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The effect of pectineus muscle therapy on gait parameters and pain in people with osteoarthritis of the hip

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Abstract

Introduction and Objective. Nowadays, osteoarthritis has become a civilization problem and is a frequent cause of disability in highly developed countries. The aim of the study is to assess the effect of relaxation of the pectineus muscle on the mobility of the hip joint during gait.

Materials and Method. 32 patients with unilateral hip osteoarthritis were qualified to the study group and 30 healthy people to the control group. Each patient in the study group underwent a technique for inhibition of the pectineus muscle. Before and after 2 weeks and 6 therapies using the technique, measurement of mobility in the hip joint during gait was performed using the Noraxon MyoMotion inertial system, and groin pain witch VAS score.

Results. The pectineus muscle inhibition had a significant ($p=0.0005$) impact on decreasing maximal external rotation on average by 5.44°. An increase ($p=0.0018$) of the maximal internal rotation, on average by 5.21° was also proved. The maximum extension was increased ($p=0.0079$), on average by 3.42°. The total range of mobility in the sagittal plane improved ($p=0.0028$), on average by 3.61°. In other movements, there was no statistically significant relationship. In VAS score, the pain of the hip decreased in the study group ($p=0.0022$).

Conclusions. The relaxation of the pectineus muscle has a positive effect on the degenerated hip joint function during gait. The pectineus muscle inhibition may be a useful technique used to treat patients with coxarthrosis.

Key words

manual therapy, hip mobility, hip osteoarthritis, pectineus muscle

INTRODUCTION AND OBJECTIVE

Degeneration is defined as pathological changes that are the result of progressive biological processes in cells and tissues, both physical and biochemical, causing at the same time functional abnormalities.

Osteoarthritis is one of the most common diseases in the motor organ. In the course of this disease, cartilage is damaged, which co-exists with the repair processes in the subchondral bone layer, resulting in increased bone mass and formation of the exostoses at the osteochondral border, called osteophytes. Although the etiopathogenesis of the degenerative disease is not fully understood, researchers adjudge that the reasons for its formation are inflammatory, immunological, and especially genetic processes. Additionally, a number of environmental risk factors: older age, obesity and joint injuries complicate the actual origin of this disease [1].

Inflammatory factors produced, among others, by the synovium, start a cascade of pathological processes in the chondrocytes. Histopathological examination allows the detection in the majority of patients, the features of synovitis. The causes are sought in molecules that are released as a result of cartilage damage and which are likely to interact through receptors in the innate immune system. The development of synovitis is also influenced by adipose tissue. Adipocytokines and immune cells can stimulate macrophages, provoking proliferation of the synovium, the image of which is mostly heterogeneous. It is estimated that an inflammatory factor, as well as genetic factors, influence the formation of osteophytes [2].

Major symptoms of clinical degeneration of the hip joint include groin pain, limitation of mobility and weakness of muscle strength (hip extensors, abductors and external rotators). Initially, pain occurs after prolonged walking or significant physical effort. As the disease develops, the pain becomes continuous, appears even at night and does not resolve after rest. The pain is not only located in the groin, but also occurs in the area of the greater trochanter, the distal part of the thigh and the medial part of the knee [3]. There are currently several theories that explain the cause of pain. One of them refers to increased pressure in the epiphyses, associated with congestion and intra-articular hypertension. Another refers to myofascial trigger points, which binds pain with the mechanical abuse of the muscle. As a result of the muscle overload, its elasticity and length is reduced, and thus limited mobility develops. There is clinical evidence that putting pressure on the trigger points causes the release of muscle tension and the improvement of the ranges of mobility. Effects of trigger point therapy have been noticed, and have already been examined in the shoulder joint [4]. Clinical improvement after muscle treatment in hip OA has also been confirmed [5].

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In the pathogenesis of pain, the thickened and constricted joint capsule, which is the reason for the limitation and appearance of contractures, also plays an important role. Limited mobility in the hip joint proceeds in a strictly defined way and is associated with the capsule pattern. First, the internal rotation is limited, then abduction and extension [3,6].

Progressive inhibition is one of the osteopathic techniques described in the *Glossary of Osteopathic Association*, prepared by the American Association of Colleges of Osteopathic Medicine (AACOM) [7]. Inhibition is based on the static pressure of soft tissues which causes relaxation and normalization of physical activity. This technique is probably the oldest that had been described by manual therapists. The aim of this therapy is to reduce tonicity, pain and restore the function of the joint. While performing the technique, the tissue may react with increased tension and pain, but gradually, when using a constant pressure force, it becomes relaxed.

The pectineus muscle is a muscle of the hip extending from the pecten pubis to the pectineal line and the proximal section of the linea aspera of the femur. The function of this muscle is adduction, external rotation and hip joint flexion. It also stabilizes the hip joint in the sagittal and frontal plane. It gains its innervation from the femoral nerve and accessory obturator nerve, from the roots L2 and L3 [8]. The pectineus muscle and its dysfunction have already been described as causing limited mobility in the hip joint and causing groin pain [19].

