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Technika energetyzacji mięśni stosowana po implantacji endoprotezoplastyki stawu biodrowego

Muscle energy techniques after total hip replacement

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Streszczenie:
Wstęp. Częstą konsekwencją braku postępu rehabilitacji, przy bardzo dużych zmianach zwyrodnieniowych, którym towarzyszy bardzo silny ból i znaczne ograniczenie ruchomości oraz lokomocji, jest leczenie operacyjne, polegające na wykonaniu alloplastyki stawu biodrowego. W pierwszej dobie po operacji, ustalany jest indywidualny program usprawniania pacjenta. Jest to czynność o podstawowym znaczeniu, ponieważ prawidłowe zaplanowanie i przeprowadzenie zabiegów fizjoterapeutycznych, umożliwia przede wszystkim zniesie bólu i uzyskanie pełnego, funkcjonalnego zakresu ruchu w stawie, wzmacniamy mięśnie dbamy o to, aby odpowiednia kontrola mięśniowa i stabilizacja uzyskana w stawie, przywróciła funkcję lokomocji i samoobsługi pacjenta na początkowym i dalszym etapie usprawniania. Sposobów i metod uzyskania poprawy wyżej wymienionych parametrów jest wiele. Jedną z nich są techniki energetyzacji mięśniowej, będące nieinwazyjną terapią u pacjentów po endoprotezoplastyce stawu biodrowego. Dzięki tym technikom, w skład których wchodzi poizometryczna relaksacja mięśni przykurczonych oraz aktywne rozluźnianie mięśni stawów biodrowych, techniki mięśniowo-powięziowe oraz ich połączenie z elementami metody PNF, możliwe jest skuteczne leczenie i usprawnianie pacjentów.
Cel pracy. Celem pracy jest porównanie efektów standardowej fizjoterapii, prowadzonej u pacjentów po wszczepieniu endoprotezy cementowej stawu biodrowego, z fizjoterapią wykorzystującą techniki energetyzacji mięśni. **Materiał i metody.** Do badania zakwalifikowano w latach 2013/2014 66 pacjentów z zaawansowanymi zmianami zwyrodnieniowymi stawów biodrowych, leczonych operacyjnie endoprotezoplastyką. Pacjentów podzielono losowo na dwie grupy,/grupa I oraz grupa II/ po 33 osoby każda. U każdej z osób zbadano poziom bólu, zakres ruchu w stawie biodrowym oraz siłę mięśniową. Różnice pomiędzy grupą I a II polegały na włączeniu w grupie I technik energetyzacji mięśni, w skład których wchodziły poizometryczna relaksacja mięśni, aktywne rozluźnianie mięśni oraz elementy metody PNF. Wykorzystano również techniki mięśniowo-powięziowe nacelowane na mięśnie z różną siłą i kierunkiem nacisku na włókna mięśniowe. w grupie II zastosowano standardową fizjoterapię. **Wyniki.** Po zastosowanej terapii energetyzacji mięśniowej w grupie z zastosowanie technik energetyzacji mięśni, nastąpiła znacząca poprawa w zmniejszeniu dolegliwości bólowych, zwiększył się funkcjonalny zakres ruchu oraz znacząco poprawiła się kontrola mięśniowa operowanego stawu, co korzystnie wpłynęło na lokomocję pacjentów. **Wnioski.** Techniki energetyzacji w znaczącym stopniu wpłynęły na poprawę funkcji czynnościowej i stabilizacyjnej mięśni obręczy biodrowej stawu z endoprotezą. Połączenie poizometrycznej relaksacji z elementami metody PNF oraz technikami powięziowo-mięśniowymi, skutecznie poprawiło równowagę, koordynację oraz stereotyp chodu. Podsumowując fizjoterapia z wykorzystaniem metody energetyzacji okazała się skuteczniejszą metodą w leczeniu choroby zwyrodnieniowej stawu biodrowego w porównaniu z metodą opartą na standardowym programie usprawniania.

