

COMPARISON OF A CONVENTIONAL
AND A COMPUTERIZED APPROACH
IN THE EARLY REHABILITATION
OF HIP ARTHROPLASTY

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Received on December 17, 2022

Presented by B. Petrunov, Member of BAS, on January 31, 2023

Abstract

The aims of this study were to compare the effectiveness of computerized versus conventional exercises, and to determine their optimal frequency, intensity, and duration after a total hip arthroplasty (THA), due to a lack of consensus. One hundred and ten patients (age 66.09 ± 10.4 years), with unilateral or bilateral THA for osteoarthritis, were randomly divided into three groups: 1st group ($n = 34$) performed computerized home exercises, 2nd group ($n = 34$) – conventional supervised exercises, and 3rd (control) group ($n = 42$) – without interventions. The outcomes (on the day before surgery, and on the 7th, 14th, and 30th day after surgery) were: Harrison Hip Score (HHS); frequency, intensity, and duration of the exercises. HHS results showed significant improvement in all groups – the weakest for the third group, better for the second one, and the best for the first group ($P < 0.05$). All results improved if exercise frequency (more than 5 times daily), intensity, and duration increased ($P < 0.05$). In conclusion, this study demonstrates that the computerized approach is an effective alternative to the conventional one in the rehabilitation of patients after THA. Optimal recommendations should include frequency of exercises more than 5 times daily, with high intensity, and long duration, regardless of the approach – computerized or conventional. To reach such frequency, it is necessary to perform the exercises independently, and not only under supervision.

Key words: computerized exercises, THA

<https://doi.org/10.7546/CRABS.2025.02.13>

Introduction. As a result of the escalating increase in the number of people suffering from osteoarthritis of the hip joint worldwide, the number of THA is increasing at a rapid rate [1]. In 2006, 230 144 arthroplasties were performed in the United States. It is estimated that by 2030, their annual number will reach 572 000 [2]. According to data from the National Center of Public Health and Analyses, only for the period from 2018–2020, the growth rate of the number of THA performed in Bulgaria increased from 3.1% to 17.5%. As the need for hip arthroplasty increases, the need for postoperative recovery increases. Early rehabilitation after THA is of crucial importance for proper functional recovery [3]. However, access to outpatient rehabilitation after surgery may be restricted due to social, economic, physical, or other reasons [4]. The shortage of personnel, the disproportionate rehabilitation in different areas of the country, the expensive procedures, the COVID-19 pandemic, and the growing computerized self-treatment show the need for evidence-based computerized self-treatment, with the goal of more widely available, cost-effective, and optimal postoperative rehabilitation. Computerized exercises help in overcoming this problem by allowing treatment to be carried out directly in the patient's home. According to other studies, computerized exercises are comparable to conventional rehabilitation [5]. We did not find any Bulgarian study within the same field. Despite the general belief that even the best surgical intervention can fail without therapeutic exercises, their optimal frequency, duration, and intensity are unknown worldwide. Our study aimed to compare the effectiveness of computerized versus conventional therapeutic exercises in Bulgaria and to determine their optimal frequency, duration, and intensity in patients after THA.

Materials and methods. One hundred and ten patients participated in the study (66.09 ± 10.4 years of age). All patients underwent THA. The surgical procedure was the same for all patients with a modified Hardinge approach, due to severe osteoarthritis of the hip. From the first postoperative day till their discharge from the orthopedic ward, all patients were trained on how to get in and out of bed and were instructed to do exercises to prevent complications of prolonged bed rest. Patients were taught how to walk with assistive devices. After discharge from the acute clinic, they were randomly divided into three groups: the first group ($n = 34$) performed home computerized exercises, the second group ($n = 34$) performed supervised rehabilitation sessions by a physical therapist at a rehabilitation hospital or clinic, and the third (control) group ($n = 42$) was without interventions. The inclusion criteria were patients over 18 years of age, diagnosed with coxarthrosis, evaluated by an orthopedist for surgery, and with the ability to move independently (without or with an aid). The exclusion criteria were the following: (1) Fractures; (2) Revisions of THA; (3) Conditions severely limiting physical activity; (4) Complications preventing the discharge of the patient after the seventh postoperative day; (5) Severe contralateral coxarthrosis or gonarthrosis restricting mobility and the possibility of participation in the reha-

bilitation program; (6) Aphasia, dementia or other diseases, limiting the patient's communication and participation in the rehabilitation process; (7) Blindness and illiteracy. All patients were followed-up on the day before surgery, and on the 7th, 14th, and 30th day after THA.

