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Magdalena Podczarska-Glowacka

Faculty of Rehabilitation and Kinesiology, Gdansk University of Physical Education and Sport in Gdansk, Poland, magdalena.podczarska-glowacka@awf.gda.pl

Malgorzata Kawa

Faculty of Rehabilitation and Kinesiology, Gdansk University of Physical Education and Sport in Gdansk, Poland, malgorzata.kawa@awf.gda.pl

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Application of selected physiotherapeutic methods and the qualitative gait assessment in elderly people with degenerative changes of the hip joint

Authors' Contribution: Magdalena Podczarska^{ABCDEF}, Małgorzata Kawa^{ABCDEF}

A Study Design

B Data Collection

C Statistical Analysis

D Data Interpretation

E Manuscript Preparation

F Literature Search

G Funds Collection

Faculty of Rehabilitation and Kinesiology,
Gdansk University of Physical Education and Sport in Gdansk, Poland

abstract

Background: Coxarthrosis is one of the most serious diseases of the musculoskeletal system due to the incidence, low efficacy of non-invasive treatment, and severe disability due to symptoms. Disturbance in the normal gait pattern resulting from symptoms of this disease may have an influence on its efficiency, on an increase in energy expenditure and on the occurrence of incorrect compensatory reactions. All physiotherapeutic activities that reduce these disorders are a priority. The aim of the study is to evaluate the effectiveness of manual therapy and traditional kinesitherapy for gait in elderly people with degenerative changes in the hip joint.

Material and methods: Three groups of 30 people each were formed based on selection and exclusion criteria. One group was subjected to manual therapy, the second one to traditional kinesitherapy, while the third, control, group consisted of patients who deliberately and voluntarily did not use physiotherapy. The tests were carried out twice before the beginning of the treatment exercise program and after completing it. The IOWA scale was used to assess gait. A walking test to cover the longest possible distance without feeling discomfort was also used.

Results: The results of the analysis showed a significant increase in the variable "Walking" on the IOWA Scale after completing the therapy compared to the pre-therapy status in the group in which manual therapy was used ($p = 0.0000$). Significant changes were not recorded within the group in which traditional kinesitherapy ($p = 0.9999$) was applied nor within the control group.

Conclusions: Out of both therapeutic procedures, only manual therapy had a positive effect on the quality of gait and the distance covered by patients with degenerative changes in the hip joint.

Key words: post-isometric muscle relaxation, degenerative changes, hip joint, manual therapy, gait.

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Corresponding author: Corresponding author: Dr Magdalena Podczarska-Głowacka, Gdansk University of Physical Education and Sport, ul. Kazimierza Górskiego 1, 80-336 Gdansk, Poland, e-mail: magdalena.podczarska-glowacka@awf.gda.pl

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INTRODUCTION

Osteoarthritis (OA), including hip osteoarthritis, is among the most common diseases of the old age; it affects 50% of the population aged over 65 years [1]. Coxarthrosis is one of the most severe musculoskeletal disorders due to its incidence, low efficacy of non-invasive treatment, as well as severe disability due to the existing symptoms [2, 3]. The World Health Organization included osteoarthritis among lifestyle diseases [4]. The hip joint is subject to the degenerative process more often than other joints, which is associated with the occurrence of high static and dynamic loads on its individual elements [5, 6]. Progressive changes in osteo- and arthrokinematics of the joint show some general trends along with age and the escalation of degenerative changes [7, 8]. Muscle weakness and accompanying pain reduce mobility in terms of internal rotation, abduction and extension. As a consequence, locomotion deteriorates, gait becomes limp, energy expenditure increases, and incorrect compensatory reactions occur. This limits the possibilities of performing professional work, which, in turn, reduces the quality of life of people suffering from hip osteoarthritis [2, 8, 9].

