Müracaat Tarihi / Application Date: 07.02.2018
Kabul Tarihi / Acceptance Date: 12.02.2018

ÖZGÜN ARAŞTIRMA/ORIGINAL RESEARCH

The Impact Of Body Mass Index On The Clinical Outcomes Of Unicondylar Knee Arthroplasty

Vücut Kitle İndeksinin Unikondiler Diz Artroplastisinin Klinik Sonuçlarına Etkisi

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Öz

Amaç: Bu çalışmanın amacı, sabit ekleme sistemi ile unikondiler diz artroplastisi yapılan hastaların vücut kütle indeksinin postoperatif fonksiyonel diz verilerine olan etkilerini araştırmaktır.

Gereç ve yöntemler: Vücut kitle indeksi, Dünya Sağlık Örgütü tarafından önerilen yöntemle hesaplandı. Hastalar beden kitle indeksi, vücut kitle indeksi 30 kg / m2'nin altına ve üstüne çıkanlara göre iki gruba ayrıldı. Preoperatif ve postoperatif eklem hareket açıklığı, Görme Analog Skalası, Diz Cemiyeti Skoru, Oxford Diz Skoru, Western Ontario ve McMaster Üniversitesi osteoartrit indeksi skoru, hastaların memnuniyetlerini ve dizlerinin fonksiyonel durumlarını saptamak için kullanıldı.

Bulgular: Vücut kitle indeksi 30 kg / m2'nin altında 44 hasta (Grup 1) ve vücut kütle indeksi 30 kg / m2'nin üzerinde 38 hasta (Grup 2) vardı. Grupların demografik verileri (vücut ağırlıkları ve vücut kütle indeksleri dışında) ve izlem uzunlukları açısından istatistiksel olarak anlamlı fark yoktu ($p>0.05$). Fonksiyonel diz skorlarının grup içi değerlendirmesinde her iki grupta postoperatif dönemde istatistiksel olarak anlamlı bir iyileşme tespit edildi (p: 0.001). Ancak, bu parametreler arasında gruplar arasında istatistiksel olarak anlamlı bir fark bulunamadı ($p>0.05$).

Sonuç: Vücut kütle indeksi obezite seviyesine ulaşırsa postoperatif klinik sonuçları etkilemez.

Anahtar Kelimeler : fonksiyonel durum, obezite, vücut kitle indeksi, hasta memnuniyeti, unikondiler diz artroplastisi.

Abstract:

Objectives: The aim of this study is to investigate the effects of the body mass index on the postoperative functional knee data of patients who have undergone unicondylar knee arthroplasty with a fixed insert system.

Patients and methods: Body mass index was calculated with the

method proposed by the World Health Organization. The patients were divided into two groups based on their body mass index, those with a body mass index of below and above 30 kg/m2. Preoperative and postoperative joint range of motion, Visual Analogue Scale, Knee Society Scores, Oxford Knee Scores, Western Ontario and McMaster Universities osteoarthritis index scores were used to identify the patients' satisfaction and the functional status of their knees.

Results: Among the 82 patients were 44 patients (Group 1) with a body mass index below 30 kg/m2 and 38 patients (Group 2) with a body mass index above 30 kg/m2. There was no statistically significant difference between the groups in terms of their demographic data other than their body weights and body mass indexes, and their follow-up lengths ($p>0.05$). A statistically significant improvement in the postoperative period was identified in both groups in the intragroup evaluation of the functional knee scores ($p:0.001$). However, no statistically significant difference was found in these parameters between the groups ($p>0.05$).

Conclusion: Body mass index reaching the level of obesity would not affect postoperative clinical results.

Keywords: functional status, obesity, body mass index, patients' satisfaction, unicondylar knee arthroplasty.

INTRODUCTION

Osteoarthritis is a chronic, progressive, and multifactorial disease that affects 12.5% of individuals over the age of 45. Age, gender, hormones, genetic factors, nutrition, previous joint damage, muscle weakness, lower extremity malalignment, laxicity, and obesity play a role in the progress of the disease (1). Such treatment options as lifestyle changes, doing exercise, and the use of food and drug supplements are available for its treatment. Surgical treatment should be considered if knee functions cannot be improved, pain cannot be reduced, and the deformity is progressing despite all these measures and the conservative treatment approach (2).