The outcome "Harrison Hip Score" (HHS) was used for the evaluation of subjective pain sensation, functional limitations, stiffness, and quality of life [6].

Results. The quantitative statistics revealed that there was not statistically significant inter-group difference in terms of age ($P > 0.05$), weight ($P > 0.05$), height ($P > 0.05$), and cumulative index (BMI) ($P > 0.05$). Regarding the HHS, there was a significant improvement in all groups, which was the weakest for the third group ($P < 0.05$), better for the second group ($P < 0.05$), and the best for the first group ($P < 0.05$). The results were statistically significantly better in the first and second groups versus the third group ($P < 0.05$) (Fig. 1).

The qualitative statistics revealed that as the frequency of exercise increased, the better the HHS outcomes. According to the regression equations, $HHS (\%) = 43.4 + (6.31 * \text{frequency})$, HHS showed a significant tendency to normalize at exercise frequency above 5 times daily (Fig. 2).

As the frequency, intensity, and duration of exercise increased, all objectifying parameters improved ($P < 0.05$). The three-dimensional linear regression between frequency, intensity, and duration of exercises showed an extremely high statistical significance ($P < 0.0001$) (Fig. 3).

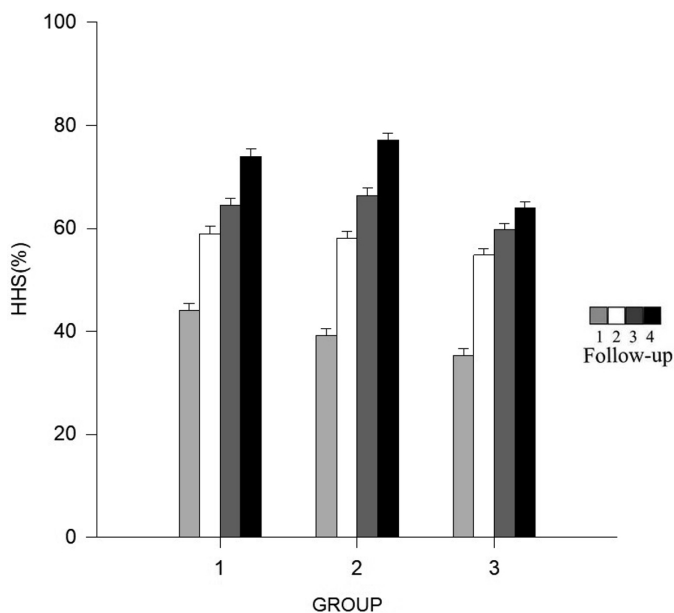


Fig. 1. HHS index in group 1 (computerized exercises), group 2 (conventional exercises), and group 3 (control), followed-up on the day before surgery (follow-up 1), on the 7th (follow-up 2), 14th (follow-up 3), and 30th (follow-up 4) days after total hip replacement

