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**Efekt terapeutyczny
działania krioterapii
miejscowej na staw
kolanowy, uzależniony
od rozpoznania choroby
zwyrodnieniowej**



**Profil chorych kierowanych do leczenia w zakresie
rehabilitacji ogólnoustrojowej**

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Efekt terapeutyczny działania krioterapii miejscowej na staw kolanowy, uzależniony od rozpoznania choroby zwyrodnieniowej

The therapeutic effect of local cryotherapy operation on the knee, joint depending on the type of diagnosis of osteoarthritis

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Streszczenie:

Wstęp. Celem przeprowadzonych badań była ocena wpływu zabiegów krioterapii miejscowej na zakres ruchu w stawie kolanowym u pacjentów z chorobą zwyrodnieniową stawów. Dodatkowo analizowano potencjalne zmiany w dolegliwościach bólowych pacjentów.

Materiał i metody. Grupa badana liczyła 50-ciu pacjentów. W badaniu wzięło udział 39 kobiet i 11 mężczyzn. Wśród pacjentów dokonano podziału na dwie grupy zgodnie z rozpoznaniem choroby. Pacjenci poddani byli 10-ciu codziennym zabiegom krioterapii miejscowej na okolicę stawu kolanowego. Przed przystąpieniem do leczenia został zebrany wywiad odnośnie chorób współistniejących oraz zbadano dolegliwości bólowe według skali VAS. U wszystkich badanych wykonano pomiar zakresu ruchów w stawie kolanowym za pomocą goniometru. Został on wykonany przed rozpoczęciem zabiegów oraz po ich zakończeniu.

Wyniki. Rozpatrując zakres ruchu zgięcia w stawie kolanowym w obu grupach, zarówno z rozpoznaniem choroby zwyrodnieniowej stawów kolanowych oraz choroby zwyrodnieniowej wielostawowej, po wykonaniu serii zabiegów krioterapii miejscowej zaszła znaczna poprawa, natomiast zakres ruchu wyprostu w stawie kolanowym polepszył się bardziej w grupie z rozpoznaniem choroby zwyrodnieniowej wielostawowej. Oceniając obie grupy badanych, zarówno w grupie z rozpoznaniem choroby zwyrodnieniowej stawów kolanowych, jak i choroby zwyrodnieniowej wielostawowej, po wykonanej serii zabiegów krioterapii miejscowej deklarowana wartość poziomu dolegliwości bólowych na skali VAS zmalała. Rozpatrując poprawę z uwzględnieniem płci, można stwierdzić, iż u kobiet z rozpoznaniem choroby zwyrodnieniowej stawów kolanowych poprawa była znacznie większa.

Wnioski. Krioterapia miejscowa jest skuteczną metodą, redukującą znaczne dolegliwości bólowe pacjentów oraz wpływającą na poprawę zakresu ruchów w stawie kolanowym u chorych z gonartrozą.

Słowa kluczowe:

krioterapia, gonartroza, staw kolanowy

Abstract

Introduction. The aim of the study was to evaluate the effect of local cryotherapy treatment for range of motion in the knee joint in patients with osteoarthritis. In addition, analyzed potential changes in symptoms of pain patients.

Material and method. The study group consisted of 50 of the patients. The study involved 39 women and 11 men. Patients were subjected to 10 daily treatments local cryotherapy on the area of the knee. Before treatment was collected interview regarding comorbidities and examined pain according to VAS. In all patients performed to measure of range of motion in the knee joint using a goniometer. It was made before and after treatment.

Results. Considering the range of flexion in the knee joint in both groups, both diagnosed with osteoarthritis of the knee and polyarticular osteoarthritis, after a series of local cryotherapy treatments became significant improvement, while the range of motion in the knee extension improved more in the group diagnosed with polyarticular osteoarthritis.

In assessing the two groups studied, both in the group with a diagnosis of osteoarthritis of the knee, as well as polyarticular osteoarthritis, and made a series of treatments local cryotherapy declared value level of pain on the VAS decreased. Considering the improvement by gender, it can be concluded that in women with a diagnosis of osteoarthritis of the knee improvement was much greater.

Conclusion. Local cryotherapy is a beneficial effect on the range of motion in the knee joint and reduction of pain in patients with gonarthrosis.

