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POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 2/2021 (21) KWARTALNIK ISSN 1642-0136

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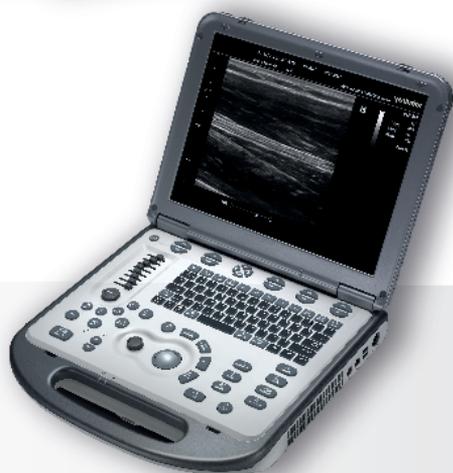
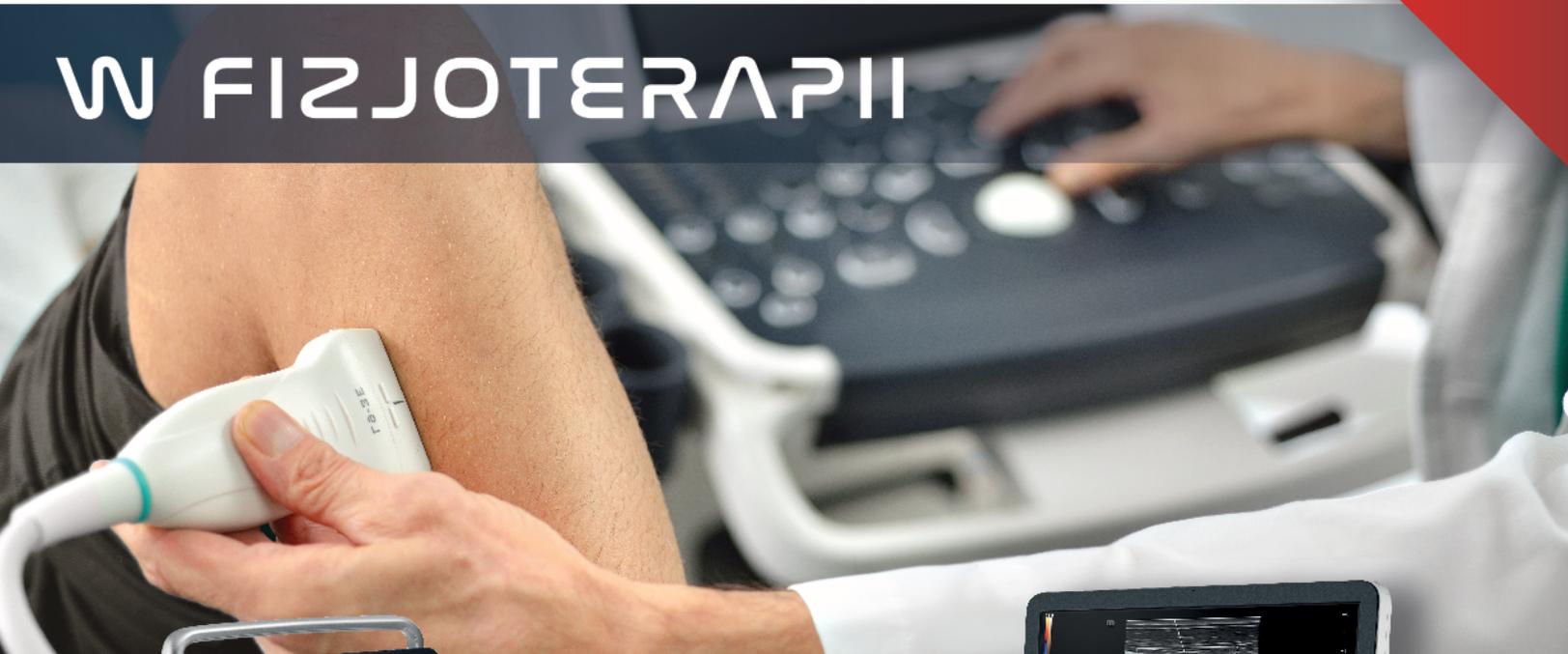


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# Rheumatoid arthritis and rheumatoid foot in physiotherapy

*Reumatoidalne zapalenie stawów i stopa reumatoidalna w praktyce fizjoterapeuty*

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## Abstract

Rheumatic diseases are not fatal, but they result in shorter life expectancy of the patients suffering from them. This applies to all inflammatory rheumatic diseases, especially rheumatoid arthritis (RA). Rheumatic diseases, in which most of all the joint inflammatory process develops with progressive joint damage, are the cause of patients' disability, prevent patients from working and everyday functioning, also at home, and affect all aspects of social life. The objective of rehabilitation in RA is to relieve pain, reduce or inhibit inflammation, and maintain the proper functioning of the locomotor system while slowing down or ceasing structural lesions in the joints.

