

ORIGINAL ARTICLE

Enhancing hip arthroplasty recovery with balneo-rehabilitation treatment

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Summary

Introduction: Balneo-rehabilitation treatment is a therapeutic approach that utilizes natural elements as a means of therapy. Hip arthroplasty is a surgical procedure that helps address hip joint dysfunction. This study aims to investigate whether the balneo-rehabilitation treatment can enhance the recovery of functional capabilities and improve the quality of life of patients who have undergone hip arthroplasty.

Material and Methods: The study included 100 patients who had undergone hip arthroplasty and participated in hydrokinesis exercises in thermal mineral water pools, alongside a standard dry-land rehabilitation program. The evaluation included assessments of hip joint range of motion and the strength of primary hip-moving muscles. Participants also rated the protocol's effectiveness based on improvements in quality-of-life parameters.

Results: The study results demonstrated that balneo-rehabilitation treatment significantly accelerated the recovery of functional abilities and enhanced the quality of life in patients following hip arthroplasty surgery.

Conclusion: Our results suggest that the balneo-rehabilitation treatment at the Special Hospital for Rehabilitation “Banja Kanjiža” accelerated recovery and improved the quality of life in patients following hip arthroplasty. Coordinated multicenter clinical trials and fundamental research are needed to verify the effectiveness of this treatment further.

Keywords: balneo-rehabilitation treatment, hip arthroplasty



INTRODUCTION

Balneo-rehabilitation treatment (BRT) represents a therapeutic modality employing natural elements to elicit healing responses, encompassing a multifaceted approach involving ingestion, immersion in mineral water, thermal and hydrotherapy (HT), inhalation, application of healing mud, and various ancillary medical interventions (1). Physiological responses to these natural stimuli are categorized into general and specific reactions. General responses entail the organism's reaction to the thermal, chemical, and mechanical stimuli inherent in the balneo-rehabilitation treatment (2). In contrast, specific reactions are contingent upon the mode of application and the physicochemical attributes of the utilized natural agent (3). External application of balneological agents at the dermal level triggers the synthesis of active biological compounds, including beta-endorphins, acetylcholine, histamine, and serotonin, which, in turn, elicit systemic responses via neurohumoral pathways. These collective effects enhance the organism's functional capacity and intrinsic potential for self-recovery (4-5).

Thermal mineral waters exhibit temperatures exceeding 20°C and mineralization levels surpassing 1 g/l. Primarily used as a balneological agent, natural thermal mineral waters offer preventive and therapeutic benefits for a range of pathophysiological conditions. Therapeutically, they are administered via ingestion, immersion, inhalation, irrigation, electrophoresis, and sonophoresis of peloids (6-8). Immersion baths may be localized to specific body regions or encompass the entire body, with recommended durations typically ranging from 10 to 20 minutes, contingent upon the patient's overall health status, and conducted daily or every other day (9). Additionally, thermal mineral waters may be applied through rain, spraying, or pressurized hydromassage tubs, with temperatures commonly maintained within the range of 34 to 36°C, owing to its tolerability and sedative effects on the body. The minimum recommended therapy duration is seven days, extendable to up to 10 weeks as warranted (10). According to established balneological criteria, Banja Kanjiža's mineral water falls under group I/a within Quentin's classification, characterized by its sodium-hydrocarbonated composition, iodine, sulphide content, medium mineralization, and hyperthermic nature (11).

Fractures affecting the proximal femur segment are frequently denoted as hip fractures (12). These injuries typically arise from forces exerted upon the knee or foot, imparting impact upon the greater trochanter region during rotational or abduction movements of the extremity (13). Additionally, hip fractures can also result from underlying stress fractures (14). In the elderly, such fractures commonly ensue following falls from standing height onto a level surface, often characterized as low-energy fractures.

Hip arthroplasty stands as an efficacious surgical intervention for addressing hip dysfunction (15). Predominantly indicated for hip fractures and longstanding arthrosis, this procedure encompasses two primary approaches: hemiarthroplasty, reserved for patients lacking significant degenerative hip alterations, and total hip arthroplasty, typically undertaken in more physically active individuals with advancing degenerative changes (16). Hemiarthroplasty involves replacing the proximal portion of the femur with an implant, whereas total arthroplasty encompasses replacing both the proximal femur and the acetabulum. The selection between these surgical approaches following a femoral neck fracture remains subject to ongoing debate (17).

