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Asessment of the impact of sanatorium treatment on patients with hip joint endoprosthesis

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Abstract

Background: As the years go by, hip replacement procedures, also known as hip endoprosthesis, are becoming more common. As life expectancy increases, it can be assumed that this number will continue to rise, with some sources reporting that it will increase as much as sevenfold by 2030.

Purpose: The purpose of this study is to evaluate the impact of a 21-day sanatorium treatment on physical fitness and quality of life after hip replacement surgery.

Methodology: selected measurements and tests were performed on the first and last day of the sanatorium stay. A questionnaire on subjective assessment of quality of life was completed on the first day of stay and one month after the end of the sanatorium by telephone. The tools used were, measurement of range of motion with goniometer, strength with Lovett scale, TUG, NRS and SF-36

Conclusions: The range of motion of flexion and abduction in the hip joint subjected to endoprosthesis increased statistically significantly. The time required to walk a distance of 6 meters in the “Stand Up and Walk” test as well as pain complaints on the NRS scale decreased significantly statistically. There was a favorable statistically significant change in all aspects examined by the SF-36 questionnaire.

Keywords: hip endoprosthesis, sanatorium treatment, range of motion, muscle strength, SF-36.

1. Introduction

Data collected on the official website of the National Health Fund (NHF) clearly indicates an increase in the number of surgeries performed in this field. In 2022, as many as 64,000 such procedures were registered, an increase compared to 55,000 performed the previous year. This upward trend may be due to both improved access to medical care and the growing number of patients suffering from chronic musculoskeletal disorders. One of the most common reasons for the need for hip replacement is advanced degenerative changes in

the hip joint that cannot be controlled with conservative treatment. In cases where hip joint functionality is significantly limited and pain persists, replacement may be the only effective therapeutic option [1-8]. According to the European Association of Rheumatology (EULAR), degenerative changes in the hip joint affect up to 11% of the adult population [9]. With the increase in average life expectancy, this number is expected to continue to rise; some sources indicate that it will increase seven-fold by 2030 [10].

Although there are scientific studies evaluating spa treatment in patients after hip replacement surgery[11-18], describing their functional improvement, many issues remain unclear. One such uncertainty is the subjective assessment of quality of life by patients after returning to daily activities. Therefore, this study, in addition to examining the range of motion of selected movements, hip muscle strength, and general pain, will examine how patients subjectively assess their health one month after completing a 21-day spa treatment. Analysis of these assessments may provide valuable information on the effectiveness and rehabilitation needs of patients after hip replacement surgery.

1.1 Hip joint endoprosthesis procedure

Hip replacement is a procedure that involves replacing biological joint components with others made of specialized biomaterials that match their structure and function. Hip replacement is performed in patients whose conservative treatment fails to achieve the desired results and whose joint-related limitations and poor health status worsen[19-20].

Common reasons for total hip replacement include degenerative joint disease, non-traumatic avascular necrosis of the femur, congenital joint defects, post-traumatic sequelae – fractures affecting the joint surfaces, rheumatoid arthritis, and inflammatory pathologies[21] Various recommendations consider criteria such as pain, radiographic changes, joint functionality, response to conservative treatment, and the patient's individual clinical condition. The latter criterion can be influenced by many factors, and sometimes situations arise where, despite deterioration in each of the possible criteria (thus qualifying for surgery), comorbidities preclude the procedure. Every procedure carries a risk of complications, therefore every decision must be made after prior analysis of all potential benefits and complications [22-25].

1.2 Sanatorium treatment

Sanatorium treatment is part of spa treatment is an extension of treatment previously provided in a hospital or on an outpatient basis. Individuals who, due to their condition, require appropriate conditions and treatments can opt for this form of rehabilitation. Sanatorium treatment utilizes the natural environment, climatotherapy, and balneology. The

holistic approach to the patient, characteristic of such a facility, also allows for meeting needs related to dietary, pharmacotherapy, and psychological issues [26-27].

