

Prospective Study

Effect of body mass index on functional outcomes following arthroplasty procedures

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Abstract

AIM: To evaluate the body mass index (BMI) change in arthroplasty patients and its impact on the patients' functional results.

METHODS: Between October 2010 and May 2013, 606 patients who were operated due to gonarthrosis, coxarthrosis, aseptic loosening of the total knee and hip prosthesis were evaluated prospectively. Patients were operated by three surgeons in three medical centers. Patients who were between 30-90 years of age and who were underwent total knee arthroplasty, total hip arthroplasty, revision knee arthroplasty, or revision hip arthroplasty were included in the study. We excluded the patients who cannot tolerate our standard postoperative rehabilitation program. Additionally, patients who had systemic inflammatory diseases, diabetes mellitus, or endocrinopathies were excluded from the study. The remaining 513 patients comprised our study group. Preoperative functional joint scores, height, weight

and BMI of all patients were recorded. We used the Knee Society Score (KSS) for knee and Harris Hip Score (HHS) for hip patients. Postoperative functional scores were measured at 1st, 6th and 12th months and recorded separately at outpatient visits.

RESULTS: The mean age of the patients was 64.7 (range: 30-90) years (207 males/306 females) and the mean follow-up duration was 14.3 (range: 12-26) mo. We found that arthroplasty patients had weight gain and had an increase in BMI at the postoperative 1st, 6th and 12th months. The mean BMI of the patients was 27.7 preoperatively, 27.8 at the postoperative 1st month, 28.1 at the 6th month and 28.6 at the 12th month ($P < 0.01$). At the last visit, the mean postoperative HHS of the hip arthroplasty patients was 82.2 ± 7.12 (preoperatively, 52.3; 1st month, 78.2; 6th month, 81.1; 12th month, 82.2), and the mean KSS of the knee arthroplasty patients was 79.3 ± 4.31 (preoperatively, 35.8; 1st month, 75.2; 6th month, 79.1; 12th month, 79.3). Worse functional results were noted in the patients who had a BMI increase, however, this correlation was statistically significant only at the postoperative 6th month ($P = 0.03$).

CONCLUSION: To prevent the negative functional effects of this weight gain during the postoperative period, arthroplasty patients should be advised for weight control and risky patients should consult with a dietician.

Key words: Body mass index; Arthroplasty; Obesity; Functional outcomes; Weight gain

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Core tip: Although the patients should be expected to mobilize more easily and loose weight after arthroplasty procedures, we hypothesized that the body mass index (BMI) usually increases in the postoperative period of total joint arthroplasty of the lower extremity. We aimed to evaluate the BMI changes in arthroplasty patients and impact of BMI changes on functional results in total knee arthroplasty and total hip arthroplasty patients. In our study, we determined that lower extremity arthroplasty patients gained weight during the postoperative period and this weight gain deteriorated functional outcomes of the patients. This correlation was statistically significant at the 6th month postoperatively ($P = 0.03$).

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INTRODUCTION

In the twenty-first century osteoarthritis (OA) is the

most common joint disorder in the adult population^[1,2]. This degenerative disease mostly affects weight-bearing joints and the number of cases of symptomatic OA is likely to increase worldwide due to the aging of the population and the epidemic of obesity^[2]. As a result of restricting functional status due to pain in OA, patients are vulnerable to gain weight. Therefore, most of arthroplasty candidates are overweight^[2,3].

In the treatment of OA, the prevalence of arthroplasty procedures has been increasing^[3]. Obesity is associated with increased risks of short- and long-term complications and higher costs in arthroplasty procedures^[4,5]. In addition, decreased functional results are associated with obesity in arthroplasty procedures^[4-7]. In consequence, orthopedic surgeons usually advised patients to loose weight preoperatively and postoperatively in order to maintain better functional results and low complication rates^[7-9].

