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# Effect of bariatric surgery on postoperative outcomes of total hip replacement in patients with hip osteoarthritis

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**Abstract**

**Introduction** Bariatric surgery is the most effective treatment of morbid obesity, which is common in patients with hip osteoarthritis. However, the extent to which weight loss after bariatric surgery affects the outcomes and complication rates of total hip arthroplasty (THA) has not been adequately explored.

The **aim** of the study was to determine the impact of bariatric surgery on the results of THA and functional restoration of the lower limbs facilitating a lower risk of postoperative complications.

**Material and methods** A retrospective-prospective cohort, single-center, controlled study included patients with hip osteoarthritis grades 3–4 as described by I. Kellgren and I. Lawrence in 1957. Patients were referred for THA, had a history of morbid obesity (body mass index > 40 kg/m$^2$) and underwent bariatric surgery. The parameters assessed included body mass index, pain, functional status of patients measured with the Harris hip score and complication rate.

**Results** The findings suggested a significant statistical difference ($p < 0.001$) in pain intensity on the first day after surgery measured in patients of the study group and the comparison group with (6.3 ± 2.3) and (7.4 ± 2.3) scores, respectively. The modified Harris Hip Score measured at 12 months of surgery reached the maximum with (90.2 ± 10.3) scores in the study group and (86.5 ± 11.6) scores in the comparison group, with a statistically significant difference in the measurements, $p = 0.021$. The Kaplan – Meier estimator showed a five-year survival rate of THA being 94.6 % (5.4 % complications) in the study group and 77.2 % (22.8 % complications) in the comparison group.

**Conclusion** The bariatric surgery used in patients with morbid obesity and grade 3–4 hip osteoarthritis prior to THA facilitated a statistically significant risk of postoperative complications reduced to 17.4 % and the five-year survival rate of THA increased to 94.6 %.

**Keywords**: morbid obesity, hip osteoarthritis, bariatric surgery

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## INTRODUCTION

Obesity is a chronic disease with rising prevalence worldwide [1]. Obese individuals, with a body mass index (BMI) > 30 kg/m2, have a higher risk of lower extremity osteoarthritis (OA) [2] due to increased stress and inflammatory adipokines [3–7]. With the increasing prevalence of obesity and an aging population, the incidence of OA continues to rise and rising obesity trends result in more total knee arthroplasty (TKA). Over one million total hip arthroplasties (THA) and total knee arthroplasties (TKA) are performed annually in the United States [8].

There is no consensus on the preoperative management of patients with obesity and osteoarthritis of the hip and knee joints [9–14]. These patients have a higher risk of postoperative complications including infections, dislocations and early revisions [13, 15–19]. The results of THA can be associated with many factors, for example, the local factor of fat thickness or circumference of the proximal femur increasing the risk of implant dislocation [20] and other factors may have an impact on the results of the surgery. Bariatric surgery (BS) can positively affect some of these factors due to weight loss, reducing the risk of obesity-related comorbidities including diabetes, hypertension and dyslipidemia [21–23].

Obese OA patients can benefit from BO performed prior to THA reducing postoperative complications [24–26] and hip pain and improving functional outcomes [27]. However, the optimal balance between the benefits of weight loss and a lower risk of orthopedic complications remains unresolved.

The **aim** of the study was to determine the impact of BS on the results of THA and functional restoration of the lower limbs facilitating a lower risk of postoperative complications.

## MATERIAL AND METHODS

A retrospective-prospective cohort single-center controlled study was performed at the Clinic of Orthopedics and Joint Pathology of Sechenov University (approved by the LEC of Sechenov University on March 14, 2024, No. 06-24).

The treatment group consisted of patients ($n$ = 62) with hip arthritis grades 3–4 according to the K&L classification (I. Kellgren and I. Lawrence, 1957) treated with total hip arthroplasty over a five-year period (from January 1, 2014 to January 1, 2019). The patients had a history of morbid obesity (BMI > 40 kg/m$^2$), who had undergone BO at the time of inclusion in the study. The comparison group ($n$ = 91) included patients with hip arthritis and morbid obesity, similar in gender and age.