## Key words:

Rheumatoid arthritis, RA, rheumatoid foot, disability, orthopaedic equipment

## Streszczenie

Choroby reumatyczne nie są chorobami śmiertelnymi, ale w ich następstwie dochodzi do skrócenia czasu życia. Dotyczy to wszystkich zapalnych chorób reumatycznych, a szczególnie reumatoidalnego zapalenia stawów (RZS). Choroby reumatyczne, w których przede wszystkim dochodzi do rozwoju procesu zapalnego stawów z ich postępującym uszkodzeniem, są przyczyną rozwoju niepełnosprawności chorego, uniemożliwiają mu pracę, codzienne funkcjonowanie, również w warunkach domowych, oraz rzutują na wszystkie aspekty życia społecznego. Celem rehabilitacji w RZS jest zniesienie bólu, ograniczenie lub zahamowanie zapalenia, utrzymanie prawidłowego funkcjonowania układu ruchu ze spowolnieniem lub zatrzymaniem zmian strukturalnych w stawach.

## Słowa kluczowe:

Reumatoidalne Zapalenie Stawów, RZS, stopa reumatoidalna, niepełnosprawność, zaopatrzenie ortopedyczne

Rheumatoid arthritis (RA – ICD10: M05, M06) is a chronic immune systemic connective tissue disease of unknown aetiology, characterized by nonspecific, mostly symmetrical arthritis, extra-articular lesions and systemic symptoms leading to disability [1, 2]. Depending on the presence or absence of autoantibodies in the serum (IgM rheumatoid factor), the disease is serologically positive or negative [1].

In addition to the characteristic symptom of pain and swelling in the joints of the hands and feet (less often large joints: knee and shoulder), the feeling of morning stiffness (over 60 minutes) causing limitations in everyday functioning, general symptoms may also occur such as: fever, low-grade fever, weakness, chronic fatigue, weight loss, anaemia [1, 2]. Moreover, mainly in the serologically positive form of RA with acute and long-lasting course, multi-organ changes are observed: rheumatoid nodules; changes in the circulatory system: pericarditis, pulmonary hypertension, atherosclerosis and thromboembolic events; changes in the respiratory system: pleurisy, rheumatoid nodules in the lungs, bronchiolitis obliterans, pulmonary fibrosis; in eyes: keratoconjunctivitis in the course of secondary Sjogren's syndrome, scleritis and keratitis; changes in the kidneys – related to the side effects of drugs; in the nervous system: carpal tunnel syndrome, polyneuropathy mainly in the course of vasculitis, compression of the roots of the spinal nerves [1, 2].

Within the locomotor system, the following symptoms are observed: joint pain and stiffness, most often in the morning and after a period of inactivity; joint swelling: resulting from synovial hyperplasia forming the so-called pannus, may be accompanied by exudate due to overproduction of inflammatory synovial fluid; tenderness of a joint to pressure: for example, painful joint pressure when shaking hands; restriction of mobility: initially loss of the full range of motion, followed by contracture and slight warming of the joint (without skin reddening) [1, 2, 3].

The most commonly affected joints are the proximal metacarpophalangeal and metatarsophalangeal joints. The upper limb joints are more often affected than the lower limb joints; atypical onset in the form of inflammation of one joint or in the form of palindromic rheumatism is also possible [2].