We hypothesized that the body mass index (BMI) usually increases in the postoperative period of total joint arthroplasty in the lower extremity. These postoperatively increased values of BMI may affect the morbidity and functional results of the patients. We aimed to evaluate the BMI changes in arthroplasty patients and impact of BMI changes on functional results in total knee arthroplasty (TKA) and total hip arthroplasty (THA) patients.

MATERIALS AND METHODS

Between October 2010 and May 2013, 606 patients who were operated due to gonarthrosis, coxarthrosis, aseptic loosening of the total knee and hip arthroplasties were evaluated prospectively. These patients were operated by three surgeons in three medical centers. Patients who were between 30-90 years of age and who were underwent TKA, THA, revision knee arthroplasty, or revision hip arthroplasty were included in our study. We excluded the patients who cannot tolerate our standard postoperative rehabilitation program. Additionally, patients who had systemic inflammatory diseases, diabetes mellitus, endocrinopathies, concomitant spinal diseases, and concomitant lower extremity deformities were excluded. Nineteen patients who refused to attend the study, 14 patients who required revision surgery, and 60 patients who discontinued the rehabilitation program due to early postoperative complications (periprosthetic fracture in 11 patients, deep venous thrombosis in 20, pulmonary emboli in 3, dislocation of prostheses in 5, early prosthetic infection in 9, and lost to follow-up in 12) were excluded. The remaining 513 patients comprised our study group.

Two hundred and thirty-five cases of primary hip prosthesis, 252 cases of primary knee prosthesis, 15 cases of hip revision prosthesis and 11 cases of knee revision prosthesis comprised the study group. Hip arthroplasty surgeries were performed *via* direct lateral approach (Hardinge) with cementless hip prostheses. In primary cases, a double wedge metaphyseal filling

1/3 proximal porous coated femoral stem was used (Synergy, Smith and Nephew) and in revision cases a cylindrical fully coated femoral stem (Echelon, Smith and Nephew) was used. A cementless porous coated acetabular shell was used for acetabular fixation (Reflection interfit, Smith and Nephew) and ultrahigh molecular weight polyethylene in combination with cobalt-chrome or ceramic head was used for bearing surfaces. Knee arthroplasties were performed *via* anterior midline skin incision and medial parapatellar incision with fixed bearing cemented posterior cruciate ligament retaining knee prosthesis in primary cases. In revision cases, fixed bearing PCL substituting knee prosthesis was used (Genesis II, Smith and Nephew).

A standard knee and hip physical therapy protocol was applied by three physiotherapists to all patients. According to this protocol all arthroplasty patients performed isometric quadriceps and range of motion exercises after the first day of operation. The day after surgery all patients were mobilized with full weight bearing *via* two crutches. All patients were allowed to walk without crutches after 6 wk. We did not give any rehabilitation program 6 wk after the operation. Patients had control visits at the 1st month, 6th month, and 12th month postoperatively. Their functional status was evaluated with Harris Hip Score (HHS) for hip and Knee Society Score (KSS) for knee arthroplasties by three physiotherapists' recordings. BMI values of the subjects were recorded at the operative day, postoperative 1st month, 6th month, and 12th month.

Detailed information on surgical interventions was provided to all patients. An informed consent form concerning the operative technique to be performed was signed by all patients. The patients were enlightened about the rehabilitation program to be instituted. We did not recommend any dietary modification to any patient.

Statistical analysis

Statistical Package Social Sciences for Windows 12.0 was used for statistical analyses. In quantitative comparisons, data were assessed by Student's *t*-test and paired samples *t*-test. In qualitative comparisons, data were assessed by χ^2 and Fisher exact χ^2 tests. Preoperative and postoperative BMI of the patients were analyzed by repeated measures analysis of variance (ANOVA). Benferroni test and Pearson correlation were used to analyze the change in BMI and related functional outcomes. Statistical significance was accepted as $P < 0.05$.