In most cases, patients who undergo hip arthroplasty get discharged from hospital after successful verticalisation and restoration of gait function. However, many patients continue to experience physical challenges and have not reached full recovery (18). In order to increase muscle strength, stretch, achieve an adequate range of motion, restore walking, and ensure proprioceptive recovery, patients are included in a rehabilitation program. There are several postoperative interventions, including early postoperative rehabilitation in hospital, inpatient rehabilitation or exercises at home, hydrotherapy, and fast-track protocols (19). Progressive resistance training (PRT) is one of the most frequent rehabilitation methods after hip replacement. It can also be introduced very early postoperatively due to muscle mass and strength loss accompanying the operation (20). In recent years, the so-called Enhanced Recovery After Surgery (ERAS) or Fast Track protocols - individualized multimodal peri- and postoperative approaches to rehabilitation - have been increasingly used to reduce the consequences after surgery, reduce pain, optimize and accelerate patient recovery and shorten the time spent in hospital (21). Another beneficial rehab method is hydrotherapy. Immersion in the aquatic environment reduces the impact of body weight on the joint, making it easier to move the extremities. Also, the water pressure protects the joint, gives the patient a sense of security when standing, and increases muscle strength, balance, and coordination (22). Despite the numerous rehabilitation options available, the most effective approach for achieving full functional recovery after hip arthroplasty remains uncertain, and there is limited information on how these methods affect the implant itself (23).

This study aims to assess the extent to which the balneo-rehabilitation treatment can augment the restoration of functional capabilities and enhance the quality of life in patients who have undergone hip arthroplasty surgery.

MATERIAL AND METHODS

Patients

Patients (n=100) included in this investigation were admitted to the Banja Kanjiža Special Rehabilitation Hospital from April 2020 to March 2021. The inclusion criteria were hip arthroplasty performed a maximum of five months before admission to the rehabilitation hospital, age between 55 and 80, eagerness to undergo a program of hydrokinesis exercises in pools with thermal mineral water, and a conventional dry-land therapeutic rehabilitation program. The Ethical Committee of the Banja Kanjiža approved this prospective study.

After obtaining the written consent of the subjects to participate in the study, the following parameters were collected: demographic data (gender, age, working ability), tobacco consumption habits, the presence of comorbidities (hypertension) and deformities (amputations), the cause of the hip arthroplasty, and how much time has passed since the surgical intervention was recorded. Body mass and height were measured, while body mass index (BMI) was calculated as well. During the course of the study, all patients continued with their regular therapy.

Research protocol

The subjects performed strength and endurance exercises, coordination and balance exercises, exercises for increasing the range of motion (stretching exercises) and aerobic exercises daily. Hydrokinesiotherapy with thermal mineral water was carried out in pools with thermal mineral water for three weeks. Patients exercised in pools once a day for 30 minutes six days a week, performing each exercise five times.

From the clinical parameters for each subject, the degree range of motion of the hip joint and the gross muscle strength of the most important muscles that move the hip joint were assessed. Measurements were carried out at the beginning of the study before therapy and at the end of the treatment. The gross muscle strength of the synergistic muscle groups involved in the movements

of the hip joint (quadriceps, hip abductor, hip adductor) was assessed and categorized as: 0 - contraction neither visible nor palpable, 1 - contraction in trace and no movement of segments, 2 - motion full range with elimination of gravity, 3 - motion full range against gravity, 4 - motion full range against gravity and 5 - full range of motion against gravity with high resistance. The absence of progress in increasing the range of motion of the hip joint and increasing the degree of gross muscle strength was considered an indicator of therapy failure. After completing the therapeutic protocol, the respondents assessed the protocol's success by looking at the improvement of the mentioned quality of life parameters. They presented their general opinion on the success of the treatment.

Statistical analysis

Descriptive statistics was used for data processing. All numerical parameters are presented as mean value \pm standard deviation, while categorical variables are presented as absolute and relative numbers. The non-parametric Wilcoxon test of equivalent pairs was used to test the significance of the difference, and Spearman's rank correlation was used to test the association. All data obtained during the research were processed using the computer statistical program SPSS 20.0 for Windows. In all tests, the accepted level of statistical significance is $p < 0.05$.

