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ORIGINAL STUDY

Does the level of obesity affect the mid-term outcomes of fix bearing medial unicompartmental knee arthroplasty ?

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The aim of this study was to investigate the effect of obesity level on the clinical outcomes and implant revision rates in obese patients who underwent unicompartmental knee replacement with fix insert for the treatment of knee medial compartment osteoarthritis.

Between September 2012 and October 2015, 62 patients with preoperative body mass index over 30 were included in the current study. These patients were divided into three groups based on their body mass index level. Preoperative and postoperative knee joint range of motion, Oxford knee scores, visual analoque scale scores and prosthetic complication rates were cumulatively evaluated and the groups were compared in terms of the above clinical outcomes.

The mean follow-up was 64.2 ± 12.5 months. In the group 1 the mean preoperative Oxford score, visual anloque scale score and range of motion of the knee joint were 25.7/7.2/116.7 °, respectively while they were 41.4/2/139˚ at the last follow-up. In the group 2, these preoperative values were 25/8.1/114,9° while their postoperative values were 38.1/1.2/139°. In the group 3, the preoperative values were 26/8.1/114,9° while they were 35.1/1.2/139,8° postoperatively. There were no statistically significant differences among the groups in terms of clinical scores and the range of knee joint motion.

In obese patients diagnosed with medial compartment osteoarthritis of the knee, unicompartmental knee replacement treatment with fix insert is a successful midterm surgical procedure. The success of this treatment does not depend on the degree of obesity.

Keywords : unicompartmental knee replacement ; obesity level ; clinical outcomes.

INTRODUCTION

Unicompartmental knee arthroplasty [UKA] is the most commonly used surgical method in the treatment of knee osteoarthritis at the medial compartment when compared to other surgical methods (total knee arthroplasty [TKA], high tibial osteotomy) *(1)*. UKA has several advantages compared to TKA such as less bone resection, early functional recovery *(2)*, and less risk of complications *(3)*. Furthermore, it is a critical advantage that it does not alter the normal knee biomechanics with its intact design which protects the anterior, posterior cruciate

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ligaments and leaves the intact lateral meniscus, patellofemoral joint and lateral compartment *(4,5)*. Beside all these advantages, high rate of early aseptic-induced revision compared to TKA *(6)* is an important disadvantage of this surgery. Therefore, a careful patient selection has been recommended in order to reduce the revision rates. According to Kozinn and Scot, ideal patients for UKA must have the following traits : being over 60 years of age with limited physical activity, having reduced pain at rest, having a knee flexion of more than 90°, having a flexion contracture of less than 5°, having limited angular deformity, having intact anterior cruciate ligament, having no signs of osteoarthritis at lateral compartment and patellofemoral joint and being less than 82 kg *(7)*.

Since obesity has been reported as an important factor in the development of osteoarthritis and there is a tendency to increase the prevalence of high body mass index [BMI] and related osteoarthritis in young patients *(8,9)*, accessing to the ideal patient described by Kozinn and Scott in 1989 has become very difficult. Several studies reported that the risk of revision of UKA surgery in obese patients is high *(10)*. More importantly, the high risk of complications and revision in obese patients causes limited options in the treatment of these patients. On the other hand, there have been also several studies suggesting that the clinical outcomes of UKA surgery in obese patients with osteoarthritis are similar to those with normal body mass index *(11,12)*. To the best of our knowledge, there is no study available in the literature about whether UKA clinical outcomes might be affected by the degree of obesity in patients with osteoarthritis.

Accordingly, we aimed to investigate the effect of obesity level on revision rate and mid-term clinical outcomes of fixed bearing UKA surgery in obese patients with osteoarthritis.

PATIENTS and METHODS

The study was approved by the SANKO University Ethics Committee for Clinical Research Trials (2019/07 ; 01.11.07.2019) and was conducted in accordance with the principles in the Declaration of Helsinki.

Figure 1. — Preoperative anteroposterior knee X-ray in standing position.