Słowa kluczowe:
endoprotezoplastyka, usprawnianie, techniki energetyzacji mięśni

Abstract
Introduction. *Surgical procedure involving total hip alloplasty is a common consequence of the absence of progress of rehabilitation in patients with significant degenerative lesions accompanied by severe pain and significantly limited mobility. An individual program for patient rehabilitation is established during the first 24 hours after the procedure. This is of particular importance as proper planning and implementation of physiotherapy allows to relieve pain and to achieve full functional joint mobility as well as to strengthen the muscles. We make sure that the proper muscle control and stability within the joint will restore patient's locomotion and self-care both at the initial and later stages of rehabilitation. There are many ways and methods to improve the above mentioned parameters. Muscle energy techniques, which represent a non-invasive therapy in patients with total hip replacement, are one of these methods. These techniques, including poizometric relaxation of contracted muscles as well as active relaxation of hip joint muscles, myofascial techniques, also in combination with elements of PNF techniques, allow for effective treatment and rehabilitation of patients.* **Aim.** *The aim of the study was to compare the effects of standard physiotherapy in patients after cemented hip arthroplasty with those of physiotherapy using muscle energy techniques.*
Materials and Methods. *A total of 66 patients with advanced degenerative arthritis of the hip, who received surgical treatment in the form of endoprosthetics, were qualified for the study between 2013 and 2014. The patients were divided into two groups (group I and II), 33 subjects each. Pain level, the range of hip motion as well as muscle strength were assessed in each patient. Group I received muscle energy techniques, including poizometric relaxation of muscles, active muscle relaxation and elements of PNF method. Also, myofascial techniques targeting muscles with different strengths and direction of pressure were used. Group II received standard physiotherapy.*
Results. *Significant improvement of pain, an increase in the range of functional motion as well as a significant improvement of muscle control of the joint were observed in the group receiving muscle energy treatment, which had beneficial effects on the locomotion of patients.*
Conclusions. *Muscle energy techniques had significant effects on the improvement of muscle function and stabilization in the pelvic girdle of the joint with endoprosthesis. Poizometric relaxation combined with elements of the PNF method as well as myofascial techniques effectively improved balance, coordination and gait pattern. In conclusion, physiotherapy using muscle energy techniques was shown to be a more effective method in the treatment of hip osteoarthritis as compared to the method based on standard rehabilitation program.*

Key words:
arthroplasty, rehabilitation, muscle energy techniques

Introduction

According to the World Health Organization (WHO), osteoarthritis is a 21st century disease of civilization [1]. In Poland, approximately 8 million people are affected by the disease, including about three million people diagnosed with hip joint lesions. Currently, hip osteoarthritis comes second after lumbar spine ailments in population aged more than 55 years. So far, osteoarthritis has not been fully understood [2,3].

Lesions develop insidiously and unnoticed. Pain syndrome, which causes changes in the locomotive system, affects posture, locomotion and all motor functions of the patient. Patients with hip osteoarthritis develop significant impairment of everyday activities, show limited mobility and experience considerable pain. In the case of advanced hip degeneration, patients frequently develop functional shortening of the lower limb on the side of the affected joint, which adversely affects the gait pattern [4].

Despite many years of experimental and clinical investigations, conservative treatment, which is used in different forms, only temporarily reduces pain and hip function. Unfortunately, surgical procedure involving total hip alloplasty is a common consequence of the absence of progress of rehabilitation in patients with significant degenerative lesions accompanied by severe pain and significantly limited mobility.

Hip replacement is a basic procedure performed in patients treated in the Department of Orthopaedics and Trauma Surgery of the Regional Specialist Hospital in Legnica. Hip replacement surgery is normally performed in a patient positioned on the side, with the use of regional anaesthesia, with anterior-lateral access to the joint, and with a subsequent reconstruction of the gluteal muscles (medium and smaller). Appropriate shape, size, geometry and adjustment of the implant to the bone stock as well as the possibility of early physiotherapy are essential for proper hip reconstruction. Modern engineering and biomechanics allowed to develop a prosthetic shape showing maximum similarity to the shape of medullary cavity, thus enabling a uniform load transfer. This in turn prevents osteolysis and ensures a longer survival of the implant. Precise adjustment of the implant to patient's bone stock allows for a mutual integration and stability of bone-implant system. As a result, a structurally and biologically durable joint, having adequate stability and ability to transfer loads during static and dynamic activities, is formed.