*Inclusion criteria*:

— patients, regardless of gender and age, with idiopathic osteoarthritis of the hip joint, characterized by pain scored above 3 on the VAS, clinical and radiological signs of hip arthritis K&L grade 3–4, with a history of morbid obesity (BMI> 40 kg/m$^2$), who underwent BO before THA, confirmed by medical documentation.

— available written informed consent for the processing of medical history data and participation in the study.

*Non-inclusion criteria*:

— severe deformities of the hip joint (valgus, varus, primary defects of bone tissue, hip dysplasia);

— patients undergoing conservative treatment for obesity;

— systemic autoimmune diseases (rheumatism, connective tissue diseases, systemic necrotizing vasculitis), severe uncorrected forms of diabetes mellitus (glycosylated hemoglobin > 9 %), blood

diseases (thrombopenia, thrombocytopenia, anemia with Hb < 90 g/l), immunotherapy and/or treatment with corticosteroids, cytostatics within six months prior to inclusion in the study.

*Exclusion criteria*:

— patient refusal to participate in the study;

— lack of possibility of dynamic monitoring and control during the established period (60 months).

Over a five-year period, 13 patients (8.5 %) were excluded from the study: three patients from the treatment group and 10 patients from the comparison group. A total of 140 patients were subjected to the final analysis: 59 patients from the treatment group and 81 patients from the comparison group, including 36 male (25.7 %) and 104 female patients (74.3 %), with an average age of 63.2 ± 7.0 years (range, 48–72 years).

Primary uncemented THR was produced for the patients following examination, confirmation of the diagnosis of hip arthritis and indications for THR with the results being assessed over a five-year period after surgery.

The patients' weight and height were measured during examination and a telephone interview to calculate BMI (kg/m2). The height was assumed to be a constant value, and the patient reported weight based on self-weighing. Pain was assessed using a 10-point visual analogue scale (VAS) [28]. The anteroposterior view and frog-leg lateral radiograph of the hip joint were used to identify radiographic signs of a hip pathology. Osteoarthritis was assessed according to the K&L classification using radiography showing subchondral sclerosis, subchondral cysts, osteophytes of the femur or acetabulum, or narrowing of the joint space [29].

The modified Harris Hip Scale (mHHS) was used to measure outcome after THA. The mHHS has a maximum of 91 points (pain — 44 points, function — 47 points). A telephone interview was used for survey research. The result was multiplied by 1.1 to obtain the maximum possible number of points — 100 [30, 31, 32]. The "Function" section included questions about the distance the patient can walk, his ability to put on shoes and socks, his ability to use public transport, the need to use a cane or crutches, limping, the ability to climb stairs and the ability to sit on a regular chair for an hour [33]., according to a systematic review by N. Ramisetty et al.reported the Harris Hip Scale as the most frequently used measure to explore outcomes of THA [34].

Patients could describe their pain during the clinical examination using the Visual Analog Scale (VAS) with an average score of 2.9 ± 1.1 and the Intermediate Pain Scale (IPS) with an average score of 55.7 ± 10.1. A comparative analysis of the patient examination by groups is presented in Table 1.

Table 1

Comparative analysis between groups of patients

| Description | | Treatment group (*n* = 59) | Comparison group (*n* = 81) | *p** |
|---|---|---|---|---|
| Male | abs. | 12 | 24 | 0.217 |
| | % | 20.3 | 29.6 | |
| Female | abs. | 47 | 57 | |
| | % | 79.7 | 70.4 | |
| Age (years) | | 63.2 ± 7.3 | 63.3 ± 6.8 | 0.941 |
| BMI (kg/m2) | | 44.5 ± 2.7# | 43.9 ± 2.8 | 0.273 |
| VAS (score) | | 3.0 ± 1.1 | 2.8 ± 1.1 | 0.284 |
| IPS (score) | | 55.2 ± 10.7 | 55.2 ± 10.2 | 0.996 |

*Note*: * t-test for equality of means in independent samples; #BMI in the treatment group were borrowed from medical records before BS

According to medical records, the average BMI measured (44.5 ± 2.7) kg/m$^2$ in patients of the treatment group prior to BS and (35.5 ± 2.6) kg/m$^2$ after BO, the weight decreased by 20.2 %.