Figure 2. — Preopertive lateral knee X-ray.

Between September 2012 and October 2015, patients with the diagnosis of medial compartment osteoarthritis who underwent fix bearing UKA were initially included in the current study. Patients who underwent lateral UKA, TKA and medial UKA with mobile insert were excluded from the study. All surgeries were performed by our two surgeons experienced in knee surgery. A cemented medial UKA implant (Zimmer® Unicompartmental High Flex Knee) with fix insert was used in all patients. Preoperative demographic data and BMI values were obtained from the files of hospital archive.

UKA was applied for the patients with medial joint pain, with radiographic medial compartment osteoarthritis, with intact patella-femoral and lateral compartment, and with flexible varus deformity in the medial compartment at least 5 mm (Figure 1,2).

Anterior cruciate ligament control was done with physical examination and anterior cruciate ligaments were intact in all patients. No imaging method was performed. UKA was performed for the patients with varus less than 15º, valgus deformity less than 10º, flexion contracture less than 5º and flexion movement greater than 90 degrees. BMI and patient age were not considered as contraindication criteria.

Patients with BMI> 30 were included in this study. These patients were divided into 3 groups based on their BMI values. Group 1 included BMI values between 30 and 34.99 while group 2 included BMI between 35 and 39.99. Lastly, group 3 included BMI values 40 and above. Pre- and postoperative clinical evaluations were performed through the Oxford Knee Score and Visual Analoque Scale [VAS] pain scales. We compared the preoperative and postoperative knee joint ranges of motion of all patients. Postoperative complications such as infection, thrombo-embolism, postoperative limitation of movement, fracture, etc. were obtained from the archive files. Patients who underwent a revision surgery for any reason were noted. The indication for revision due to an aseptic loosening was confirmed by X-ray and scintigraphy.

In all surgeries, following anesthesia and tourniquet application, a mini incision was done with starting from the proximal medial knee patella and descending 2 cm inferior to the joint distance adjacent to the patellar tendon. The patella was not luxated. After crossing the layers appropriately, the anterior cruciate ligament, lateral joint compartment and patellofemoral joint were checked. In the medial

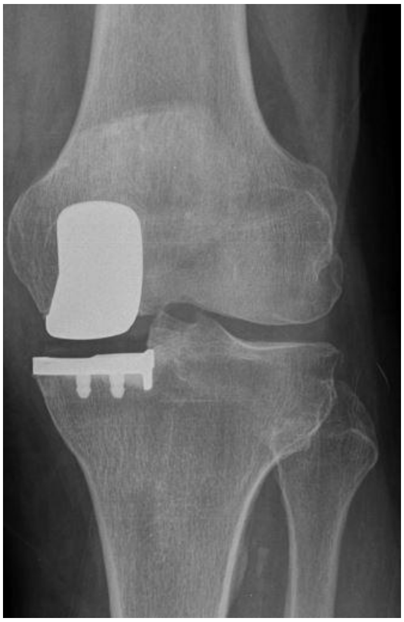

Figure 3. — Postoperative anteroposterior knee X-ray in standing position.

Figure 4. — Postoperative lateral knee X-ray.

femoral condyle, osteophytes adjacent to the medial collateral ligament were removed and the medial meniscus was excised. Tibial and femoral bone cuts were made according to the manufacturer's guide while equality of flexion and extension gap was controlled. After the places of components were prepared, the appropriate femoral and tibial components were placed with cement (Figure 3,4). The measured insert was inserted and osteophytes around the patella were removed if any. After washing and cleaning process, the final control was performed with flexion and extension movements. Finally, a hemovac drain was placed and surgical wound was closed. The patients' wound was dressed at 3-day intervals after the surgery. After 2 weeks, the sutures were removed and the patients were followed-up at 6 weeks, 3 months, 6 months later, and once a year. Preoperative and annual follow-up BMI values, Oxford clinical score, VAS pain assessment and degree of joint motion clearance were recorded. Final BMI, Oxford, VAS values and the degree of motion clearance of the joints were taken into consideration.