All physiotherapeutic activities that reduce the occurrence of these disorders are a priority. In the case of degenerative changes, a physiotherapeutic procedure is a complex and comprehensive treatment. This may result from the duration of the disease process, but also from the lack of therapeutic patterns in dealing with a patient as well as from negligence in prophylaxis [10]. The ailments and co-morbidities accompanying the development of the disease deepen functional limitations, thus increasing the disability. To some extent, their consequences can be minimized by involving seniors in an individually selected therapeutic program that would allow them to function independently as long as possible [10-12]. In geriatrics, non-pharmacological methods are noteworthy, due to the low risk of their adverse effects [13]. These include kinesitherapy, physical therapy, soft tissue techniques as well as educating the patient and his family and selecting appropriate rehabilitation supplies to facilitate self-service [14, 15]. Many studies emphasize the special importance of kinesitherapy as a very effective and inexpensive form of non-invasive therapy in overcoming pain and improving mobility and, as a consequence, improving functional activity in hip osteoarthritis [16, 17]. Therefore, appropriately selected joint mobilization and manipulation, therapeutic exercises, including the passive ones, focused on increasing the range of motion in the joint are considered to be optimal actions. Comprehensive treatment includes the use of appropriately selected muscle energy techniques, including post-isometric relaxation of muscles (PIR) in order to restore the correct length and elasticity of muscle fibres, and thus possibly to restore the correct range of motion in the hip joint, and hence the correct movement pattern [18, 19].

Many scientific studies have proved that properly selected therapeutic exercises and manipulations and mobilisations can reverse the decreasing trend in joint mobility. In addition, a combination of the above techniques with stretching may result in an improvement in joint dysfunctions in patients with hip osteoarthritis [18, 20, 21].

The aim of this study is to evaluate the effectiveness of manual therapy and traditional kinesitherapy for gait in elderly people with degenerative changes in the hip joint.

MATERIAL AND METHODS

The study was conducted at the Nadmorskie Centrum Medyczne [Seaside Medical Centre] in Gdańsk and at Gdansk University of Physical Education and Sport. A total of 90 seniors were examined, including 20 men and 70 women with clinically and radiologically diagnosed hip osteoarthritis. At the start of observation, the mean age of all subjects involved in the therapeutic program was 67 years, with standard deviation of 9.95 (Table 1). Patients were selected in a purposeful manner, according to specific criteria. The inclusion criteria for the scientific experience were: clinically and radiologically diagnosed osteoarthritis of the hip joint(s), morning stiffness, consent to participate in the study, and in case of pharmacological treatment, a constant dose of medication throughout the experiment. The exclusion criteria for the scientific experience were: patients after hip replacement, intra-articular or other systemic administration of steroids in the previous month.

Table 1. The characteristics of the study groups

Group	n	Sex		Age mean \pm SD
		M	F	
Group I	30	7	23	66.17 \pm 10.36
Group II	30	3	27	68.87 \pm 10.45
Group III	30	10	20	66.00 \pm 9.10
Total number of patients	90	20	70	67.00 \pm 9.95

The therapy was conducted in an outpatient clinic, from Monday to Friday, once a day, for a period of 4 weeks (i.e. 20 treatment sessions), and the duration of each treatment session for the groups was about 30 minutes. The study program was based on the decision of the Bioethics Committee at the Regional Medical Chamber in Gdańsk.

Patients in Group I were subject to individual manual therapy, i.e. post-isometric relaxation of muscles, and patients in Group II independently performed active non-weight bearing exercises with pulleys. Group III was a control group. The IOWA scale was used in the study. The walking test to cover the longest distance without feeling discomfort was also applied.