BS in patients of the treatment group performed (14.2 ± 1.4) months before THA: sleeve gastrectomy — in 44 (74.6 %), interintestinal anastomosis — in 12 (20.3 %), combined surgery — in three (5.1 %) patients. The treatment study group included overweight patients, stages 1 and 2 obesity (Table 2).

Table 2

Distribution of patients in the treament group by stage of obesity and gender after BS

| Stage of obesity | BMI, kg/m$^2$ | Number of patients | | Male | | Female | |
|---|---|---|---|---|---|---|---|
| | | abs. | % | abs. | % | abs. | % |
| Normal | 20–24.9 | – | – | – | – | – | – |
| Overweight | 25–29.9 | 3 | 5.1 | 3 | 25.0 | – | – |
| Stage 1 | 30–34.9 | 16 | 27.1 | 2 | 16.7 | 14 | 29.8 |
| Stage 2 | 35–39.9 | 40 | 67.8 | 7 | 58.3 | 33 | 70.2 |
| Stage 3 | 40 and over | – | – | – | – | – | – |

It should be noted that all patients left the morbid obesity group, but not a single patient achieved a normal BMI. Only three men transitioned to the overweight group, and none of the women achieved this. Thus, the majority of patients transitioned to the obesity groups of stages 1 and 2 (56 patients, 94.9 %). When interviewed, many patients reported that their weight significantly decreased for up to six months after surgery and then began to increase again; however, we were unable to collect accurate, reliable data.

Parameters evaluated postoperatively included pain measured with the Visual Analog Scale (VAS) next day, after three, seven and 14 days; functional outcome measured with IPS at three and 12 months, and then every 12 months up to 60 months; the presence of early postoperative complications in the first three months after surgery. We then determined the Survival rate of THA and the pattern of revision surgeries were evaluated every 12 months up to 60 months.

Statistical analysis was performed using the IBM SPSS Statistics 22 software package. The weighted mean difference (WMD) was used in the obese group to determine BMI, to assess pain (VAS), and to score on the Harris Hip Injury Scale with corresponding 95 % CI (CI). The Mann-Whitney test was used to assess early and late postoperative complications and the Kaplan-Meier method was used for THA survival.

## RESULTS

The preoperative VAS scores were similar in both study groups and showed no statistically significant difference ($p < 0.001$). The score increased sharply next day after the surgery showing no statistically significant difference ($p < 0.001$). The scores had decreased after three days but the difference was statistically significant, $p = 0.003$. Thje pain was arrested after seven and 14 days with no difference between the groups. By the end of the 12-month observation period, the VAS scores were significantly lower at 12 months than before the surgery with no statistical difference in the groups, $p = 0.243$ (Fig. 1).

The mHHS were similar in both groups before surgery, $p = 0.364$. The hip joint function gradually increased postoperatively in a progressive manner with a statistically significant difference at three months $p = 0.021$, at six months $p = 0.003$, and reached the maximum at 12 months with a statistically significant difference in the results $p = 0.021$ (Fig. 2).