Spa treatments encompass a variety of therapeutic methods. Balneotherapy and climatotherapy are at the forefront, given the specific purpose and capabilities of the spa area. These methods also include hydrotherapy, thermotherapy, physical therapy, and kinesiotherapy. Thanks to their versatility, these treatments can be combined, and in appropriate combinations, their therapeutic effect is enhanced. Treatments beyond the above-mentioned methods also complement these treatments, such as pharmacotherapy, health education, psychotherapy, and diet. Balneotherapy encompasses water and therapeutic baths, crenotherapy, and inhalations [28-31].

The evaluation and effects of sanatorium treatment are issues that, in many cases, remain insufficiently researched. Despite the significant importance of sanatoriums as places of treatment and rehabilitation, there is relatively little scientific research that focuses on assessing the effectiveness of these therapies and their long-term effects. Therefore, there is a need for greater exploration of this topic and continued research on sanatorium treatment.

The aim of our study was to assess the impact of 21-day sanatorium treatment on functioning and quality of life after hip joint replacement surgery.

In our research we considered two hypotheses:

1. 21-day spa treatment improves the physical functioning of patients after hip replacement surgery

2. 21-day spa treatment positively affects the subjective assessment of quality of life of patients after hip replacement surgery.

2. Methods

The study was conducted from October 2023 to April 2024 among patients undergoing sanatorium treatment after hip replacement surgery. The research protocol was approved by the Bioethics Committee of the Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń (no. KB/413/2023, date of approval: October 24, 2023).

2.1 Participants

The study involved 30 individuals: 18 women and 12 men, aged 51-83 years, who had undergone hip replacement surgery within a year of enrollment. The individuals had

undergone primary hip replacement surgery. The type of hip replacement and incision used for the procedure were not recorded. The group underwent a 21-day spa treatment program, which included a range of physical therapy procedures, including laser therapy, cryotherapy, magnetic therapy, and thermotherapy.

The study utilized a diagnostic survey method, a questionnaire technique, and selected functional tests. Selected measurements and tests were performed on the first and last day of the patient's stay at the sanatorium. The tools used were, measurement of range of motion with the goniometer, strength with the Lovett scale, "Up&Go" (TUG), NRS and SF-36.

Table 1. Characteristics of the study group, including: age, weight, height, BMI

	Min	*Max*	*M*	*SD*	*Me*
Age (years)	51	83	67,93	7,88	67,5
weight (kg)	58	120	80,47	17,44	76
height (m)	1,52	1,96	1,69	0,11	1,68
BMI (kg/m^2)	21,30	36,23	27,99	4,03	28,06

2.2 Statistical Analysis Methods

The following were used for statistical analyses:

The Wilcoxon statistic is given by the formula:

$$Z=\frac{T-\frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}+\frac{\sum t^3-\sum t}{48}}}$$

Where n - number of ranked characters, t - number of cases included in the tied rank.

Student's t-test for dependent samples:

$$t=\frac{d}{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_{1i}-x_{2i}-d)^2}}\cdot\sqrt{n}$$

where $d=\frac{1}{n}\sum_{i=1}^{n}(x_{1i}-x_{2i})$, $x_{1,2}$- means in groups 1 and 2, n- group size.

Student's t-test for independent samples:

$$t=\frac{X_1-X_2}{\sqrt{\frac{(n_1-1)\cdot s_1^2+(n_2-1)\cdot s_2^2}{n_1+n_2-2}\cdot(\frac{1}{n_1}+\frac{1}{n_2})}}$$

where $X_{1,2}$- means in groups 1 and 2, $s_{1,22}$- variances in groups 1 and 2, $n_{1,2}$- size of groups 1 and 2.

3. Results

First, we examined whether there was a statistically significant improvement in the subjective assessment of physical functioning and physical health-related limitations after sanatorium treatment. We also examined whether there was a statistically significant improvement in the subjective assessment of energy/fatigue and general health status after sanatorium treatment.