An individual program for rehabilitation of patients should be established during the first 24 hours after the procedure. This is of particular importance as proper planning and implementation of physiotherapy allows to relieve pain and to achieve full functional joint mobility. However, it should be noted that abduction, excessive flexion or rotary movements within the operated joint should be avoided, especially in the postoperative period. By strengthening muscles we make sure that the proper muscle control and stability within the joint will restore patient's locomotion and self-care both at the initial and later stages of rehabilitation. There are many ways and methods to improve the above mentioned parameters. Muscle energy techniques, which represent a non-invasive therapeutic me-

thods in patients with total hip replacement, are one of these methods. These techniques, including poizometric relaxation of contracted muscles as well as active relaxation of hip joint muscles, myofascial techniques, also in combination with some elements of PNF techniques, allow for effective treatment and rehabilitation of patients.

Aim

The aim of the study was to compare the effects of standard physiotherapy in patients after cemented hip arthroplasty with those of physiotherapy using muscle energy techniques.
Therefore, it was necessary to formulate the following research questions:
1. What are the effects of muscle energy techniques on pain reduction in the operated joint?
2. Has the range of motion within the evaluated joint increased significantly and became functional following the application of the discussed techniques?
3. To what extent have the energy techniques improved muscle function and stabilization in the pelvic girdle of the joint with endoprosthesis?
4. How significant were the effects of a combination of poizometric relaxation with the elements of PNF techniques and myofascial techniques on the improvement of balance, coordination and gait pattern?
5. Which of the selected types of therapy proved to be an effective method in the treatment of hip osteoarthritis following alloplasty?

Materials and methods

The study group included 66 patients operated on in the Regional Specialist Hospital in Legnica. Each of these patients underwent cement total hip replacement due to advanced degenerative –deforming disease of the hip joint.
Inclusion criteria were as follows:
- status post cement total hip replacement,
- age up to 85 years,
- absence of acute conditions, exacerbations of chronic diseases, which might affect the current f unctional status of the patient ,
- intellectual status allowing for understanding and performing tasks,
- patient's consent to participate in the study.

Exclusion criteria were as follows:
- poorly-seated endoprosthesis, e.g. prosthetic shank loosening, excessive acetabular rotation,
- comorbidities which are a direct contraindication, such as cardiorespiratory failure,
- intellectual status not allowing for understanding and performing tasks,
- lack of patient's consent to participate in the study.

Patients were divided into two groups (group I and II), 33 subjects each. Group I included 17 males (52%) and 16 females (48%). The mean age was 63 years (42 – 85 years). Group II included 9 males (27%) and 24 females (73%). The mean age was 66 years (46-84 years). Pain level, the range of hip

motion (extension and abduction) as well as muscle strength were assessed in each patient. The assessment was performed three times: prior to the procedure, on the second day after the procedure and following rehabilitation, i.e. about 10 days after the procedure. The absolute and relative lengths of both limbs were measured prior to and 2 days after the procedure. The study was supplemented with a survey, whose purpose was to enrich the research material with the data on pain during the night as well as difficulties in performing everyday activities (hygiene, bending, climbing stairs, walking distance).

A 5-point scale of pain intensity was used to assess pain. Range of motion was measured using a goniometer, in accordance with the SFTR principles. Lovette's test and functional tests were used for the assessment of muscle control and strength.

All patients received conservative treatment, including pharmacological treatment and physiotherapy, prior to surgery, however, without satisfactory outcomes in the form of reduced pain or increased range of mobility within the hip.

In both groups of patients, X-ray of the operated joint was performed on the second day after the surgery in order to assess the setting of the endoprosthesis relative to the structure of the surrounding bone tissue. All operated patients were included in the rehabilitation program (with regard to all principles after a surgery of total hip replacement, i.e. no abduction, external rotation, hip flexion limited to 90° as well as limited internal rotation), which included antithrombotic prophylaxis, breathing exercises, balance exercises, verticalization, learning to walk using elbow crutches and exercises for the healthy lower limb. The planned physiotherapy was introduced on the subsequent days following the surgery until hospital discharge, i.e. about 10 days after the procedure.