Swelling, atrophy of the palmar interossei and lumbricales muscles as well as palmar erythema in the area of the thumb and hypothenar are observed in the area of the joints of the hands; then deformities in the form of ulnar deviation of the fingers, in advanced form, palmar subluxation of the phalanges, swan neck deformity, boutonniere finger deformity (due to changes in ligaments, tendons and muscle contracture); as a result of bone changes and destruction of the tendon and ligament apparatus of the wrist, it may become stiffened, and the growing synovial membrane may cause pressure on the median nerve, which may cause carpal tunnel syndrome [1]; in the affected elbow joint pain and limitation in extension are observed, permanent flexion contracture may develop; while in the shoulder and acromioclavicular joints – synovitis of both joints, coracohumeral ligament, bursa, rotator cuff (joint subluxation), surrounding muscles and tendons [1, 2].

In the joints of the spine in the course of RA, typical changes in the cervical part are observed, unfortunately they can lead to

subluxations, microfractures, destruction of the fibrous ring of the intervertebral disc and disc herniation [1, 2].

The lower limb joints are most often affected later in the disease course; pain in the inguinal region in the hip joint and difficulty walking are observed; on the other hand, exudate in the knee joint causes ballottement or bulging on the lateral side of the joint, which increases with pressure on the suprapatellar area; a Baker's cyst may develop (palpable as a bulging of the popliteal area), its rupture may result in fluid penetration into the tissues of the shin, significant swelling, increased pain and contracture [1, 2].

A set of pathological foot symptoms in the course of RA is called rheumatoid foot [5].

Deformation of the joints and tendons of the feet caused by the degenerative disease can lead to a number of changes. In the course of the disease, the following can be observed:

- lowering the longitudinal and transverse vault with excessive lowering of the metatarsal heads,
- subluxations and dislocations in the metatarsophalangeal joints,
- deformed position of the tarsus,
- formation of the flat valgus foot,
- deformed position of the big toe,
- deviations of fingers 2-5,
- formation of hammer fingers,
- destruction of tarsal articular surfaces – stiffness, limitation or elimination of rotation and inversion,
- atrophy of soft tissue, especially on the plantar side of the forefoot, which, in combination with deformations, leads to the formation of calluses,
- inflammation of the synovial bursa, especially the anterior synovial bursa of the Achilles tendon,
- pain, often very severe, especially in the forefoot and heel area,
- swelling around the ankle and metatarsophalangeal joints.

Foot deformities in RA include the inferior ankle joint, which is mainly responsible for the heel bone rotation and inversion movements, to a lesser extent for dorsal and plantar flexion movements, and for foot adduction and abduction. In turn, inflammation of the upper ankle joint leads to contraction of the articular capsule. It preserves the horse's position of the foot, forcing the patients to walk in shoes with high heels [5, 6, 7].

Occurring deformations cause disturbances in locomotion. The patient moves with increasing difficulty. The gait becomes slow and the step length shortened [5].

In recent years, attention has been paid to the need for early diagnosis of RA and rapid implementation of effective treatment leading to remission or low activity of the inflammatory process [8]. It was also found that a good response to treatment is a derivative of the time elapsing from the onset of the disease. Based on clinical observations, the concept of a window of opportunity was proposed, i.e. the initial phase of the disease, where the applied treatment significantly reduces the health consequences of the disease and often leads to long-term remissions [8].

Treatment of rheumatoid arthritis (RA) should be comprehensive and should be based on pharmacological

treatment, rehabilitation, patient education and psychotherapy [3]. The objective of RA treatment is to relieve pain, reduce or inhibit inflammation, maintain the proper functioning of the locomotor system with slowing or stopping structural changes in the joints, and prevent organ changes [3]. Pharmacological treatment of RA should be initiated as soon as possible, preferably within 6–12 weeks of the onset of symptoms, and should be effective, i.e. lead to remission of the disease [3, 9]. The time factor, i.e. the therapeutic window (up to 12 weeks from the onset of the first symptoms of the disease) is the strongest predictor of achieving remission [9]. According to the recommendations of the European Rheumatic League (EULAR) of 2013, patients with active RA should be monitored every 3 months, and the change of treatment in the event of its ineffectiveness should take place no longer than after 6 months of therapy [9].

In the treatment of RA, the most important are classic disease-modifying antirheumatic drugs (cDMARDs) and biological disease-modifying antirheumatic drugs (bDMARDs) [2, 3]. Their task is to inhibit further development of the disease [2, 3]. Drugs influencing the symptoms of the disease, but not inhibiting its progression, include: non-steroidal anti-inflammatory drugs (NSAIDs), glucocorticosteroids (GCS) and analgesics [2, 3].