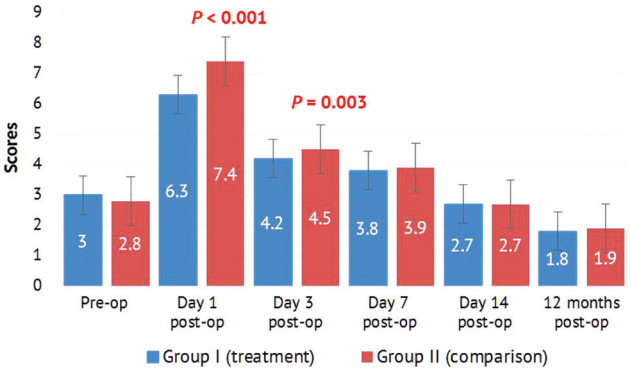


**Fig. 1** Dynamics in pain measured with VAS during the study

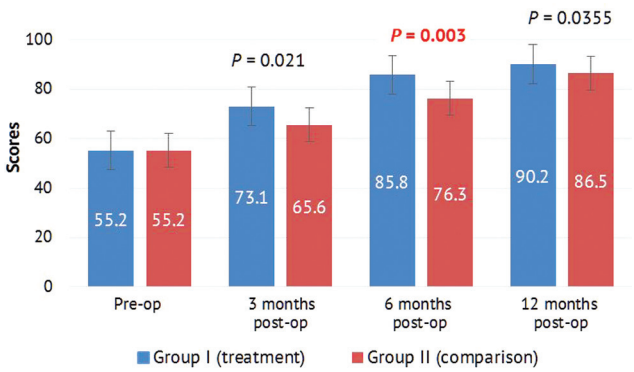


**Fig. 2** Dynamics in function measured with IPS

The five-year survival rate (absence of complications) (60 months) using the Kaplan – Meier method was 94.6 % (5.4 % complications) in the treatment group and 77.2 % (22.8 % complications) in the comparison group. The use of BS in patients with hip arthritis K&L stage 3–4 facilitated a risk of complications reduced by 17.4 % (Log Rank (Mantel-Cox) $p = 0.006$), which is presented in Fig. 3.

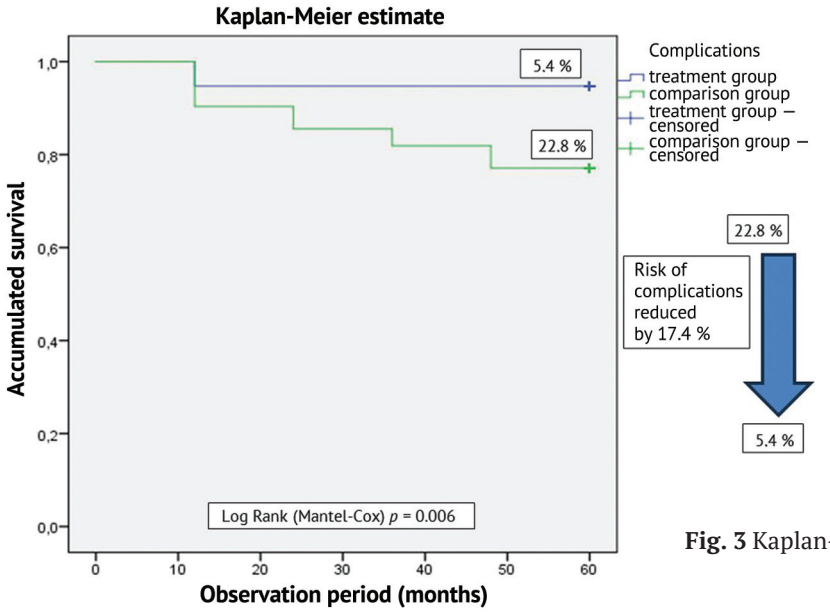


**Fig. 3** Kaplan-Meier estimate

Superficial surgical site infections occurred in 2.4 % of patients in the comparison group and were absent in patients in the treatment group. Deep and periprosthetic joint infections were twice as common in patients in the comparison group: 1.8 % in the treatment group and 3.6 % in the comparison group (Table 3). The four cases of deep infection and one of the two cases of superficial infection in our series required removal of the implant and a two-stage revision surgery within the first two years of the study. Deep vein thrombophlebitis of tibia occurred in one case in the treatment group early post-op (1.8 %), and sciatic nerve neuritis developed in one patient in the comparison group (1.2 %). These complications did not require revision surgery. Periprosthetic fractures (2.4 %), aseptic loosening (4.8 %), and prosthetic component wear (3.6 %) were observed in patients of the comparison group, and occurred in the final two years of follow-up. Early revision surgeries were not associated with surgical site infection.

Dislocation of implants occurred in both groups and were not common for patients with BMI < 40 kg/m$^2$ who underwent BS; the complication was observed in 1.8 % of cases of the treatment group (revision intervention was not required) and in 4.8 % of cases of the comparison group (all underwent one-stage revision surgeries).