Radiological examinations of the patients were performed pre and postoperatively with knee lateral, patella tangential and knee loading at standing position while knee anteroposterior radiographs were obtained. The evaluation of the radiolucent area, if any, was performed using the method described previously by Gulatin *(13)*.

All statistical analyses were conducted using IBM SPSS Statistics 23 package program. Mean and standard deviation or frequency and percentage values were reported as descriptive statistics. The continuous data for normal distribution was validated by the Shapiro-Wilk test while one way ANOVA was used for the group comparison. Chi-square test was used for the group comparisons of qualitative data. For all analyzes, $p < 0.05$ was considered as a statistically significant level.

RESULTS

Between September 2012 and October 2015, a total number of 758 knee arthroplasties were performed in our clinic. Among these surgeries, 580 of them were TKA. Between these dates, 218 knees of 178 patients underwent UKA surgery. Ninety knees of 72 patients with BMI 30 and above were included in the current study. Ten patients were excluded from the study because of death (2 patients) and because of not reaching to 8 patients. A total number of 80 knees from 62 patients were evaluated in the study. The mean age of the patients was 59.6 (54-64) years old. There were 48 female and 14 male patients. The mean follow-up was 64.2 ±12.5 months.

BMI of twenty-six patients was in the range of 30-34.99 while 24 were in the range of 35-39.99, and 12 were above 40. The mean age was 61.43 (58-64) years old in Group 1 while it was 60.4 (57-63) years old in Group 2 and 57.2 (54-59) years old in Group 3. There was no statistically significant difference among the two groups in terms of age.

In group 1, female-to-male ratio was 20/6 while it was 19/5 and 9/3 in group 2 and 3, respectively. There was no statistically significant difference among the groups in terms of gender (**Table** 1). 18 patients underwent surgery on both knees in one consecutive session. Of these 18 cases, 9 were in the first group, 2 were in the second group and 1 was in the third group.

When evaluating all cases together, the mean preoperative Oxford score was 25.5 (22-27) while it was 38.2 (29-43) in the last follow-up. The mean VAS score was 7.8 (6-9) preoperatively and 1.4 (0-4) in the last follow-up. The mean preoperative knee range of motion was 114.5 (103-120) and it was 139.4 (136-142) postoperatively. Preoperative mean Oxford score was 25.7 (24-26) in Group 1, 25 (22-27) in Group 2, and 26 (24-27) in Group 3, while it was 41.4 (39-43), 38.1(33-42), 35.1 (29-40) at the last follow-up, respectively. The preoperative values of range of motion of the knee joint were 116.7 (113-120) in the Group 1, 112 (103-120) in

Table 1. — Comparison of age, sex, Oxford clinical score, VAS pain score and range of motion between groups

Groups	BMI	Age (years)	Gender K/E	Preoperatif Oxford	Postoperatif Oxford	Preoperatif VAS	Postoperatif VAS	Preoperatif ROM	Postoperatif ROM
Group1 n=26	30-34,9	61,43(58-64)	20/6	25,7(24-26)	41,4(39-43)	7,2(6-8)	2(0-4)	116,7(113-120)	139,6(137-141)
Group2 n=24	35-39,9	60,4(57-63)	19/5	25(22-27)	38,1(33-42)	8,1(7-9)	1,2(0-4)	112(103-120)	139(136-141)
Group3 n=12	40≤	57,2(54-59)	9/3	26(24-27)	35,1(29-40)	8,1(7-9)	1,2(0-4)	114,9(112-117)	139,8(136-142)

the Group 2, and 114.9 (112-117) in the Group 3 while the postoperative values were 139.6 (137-141), 139 (136-141), 139.8 (136-142), respectively (Table 1). No statistically significant difference was found between the groups in terms of Oxford clinical scores. The Oxford clinical score was significantly increased in three groups. In group 3, clinical improvement was less than the other groups. This change was not statistically significant. The statistically insignificant result may be related to the small number of patients. Preoperative mean VAS score was 7.2 (6-8) in Group 1, 8.1 (7-9) in Group 2, and 8.1 (7-9) in Group 3 while the postoperative values were 2 (0-4), 1.2 (0-4), 1.2 (0-4), respectively (Table 1). There was no statistical difference among the groups in terms of VAS scores.