Apart from early detection and pharmacological treatment, non-pharmacological treatment plays a very important role [10]. It is multidirectional and includes:

- rehabilitation (medical rehabilitation): physiotherapy, kinesiology and physical therapy, manual therapy, occupational therapy, orthopaedic equipment;
- surgical treatment: prophylactic treatment, e.g. synovectomy, regenerative treatment, e.g. endoprosthetics;
- psychotherapy;
- balneoclimatic treatment;
- vocational and social rehabilitation;
- education [6, 10].

Comprehensive rehabilitation depends on the biomechanical and functional state of the patient [6]. It should be commenced at the very beginning of the disease, and its aim is treatment and prevention [6, 11]. This creates a greater reserve of functional capacity in the next exacerbation of the disease. In the case of multi-site lesions, rehabilitation should begin with joints that are critical to functional fitness. Establishing a rehabilitation program is difficult due to the multi-site lesions of varying degrees of severity of the inflammatory process, causing functional disorders that change with the next relapse. When establishing a rehabilitation program, one should strive to restore fitness from before the next relapse, compensate for the lost efficiency and teach how to perform everyday activities, taking into account the patient's limited functional abilities [11].

The patient's body, striving to maintain balance and the ability to perform daily tasks, often produces not always favourable replacement – compensatory mechanisms. One of the basic tasks of rehabilitation is appropriate compensation control [11].

The basic tasks of exercises recommended for patients with RA include: nourishing the articular cartilage and increasing

the range of motion (e.g. passive, self-assisted, active, slow, unloaded exercises, exercises with resistance), elimination of contractures (e.g. fixation, mobilization using manual techniques), restoration of proper work muscles (isometric muscle exercises, resistance exercises, exercises in water) [11]. Properly selected kinesiotherapy creates new movement patterns using the possibility of proper compensation, restores the lost functions of joints and limbs [11].

On the other hand, physical therapy is aimed at: preparing tissues for various forms of kinesiotherapy, it has an analgesic, anti-inflammatory effect and regulates muscle tension [11].

The most potent analgesic treatments include: cryotherapy (local and systemic), transcutaneous electrical nerve stimulation (TENS), and laser acupuncture. Electrotherapy [stimulation, diadynamic currents (DD), electroplating], magnetic field, laser and ultrasound also give good results.

In comprehensive rehabilitation, hydrotherapy (massage: underwater, whirlpool, pearl, aquavibron) and manual massage also play an important role [11].

The specificity of rehabilitation of patients with foot deformities in the course of RA is related to the course of the disease in which exacerbation of symptoms alternates with periods of remission. When planning a physiotherapy program, one should consider that inflammation is associated with dysfunction of other joints, muscle atrophy, and muscle weakness. The choice of the rehabilitation method depends on the duration of the disease, the patient's age, physical fitness and attitude towards the rehabilitation process [11, 12, 13, 14].

The condition of the articular surfaces, and hence the patient's ability to perform exercises suitable for the lesions in the joints, can be determined on the basis of the test developed by Seyfried (Table 1) [12, 13, 14].

**Table 1. Seyfried's test [12]**

Degree of joint damage	Description	Possibilities
I	The patient moves his/her limb smoothly with load (in full range, with submaximal resistance)	Resistance exercises with 50% of maximum load in sets of 10 repetitions over the full range of motion. For each day, the number of repetitions is increased by 1. On day 6, the maximum strength is assessed and load is planned for the next week
II	The patient moves his/her limb smoothly without load. Light load on the limb causes pain and restriction of movement in the joint	Slow exercises and exercises without load with dosed resistance

Degree of joint damage	Description	Possibilities
III	The patient performs a movement slowly, in stages. Removing the load results in smooth full range of movement	Exercises without load, with little resistance
IV	The patient cannot perform a movement, removing the load causes that the movement takes place to a small extent and is smaller than the passive range of motion	Supported and passive-active exercises

Rehabilitation is of particular importance in the early stage of the disease, when lesions in the locomotor organ have not yet become permanent [13,14].