Group I received muscle energy techniques, including poizometric relaxation of muscles, active muscle relaxation and elements of PNF method. Also, myofascial techniques targeting muscles with different strengths and direction of pressure

were used. (Figs 1, 2, 3) The purpose of these techniques was to eliminate dysfunctions within the soft tissue. Timing for Emphasis in accordance with PNF principles, i.e. work on a weaker component using feedback and rhythmic stabilization techniques as well as through dynamic reversals, by working on the eccentric contraction of hip abductors and rotators, was used in order to improve the decreased muscle strength, impaired coordination and limited range of motion within the operated joint in this group. Selected muscle energy techniques were used to strengthen the gluteal muscles, sciatic-tibial muscles as well as the quadriceps.

Group II received standard therapy involving the use of isometric, active-passive exercises, active exercises with unloading and active exercises with unloading with dosed resistance. In these patients, the static-dynamic function of the operated limb was being restored.

Fig. 1. Lateral stretching when the force of pressure is transverse to muscle fibers, it may be performed in one direction or in opposite directions.

Fig. 2. Stretching along the muscle, when the force of stretching is parallel to fibers, it may involve whole muscles

Fig. 3. A deep vertical pressure with respect to fibers, particularly useful in patients after muscle transplantation.

Results

Statistical analysis was performed using descriptive statistics, whose purpose was to present a general description of the subjects. The following statistical indicators were calculated: the arithmetic mean (χ), the min-max range of variation and standard deviation (s). T-Student test was used to assess the effects of rehabilitation on the improvement of physical function. The level of statistical significance was $p < 0.05$

When analyzing hip pain histograms, it may be concluded that the use of the energy muscle technique in group I resulted in a significant pain reduction and/or elimination in the individual patients. Table 1. The result was statistically significant $p = 0.03$.

Table 1. The number of patients assessing the severity of hip pain

Pain assessment	test 1	test 2	test Group I	test 3 Group II
no pain	0	0	17	13
mild pain	0	35	10	13
moderate pain	15	50	6	7
severe pain	26	10	0	0
very severe pain	34	5	0	0

As can be seen from the questionnaire responses, 50 patients experienced pain disrupting the sleep at night. The night pain subsided following the implementation of the planned types of rehabilitation in each group.

Common differences in the relative length of the lower limbs resulted from the reduction of the articular space and a contracture of hip girdle and knee muscles due to advanced degenerative lesions. After the surgery, limb equality was achieved in 70% of patients, and 25% of patients had the mean difference in limb length from 0.7 cm up to 1.3 cm. This value was greater than 2 cm in 5% of patients, who used shoe inserts for limb compensation. Table 2. The results are statistically significant.

Tab. 2. The mean values of the differences and min/max values (cm) between the affected and the healthy

	test 1			test 2		
The length of the lower limbs	Av.	Min	Max	Av.	Min	Max
Relative length	2.7	1.3	4.0	0.0	1.2	2.5
Absolute length	1.7	1.2	3.0	1.3	0.7	1.7

When comparing the values of the range of motion (test 2) following surgical treatment and (test 3) after the use of therapy, it may be concluded that all parameters increased. Statistical significance was 0.04.
Comparing the values of the range of motion included in tables 3 and 4, it may be concluded that the mean values of all parameters increased in groups I and II after treatment. The largest increase occurred in group I and related to passive flexion, which was 90 degrees as well as hip abduction, which was 47 degrees.

Tab. 3. Mean values of the range of motion in the three subsequent tests expressd in degrees

Range of motion		Test 1	Test 2	Test 3 Group I	Test 3 Group II	Test 2 and 3 Group I	Test 2 and 3 Group II
Flexion	Active	80	50	75	70	17.67	14.14
	Passive	85	60	80	75	12.42	10.12
Abduction	Active	20	20	30	25	15.96	10.98
	Passive	25	23	35	30	15.55	16.01

Tab. 4. Maximum and minimum values of the range of motion achieved in the three subsequent tests and expressed in degrees.