Based on the anterior posterior radiographs of the knees in the standing posterior position at the last follow-up, in the group 1, preoperative mean tibiofemoral angle was 3° varus (10° varus to 5° valgus) while it was 3° valgus at last control. In the group 2, the mean tibiofemoral angle was 3° varus (7° varus to 4° valgus) preoperatively while its postoperative value was 2° valgus. In the group 3, the preoperative mean tibiofemoral angle was 5° varus (10 ° varus to 3° valgus) while it was 2° valgus at the last follow-up. There was no statistical difference among the groups. Radiolucent area in tibial component was detected in 4 cases where two of them were in the Group 2 and the other two were in the Group 3.

We observed that two patients underwent the revision surgery with primary knee prosthesis due to early aseptic tibial loosening. One of these cases was in the Group 1 and the other was in the Group 2. Complications of tibial loosening in Group 1 were observed at the postoperative 5th month and in the Group 2 at 49 months. Except these two cases, infection and loosening complications were not observed in any case.

DISCUSSION

The increased number of obesity is a critical problem in the world. The data of the World Health Organization (WHO) in 2014 reported that obesity has become epidemic with 1.9 billion people and at least 600 million of them are clinical obesity *(14)*. Furthermore, obesity is considered as one of the etiological factors of gonarthrosis *(15)*. Therefore, the incidence of gonarthrosis would most likely increase at a relatively young age because obesity has become epidemic. On the other hand, an increased incidence of gonarthrosis means that gonarthrosis surgical treatment, most specifically UKA surgery, would be performed more frequently in the near future. In this perspective, the investigation of UKA survival and clinical scores in patients with obesity may shed light on orthopedic surgeons in making decisions about the treatment of these patients. In our study, based on the degree of obesity level, we grouped the patients with BMI above 30 among the patients who underwent fix bearing medial UKA surgery due to medial compartment osteoarthritis in our clinic. We evaluated the results of all these patients with a mean follow-up of 64.2 months and compared these groups. The main findings of this current study as follows : 1) in the obese patients with medial compartment osteoarthritis, fix bearing UKA surgery has a successful clinical outcome in the mid-term with low early revision rates. 2) The obesity level of the patients does not affect the clinical outcomes and the revision rates.

While both mobile or fix inserts can be used in UKA implants, it has not still been known which type of UKA implant is more successful in obese patients with osteoarthritis. In 2019, Kuyucu et al. *(16)* conducted a study investigating the clinical difference and implant survival between mobile or fix bearing UKA at least 18 months of follow-up period on 57 patients over 30 BMIs. They reported that clinical scores and range of motion of the knee joint did not change with insert type *(16)*. However, they stated that fix bearing UKA surgical technique may be a more appropriate implant for the patients with obesity because its learning curve is easier and also because of possible dislocation of the mobile insert fixation *(16)*. Similarly, we preferred fix bearing UKA surgery in obese patients, and evaluated 62 patients with BMI above 30 who underwent UKA with fix insert.