Key words:

cryotherapy, gonarthrosis, knee joint

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Introduction

Human body is exposed throughout life to different loads, that are related with natural need of movement, improving mobility, high sport exploitation, or requirements which are related to the performed profession. To the present, not invented effective method, that could help prevent in degeneration of the joints. For many people, the cause of complaints from the locomotor system is typical of our time, the race against time, without rational counting the adaptive capacity and the compensation body. Soft tissue injury musculoskeletal, do not have to start from a strong injuries. In the most cases this is due to by summing up microtraumas and normal overload, and also as the secretive development of the disease, give clear signs, with the exception of pain [1]. The knee joint is the largest pond of the human body, and the most sensitive and often undergoing damage. Knuckles of femur create the head of the joint, while acetabular cup create shin knuckles and knee – cap, which acts as a protective joint from the front and enhances the effect of the quadriceps. Part of the joint that is located between the femoral condyles and the patella is defined clinically as the patellofemoral joint – thigh. With the cartilage occurs even load distribution, also increases the elasticity of the pond, and the shock when walking or jumping is reduced [2]. Each person in life struggling or will be struggling with the pain of the joints. It is these that are the most important part of the musculoskeletal system. Articulations due to their functions and the complex anatomy of the most often are damaged. Joint pain can be a sign of inflammation or disability, which can be divided on:

- intra joints, concerning synovium, cartilage, menisci and cruciate ligaments;
- periarticular, concerning on the tissues associated with a pond, that is, tendons, ligaments and synovial bursa;
- and extra-articular, relating to muscle, bone, nervous system and the cardiovascular system [3].

Osteoarthritis may include one or more joints. The probability of its occurrence increases with age. Location of changes is different and it depends on gender, race and age. Lesions occur earlier in people with congenital defects, such as varus or valgus knee. Pain worsen with increased stress and activity, and reduce in rest time. Accompanied by the instability of the joint, periarticular muscle weakness and fatigue. Damage the elements of the joint, can lead to an imbalance between the ability transfer of mechanical stress and amortization [4, 5].