#### Phase I – acute relapse

The most important goals of acute rheumatoid foot physiotherapy are pain and swelling relief and relaxation. It is inadvisable to perform intense exercise and apply long-term load on the joints [15]. Treatments with the use of low temperatures, hydrotherapy as well as relaxing, passive, isometric and self-assisted exercises are recommended [5, 15]. It is recommended that cryotherapy be performed 10-20 minutes before exercising. The analgesic effect of cryotherapy results from blocking of sensory receptors by cold, their connections with proprioceptors, slowing conductivity in sensory fibres and blocking the release of pain mediators. The analgesic effect is due to the release of  $\beta$ -endorphins. During the stimulation of the receptors with cold, a factor releasing the  $\beta$ -endorphin precursor [propiomelanocortin, ACTH (adrenocorticotropic hormone)] is secreted in the hypothalamus. Under the influence of cryotherapy, the local metabolic activity of cells affected by the inflammatory process is reduced and enzymatic reactions are decreased, which is tantamount to a decrease in the activity of inflammatory mediators. The anti-inflammatory effect is also favoured by the reduction of local blood supply to the inflamed tissues [16, 17].

Muscle tension is reduced as a result of a reduced inflow of pain stimuli to the spinal cord and segmental inhibition of gamma-motoneuron stimulation. Another relaxing effect is the slowing of the conduction in the motor nerves and the analgesic effect of cryotherapy. After the use of cryotherapy, muscle strength is significantly increased, as evidenced by clinical observations and effort electromyography (EMG) of muscles. After cold wrapping of pathologically tense muscles, electromyography showed an improvement in bioelectrical activity (reduction of relaxation time after maximum contraction, improvement of gait phasing in the EMG recording). A ten-minute treatment at 0°C or more than one-minute cooling with nitrogen has a relaxing effect [18, 19].

The anti-swelling effect is due to the improvement of the lymphatic circulation. After exposure to cold, several-hour active hyperaemia, increased capillary filtration and better patency of lymphatic vessels draining the intercellular space are observed. Additionally, the anti-swelling effect is favoured by kinesiotherapy after cryotherapy. During the procedure, harmful metabolic products are eliminated and metabolism is accelerated, which also favours the anti-swelling effect [20].

Hydrotherapy is one of the types of therapy used in diseases causing degenerative lesions in muscle fibres, inflammation or blood supply abnormalities. It has relaxing properties, so it should be combined with stretching exercises and exercises increasing the range of motion. The most common form of hydrotherapy of this ailment is a whirlpool massage. It reduces venous stasis, reduces or eliminates swelling, improves metabolism, and increases the level of blood supply to the muscles. The whirlpool movement of the water at high speed gives a superficial massage with a slight irritation of the skin, which increases its hyperaemia.

The optimal time for the treatment is 20 minutes. The water temperature should be 36–37°C, but in the presence of inflammation, higher water temperatures should not be used. They can aggravate inflammation and cause swelling [19, 20].

Passive movements reduce the pressure of the muscles on the joint and the friction in the joint. If possible, they should be performed twice a day, repeating each movement 10-20 times. The total exercise time should not exceed half an hour [5, 21].

However, thanks to isometric exercises, the muscle tension in the immobilized joint is maintained. The duration of contraction at the beginning of the exercise should be 5 seconds and relaxation time – 10 seconds. The rest period must be sufficiently longer than the contraction time to ensure sufficient blood supply. Initially, 6-10 repetitions are recommended. As strength increases, the number of repetitions and series should be gradually increased [5, 21].

In the initial period of rehabilitation, isometric exercises are used, with joint movement control and without load on the foot. In the case of acute conditions, exercises should be performed in a sitting or lying position [5, 21].

The authors recommend the use of physical therapy in the form of electrotherapy (diadynamic currents), laser therapy, magnetotherapy and thermotherapy. The main goal of physical treatments is to reduce pain in the joints and adjacent tissue, reduce inflammation and resorptive effects, improve circulation in the limbs, reduce morning stiffness, have a nutritional effect on the skin and muscles, and reduce the symptoms of secondary anaemia [5, 12]. In balneological treatment, stimuli that strongly burden the body, e.g. mud compresses, should be avoided.