MATERIALS AND METHOD

32 participants were qualified to the study group that consisted of 21 women and 11 men diagnosed with hip osteoatrhritis. The inclusion criteria were a clinical examination and an X-ray examination confirming the diagnosis. During the clinical examination, groin pain using the VAS scale, limitation of mobility involving internal rotation, extension or abduction, as well as muscle weakness were found. The age of the patients with degenerative lesions ranged from 55–65 years. The body mass index (BMI) in 68.8% patients exceeded the normal value. Characteristics of the examined persons are presented in Table 1.

Into the control group were qualified 30 people between the age of 58–60 – 23 women and 7 men, who had no diagnosed degenerative changes in the hip joints and no pain complaints. All persons were examined at the Laboratory of Physical Effort and Genetics in Sports at the Jędrzej Śniadecki Academy of Physical Education and Sport in Gdańsk, Poland.

Table. 1 Research and control group characteristic

	Study Group n=32 w*=21 m*=11	Control Group n=30 w*=23 m*=7
Age	59.9 ± 3.5	57 ± 2,5
Height	1.65 ± 0.06	1.71 ± 0.11
Weight	72.38 ± 11.34	66.20 ± 15.11
BMI (%)		
Normal	32%	44%
Overweight I and II	68%	66%

*w – women *m- men

The examination was performed using Noraxon MyoMotion equipment with inertial sensors (MyoMotion Research Pro model) to determine the angular velocity and acceleration measurement. The sample rate is 100 Hz, the accuracy of the test in the statics is ± 1°, and in the dynamics ± 1.2°. An inertial sensor, the IMU (inertial measurement unit) is a unit used for inertial navigation, equipped with 3 orthogonal rate gyroscopes and 3 orthogonal accelerometers. This system measures movement in 3 degrees of freedom. The software makes it possible to create reports with graphical presentation of results and to determine the value of maximum and minimum deflections, as well as the entire range of mobility. Inertial sensors are placed on the body, on those parts of the limbs that move during movement with respect to each other. They are light, wireless, and do not hinder movements. Thanks to their mobility and lack of cables, patients feel free and are not stressed by the course of the examination. During the walking test, groin pain was measured using the VAS scale.

Muscle inhibition was performed in 6 sesions in 2 weeks. The therapy in the research group was performed on the side of the degenerative changes, and in the control group on a randomly selected lower limb. The muscle technic involved pressing the muscle until it relaxed. The muscle inhibition technique was performed 3 times in 1 therapy.

The starting position for the technique is lying the participants on the back, with the hip joint flexed to 90 degrees and in the position of greatest abduction. The foot of the limb undergoing therapy is placed next to the knee of the other limb.

Pressure on the pectineus muscle is performed with the thumb of the caudally positioned limb. It is precisely made towards the ground, until complete relaxation and pain reduction (about 10 seconds). From all the parameters obtained during working with the apparatus, the parameter of the maximum deflection in each range of mobility during gait was used. The measurement of ranges of mobility was carried out 3 times before and after the manual treatment. During the walking test, groin pain was measured using the VAS scale. Measurement of range of motion during walking before first and after last therapy used for statistical analysis were means of 3 walks by the patients. To analyse the results, non-parametric Wilcoxon test was used as an alternative to the t-distribution of dependent sample.

RESULTS

The pectineus muscle inhibition has a significant ($p = 0.0005$) impact on decreasing maximal external rotation on average by 5.44°. An increase ($p = 0.0018$) of the maximal internal rotation on average by 5.21° was also proved. The maximum extension was increased ($p = 0.0079$), on average, by 3.42°. The total range of mobility in the sagittal plane improved ($p = 0.0028$), on average, by 3.61°. In other movements, there was no statistically significant relationship (Tab. 2). Analysis of the results in the control group did not show significant statistical differences (Tab. 3).

Table. 2 The range of motion during gait statistical analysis before and after pectineus muscle inhibition in the study group

Range of motion [°]	Before therapy	After therapy	p
External rotation	11.27 ± 4.08	5.83 ± 2.61	0.0005*
Internal rotation	6.89 ± 3.02	1.68 ± 2.72	0.0018*
Total range of rotation	5.85 ± 4.59	6.60 ± 4.44	0.1552
Extension	-5.07 ± 4.94	-8.49 ± 6.03	0.0079*
Flexion	24.97 ± 4.43	25.73 ±5.02	0.3498
Total range in the sagittal plane	36.77 ± 6.00	40.39 ±7.48	0.0028*
Adduction	4.97 ± 6.15	3.85 ± 7.22	0.3498
Abduction	-3.47 ± 4.01	-3.64 ± 3.96	0.2540
Total range in the frontal plan	9.11 ± 2.63	11.18 ±3.87	0.3794
VAS scale	6.2 ± 2.3	3.1±1.8	0.0022*