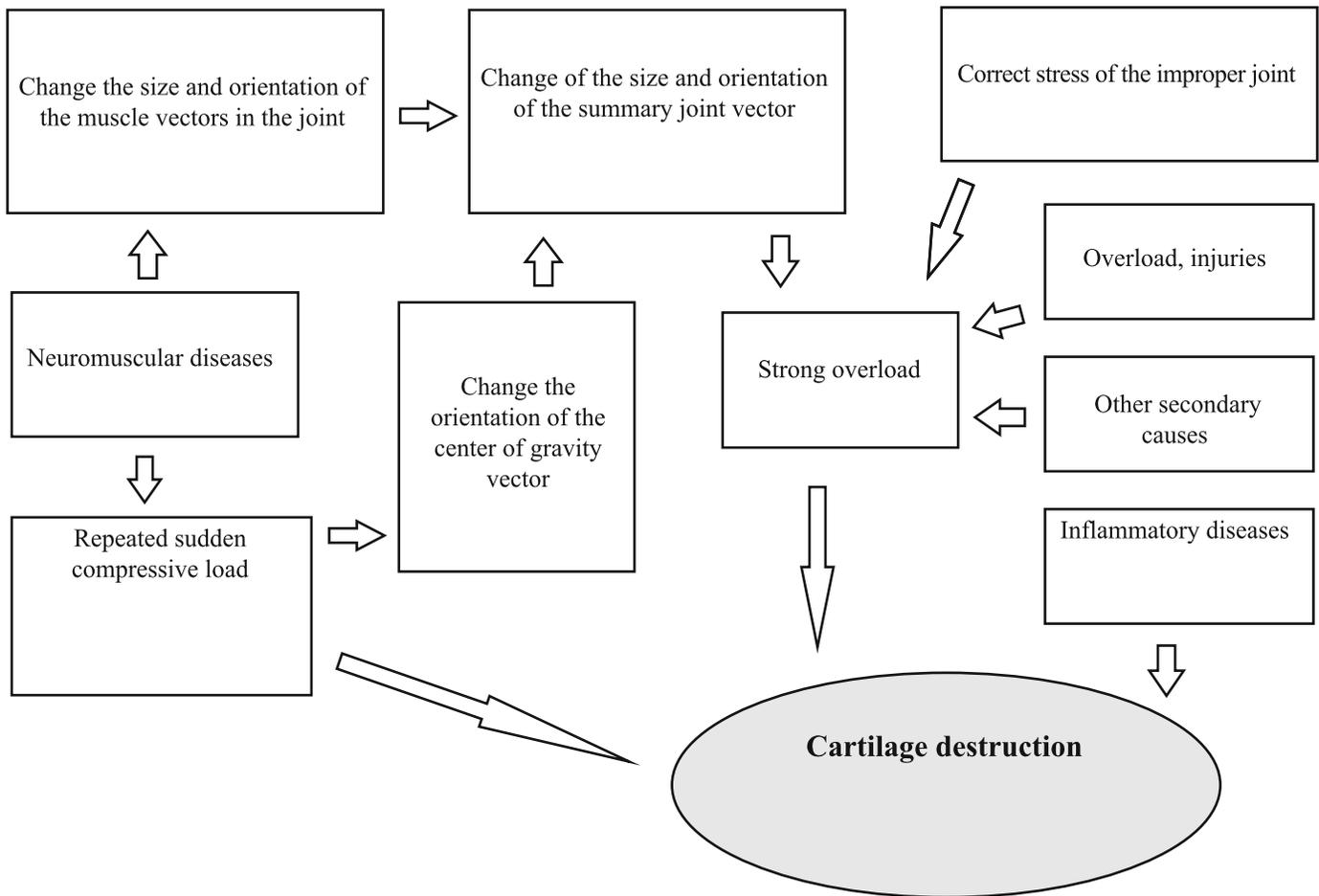


Fig. 1. Model of factors damage of articular cartilage [6]

There is a division of osteoarthritis on: primary and secondary.

In the primary form of the disease, concomitant changes in both joints and diagnose the specific reasons is impossible. Secondary form arises due to influence on articular surfaces the forces, that are exceeding the strength of joint cartilage, resulting in a further step permanent damage [7]. Osteoarthritis of the knee is a very big problem, which shows how important it is to find the correct diagnosis [8]. It should be comprehensive and include the key elements for the planning of appropriate treatment program [9]. The aim of treatment is adequate control of pain and improvement in function and quality of life of the patient while minimizing side effects of therapy. Non-pharmacological methods should include education of the patient and his family, the recommendation to maintain the current daily activities, avoiding noxious mechanical factors, joint protection, weight loss, physical therapy, topical application of heat or cold, psychotherapy and orthopedic measures. In osteoarthritis should seek primarily to get rid of the pain and increase joint mobility [10].

Material and methods

The study was conducted at the Regional Center in Occupational Medicine in Szczecin. The study group consisted of 50 patients with a diagnosis of osteoarthritis of the knee or polyarticular osteoarthritis. The study involved 39 women and 11 men. The youngest person tested was 37 years, and the oldest 92 years. Mean of age was 69 years \pm . The patients were divided into two groups according to the diagnosis of the disease. The first group consisted of patients with a diagnosis of osteoarthritis of the knee, while the other patients diagnosed with polyarticular osteoarthritis. The evaluation of patient to a medical treatments, to eliminate contraindications and the selection of the appropriate method of treatment, were made by a doctor. Patients were subjected to the 10 local cryotherapy treatments daily for the area of the knee, with free day of the weekend. Before cryotherapy were interviewed regarding comorbidities and pain were examined by VAS. Before starting treatment all patients was performed to measure the range of motion in the knee joint. The same measurement was taken after the end of treatment. Measurements were made using a goniometer, which measured range of motion of flexion and extension of the knee joint. Before testing, each patient has agreed to participate in the study and was informed about the technique and the course of measurements. Patients were also informed about the anonymity of research. Local cryotherapy treatment was performed once a day using kryostimulator, acting on the system liquid nitrogen [fig. 2].



Fig. 2. Local cryotherapy on the knee joint.

The treatment consists of the application cold, on the area of the knee, at -160°C at the outlet nozzle. It causes only a local effect. Kind of the refrigerant used to perform the surgery were liquid nitrogen vapors. The method of cooling the knee held up by using a special nozzle directed at the treatment area. The treated site due to patient safety, was completely dried. The application was movement and and regulation in cooperation with patient. The treatment was carried out for 2 minutes [11].

When measuring the range of motion of flexion and extension of the knee joint, the patient was on the couch in the supine position ahead, lower limbs are straight in the knee joints and extended beyond the substrate so that the patient's knee joint was not supported. The study was carried out in the sagittal plane, wherein the axis of the goniometer was placed in the region of the head of the arrow according to a transverse joint axis [fig. 3].



Fig. 3. The measurement range of flexion in the knee joint

The scale of the goniometer was directed upwards in the examination downward flexion and extension during the test. Arm still run along the long axis of the femur and was directed toward the greater trochanter of the femur, while the movable arm was positioned along the lower leg and was directed toward the lateral malleolus of fibula. During the study followed the movable arm leg below the knee, and shoulder still remained in its original position [12]. Valid ranges of movement of the knee joint of the ISOM (International Standard Ortopedica Measurement) are for bending $130-135^{\circ}$, and for extension 0° [13].