Table 3

Types of complications

| Complications | Treatment group ($n$ = 59) | | Comparison group ($n$ = 81) | | $p$-value* |
|---|---|---|---|---|---|
| | abs. | % | abs. | % | |
| Superficial SSI | – | – | 2 | 2.4 | – |
| Deep SSI | 1 | 1.8 | 3 | 3.6 | 0.04 |
| Periprosthetic fractures | – | – | 2 | 2.4 | – |
| Aseptic loosening | – | – | 4 | 4.8 | – |
| Wear of prosthetic components | – | – | 3 | 3.6 | – |
| Thrombophlebitis, pulmonary embolism | 1 | 1.8 | – | – | – |
| Dislocated implant | 1 | 1.8 | 4 | 4.8 | ⩽ 0.01 |
| Neurological disorders | – | – | 1 | 1.2 | – |
| Total | 3 | 5.4 | 19 | 22.8 | < 0.001 |

*Note*: *Mann – Whitney test

## DISCUSSION

Patients with a BMI > 40 kg/m2 have a relative risk for THA that is more than 30 times higher than patients with a BMI < 25 kg/m2 [35]. Surgery related weight loss is the most effective treatment in obese patients, and some authors suggest that it reduces obesity-related comorbidities and prolongs life [36, 37].

There are associations between obesity and the risk of OA of lower-limb joints and between obesity and complications after THA, it is important to understand whether obesity is a modifiable risk factor before THA. The aim of our study was to investigate a positive or a negative effect of BS on THA outcomes. We found that the use of BS in patients with K&L grade 3–4 hip arthritis provides a 17.4 % reduction in the risk of complications including postoperative superficial and deep complications. The most important finding was a reduced number of revision surgeries after BS, which is confirmed by data from other studies [38].

Some authors reported no greater risk of re-operation after BS and subsequent TKA [39, 40, 41], other authors suggested a higher rate of re-operation in patients with BS and TKA compared to TKA patients with low BMI [42, 43, 44], and a reduced risk of re-operation in TKA patients after BS was reported in one study [45].

Studies exploring the effect of BS on the incidence of early postoperative complications after THA yielded mixed results [38, 39, 42, 46]. In-hospital complications may be less common in those who underwent BS before THA than in morbidly obese patients [38]. No difference in early complications was reported in three studies [39, 47, 48] including 233 patients who were stratified by the time interval between BS and THA. Complications being most common in patients who had BS before THA were reported in the largest study assessing the effect of BS on early complications, including 5914 patients. It should be noted that a potential confounding factor was that preexisting comorbidities were also more common in this group [38, 42, 45–47, 49–51].

There is no consensus based on current evidence for the need of BS to be performed before THA, and each study should be critically reviewed. In several comparative studies, imbalances in comorbidity between study groups may have confounded their analyses and biased them against BS cohorts, as it is known that morbidly obese patients who underwent BS tend to have a higher baseline comorbidity rate than morbidly obese patients who did not undergo BS [52, 53].

Given that obese patients represent an increasing proportion of patients undergoing THA, risk optimization in this more medically complex patient population is essential. Obese patients are

more likely to experience complications, including superficial and deep infection, acute kidney injury, cardiac arrest, and re-operation after THA [16, 54]. Obesity also increases the medical costs associated with THA [55].

BS is evaluated as a potential way to reduce the risk of surgery in morbidly obese patients, but given the risks of a second elective surgery, it is crucial that orthopedists provide recommendations to the patients based on an understanding of the current literature. No studies have assessed whether weight loss after BS eliminates the need for THA. Increased mobility and exercise after BS may increase the number of patients requiring subsequent THA [56]. This issue remains controversial, as some researchers suggest that reduced patient complaints are associated with weight loss after BS [57].

Further studies are needed to assess the proportion of patients requiring THA after BS, and it would be useful to compare BS with conservative management of obesity before hip surgery to determine how outcomes differ [47]. Finally, sleeve gastrectomy is becoming increasingly popular and is superior to laparoscopic Roux-en-Y gastric bypass [58]. There is a controversy regarding the impact of BS on early, short-term, and long-term postoperative complications after THA. The impact of different types of BS on THA outcomes remains to be elucidated. Ideally, prospective studies with a higher level of evidence are needed to draw definitive conclusions regarding the impact of biologic therapy on THR outcomes. Our study demonstrated that very few patients lose weight before joint replacement surgery. This highlights the need for targeted non-surgical weight loss interventions for patients awaiting joint replacement.

## CONCLUSION

The use of bariatric surgery in patients with morbid obesity and grade 3–4 hip arthritis before THA allows for a statistically significant reduction in the risk of postoperative complications by 17.4 % and an increase in the five-year survival rate of THA to 94.6 %.

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***Informed Consent*** *Informed consent was obtained from all patients for being included in the study.*

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