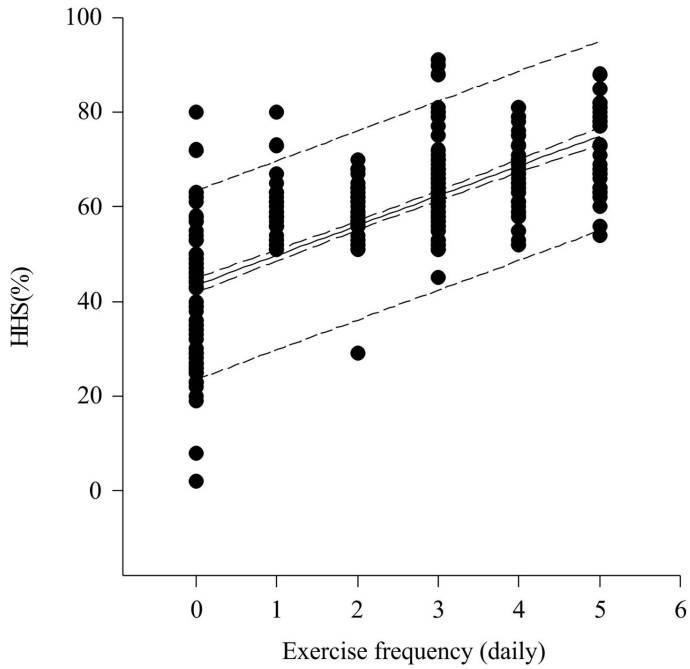


Fig. 2. Linear regression between the daily exercise frequency and Harrison Hip Score (HHS%)

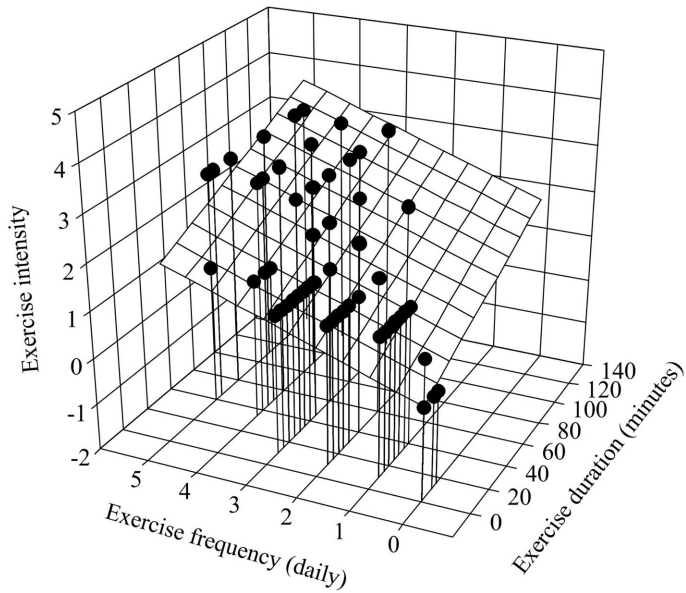


Fig. 3. The three-dimensional linear regression between frequency, intensity, and duration of exercises. Exercise intensity is presented in three levels: 1 – minimal; 2 – median; 3 – maximal; exercise daily frequency – in daily number of exercise sessions; and exercise duration – in number of minutes per day

Discussion. Our quantitative results are in line with other international studies in the same field [5], that the computerized method of rehabilitation achieves levels of physical recovery comparable to those of the conventional one.

For the first time our study investigates the frequency, duration and intensity of exercises and it shows that the frequency of exercise should be more than 5 times daily to reach sufficient effectiveness. With increasing frequency, duration, and intensity, the effectiveness of rehabilitation increases. Therefore, optimal recommendations should include frequency of exercises more than 5 times daily, with high intensity, and long duration, regardless of the approach – computerized or conventional. To reach such a daily frequency, it is necessary to perform the exercises independently at home and not only under supervision in inpatient or outpatient facilities.

However, we did not compare the cost-effectiveness between both programs. We can assume that because of the use of fewer resources in the computerized method, it is probably more economically advantageous. Future studies are needed on this issue in Bulgaria.

Conclusion. Our study clearly demonstrates that home-based computerized rehabilitation is comparable to the conventional one regarding improving the mobility, functional capacity, and health-related quality of life of THA patients. Furthermore, the computerized approach could be useful in pandemic conditions. Performing the exercises only under supervision is not enough, since a five-fold daily frequency cannot be reached. It is necessary to perform the exercises independently, whether at home or in hospital, to reach an overall frequency of at least 5 times a day.

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