In order to improve the gait quality, the therapeutic procedure used post-isometric relaxation of muscles (PIR): flexors, extensors, abductors, adductors, internal and external rotators of the hip. The therapy of the abovementioned muscles was conducted individually. The post-isometric relaxation of muscles (PIR) was performed cyclically, where one cycle consisted of three phases. During the first phase, the muscles were stretched until feeling light pain or until feeling slight stretching in the exercised group of muscles or muscle. The second phase consisted of flexing the muscle isometrically for 8–10 seconds, follows by the third phase. During the third phase, there was complete muscle relaxation of the muscle with re-stretching of the exercised muscle group. The whole cycle was repeated 3 to 5 times. One treatment session lasted about 30 minutes. The procedures of active non-weight bearing exercises in Group II were performed according to the classic Rocher's methodology. The limb, suspended in a Universal Exercise Unit, performed movements in two planes: the sagittal and the frontal ones. Group III was a control group. The control group consisted of patients who consciously and voluntarily did not use

rehabilitation, despite physiotherapy being prescribed by a doctor specialising in medical rehabilitation. This usually resulted from a lack of time or faith in the success of the therapy.

The study was conducted twice, before and after the program of therapeutic exercises. The patient's gait was assessed according to the IOWA scale. The maximum number of points obtained by the patient was 10. The maximum number of points was given to the patient who walked without limping and without support. 8 points were given to a person who did not limp while walking with a stick or when limping was caused by weakened muscular strength of the hip abductors or when limping was caused by a shorter leg. If the subject needed two sticks to move, he/she received 6 points, and if two crutches - 4 points. In case of being unable to move, the patient obtained 0 points. Before and after the experiment the subjects performed a fitness test of covering the distance, i.e. walking as long as possible (the distance measured as a multiple of 400 meters), without an accompanying feeling of discomfort. The distance was divided into sections of 400 m, 800 m, 1600 m, and 3200 m. After each section, the patient decided himself whether to cover the next section of the distance. The test was discontinued when the patient reported pain, fatigue, weakness, or inability to walk further. The study took place on a pedestrian path, under control of a physiotherapist. During the test, patients were supposed to cover the distance at their own pace, freely, and without haste. Time was not measured during the test; only the distance that the patient could cover without any discomfort was checked. If normally the subjects needed aids to walk comfortably (e.g. crutches), they used them during the test.

The test results were statistically processed with a use of the Statistica package ver. 10.0. The ANOVA analysis of variance tool, with the repeated measurements system, was used to verify the significance of differences between the groups in which different types of treatments were applied. Statistical significance was set at $p < 0.05$. Due to the ordinal nature of the variable "distance covered", the χ^2 test was applied to analyse the significance of differences between the groups.

RESULTS

The results of the analysis showed a significant increase in the value of the variable "Walking" on the IOWA scale after the therapy compared to the state before it in the group in which post-isometric relaxation of muscles was applied ($p = 0.0000$). No significant changes were noted in the group in which traditional kinesitherapy was used ($p = 0.9999$) or within the control group. A comparison of the results after applying the therapy showed significantly higher values of the variable "Walking" on the IOWA scale in the manual therapy group than in the group of traditional kinesitherapy ($p = 0.0001$). There were no significant differences between the values of the variable "Walking" on the IOWA scale in the traditional kinesitherapy group compared to the control group ($p = 0.9284$), and there were significantly higher values of this variable in the manual therapy group than in the control group ($p = 0.0001$). The obtained effect confirms the Authors' assumptions about higher effectiveness of post-isometric relaxation of muscle on the gait quality of the examined elderly persons with degenerative changes of the hip joint (Table 2).

Table 2. Gait according to the Iowa scale before and after the therapy in Group I, II and III

Group	Variable	Pre treatment Mean ±SD	Post treatment Mean ±SD	P-value	Significance
Group I	Manual therapy	8.60 ±2.0	9.13 ±2.1	0.00001	S
Group II	Traditional kinesitherapy	8.40 ±1.5	8.40 ±1.5	0.9999	NS
Group III	Control group	8.60 ±1.8	8.60 ±1.8	0.9999	NS