Table 2. Comparison of SF-36 quality of life scales before and after sanatorium treatment

	Before treatment		After treatment		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Overall quality of life	50,26	13,08	66,69	9,22	9,77	0,000	1,78
Physical quality of life	36,91	9,62	51,31	8,30	8,21	0,000	1,50
Physical functioning	41,33	18,66	65,17	13,55	11,07	0,000	2,02
Physical limitations	14,17	21,46	70,00	27,39	10,24	0,000	1,87
Pain	52,42	22,55	71,75	16,68	4,67	0,000	0,85
General health	53,17	17,09	64,83	17,29	4,93	0,000	0,90
Mental Quality of Life	63,61	21,48	82,06	13,99	7,75	0,000	1,42
Energy/Fatigue	55,83	20,68	69,50	16,21	6,92	0,000	1,26
Social Functioning	73,33	24,06	90,00	15,19	4,97	0,000	0,91
Social Limitations	58,89	40,76	88,89	26,74	4,51	0,000	0,82
Mental Health	66,40	21,05	79,87	13,31	5,32	0,000	0,97

M – mean, SD – standard deviation, t – student t statistic, p – level of statistical significance, d – size of differences

Using Student's t-test analyses for dependent samples, it was demonstrated that undergoing sanatorium treatment had a statistically significant impact on the quality of life of the participants in all analyzed areas. The overall quality of life of the participants before treatment ranged from 22.54 to 71.81 points, with a mean of 50.26 points, and after treatment ranged from 46.57 to 83.75 points, with a mean of 66.69 points.

On the physical quality of life scale, the participants achieved scores between 13.13 and 53.75 points before treatment, with a mean of 36.91 points, and after treatment ranged from 29.38 to 67.55 points, with a mean of 51.31 points. After treatment, the greatest change was observed in terms of physical functioning (41.33 points before treatment and 65.17 points after treatment) and in terms of limitations related to physical problems (14.17 points before and 70 points after treatment), while smaller differences were shown in terms of pain (52.42 points

before treatment and 71.75 points after treatment) and general health condition (53.17 points before treatment and 64.83 points after treatment).

Table 3. Comparison of range of motion, performance, and NRS pain scale

		Min	*Max*	*M*	*SD*	*Me*	*Z*	*p*	*r*
Flexion Range	Before treatment	45	90	64,33	14,13	62,5	4,57	0,000	0,83
	After treatment	45	100	74,33	11,94	75			
Extension Range	Before treatment	0	15	9,17	3,49	10	2,00	0,046	0,37
	After treatment	0	20	9,83	3,59	10			
Abduction Range	Before treatment	5	50	25,00	10,17	20	4,63	0,000	0,84
	After treatment	10	50	31,00	8,94	30			
Flexion Strength	Before treatment	3	5	4,10	0,40	4	0,00	1,000	0,00
	After treatment	3	5	4,10	0,40	4			
Extension Strength	Before treatment	3	5	3,60	0,56	4	0,00	1,000	0,00
	After treatment	3	5	3,60	0,56	4			
Abduction Strength	Before treatment	3	5	3,90	0,48	4	0,00	1,000	0,00
	After treatment	3	5	3,90	0,48	4			
Get-up-and-Go Test	Before treatment	7	50	13,20	7,32	13	4,67	0,000	0,85
	After treatment	7	38	10,93	5,36	10			
NRS Pain Scale	Before treatment	0	6	4,37	1,43	5	4,78	0,000	0,87
	After treatment	0	5	2,57	1,33	3			

Min – minimum, Max – maximum, M – mean, SD – standard deviation, Me – median, Z – Wilcoxon statistic, p – level of statistical significance, r – size of differences

Wilcoxon signed-rank tests showed that sanatorium treatment had a statistically significant effect on the flexion range $Z = 4.57$; $p < 0.001$; $r = 0.83$, extension range $Z = 2.00$; $p < 0.05$; $r = 0.37$, and abduction range $Z = 4.63$; $p < 0.001$; $r = 0.84$. The flexion range before treatment was between 45 and 90° with a mean of 64.33°, and after treatment between 45 and 100° with a mean of 74.33°. The extension range was between 0-15° with a mean of 9.17°, and after treatment between 0-20° with a mean of 9.83°. The range of abduction before treatment was between 5 and 50°, with an average of 25.00°, and after treatment between 10 and 50°, with an average of 31.00°. Therefore, the patients' participation in sanatorium treatment had an impact on the increased range of motion in the study group.