RESULTS

The mean age of the patients was 64.7 years (range: 30-90 years; 207 males/306 females) and the mean follow-up duration was 14.3 (range: 12-26) mo. At the last control, the mean postoperative HHS of the hip arthroplasty patients was 82.2 ± 7.12 , and the mean KSS of the knee arthroplasty patients was 79.3 ± 4.31 .

According to the results of our study, we observed

that our patients had gained weight throughout the postoperative period due to decreased mobilization. The mean BMI of the patients was 27.7 preoperatively, 27.8 at the postoperative 1st month, 28.1 at the 6th month and 28.6 at the 12th month. Preoperative and postoperative BMI values of the patients were analyzed by repeated measures ANOVA. According to this analysis, the mean BMI change was statistically significant ($P < 0.001$).

The mean HSS of the hip arthroplasty patients was 52.3 preoperatively, 78.2 at the postoperative 1st month, 81.1 at the 6th month, and 82.2 at the 12th month. The mean KSS of the knee arthroplasty patients was 35.8 preoperatively, 75.2 at the 1st month, 79.1 at the 6th month, and 79.3 at the 12th month. There were statistically better postoperative results in comparison to the preoperative values ($P = 0.0002$). In the correlation analysis of functional parameters with postoperative BMI values, there was no correlation between BMI increase and bad functional outcomes ($P > 0.05$). However, in the correlation analysis of functional outcomes and BMI increase at the 6th month postoperatively, there was a correlation between BMI increase and bad functional outcomes ($P = 0.03$).

The patients were analyzed separately by Bonferroni test and this also revealed the statistically significant BMI change between preoperative values and values at the 1st, 6th and 12th months ($P < 0.001$). Also a subgroup analysis was done; one group was the patients who had a BMI increase and the other was the patients who had no BMI increase. In the functional assessment and comparison of these two subgroups, there was no statistical difference ($P = 0.152$).

DISCUSSION

OA mostly affects weight bearing joints and the number of cases of symptomatic OA is likely to increase worldwide due to the aging of the population and the epidemic of obesity^[2,3]. Arthroplasty is the final option for these patients with high satisfaction. However, obesity (BMI > 30 kg/m²) related bad functional outcomes had been reported by many authors^[2,5,8]. We evaluated the change in BMI of patients after arthroplasty operations and its correlation with functional outcomes.

BMI is a frequently used tool for measurement of obesity in epidemiological studies^[2]. According to the World Health Organization, the optimal BMI for good health is 20-25 kg/m²^[2].

The effect of obesity on the clinical and functional status of the arthroplasty patients is controversial^[6,10-13]. Ibrahim *et al*^[11] made a comparative study on hip arthroplasty patients and reported that in the short term a BMI > 30 plays no role in an increase in complications or re-operation. In another study, 78 THA patients were evaluated for BMI and functional outcome at 2 years. The authors concluded that the majority of patients undergoing primary THA had an increase in

their BMI. Also, they reported that pre-operative BMI or BMI change postoperatively is not a predictor of complications or mid-term outcome of THA^[12]. However, in a cohort study that evaluated 5357 hip arthroplasties, the authors reported that with a minimum 1-year follow-up the outcome and early revision were statistically and clinically poorer for obese patients^[6]. Similarly, Kremers *et al.*^[13] found that obesity was associated with high treatment costs and long hospital stay in a large cohort of patients who underwent TKA. Their cohort study was performed with 8129 patients in 2000-2008 years and at the end of the study the effect of obesity on costs was independent of obesity-related complications^[13]. In our study, we did not find any difference in the functional evaluation of the patients who had a BMI increase and those who had no BMI increase at the last follow-up ($P > 0.05$). However, there was a correlation between bad functional outcomes and BMI increase at the 6th month ($P = 0.03$).

In a study with 78 women who underwent elective primary TKA, it was found that obesity had a negative impact on functional recovery and mobility^[10]. In that study, all the patients were overweight. However, in our study we evaluated BMI changes and our main finding was the weight gain of the patients independent from other factors like comorbidities. Although we detected a significant increase in BMI in patients, there was no correlation between BMI changes and functional outcomes.