RESULTS

Demographic parameters

In this study, 39% of participants were male, while 61% were female. The majority of participants were classified as overweight, comprising 44% of the overall sample, while 61% reported a history of never smoking. Furthermore, 62% were diagnosed with hypertension. Through data analysis it was found that most patients in this study were older females who underwent surgery due to arthrosis of the hip joint (**Table 1**).

Table 1. Demographic parameters of the experimental group and causes of hip arthropathy

Age (mean \pm standard deviation, years)	68 \pm 9			
Male n (%)	39 (39%)			
Female n (%)	61 (61%)			
BMI (kg/m ²) (%)	underweight	normal	overweight	obese
	2	27	44	27
Smokers (%)	Never	ex-smokers	active	
	61	24	15	
Hypertension (%)	62			
Amputation (%)	0			
Hip fracture	26 (n=25)			
Arthrosis of the hip	75 (n=77)			

Abbreviations: BMI – body mass index

Hip joint mobility

Based on data analysis (Table 2), we determined that at the end of the therapy in 57% (n=58) of the subjects, there was an improvement in the degree of mobility of the hip joint, which reached a statistically significant level of difference ($p < 0.05$) in the registered categories compared to the initial ones.

At the start of the study, none of the subjects had a standard level of mobility; however, by the end of the therapy, 9% (n=9) of the participants had regained average mobility levels.

In 43% (n=44) of the subjects, the same categories of degree of hip joint mobility were registered at the beginning of the therapy.

Table 2. The degree of range of motion of the hip joint

Category	Before therapy	After therapy
I	1 (n=1)	9 (n=9)
II	13 (n=13)	51 (n=52)
III	82 (n=84)	39 (n=40)
IV	4 (n=4)	1 (n=1)
V	0 (n=0)	0 (n=0)

The table shows the variables as a percentage share in the given group (%) and absolute numbers (n - number of respondents). I - normal, II - easily limited (30% less than normal), III - medium limited (30-60% less than normal), IV - severe limitation (more than 60% less than normal), V - hypermobility.

Muscular strength

At the end of the therapy, we determined that in 72% (n=74) of the subjects, there was an increase in the intensity of gross muscle strength of synergistic muscle groups of hip joint movers, which reached a statistically significant level of difference ($p < 0.05$) in the registered categories compared to the initial ones. In 26% (n=28) of the subjects, the intensity levels of gross muscle strength in the synergistic muscle groups that move the hip joint remained unchanged from the beginning of therapy.

At the beginning of the study, none of the subjects registered a full range of motion against the gravitational force and significant resistance, while at the end of the therapy, 12% (n=12) of the subjects regained these values.

Table 3. Gross muscle strength of synergistic muscle groups involved in hip joint movements

Category	Before therapy	After therapy
I	0 (n=0)	0 (n=0)
II	2 (n=3)	0 (n=0)
III	88 (n=89)	28 (n=29)
IV	10 (n=10)	60 (n=61)

The table shows the variables as a percentage share in the given group (%) and absolute numbers (n - number of respondents). I - contraction is not visible or palpable, II - contraction in trace and no initiation of segments, III - full range of motion while eliminating the force of gravity, IV - full range of motion against gravity.

Quality of life

Upon arrival at the spa, only 3 (6%) patients were able to stand for as long as they wanted. At the end of the therapy, 31 (62%) patients did not have any pain related to the condition and were able to stand for as long as they wanted. Only one patient older than 70 years, body mass index 29, who, due to hip arthrosis, had come to the spa only 5 months after the surgical intervention, and after completing the therapeutic protocol, was able to stand for less than ten minutes (Table 4).