P-value = Probability, S = Significance, NS = Non significance

The analysis showed correlations between the type of the applied therapy and the degree of improvement in the covered distance ($\chi^2 = 35.61$, $p = 0.0000$). In the manual therapy group, improvement occurred for more than 8 out of 10 respondents, while in the other groups this indicator was significantly lower: on average, improvement was noted in 3 out of 10 people in the traditional kinesitherapy group and in 1 in 10 people in the control group. Due to the fact that for the majority of respondents (over 90% of the total number of subjects) either there was no improvement in the covered distance or there was an improvement of exactly 800 meters, the analysis was carried out using the χ^2 test for a categorised variable with two variants: no improvement in the result and an improvement in the result of 800 m and more (Table 3).

Table 3. The change in the value of the covered distance in comparison to the state before the therapy in the categories of the studied groups

Group	Covered distance - no improvement in the result	Covered distance - an improvement in the result of 800 m and more	Total
Manual therapy	5	25	30
%of the whole group	16.67%	83.33%	100%
Traditional kinesitherapy	21	9	30
%of the whole group	70.00%	30.00%	100%
Control group	27	3	30
%of the whole group	90.00%	10.00%	100%
Total	53	37	90

DISCUSSION

A review of the literature indicates the key role of rehabilitation in the therapy of people with hip osteoarthritis [14]. The degenerative process is a complex process that slowly leads to a loss of structural and dynamic efficiency of the joint. These factors translate into the general health status by limiting the patient's physical activity, fitness and a possibility of independent functioning [22-25].

Progressive changes in osteo- and arthrokinematics of the joint show some general trends along with age and the intensification of degenerative changes, including, for example, a gradual decrease in the range of motion (ROM) of the thigh relative to the pelvic bone, and as a consequence, a reduced functional status of the senior [7]. Such limitations concerned all subjects in this experiment. These observations are consistent with study results of other authors [26-30]. Attention is also drawn to the constant necessity to look for an appropriate therapeutic program tailored to the patient's individual needs. Mc Nair et al. [11] suggest further search for advanced and effective

rehabilitation programs for patients with diagnosed degenerative changes of the hip joint. In the opinions of the authors of this study, this is also particularly important in the context of the latest scientific reports [31–33]. The analysed results of our own research of the gait and the walking distance showed significant improvement after application of post-isometric relaxation of muscles in degenerative changes of the hip. The effectiveness of manual therapy techniques is also confirmed by other authors, including Hoeksma et al. [18], who, by comparing the effectiveness of manual therapy techniques with traditional active exercises, indicated greater effectiveness in improving the hip joint mobility, and thus improving the seniors' functional status. Researchers from Norway [34] conducted a physical endurance test in the form of a 6-minute test for patients with degenerative changes of the hip. The study was conducted twice, i.e. before the therapeutic program and after 6 months of observation. The obtained results showed that the 12-week therapy improved the patient's walking result by 83 meters. Stratford et al. [35] conducted four fitness tests in their study: test of walking at one's own pace, stair test, "Up and Go" test and a 6-minute test. They checked to what extent the examined variables of pain and functioning accurately reflected the actual status as described in a self-assessment questionnaire. Preliminary analysis yielded results consistent with the study assumptions. The authors believe that the use of the above-mentioned tests can provide the patient and researchers with a clear description of the intensity of pain, joint mobility and functioning that will complete the information from the questionnaire.

A review of the literature on non-invasive treatment of degenerative changes of the hip allows drawing conclusions that there is still room for research on the effectiveness of physiotherapeutic procedures aimed at improving the quality of provided medical services, hence, along the cognitive value, this study also has a practical implication [20,36,37]. Simultaneously, the study authors assert that the effectiveness of the therapy must be verified by a multi-centre, long-term and large-sample research.

CONCLUSIONS

1. Out of the two therapeutic procedures, only manual therapy positively affected the quality of gait in patients with degenerative changes of the hip joint.
2. The results of the distance covered by subjects from the manual therapy group more often significantly improved than the results of subjects from the other groups.

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