Table. 3 The range of motion during gait statistical analysis before and after pectineus muscle inhibition in the control group

Range of motion [°]	Before therapy	After therapy	p
External rotation	5.14±6.45	5.83±2.54	0.2514
Internal rotation	-6.69±5.13	-5.98±4.09	0.3125
Total range of rotation	12.1±3.42	13.14±4.12	0.2314
Extension	-14.22±5.51	-13.49±4.13	0.1243
Flexion	32.45±7.25	34.45±7.89	0.0998
Total range in the sagittal plane	45.53±3.54	43.65±5.13	0.3875
Adduction	5.48±7.14	6.01±5.12	0.4584
Abduction	-5.41±3.21	-4.63±2.53	0.3264
Total range in the frontal plane	12.10±3.21	11.24±4.21	0.2211
VAS scale	0.0±0,00	0.0±0.00	-

DISCUSSION

Manual therapy as a non-pharmacological, non-surgical method for the treatment of joint degeneration includes techniques such as manipulations, mobilizations, or working on soft tissues. This therapy is recommended by the National Institute for Health and Care Excellence [10]. The American College of Rhematology is also a supporter of manual therapy in cases of chronic pain in patients for whom surgery is not recommended [11].

Although these recommendations are dictated by scientific reports, it should be emphasized that there are only a few of them and their value is insignificant. A large part of reports from around the world concern the comparison of manual therapy and exercises, physical treatments, and acupuncture. On their basis, it was concluded that non-surgical and non-pharmacological procedures are important for people with clinical symptoms of degenerative lesions in the hip. Current reports on the use of manual therapy in hip osteoarthritis seem promising. Mobilization of the hip joint in the course of this disease improves the clinical condition of patients [12,13].

Previous studies have been performed using a goniometer, lower limb functional questionnaires and a pain scale. There is currently high-quality scientific evidence that exercise therapy reduces pain. Unfortunately, current reports regarding the beneficial effect of manual therapy on osteoarthritis of the hip joint are confirmed by low-quality studies [14]. A recent study by Beselg et al. [15] conducted on 40 patients with degenerative lesions of the hip joint demonstrated the positive impact of the Mulligan concept techniques. With the help of mobilization of the joint with movement, immediate reduction of pain and increase in the ranges of mobility of internal rotation and flexion in the hip joint were achieved. The examination of ranges of mobility concerned maximum deflections during passive and active movement [15]. Due to the fact that unreliable measuring tools are used in current studies, it is advisable to extend this issue with research that would be based on modern equipment with high precision of measurement. It is also expected to examine the short and long-term effect of manual therapy in osteoarthritis of the hip joint [14]

The main clinical symptom recorded in people with degenerative lesions of the hip joint is pain and flexion and rotation contracture. In physical examination, there is a limitation of the range of passive and active mobility concerning internal rotation, extension and abduction, consistent with the capsule pattern. The manifestation of these limitations in the hip joint during gait is widely described in the current literature [16,8]. Recent reports using optoelectronic systems such as Vicon or inertial sensors such as Noraxon Myomotion confirm that the most restricted range of motion during gait is the extension in the hip joint [17].

In connection with clinical observation of increased tension and painfulness of the pectineus muscle in people with degenerative lesions of the hip joint and analysis of its course, it can be concluded that its hypertonia may participate in the development of the observed pathology in these patients. In an attempt to answer the question whether the pectineus muscle affects the rotation and flexion position during gait, the study was designed to use the technique that will be as precise as possible and will not affect neighbouring structures such as the technique of postisometric relaxation [18]. A statistical result of increased extension and decreased external rotation with an increase in internal rotation was obtained after using the technique of inhibiting the pectineus muscle during walking, despite the fact that osteoarthritis of the hip joint co-exists with dysfunction of many muscle groups [1,8,16]. The obtained results, however, may indicate the importance of the co-occurrence of the pectineus muscle hypertonia in osteoarthritis of the hip joint and its influence on gait. Unfortunately, the results obtained during the tests are the results immediately after treatment and do not take into account the long-term effects. There are no reports from Poland or other parts of the world about manual therapy for each muscle, and do not allow comparison with other results. Based on statistical analysis, there is significant impact on parameters during gait after performing the muscle inhibition technique. A control group of healthy people subjected to the muscle inhibition technique showed no effect on gait parameters, which excluded the effect of placebo, and indicates the occurrence of hypertonia of the pectineus muscle in hip osteoarthritis.

CONCLUSIONS

1. Relaxation of the pectineus muscle improves the function of the hip during gait and decreases groin pain in people with coxarthrosis.

2. Inhibition of the pectineus muscle may be a useful technique in the manual therapy of patients with osteoarthritis of the hip joint.

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