Table 4. Ability to stand independently

	Category	Before therapy	After therapy
Ability to stand independently	I	6 (n=3)	62 (n=31)
	II	56 (n=28)	32 (n=16)
	III	22 (n=11)	2 (n=1)
	IV	12 (n=6)	2 (n=1)
Use of walking aids	I	12 (n=6)	34 (n=17)
	II	46 (n=23)	56 (n=28)
	III	32 (n=16)	8 (n=4)
	IV	10 (n=5)	2 (n=1)
Ability to dress independently	I	20 (n=10)	92 (n=46)
	II	78 (n=39)	6 (n=3)
	III	2 (n=1)	2 (n=1)

The table shows the variables as a percentage share in the given group (%) and absolute numbers (n - number of respondents). Ability to stand independently: I - stand as long as they want without pain, II - stand as long as they want with a feeling of pain, III - due to pain for less than 30 minutes, IV - due to pain less than 10 minutes. Use of walking aids: I - they do not use aids, II - they use 1 or 2 sticks, III - use 1 or 2 crutches, IV - a Walker. Ability to dress independently: A - can dress myself without difficulty, II - can dress myself with significant pain, III - I can't dress myself.

We found that upon arrival, only six patients (12%) were able to move without using a medical aid. After completing the therapeutic protocol, 17 patients (34%) were able to walk independently, while 23 patients (46%) transitioned to different mobility aids; those who initially used walkers switched to crutches, and those using crutches began using a cane, while 10 (20%) patients continued to use the same device. These findings indicate that there has been a significant improvement in the field of mobility, but additional weight is brought by the knowledge that the frequency of use of walking aids has also been significantly reduced. As we have already pointed out, only 6 (12%) patients did not use an aid upon arrival, while at the end of the therapy, another 11 (22%) patients were able to walk independently. Only 7 (14%) patients who completed the therapy continued to use a walking aid all the time, but we must point out that all of them were over 75 years of age. The largest number of patients, 27 of them (54%), significantly reduced the use of aids when moving

(Table 4). Also, we found that 90% of the respondents experienced a statistically significant change ($p < 0.05$) in the ability to dress independently after therapy compared to their abilities before therapy (Table 4).

After completing the therapy, all patients were able to walk significantly longer distances. As many as 14 (28%) patients were able to cover a distance that was 500% longer than the results they could achieve upon arrival at the spa (Table 5).

Table 5. An increase in the distance that the subjects could walk after the therapy

Lengthening category in relation to pretherapy distance	Respondent
I	0 (n=0)
II	12 (n=6)
III	28 (n=14)
IV	32 (n=16)
V	28 (n=14)

The table shows the variables as a percentage share in the given group (%) and absolute numbers (n - number of respondents. I - same or less than 50% extension, II - extension of more than 50% but less than 100%, III - elongation more than 100% but less than 300%, IV - elongation more than 300% but less than 500%, V - extension more than 500%.

DISCUSSION

Balneo-rehabilitation treatment, a treatment method that has been integrated into routine clinical practice across numerous European countries and globally (1), holds a significant place in the medical field. However, despite its extensive historical usage and cultural heritage, the scientific validity of balneo-rehabilitation treatment remains a topic of expert discourse, largely due to the imperative for evidence-based substantiation regarding the effects of balneological agents.

Among our cohort of 100 patients referred for spa rehabilitation, the majority were elderly females with a high prevalence of hypertension. The primary impetus for surgical intervention, precipitating subsequent referral for spa treatment within an average timeframe of three months, predominantly stemmed from hip joint arthritis. Given that impaired independent mobility and standing significantly compromise the quality of life among individuals with hip joint dysfunction, our investigation sought to elucidate this critical facet of functional recovery. This entailed documenting the type and frequency of medical aids employed during ambulation, monitoring the duration of unassisted standing without difficulty, and assessing the distance travelled by patients.

Observing the realized enhancements in mobility and muscle strength, the anticipations regarding patients' progression in executing fundamental daily activities autonomously were substantiated. Kars et al. elucidated through a randomized clinical investigation that hydrokinesiotherapy engenders advancements in functional capacities, joint mobility, and pain alleviation among osteoarthritis patients (17). Similarly, Hin-

man et al. underscored the significant enhancements in muscle strength, functional abilities, joint mobility, and pain mitigation resulting from hydrokinesiotherapy in osteoarthritis patients (24). Notably, a relatively limited number of clinical inquiries have comprehensively examined the manifold contributions of balneotherapy to the recuperation of patient's post-hip arthroplasty. Furthermore, Di Monaco et al. underscore the pivotal role of hydrokinesiotherapy in rehabilitating post-hip arthroplasty patients (25). Additionally, Papalia et al. highlighted the ongoing necessity for further exploration in the realm of evidence-based assertions regarding the beneficial effects of controlled physical activity, both on land and in aquatic environments, on the recovery of patients' post-surgical interventions at the hip and knee joint levels (26).