### **Phase II – relapse without inflammation**

At this phase, it is important to prevent deformities by using appropriate orthopaedic equipment. Orthopaedic footwear should have soft and thick soles, wide toes and a spacious inside that fits the feet. Footwear should be equipped with prophylactic and orthopaedic insoles with a metatarsal arch support or metatarsal support, support for the longitudinal arch of the foot and a recess for the heel that stabilizes the position

of the hindfoot. In the case of ankle joint inflammation, the articular capsule shrinks and the equine position of the foot is fixed. In such cases, it is recommended to wear footwear with a higher heel, pads under the feet, casts, which make it possible to maintain the right angle between the foot and shin. In the case of inflammation of the talocalcaneonavicular joint in the valgus heel, it is recommended to use orthopaedic footwear with a stiff heel or uppers and a raised heel. Footwear selected in this way should be supplemented with insoles if the flexibility of the foot joints is maintained. It is also recommended to use orthopaedic equipment in the form of toe separators, covers for hallux valgus, gel pads under the forefoot [5, 10, 11, 12].

At the same time, actions should be taken to maintain the full range of motion in the joints. The prolonged inflammatory process within the joints of the foot leads to stiffening and limitation of mobility, which prevents active movements. Maintaining mobility in the joints is conditioned by the use of passive and active exercises of ankle joints, talocalcaneal joints and fingers, as well as stretching the Achilles tendon and plantar aponeurosis [3, 4, 5]. At the same time, exercises to increase the range of motion should be used, however, if exercises to increase the range of motion are painful, water exercises may be the solution [5]. Additionally, proprioception exercises should be carried out as disturbances of the sensorimotor system may result in an increased risk of injuries of the musculoskeletal system. Functional instability and/or a feeling of the joint "giving way" result from damage to the mechanoreceptors in ligaments or muscles [22]. In training to develop proprioception, it is advisable to perform static and dynamic balance exercises. A command to close one's eyes or perform exercises on a soft or uneven surface, e.g. a mattress, may constitute difficulty.

The benefits of stretching include increasing the range of motion, relaxing muscles, increasing muscle flexibility, and improving blood circulation. As a result of the improvement of blood supply, oxygen has easier access to damaged tissues and promotes regeneration. A safer form of stretching is static stretching. It consists in gradual stretching of the muscles until maximum resistance is felt. In order to progress while stretching, the range of motion should be gradually increased by overcoming muscle resistance. It is important to properly feel the limits of tissue stretching because too fast attempts to extend the range of muscle stretching may end with their injury [5].

However, in order to prevent muscle atrophy and joint instability, additional exercises to strengthen the muscles should be used [5].

An extremely important task for the rehabilitation team is to teach the patient to protect joints against overload, in accordance with the principles of the distribution of forces acting on the lever in the movement system (the so-called learning ergonomics of everyday activities). The specificity of rheumatoid rehabilitation is controlling the compensation of dysfunctions. Due to changes in many parts of the musculoskeletal system, the ability of internal compensation is limited. The reduced value of connective tissue generally makes it impossible to use the functions of efficient sections of

the musculoskeletal system. Therefore, in the process of rehabilitation of patients with RA, orthopaedic equipment is often used to facilitate the performance of everyday activities (external compensation) [11].

### **Orthopaedic equipment used in patients with RA**

In conservative treatment of patients with rheumatoid arthritis (RA), orthoses and auxiliary equipment are of the greatest importance. Orthoses (or braces), external technical structures covering anatomical parts of the body, affect the function and/or structure of the lower and upper limbs, spine (neck and torso). They are used to stabilize anatomical elements in a therapeutically defined setting (after physiotherapeutic or orthopaedic treatment), static or dynamic correction (in order to consolidate the achieved effects of therapy), relieve selected structures, control the range, direction and strength of movements in the joints. For example, immobilization (stabilization) of the wrist joints reduces pain and improves function, and affects the grip strength of the rheumatoid hand [4, 11, 23, 24, 25].

In the lower limb, deformities resulting from progressive RA can lead to problems with the biomechanics of the foot, which in the long term lead to walking difficulties. It is very important that the patient, apart from pharmacological and health resort treatment, also remembers about orthopaedic equipment, which, especially at the beginning of the disease, may stop the deformation process [25].