Range of motion		Test 1		Test 2		Test 3 Group I		Test 3 Group II	
		Max	Min	Max	Min	Max	Min	Max	Min
Flexion	Active	100*	30	75	35	85	55	75	55
	Passive	105*	35	75	35	90	60	80	60
Abduction	Active	20	5	30	10	45	15	35	10
	Passive	25	5	35	10	47	18	37	15

* w badaniu 1, przed zabiegiem nie ma przeciwwskazań dla zakresu ruchu zgięcia stawu do kata 90º/ there are no contraindications for the flexion range of motion up to 90º in test 1

Comparing the mean results of the range of motion between groups it should be noted that the largest increases in the range of flexion and abduction motion were observed in group I.
A comparison of the tested muscle strength showed a comparable increase of 45% in group I and 43% in group II (Table 5). The result was statistically significant (p = 0.05).

Tab. 2. The mean values of the differences and min/max values (cm) between the affected and the healthy

Mięsień/Muscle	Group I			Group II		
	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3
hip flexors	3	3	3.5	3	3	3.5
hip abductors	2.5	2.5	3.5	2.5	2.5	3
knee flexors	3.5	3.5	4.5	3.5	3.5	4
knee abductors	3.5	3.5	4	3.5	3.5	3.5

A comparison of the ways of patient's locomotion following total hip replacement allowed to conclude that all patients, regardless of the group, showed an equal improvement in proper gait pattern using crutches. Minor differences resulted from the age of patients, their psychosomatic features and BMI differences. Further data resulting from the survey on the method of unassisted mobility, everyday activities and walking distance will be evaluated three months after total hip replacement.

Discussion

The obtained results allow to conclude that appropriately selected rehabilitation programs have positive effects on the functional status of patients with total hip replacement. It is also important to provide patients with necessary information regarding measures they should take in the further postoperative period. According to Kokoszka et al. [5], an appropriate level of education on the protection of the operated joint, indications and contraindications regarding behavior as well as systematic rehabilitation at home as a continuation of hospital treatment are particularly important.

According to Long et al. [6], improperly conducted therapy, which fails to increase the muscle strength may compromise the stability of the prosthesis and lead to reduced functionality in everyday activities of patients as well as significantly limit the patient's ability to function. Skolimowska et al. [7] show that a four-week rehabilitation combined with physical activity significantly improves limb functional parameters, balance as well as facilitates returning to daily activities following total hip replacement. Other authors focused on the pain factor, which, according to Wilk et al. [8], if properly eliminated, allows the patient to reach a correct range of motion and muscle strength in a more rapid way, and thus improve e.g. gait pattern. Similar findings were reported by Starowicz et al. [9]. According to the authors, pain is the cause of limited patient rehabilitation, whereas reduction of pain severity has much more beneficial effects on both physical and mental rehabilitation of patients.

Similar results to those presented in this paper were obtained by Wójcik et al. [10], who compared the efficacy of fascial relaxation with classical physiotherapy in patients with hip replacement, based on the analysis of the range of motion, the presence of pain as well as life quality, to the benefit of relaxation techniques.

Prof. L. Hartman [11] described the performance of muscle energy techniques aimed at the relaxation of the tissue surrounding the blocked joint. In degenerative lesions, contractures of ligaments as well as increased muscle tension, which are manifested by pain, fatigue and poor stabilization of the contracted muscle, are particularly severe for patients. Elimination of the causes and effects of the disease is possible at the early postoperative period using an appropriate method aiming to alleviate the symptoms. Myofascial methods using muscle energy techniques ensure good and rapid effects of treatment. These techniques relax muscles, eliminate increased muscle tension and restore normal range of motion in the joint.

As apparent from the present study, these techniques are very effective in restoring full joint function in patients requiring an increase in muscle elasticity following total hip replacement. Therefore, active relaxation of the quadriceps, gluteal and sciatic-tibial muscles is particularly important, strengthening groups of muscles that stabilize the joint as well as achieving an adequate muscle control.

Conclusions

1. Muscle energy techniques have major effects on decreasing pain in the operated joint.
2. The use of the discussed techniques resulted in a significant increase in the range of motion in the joint, which became functional.
3. Muscle energy techniques had significant effects on the improvement of muscle function and stabilization in the pelvic girdle of the joint with endoprosthesis.
4. Poizometric relaxation combined with elements of the PNF method as well as myofascial techniques effectively improved balance, coordination and gait pattern.
5. Physiotherapy using muscle energy techniques was shown to be a more effective method in the treatment of hip osteoarthritis as compared to a method based on standard rehabilitation program.

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