In a multicenter clinical investigation, Liebs et al. emphasized the importance of determining the optimal timing for integrating hydrokinesiotherapy into the rehabilitation protocol for patients undergoing knee and hip arthroplasty (27). Specifically, Giaquinto et al. determined that among the geriatric demographic, the administration of hydrokinesiotherapy, even six months post-surgical intervention on the hip joint, markedly contributed to functional rehabilitation and alleviation of subjective pain perception (28). Moreover, the findings elucidated by Musumeci et al. underscored the considerable significance of early incorporation of balneological intervention with thermal mineral water, showcasing notable enhancements in quality of life and functional recuperation, including muscle strength and joint mobility among patients who underwent hip joint arthroplasty procedures (29).

It is imperative to highlight the escalating global prevalence of obesity across all age demographics. This phenomenon significantly impacts not only the functional recuperation of patients following surgical intervention for hip dislocation but also poses a substantial risk factor for traumatic incidents predisposing to hip joint integrity compromise, particularly among the elderly. Within our study cohort, it was observed that individuals in the test group with elevated body mass index demonstrated comparatively less progress than other categories. Importantly, evidence from diverse global studies underscores the potential of balneotherapy and hydrotherapy in facilitating the attainment of appropriate body mass, with demonstrated safety profiles even among obese individuals (30-33).

The delineated advantages stemming from balneo-rehabilitation treatment procedures conducted within the Banja Kanjiža Special Hospital underscore the underutilized balneological potential inherent in our region. This assertion gains further weight when considering the established practices observed in neighboring Hungary, which shares a congruent geological origin and structure with our segment of the Pannonian region (34, 35).

To further solidify the position of balneology, it is imperative to undertake coordinated multicenter clin-

ical trials alongside fundamental research endeavors. Acknowledging the inherent complexity associated with such initiatives, particularly concerning the diverse physical and chemical properties of thermal mineral waters and their intricate interplay, challenges abound in isolating the effects of individual factors. Nevertheless, a strong commitment to utilizing our region's abundant natural healing resources, alongside the expertise of qualified healthcare professionals and well-equipped spa facilities, is essential. These efforts aim to benefit our local population and extend the therapeutic potential of balneological interventions to a global audience.

CONCLUSION

Our results suggest that the balneo-rehabilitation treatment at the Special Hospital for Rehabilitation "Banja Kanjiža" accelerated recovery and improved the quality of life of patients after hip arthroplasty. Furthermore, it is important to highlight the significant potential of using balneological agents for preventive purposes to maintain and enhance overall health while reducing the onset and progression of degenerative conditions. This preventive approach holds promise across diverse demographics, from children and adolescents to the elderly, offering holistic health benefits to the broader population. Coordinated multicenter clinical trials and fundamental research are needed to verify the effectiveness of this treatment further.

Author Contributions

Attila Klimó contributed to patient recruitment and initial manuscript drafting. Mina Bogetić and Marija Babić were responsible for data analysis and interpretation. Rada Jeremić and Predrag Brkić contributed to the study's conception, design, and provided manuscript review and editing.