Table 4. Comparison of range of motion, efficiency and NRS pain scale according to the type of work performed

	Mental work		Physical work		*Z*	*p*	*r*
	M	*SD*	*M*	*SD*			
Flexion range	73,95	11,97	75,00	12,45	0,07	0,948	0,01
Extension range	9,47	3,29	10,45	4,16	0,35	0,729	0,06
Abduction range	30,53	9,56	31,82	8,15	0,33	0,741	0,06
Flexion strenght	4,00	0,33	4,27	0,47	1,79	0,073	0,33
Extension strenght	3,37	0,50	4,00	0,45	2,95	0,003	0,54
Abduction strenghr	3,74	0,45	4,18	0,41	2,42	0,016	0,44
Get-up-and-go Test	11,37	6,67	10,18	1,54	0,24	0,810	0,04
NRS Pain Scale	2,63	1,30	2,45	1,44	0,54	0,591	0,10

Min – minimum, Max – maximum, M – mean, SD – standard deviation, Me – median, Z – Mann–Whitney U statistic, p – level of statistical significance, r – size of differences

It was also examined whether patients performing physical work before the procedure achieved better measurement results after sanatorium treatment than patients performing white-collar work. These comparisons were performed using Mann-Whitney U tests, and the results are presented in Table 4. It was shown that people performing different types of work differed statistically significantly in terms of extension strength $Z = 2.95$; $p < 0.01$; $r = 0.54$ and abduction strength $Z = 2.42$; $p < 0.05$; $r = 0.44$. People performing physical work had higher levels of extension strength ($M = 4.00$; $SD = 0.45$ vs. $M = 3.37$; $SD = 0.50$) and abduction strength ($M = 4.18$; $SD = 0.41$ vs. $M = 3.74$; $SD = 0.45$) compared to people performing white-collar work.

4. Discusion

The aim of the study was to assess the impact of sanatorium treatment on the physical function of patients after hip replacement. The analyses included range of motion, muscle strength, time required to complete the Up&Go test, and pain. Patients included in the study demonstrated a highly significant increase in flexion and abduction ranges ($p=0.000$ in both ranges) and a significant decrease in pain on the NRS scale ($p=0.000$). In a study conducted at an Italian health spa, Musumeci [29] et al., examining a group of 12 patients undergoing kinesiotherapy and physical therapy, also obtained statistically significant results ($p<0.05$) in improving flexion and abduction ranges, but did not demonstrate a statistically significant change in pain sensations ($p=0.350$). The lack of pain reduction observed in the study by Musumeci et al. may be related to the time elapsed between the procedure and the initiation of rehabilitation, as the patients were enrolled in treatment after the 10th day of the procedure.

The study by Griniena [30] et al. included 30 patients who underwent kinesiotherapy twice daily for 45 minutes, as well as aquatic kinesiotherapy, isometric exercises, walking, and massage. Similar statistical results were achieved regarding increased hip flexion range, decreased pain, and increased extension amplitude and quadriceps strength ($p<0.001$), in contrast to the present study, where there was no significant change in extension, flexion, extension, and abduction strength ($p=1.000$). The difference may result from the patient's low involvement in the measurement of strength on the Lovett scale or may refer to the modalities of the kinesiotherapy classes and other treatments.

In their systematic review, Coulter[31] et al. included literature comparing rehabilitation following hip replacement surgery, conducted in a home and outpatient setting, which could last up to 8 weeks. They indicated significant benefits from both forms of rehabilitation, namely a statistically significant increase in abduction strength, but did not demonstrate a significant difference in the results obtained with respect to the form of rehabilitation. In this study, flexion, extension, and abduction strength did not change. This may be due to the short duration of rehabilitation in the sanatorium, as Jan [32] et al., mentioned in the aforementioned review, demonstrated that only a 12-week rehabilitation program, performed daily for 60 minutes, can increase bilateral hip muscle strength. Trudelle-Jackson [33] et al. also reported showed in their study that adding isometric and active exercises, strength and balance exercises to an 8-week program increases flexion, extension and abduction strength by 24.4%, 47.8% and 41.2%, respectively [31,32,33].

