluded that ultrasound therapy effectively relieves pain in lateral epicondylitis patients.

In article Gail ter Haar (2007) discusses the therapeutic applications of ultrasound, which were originally used before it was used for imaging [41]. It is pointed out that ultrasound can cause different biological effects depending on the level of exposure, with "low-power" applications including physiotherapy, fracture repair, sonophoresis, sonoporation and gene therapy. "High-power" ultrasound, especially high-intensity focused ultrasound, is used in various medical applications to achieve therapeutic effects through both thermal and non-thermal interaction mechanisms.

Peter A Siska et al (2008) noted that modern approaches to fracture management involve the use of various techniques to accelerate the time to fracture healing and increase the overall healing rate [42]. One method that is increasingly being recognised and used is low-intensity pulsed ultrasound, which has proven to be a safe, cost-effective and reliable treatment for both recent fractures and nonunion cases. Basic scientific research in vivo and in vitro has contributed to the understanding of the potential mechanisms underlying the action of ultrasound. In addition, a number of well-designed prospective, randomised, double-blind, placebo-controlled studies provide evidence supporting the clinical efficacy of low-intensity pulsed ultrasound in the treatment of fractures. This article reviews the available evidence on the use of low-intensity pulsed ultrasound in the context of fracture treatment.

**Conclusions.** The use of ultrasound diagnostics in the assessment of injuries and damages is proving to be extremely important in modern medicine. Due to the high resolution and safety of this method, doctors can accurately determine the extent of damage to muscles, ligaments, tendons and joints. This makes it possible to develop an individualised and effective treatment plan aimed at maximising function recovery and preventing possible complications.
Ultrasound therapy, which is based on the use of sound waves to treat injuries and diseases, also has a significant positive effect in the rehabilitation process. This method helps to activate regenerative processes, reduce pain and inflammation, and improve blood circulation in the affected areas. The use of ultrasound therapy can help patients return to normal physical functioning more quickly, making it an important component of modern physiotherapy and treatment of traumatic injuries.

**Prospects for further research.** The role of ultrasound therapy in the diagnosis and treatment of traumatic injuries is an exciting and developing field with considerable scope for further research.

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