Pain subjects were evaluated before and after a series of local cryotherapy treatments according to 10-point visual analogue scale VAS (Visual Analogue Score), where ill patient was defined degree of pain intensity on a line with

a length of 10 cm, where 0 represents no pain and 10 - the strongest pain that you can imagine. VAS value in the range 0-3 indicate correct the effects of therapy and of feeling improvement. VAS over 7 means a very strong pain and the need for further evaluation and consultation with a doctor.

Statistical analysis was performed in STATISTICA (version 10 PL). In addition to descriptive statistics (arithmetic mean, standard deviation, minimum, maximum), defined normality distribution of test parameters using the Shapiro-Wilk test. Since most of the measured values showed deviating from the normal distribution, to their comparison was used non-parametric Wilcoxon test, for comparison of the range of motion before using local cryotherapy [t1] and after application [t2], and to compare the value of VAS local cryotherapy before [t1] and after application cryotherapy [t2]. In order to verify significant differences between men and women used a nonparametric U Mann-Whitney test.

To carry out the aforementioned statistical analyzes the level of significance at $p < 0.05$.

Results

Results of this study are summarized in Tables 1-2.

Considering the range of flexion of the knee joint in both groups, both diagnosed with osteoarthritis of the knee and polyarticular osteoarthritis, after a series of treatments to improve the local cryotherapy became highly statistically significant ($p \leq 0.001$). Whereas the range of motion of the knee extension improved more in the group diagnosed with polyarticular osteoarthritis ($p \leq 0.01$), than in the group of patients whose doctor diagnosed osteoarthritis of the knee ($p \leq 0.05$). Having regard to sex, it can be concluded that in women with osteoarthritis of the knee became greater improvement in range of motion of flexion and extension, than in men.

In women, there is a significant improvement in both flexion and extension, while in the men reported no improvement both with regard to the scope of flexion and extension [Table 1].

In assessing both groups of respondents, both in the group with a diagnosis of osteoarthritis of the knee, as well as polyarticular osteoarthritis, after made a series of local cryotherapy treatments declared value of the level of pain on the VAS decreased, and the result is highly significant.

($p \leq 0.001$). Considering the improvement of gender, we can conclude that in women with

a diagnosis of osteoarthritis of the knee there was a much greater improvement ($p \leq 0.01$) than in men with the same diagnosis ($p \leq 0.05$). In the group of patients

with polyarticular osteoarthritis, women suffered a significant reduction in pain ($p \leq 0.001$), while in men there was no significant improvement in [Table 2].

Table 1. The range of motion before local cryotherapy [t1] and after treatment [t2] having regard to the type of degeneration.

Grupy Groups	Z t1 [°] Flexion			Z t2 [°] Flexion			W t1 [°] Extension			W t2 [°] Extension		
	\bar{x}	min	max	\bar{x}	min	max	\bar{x}	min	max	\bar{x}	min	max
Osteoarthritis of the knee [SK] n=16	106.81 ±6.99	92	119	110.19 ±7.12 ***Zt1SK	95	123	-0.81 ±1.28	-4	0	-0.31 ±0.87 *Wt1SK	-3	0
Women [SK] n=9	106.33 ±7.62	92	116	109.89 ±7.82 **Zt1K[SK]	95	120	-1.33 ±1.50	-4	0	-0.56 ±1.13 **Wt1K[SK]	-3	0
Men [SK] n=7	107.43 ±6.65	99	119	110.57 ±6.71 *Zt1M[SK]	103	123	-0.14 ±0.38	-1	0	0.00 ±0.00	0	0
Osteoarthritis polyarticular[WS] n=34	106.15 ±5.57	96	118	108.97 ±5.52 ***Zt1WS	99	121	-1.00 ±1.52	-6	0	-0.50 ±1.02 **Wt1WS	-4	0
Women [WS] n=30	106.20 ±5.36	97	118	109.07 ±5.35 ***Zt1K[WS]	100	121	-1.07 ±1.57	-6	0	-0.53 ±1.07 **Wt1K[WS]	-4	0
Men [WS] n=4	105.75 ±7.93	96	115	108.25 ±7.63	99	117	-0.50 ±1.00	-2	0	-0.25 ±0.50	-1	0

Table 2. The VAS scores before local cryotherapy [t1] and after treatment [t2] having regard to the type of degeneration.