The Up & Go test was used to measure the time required to walk a distance of 6 meters. The average time before treatment was approximately 13.2 seconds. A similar result was obtained by Federico Temporiti [34] et al., who examined patients seven days after the procedure and obtained a result of 13.3 seconds for unilateral endoprosthesis and 15.9 seconds for bilateral endoprosthesis. The patients in their study underwent two daily exercise sessions in the hospital, aimed at increasing range of motion, strengthening muscles, improving balance, and honing crutch mobility. The similarity in the obtained results may be due to the patients performing a similar set of exercises during their hospital stay after the procedure. However, the improvement expressed by the reduction in time required to complete the test (from 13.2 to 10.93 seconds) may support the effectiveness of sanatorium treatment.

Literature review has not yet yielded any examples examining the relationship between the type of work performed before joint replacement and the results obtained after sanatorium treatment. Studies have shown that individuals performing physical labor achieve greater strength in extension and abduction after sanatorium treatment compared to those working in

white-collar jobs. There are many possible explanations for this phenomenon, one of which may be the sedentary nature of white-collar workers. The lack of regular engagement of the extensor and abductor muscles, typical of this type of activity, may lead to their weakening in the long term, unlike the continuous exertion of the extensor muscles in a standing position, typical of physical work.

The study also examined the subjective assessment of quality of life in patients undergoing hip replacement surgery one month after completing a 21-day treatment period in a health resort. The tool used for this purpose was the SF-36 questionnaire. Despite the general availability of research on the impact of the surgery itself on quality of life, there are no studies focusing on the specific population of patients treated in health resorts after this procedure 26. No studies with characteristics similar to the present study were found. Therefore, to attempt to understand the impact of health resort treatment on the quality of life of patients after hip replacement, available studies on general changes in quality of life in patients undergoing this type of surgery, treated in settings other than health resorts, were used. It should be emphasized that although studies on the quality of life of patients after hip replacement exist, the impact of the health resort environment on quality of life after this procedure remains insufficiently researched.por [35-40].

Kieszkowska-Grudny [41] et al. also examined the quality of life of patients after hip replacement surgery. They conducted the study on 55 individuals before and four months after the procedure. They also achieved statistically significant improvement in each element measured by the SF-36, but their mean scores on a scale of 0 to 100 appear low. For example, in this study, the general health status was assessed at an average of 64.83 one month after completing the spa treatment, while in the study by Kieszkowska-Grudny et al., it was 17.54 four months after the procedure. This significant difference in the obtained results may stem from the lack of any form of rehabilitation available after the hip replacement procedure. These authors did not provide information on any therapeutic intervention.

To summarize the discussion on quality of life, it's important to remember that the SF-36 is a subjective assessment of quality of life by patients themselves. Each patient has different circumstances, approaches to illness, levels of acceptance of various life situations, and, very often, various comorbidities. Therefore, patients undergoing the same rehabilitation plan may indicate their responses differently. From the articles mentioned above, it can be concluded that both the endoprosthesis procedure itself and rehabilitation in various forms (the latter statistically significantly) improve patients' subjective quality of life.

5. Study limitations

While conducting this study, assessing the quality of life of patients undergoing spa treatment, certain errors were unavoidable, which could have influenced the final results. The age of the study group ranged from 50 to 83 years, increasing the likelihood of comorbidities, which could have significantly influenced the SF-36 questionnaire, lowering its scores.

6. Conclusion

1. A 21-day sanatorium treatment improves the functioning of patients after hip replacement surgery.
2. A 21-day sanatorium treatment had an impact on the subjective assessment of quality of life in patients after hip replacement surgery.
3. Statistically correct subjective interpretations of the use and exclusion from physical health of individuals after spa treatment were observed.
4. There was an automatic improvement in subjective energy/fatigue and overall health of individuals .
5. Sanatorium treatment affected the range of flexion and mobility, as well as pain and the duration of walking 6 meters.

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Institutional review board statement: the study conformed to the Declaration of Helsinki protocols. Prior to the study, the authors obtained an approval from the Bioethics Committee of the Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń (KB: 413/2023, date of approval: October 24, 2023). Informed consent statement: All participants provided written informed consent for the study.

Data availability statement: Data sets generated or analyzed during the current study are available from the corresponding author upon reasonable request.

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