Foot deformities occurring in approximately 70–80% of RA patients (e.g. flattening of the transverse vault, hallux valgus, hammer toes, flat valgus foot) indirectly affect the knee joints, hip joints and the spine, impairing gait. Therefore, selection of healthy footwear constitutes an important element of rehabilitation. Healthy footwear meets the following conditions: the sole must be springy and flexible (stiff and hard soles impede mobility of bones in the joints, limit the work of the muscles), wide enough for the foot to rest freely on it with three points of support; it is advisable that the inner surface of the footwear is straight, in line with the direction of the so-called midline of the foot; the outer edge of the footwear, at the height of the forefoot, may be rounded (it should not narrow too much – then toe 5 is pressed against the adjacent one, and as a result, both of them are deformed); footwear should be approx. 10 mm longer (the foot lengthens while walking; too short footwear promotes the formation of hammer toes) and adjusted to the size of the foot; when buying footwear, make sure that the heel counter is stiff and tightly around the heel; the heel should not be higher than 4 cm and too narrow (the heel is the place of support for the heel); connecting seams on the upper part of the footwear must not run in the sensitive areas of the foot (head and metatarsal bones) [11, 23, 24, 25].

Depending on the dysfunction of the feet and/or adjacent joints of the lower limbs, rehabilitation uses individually made orthopaedic insoles. The ready cheaper ones do not always produce the expected therapeutic effect. It should be noted that insoles do not heal or eliminate the cause of foot disease, they only reduce the consequences of improper support during walking [11, 23, 24, 25].

Rheumatoid arthritis (RA) involves changes in the structure and function of the foot, causing pain. Chronic pain is generally defined as pain that persists for three months or more or lasts longer than the time required for normal tissue healing. There are several non-pharmacological treatments for chronic pain, such as exercise, rehabilitation, and psychological treatments. Foot orthoses are one example of the non-pharmacological treatment of chronic pain and include: custom-made or pre-fabricated insoles, orthopaedic footwear made to order. Orthoses and footwear are designed to support the feet, prevent or correct foot deformities. Insoles are specialized orthoses that are used for healing. There are soft, semi-rigid and rigid insoles [Fig. 1]. In the treatment of chronic pain, foot orthoses are used in people with various diseases, including rheumatoid arthritis.



**Figure 1. Orthopaedic insoles on individual order (own source)**

The report of the Canadian Agency for Drugs and Technologies in Health showed inconsistencies in the effectiveness of the use of foot orthoses in people with painful rheumatoid foot. Some studies present statistically significant differences between the groups differentiated according to the reported pain, favouring foot orthoses; in others no differences between the groups were presented. Statistically significant results were collected in the group of people using individual insoles supporting the rheumatoid foot [26].

Ramos-Petersen et al. point out the correlation between the use of insoles and physical activity undertaken by patients with RA. Foot orthoses are used to reduce foot pain, keep the feet mobile and maintain the proper position of the joints. The purpose of using orthoses is to maintain physical activity in patients with rheumatoid foot, which, thanks to the orthoses, will be undertaken painlessly [27].

On the other hand, Japanese researchers indicate a correlation between the use of foot orthoses and the intensity of physical activity undertaken by patients with rheumatoid foot. Loss of

muscle mass was very common in patients with foot problems associated with RA. Treatment with foot orthoses increases low-intensity physical activity, such as walking, but does not improve the effectiveness of moderate or high-intensity exercise [28]. Tenten-Diepenmaat and a group of colleagues from Amsterdam proved that foot orthoses developed according to the protocol improving the properties of plantar pressure redistribution lead to moderate to significant improvements in terms of pain reduction and improved physical performance [29].

Gaino et al. conducted a study focused on comparing balance, foot function and mobility in patients with rheumatoid arthritis with and without foot orthoses. The following tests were used in the evaluation: "Foot Function Index", "Berg Balance Scale" and "Timed-up-and-go Test", and patients were assessed at the beginning and after four weeks. Foot orthoses improved foot function and balance in patients with rheumatoid arthritis [30].

The above results indicate that the use of foot orthoses is important in the treatment of rheumatoid foot, as they reduce pain and increase physical activity undertaken by people with RA. The costs of orthopaedic foot equipment is not reimbursed by the National Health Fund, therefore the patients are obliged to cover all related costs from their own funds.

The types of insoles available on the medical devices market in Poland include serially produced equipment in European sizes and individually designed insoles. In individual production, modern measurement methods are used, such as direct scan of the foot, and on this basis, an individual model is designed taking into account the needs of the patient using CAD/CAM computer design and manufacturing techniques. The materials to make insoles include EVA foams with a different hardness of 20-80 ShoreA. Increasingly, additive technologies find their application in orthopaedic technique. 3D printing allows for the production of geometry that is unavailable in traditional methods, and thus for the use of relief and correction elements in a more varied and individual manner.

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