REFERENCES

- Ma T, Song X, Ma Y, Hu H, Bai H, Li Y, et al. The effect of thermal mineral waters on pain relief, physical function and quality of life in patients with osteoarthritis: A systematic review and meta-analysis. *Medicine (Baltimore)*. 2021 Jan 29;100(4):e24488. doi: 10.1097/MD.00000000000024488. PMID: 33530266; PMCID: PMC7850667.
- Gutenbrunner C, Bender T, Cantista P, Karagülle Z. A proposal for a worldwide definition of health resort medicine, balneology, medical hydrology and climatology. *Int J Biometeorol*. 2010 Sep;54(5):495-507. doi: 10.1007/s00484-010-0321-5. Epub 2010 Jun 9. PMID: 20532921.
- Mooventhan A, Nivethitha L. Scientific evidence-based effects of hydrotherapy on various systems of the body. *N Am J Med Sci*. 2014 May;6(5):199-209. doi: 10.4103/1947-2714.132935. PMID: 24926444; PMCID: PMC4049052.
- Fioravanti A, Giannitti C, Chelleschi S, Simpatico A, Pascarelli NA, Galeazzi M. Circulating levels of adiponectin, resistin, and visfatin after mud-bath therapy in patients with bilateral knee osteoarthritis. *Int J Biometeorol*. 2015 Nov;59(11):1691-700. doi: 10.1007/s00484-015-0977-y. Epub 2015 Mar 7. PMID: 25750093.
- Prandelli C, Parola C, Buizza L, Delbarba A, Marziano M, Salvi V, et al. Sulphurous thermal water increases the release of the anti-inflammatory cytokine IL-10 and modulates antioxidant enzyme activity. *Int J Immunopathol Pharmacol*. 2013 Jul-Sep;26(3):633-46. doi: 10.1177/039463201302600307. PMID: 24067460.
- Tefner IK, Németh A, Lászlófi A, Kis T, Gyetvai G, Bender T. The effect of spa therapy in chronic low back pain: a randomized controlled, single-blind, follow-up study. *Rheumatol Int*. 2012 Oct;32(10):3163-9. doi: 10.1007/s00296-011-2145-y. Epub 2011 Sep 27. PMID: 21947373.
- Kovács C, Pecze M, Tihanyi Á, Kovács L, Balogh S, Bender T. The effect of sulphurous water in patients with osteoarthritis of hand. Double-blind, randomized, controlled follow-up study. *Clin Rheumatol*. 2012 Oct;31(10):1437-42. doi: 10.1007/s10067-012-2026-0. Epub 2012 Jul 29. PMID: 22843170.
- Karagülle M, Kardeş S, Dişçi R, Karagülle MZ. Spa therapy adjunct to pharmacotherapy is beneficial in rheumatoid arthritis: a crossover randomized controlled trial. *Int J Biometeorol*. 2018 Feb;62(2):195-205. doi: 10.1007/s00484-017-1441-y. Epub 2017 Sep 7. PMID: 28884308.
- Fernandez-Gonzalez M, Fernandez-Lao C, Martin-Martin L, Gonzalez-Santos A, Lopez-Garzon M, Ortiz-Comino L, et al. Therapeutic Benefits of Balneotherapy on Quality of Life of Patients with Rheumatoid Arthritis: A Systematic Review. *Int J Environ Res Public Health*. 2021 Dec 15;18(24):13216. doi: 10.3390/ijerph182413216. PMID: 34948827; PMCID: PMC8701266.
- Moufarrij S, Deghayli L, Raffoul W, Hirt-Burri N, Michetti M, de Buys Roessingh A, et al. How important is hydrotherapy? Effects of dynamic action of hot spring water as a rehabilitative treatment for burn patients in Switzerland. *Ann Burns Fire Disasters*. 2014 Dec 31;27(4):184-91. PMID: 26336365; PMCID: PMC4544428.
- Brodermann J. Classification of medicinal mineral waters analyzed by the National Institute of Medical Hydrology and Climatology. *Arch Cuba*. 1948;2(2):185-188.
- Lewis SR, Macey R, Parker MJ, Cook JA, Griffin XL. Arthroplasties for hip fracture in adults. *Cochrane Database Syst Rev*. 2022 Feb 14;2(2):CD013410. doi: 10.1002/14651858.CD013410.pub2. PMID: 35156194; PMCID: PMC8841979.
- Sheehan SE, Shyu JY, Weaver MJ, Sodickson AD, Khurana B. Proximal Femoral Fractures: What the Orthopedic Surgeon Wants to Know. *Radiographics*. 2015 Sep-Oct;35(5):1563-84. doi: 10.1148/rg.2015140301. Epub 2015 Jul 17. Erratum in: *Radiographics*. 2015 Sep-Oct;35(5):1624. PMID: 26186669.
- Bernstein EM, Kelsey TJ, Cochran GK, Deafenbaugh BK, Kuhn KM. Femoral Neck Stress Fractures: An Updated Review. *J Am Acad Orthop Surg*. 2022;30(7):302-311. doi:10.5435/JAAOS-D-21-00398
- Sonaje JC, Meena PK, Bansiwala RC, Bobade SS. Comparison of functional outcome of bipolar hip arthroplasty and total hip replacement in displaced femoral neck fractures in elderly in a developing country: a 2-year prospective study. *Eur J Orthop Surg Traumatol*. 2018 Apr;28(3):493-498. doi: 10.1007/s00590-017-2057-y. Epub 2017 Oct 13. PMID: 29030710.
- Guyen O. Hemiarthroplasty or total hip arthroplasty in recent femoral neck fractures?. *Orthop Traumatol Surg Res*. 2019;105(1S):S95-S101. doi:10.1016/j.otsr.2018.04.034
- LeBlanc KE, Muncie HL Jr, LeBlanc LL. Hip fracture: diagnosis, treatment, and secondary prevention. *Am Fam Physician*. 2014 Jun 15;89(12):945-51. PMID: 25162161.
- NICE. Joint replacement (primary): hip, knee and shoulder. [Internet]. Nice. 2020. 1-75 p. Available from: www.nice.org.uk/guidance/qs206%0Ahttps://www.nice.org.uk/guidance/ng157
- Papalia R, Campi S, Vorini F, Zampogna B, Vasta S, Papalia G, et al. The role of physical activity and rehabilitation following hip and knee arthroplasty in the elderly. *J Clin Med*. 2020;9(5):1-12.
- Chen X, Li X, Zhu Z, Wang H, Yu Z, Bai X. Effects of progressive resistance training for early postoperative fast-track total hip or knee arthroplasty: A systematic review and meta-analysis. *Asian J Surg*. 2021;44(10):1245-53.