UKA has significant advantages over the high tibial osteotomy and total knee replacement surgery in the patients with isolated single compartment osteoarthritis *(17)*. However, the high revision rates because of aseptic causes have been also reported over time *(18)*. Therefore, a careful patient selection and avoidance of this surgery, especially in obese patients, have been generally suggested *(18)*. The existence of conflicting results in the literature, regarding the application of UKA in obese patients causes orthopedic surgeons to doubt the application of UKA surgery in the patients with obesity. For example, Berend et al. *(19)* reported a revision rate of 22% on average 40.2 (24-49) months in their study on 79 obese patients who underwent UKA surgery with two different implants, and concluded that implant survival was shorter in patients with BMI above 32 *(19)*. In another study published in 2011, Peter et al. *(20)* compared the mean follow-up of 3 years in two groups of patients with BMI above 35 (34 patients, 40 knees) and below 35 (35 patients, 40 knees). This study showed that 5 (12%) of the patients with BMI above 35 were required revision and no revision was seen in the other group. In the clinical evaluation of the patients based on the Knee Society Scores (KSS), they observed worse clinical results in the group with BMI above 35 (20). In 2019, Xu et al. (21) compared the 10-year clinical outcomes and revision rates of obese (BMI> 30, n = 42) and non-obese (n = 142) subjects. In the study comparing Oxford, KSS and range of motion in the 10-year period, they found that both groups had improved clinical results, but the clinical scores and range of motion was lower in the obese group. At the end of 10 years, they observed 98% implant survival in the non-obese group and 88.1% in the obese group. Thus, they concluded that the rate of revision is higher in obese patients and that obesity is the factor for the failure of UKA surgery *(21)*.

Unlike the results of the studies suggesting a negative association between obesity and UKA out-comes, there have been also other studies suggesting that obesity has no negative effect on UKA results. For example, Xing et al. *(22)* reported that UKA results were not affected by obesity based on their study on 178 cases. Similarly, Plate et al. *(23)* reported the mean 34.6 month results of robotic-assisted UKA applications in 746 obese patients with medial compartment osteoarthritis with a mean BMI of 32.1 and found that the Oxford knee score was 37 on average at the last follow-up, revision rates were 5.8% *(23)*. More importantly, they stated that obesity did not affect clinical results and revision rates, and UKA surgery is contraindicated in cases with BMI above 30 is not valid with the use of modern implants *(23)*. Moreover, Çepni et al. *(11)* followed-up 67 patients with BMI over 30 who underwent mobile bearing UKA for an average of 67.5 months in 2014. In this study, they showed that the preoperative Oxford clinical score was 18.5 ± 4.7 and it changed to 40.0 ± 5.0 in the postoperative follow-up *(11)*. They observed no complication other than insert dislocation seen in 3 patients *(11)*. In a retrospective multicenter study on 4964 patients, Affatato et al. *(24)* divided the patients into 3 groups (30 <, 30-40, and 40 <) according to their BMI values and compared them in terms of implant survival. They reported no significant difference between the groups in terms of implant survival *(24)*. In another study, Molloy et al. *(25)* divided 1000 patients who underwent mobile bearing UKA into 4 groups according to BMI values (25>, 25-30, 30-35, and 35<), and compared the implant survival. They reported no statistical difference between the groups in terms of implant survival at 10-year follow-up *(25)*. They also reported that the highest clinical Oxford score was in the 35+ kg / m^2 group *(25)*.

In this current study, we evaluated the mid-term clinical outcomes and revision rates of obese patients who underwent UKA surgery. Our results showed that mean Oxford knee scores were 25.7 in Group 1, 25 in Group 2 and 26 in Group 3, but they increased to 41.4, 38.1, and 35.1, respectively at the last follow-up. We also observed limited revision due to tibial relaxation in only 2 cases (2.5%, one was in the first group and the other was in the second group). Taking all into consideration, we concluded that the clinical scores and the need for revision were not associated with the degree of obesity.

This study has also limitations. The lack of a retrospective single-center study, performing the surgeries by only two surgeons and a mid-term follow-up time are among the limitations of this study. Therefore, the findings of the study need to be validated by future multi-center studies involving high number of patients.

CONCLUSION

Obesity level does not affect the clinical outcome and revision rates of mid-term fix bearing UKA surgery. Therefore, fix bearing UKA could be a viable option in the surgical treatment of obese patients with medial compartment osteoarthritis.

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