Groups	VAS t1			VAS t2		
	\bar{x}	min	max	\bar{x}	min	max
Osteoarthritis of the knee [SK] n=16	6.75 ±1.88	4	10	5.25 ±1.57 ***VAS T1SK	3	9
Women [SK] n=9	6.89 ±2.09	5	10	5.33 ±1.87 **VAS T1K[SK]	3	9
Men [SK] n=7	6.57 ±1.72	4	9	5.14 ±1.22 *VAS T1M[SK]	4	7
Osteoarthritis polyarticular[WS] n=34	7.24 ±1.54	3	10	5.85 ±1.79 ***VAS T1WS	2	9
Women [WS] n=30	7.27 ±1.62	3	10	5.87 ±1.89 ***VAS T1K[WS]	2	9
Men [WS] n=4	7.00 ±0.82	6	8	5.75 ±0.96	5	7

Discussion

In this own study showed, that in patients diagnosed with polyarticular osteoarthritis, and in patients with a diagnosis of osteoarthritis of the knee, improve range of motion in flexion and extension of the knee joint was seen in both groups. In assessing both groups of patients in terms of perceived pain, and made a series of local cryotherapy treatments, declared value of the level of pain on the VAS was decreased.

Reviewing the effects of cold treatment, the E. Birkner et al., Relied on one of the fundamental rights of biophysics and concluded that the biological effect of the treatment depends on the size of the absorbed dose and not exposure, and therefore it is very important what the temperature will be reached in the tissues and by how long the cells will operate at reduced temperatures. The reaction for a cold is much larger in blood vessels muscle rather than in the skin. The cooling of the space under treatment causes the instantaneous release of blood flow due to contraction of blood vessels, then there is an increase tissue temperature. The temperature increase is dependent on cooling of the process, the greater will be the cooling down, the greater the increase in temperature. From a few to several minutes after the procedure in place there is a sudden cooling of active hyperemia, and this raises the body temperature and inhibition of noradrenaline release. As a result of this action will occur vasodilatation and hyperemia of tissues, which improves metabolism, increase tissue oxygen saturation as well as the elimination of the accumulated products of metabolism [14].

Łukowicz et al., paying especially attention on the physical procedure in osteoarthritis of the knee. According to them, cryotherapy as a result of lowering the temperature of the skin and other tissues reduces the pain associated with a reduction in conduction velocity of nerve fibers, the inhibition of nociceptors in the skin, and total or partial blockage C-fibers and a decrease in the release of mediators of pain. It also results in inhibition of the inflammatory process. Another treatment that brings therapeutic effects in osteoarthritis of the knee by authors magnet. The magnetic field improves the oxidation and cellular respiration, causing aggravation of soft tissue regeneration, accelerates the formation of bone adhesion and anti-inflammatory and anti-oedematous. Depending on the etiology of pain syndrome of the knee joint and the pathogenesis of the disease has been confirmed the effectiveness of cryotherapy and magnetic therapy [15].

The influence of local cryotherapy on mobility of patients with osteoarthritis of the knee joint also studied Romanowski et al. Patients were measured range of motion goniometer, using the international method of measuring published by the ISOM (International Standard Orthopedic Measurement). Evaluates concerned, active movement of flexion and extension, and in addition made to measure muscle strength and "50 m walk test". The results confirm the physical efficiency improvements after local cryotherapy. Cause to achieve improved mobility could be an analgesic effect and cryotherapy. The authors also argue that due to the cold, a reduction in muscle tone, which is beneficial to improve

the function, especially locomotion. Lowering the temperature of the involved joint inflammation contributes to the release of cartilage destruction processes by inhibiting the activity of enzymes and cell metabolism [16].

As a result of personal research also showed that local cryotherapy treatment had a significant impact on improving the range of motion in the joint and to reduce pain in a group of patients.

Conclusions:

1. A series of 10 daily local cryotherapy treatment has a beneficial impact on the range of motion of flexion and extension of the knee joint in patients with gonarthrosis.
2. Having regard to gender, there was a significantly greater improvement in flexion and extension of the knee joint in women than in men.
3. In all patients, undergoing a series of local cryotherapy on the knee joint, demonstrated a significant reduction of the declared value of pain according to VAS after treatment.
4. Among the patients studied, having regard to the diagnosis, in both groups: with osteoarthritis of the knee and polyarticular osteoarthritis, reported improvement in flexion in the knee joint and the declared values of pain according to VAS. The range of motion extension in the joint-knee, improved more in the group in which diagnosed with polyarticular osteoarthritis.

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