21. Di Martino A, Brunello M, Pederiva D, Schilardi F, Rossomando V, Cataldi P, et al. Fast Track Protocols and Early Rehabilitation after Surgery in Total Hip Arthroplasty: A Narrative Review. *Clin Pract*. 2023;13(3):569–82.
22. Liebs TR, Herzberg W, Rther W, Haasters J, Russlies M, Hassenpflug J. Multicenter randomized controlled trial comparing early versus late aquatic therapy after total hip or knee arthroplasty. *Arch Phys Med Rehabil* [Internet]. 2012;93(2):192–9. Available from: <http://dx.doi.org/10.1016/j.apmr.2011.09.011>
23. Papalia R, Campi S, Vorini F, Zampogna B, Vasta S, Papalia G, et al. The role of physical activity and rehabilitation following hip and knee arthroplasty in the elderly. *J Clin Med*. 2020; 9(5).
24. Bhandari M, Swiontkowski M. Management of Acute Hip Fracture. *N Engl J Med*. 2017 Nov 23;377(21):2053–2062. doi: 10.1056/NEJMcp1611090. PMID: 29166235.
25. Hinman RS, Heywood SE, Day AR. Aquatic physical therapy for hip and knee osteoarthritis: results of a single-blind randomized controlled trial. *Phys Ther*. 2007 Jan; 87(1):32–43. doi: 10.2522/ptj.20060006. Epub 2006 Dec 1. PMID: 17142642.
26. Di Monaco M, Castiglioni C. Which type of exercise therapy is effective after hip arthroplasty? A systematic review of randomized controlled trials. *Eur J Phys Rehabil Med*. 2013 Dec;49(6):893–907, quiz 921–3. Epub 2013 Oct 30. PMID: 24172644.
27. Papalia R, Campi S, Vorini F, Zampogna B, Vasta S, Papalia G, et al. The Role of Physical Activity and Rehabilitation Following Hip and Knee Arthroplasty in the Elderly. *J Clin Med*. 2020 May 9; 9(5):1401. doi: 10.3390/jcm9051401. PMID: 32397459; PMCID: PMC7291199.
28. Liebs TR, Herzberg W, Ruther W, Haasters J, Russlies M, Hassenpflug J; Multicenter Arthroplasty Aftercare Project. Multicenter randomized controlled trial comparing early versus late aquatic therapy after total hip or knee arthroplasty. *Arch Phys Med Rehabil*. 2012 Feb;93(2):192–9. doi: 10.1016/j.apmr.2011.09.011. Epub 2011 Dec 21. PMID: 22196125.
29. Rahmann AE, Brauer SG, Nitz JC. A specific inpatient aquatic physiotherapy program improves strength after total hip or knee replacement surgery: a randomized controlled trial. *Arch Phys Med Rehabil*. 2009 May; 90(5):745–55. doi: 10.1016/j.apmr.2008.12.011. PMID: 19406293.
30. Giaquinto S, Ciotola E, Dall'armi V, Margutti F. Hydrotherapy after total hip arthroplasty: a follow-up study. *Arch Gerontol Geriatr*. 2010 Jan-Feb; 50(1):92–5. doi: 10.1016/j.archger.2009.02.005. Epub 2009 Mar 12. PMID: 19282040.
31. Musumeci A, Pranovi G, Masiero S. Patient education and rehabilitation after hip arthroplasty in an Italian spa center: a pilot study on its feasibility. *Int J Biometeorol*. 2018 Aug; 62(8):1489–1496. doi: 10.1007/s00484-018-1548-9. Epub 2018 May 11. PMID: 29748911.
32. Masiero S, Vittadini F, Ferroni C, Bosco A, Serra R, Frigo AC, et al. The role of thermal balneotherapy in the treatment of obese patient with knee osteoarthritis. *Int J Biometeorol*. 2018 Feb; 62(2):243–252. doi: 10.1007/s00484-017-1445-7. Epub 2017 Sep 22. PMID: 28940031.
33. Lim JY, Tchai E, Jang SN. Effectiveness of aquatic exercise for obese patients with knee osteoarthritis: a randomized controlled trial. *PM R*. 2010 Aug; 2(8):723–31; quiz 793. doi: 10.1016/j.pmrj.2010.04.004. PMID: 20709301.
34. Kamioka H, Tsutani K, Okuizumi H, Mutoh Y, Ohta M, Handa S, et al. Effectiveness of aquatic exercise and balneotherapy: a summary of systematic reviews based on randomized controlled trials of water immersion therapies. *J Epidemiol*. 2010; 20(1):2–12. doi: 10.2188/jea.je20090030. Epub 2009 Oct 31. PMID: 19881230; PMCID: PMC3900774.
35. Bender T, Bálint G, Prohászka Z, Géher P, Tefner IK. Evidence-based hydro- and balneotherapy in Hungary--a systematic review and meta-analysis. *Int J Biometeorol*. 2014 Apr; 58(3):311–23. doi: 10.1007/s00484-013-0667-6. Epub 2013 May 16. PMID: 23677421; PMCID: PMC3955132.