In the literature there are few studies noticing that arthroplasty patients have weight gain independent from other factors^[14,15]. In a study the authors noticed that obese patients could not achieve weight loss after THA operation although their mobilization problems had resolved^[14]. Zeni *et al.*^[15] reported that 66% of their TKA patients had weight gain at the end of the two-year follow-up. We also determined that our patients also gained weight independent from other comorbidities and confirmed this BMI increment in THA patients with functional assessment.

Although dissenting opinions have been proposed by some authors^[11], there were many studies that reported higher complication rates and bad functional outcomes^[4,8,9,14]. In one of the largest studies that examined the relationship between obesity and complications after TKA and hip arthroplasty, 35817 THR patients and 32485 TKR patients were included in the study and postoperative complications during the 6 mo following total hip and knee replacement surgery were recorded. The study revealed that obesity increased the risk of wound infection and DVT^[16]. In our study, we did not see any difference in complications due to BMI increase.

According to the results of our study, we observed that our patients had gained weight throughout the postoperative period. This may be due to decreased mobilization and change in eating habits. Although we treated these patients for their functional recovery, postoperative weight gain can result in bad functional

outcomes, higher rates of postoperative complications, and higher risk of hypertension, diabetes mellitus and cardiovascular diseases.

Main limitation of our study is the absence of a control group with a given dietary program. Additionally, physiotherapy effect has not been evaluated. Besides immobilization, other factors (genetic, nutritional type, and other diseases) that could cause patients to gain weight were not considered. The sample size was limited to 513 patients including 207 men and 306 women. It is possible to reach statistical results closer to reality by increasing the sample size. Multivariate analyses were also examined with consideration of age, sex and genetic factors. Follow-up time shows differences within the population and the mean follow-up period was 14.3 mo (range: 12-26). The main strength of our study is the absence of any data investigating the functional outcomes regarding the BMI changes in the literature. References were limited to compare the results of our research due to the scarcity of research which compared preoperative and postoperative BMI in patients undergoing total knee and hip arthroplasty. In contrast, there were pretty many sources investigating the effect of BMI on the results of TKA and THA.

In conclusion, by taking into consideration of the statistical analysis of data related to our study, it is possible to mention that our patients had an increase in their body weight. However, this BMI increase does not affect the functional outcomes of the patients. This BMI increase may be due to decreased mobilization and change in their eating habits. To prevent the negative functional effects of this weight gain during postoperative period, arthroplasty patients should be advised for weight control and risky patients should consult with a dietician.

COMMENTS

Background

The main objective of this study was to assess the body mass index (BMI) change in arthroplasty patients independent from the other factors like comorbidities and effect of BMI change on the functional outcomes.

Research frontiers

In addition to the effects on musculoskeletal system, especially on weight bearing joints like knee and hip, BMI or obesity effects general health of the patients like cardiovascular diseases. Most of the arthroplasty candidates are overweight people due to decreased mobilization and problems in their daily living activities. There are some studies that analyzed the effect of high BMI or obesity on the functional recovery of the arthroplasty patients and related complications. However, there is no study that evaluated the patients prospectively for BMI change independent from other factors.

Innovations and breakthroughs

Nowadays, most of the patients need and request faster recovery from the surgery. Due to this, in the orthopedic literature there are many studies that analyzed the functional outcomes and the effect of other factors on these outcomes like obesity and postoperative rehabilitation, especially for arthroplasty procedures. In order to get better functional results, the surgeons should take care of other factors apart from surgical procedure like daily

activities or eating habits after surgery.

Applications

BMI increase may cause other problems for patients and if most of the arthroplasty patients gain weight after these surgical procedures, patients should be warned for this problem or may consult with a dietician.

Peer-review

This paper aimed to study the effect of BMI on functional outcomes following arthroplasty procedures.

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