POBOLJŠANJE FUNKCIONALNOG OPORAVKA POSLE ARTROPLASTIKE KUKA PRIMENOM BALNEO-REHABILITACIONIH TRETMANA

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Sažetak

Uvod: Balneorehabilitacioni tretman je terapijski pristup koji koristi prirodne elemente kao sredstvo lečenja. Artroplastika kuka je hirurška procedura koja pomaže u rešavanju disfunkcije zgloba kuka. Ova studija ima za cilj da istraži da li balneorehabilitacioni tretman može poboljšati oporavak funkcionalnih sposobnosti i poboljšati kvalitet života pacijenata koji su bili podvrgnuti artroplastici kuka.

Materijal i metode: U studiju su uključeni pacijenti (n=100) koji su bili podvrgnuti artroplastici kuka i učestvovali u vežbama hidrokineze u bazenima sa termomineralnom vodom, pored konvencionalnog programa terapijske rehabilitacije na suvom. Evaluacija je uključivala procene opsega pokreta zgloba kuka i snage ključnih mišića pokretača zgloba kuka. Ispitanici su takođe oce-

nilni uspeh protokola na osnovu parametra poboljšanja kvaliteta života.

Rezultati: Rezultati istraživanja su pokazali da je primena balneorehabilitacionog tretmana značajno ubrzala oporavak funkcionalnih sposobnosti i poboljšala kvalitet života pacijenata koji su bili podvrgnuti operaciji artroplastike kuka.

Zaključak: Na osnovu naših rezultata može se zaključiti da je balneorehabilitacioni tretman u Specijalnoj bolnici za rehabilitaciju „Banja Kanjiža” doveo do ubrzanja oporavka i poboljšanja kvaliteta života pacijenata nakon artroplastike kuka. Da bi se dalje proverila efikasnost balneorehabilitacionog tretmana, neophodna su koordinirana multicentrična klinička ispitivanja i fundamentalna istraživanja.

Ključne reči: balneorehabilitacioni tretman, artroplastika kuka

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