Unicondylar knee arthroplasty (UKA) is a surgery with pleasing results when performed on a limited group of patients that accounts for 5-20% of those patients who have been diagnosed with tibiofemoral osteoarthritis with single compartment involvement and are in need of a prosthesis (2-4). UKA has been increasingly preferred over total knee arthroplasty and high tibial osteotomy in suitable cases especially over the last decade because it provides normal joint kinematics, maintains proprioception and joint range of motion, is minimally invasive, has lower mortality and fewer major complications, provides functional recovery earlier, provides a higher rate of return to sports, has satisfactory long-term follow-up results, and because implant designs are advancing (4-7).

This surgical method was first defined in 1970s (8). However, because a need for early revision arouse, the surgical method was developed in 1998 and new criteria were suggested for patient selection (9). Being over 60 years of age, having a diagnosis of non-inflammatory arthritis, having an intact anterior cruciate ligament, no patellofemoral osteoarthritis, presence of low physical activity, no flexion contracture, the extension contracture not exceeding 5 degrees, the angular deformity not exceeding 15 degrees, feeling minimal pain at rest, and obesity, which plays a role both in the pathogenesis-progression of tibiofemoral osteoarthritis and the determination of prosthesis lifetime, have been cited among these criteria (1,10,11). Over the years, the right selection of patients and the surgeons' gaining experience has made it possible to reduce the revision rate of UKA to as low as 8% (6).

Although obesity appears to be the most modifiable factor among the criteria suggested

for patient selection, today the prevalence of obesity is increasing incrementally. Correspondingly, late-stage knee osteoarthritis has also shown an increase (12,13). The literature suggests that technical difficulties will be experienced in all types of orthopaedic surgery due to obesity and that the complication risk and revision rates will be higher (2). Especially in obese individual who undergo UKA, the fact that the bone-implant surfaces are in contact in a small area increases the pressure of loading points. It is proposed that this situation may impact patient satisfaction and the success of the operation (13). Many studies have been carried out based on this prediction. As a result of these studies, certain researchers have suggested that 82 kg or 90 kg should be taken as limit for body weight and 32 kg/m2 or 35 kg/m2 for body mass index, reporting that the clinical and functional results of those patients over these limit values are lower (13). On the other hand, there are also some authors who argue that body weight or body mass index does not have any adverse effects on postoperative results (14,15).

The aim of this study is to investigate the effects of the body mass index value announced by the World Health Organisation as the obesity limit on the postoperative functional knee data of patients who have undergone UKA with a fixed system.

PATIENTS AND METHODS

The study was started after obtaining an approval from the local ethics committee. Patients within the age range of 40-80 with a preoperatively intact anterior cruciate ligament, an extension limitation of less than 10°, a varus and valgus deformity of less than 10°, no patellofemoral symptoms, who had undergone UKA with the diagnosis of primary non-inflammatory osteoarthritis with isolated medial compartment involvement and been followed up for at least 24 months postoperatively were designated as the study group (11). Those patients with an indication for primary surgery had been operated by a single senior knee surgeon (M.U.), using the same surgical technique (medial mini incision with mini medial parapatellar arthrotomy) and the same type of implant (Zimmer High Flexion for fixed system, USA).

All the patients were initiated on continuous passive joint range of motion exercises starting from postoperative day 1. The patients were allowed to apply partial weight-bearing and full joint range of motion exercises and lower extremity strength and endurance exercises were started from postoperative day one (2,11). The supervised postoperative physiotherapy programme was sustained for 6 weeks (11). It was suggested that the patients continue their exercises for 6 months. Routine postoperative checks were performed on postoperative week 6, month 3, year 1, and every following year.

The patients, whose preoperative body mass index, joint range of motion, pain score, and functional knee scores had been recorded (4,9), were invited to our clinic in order for their postoperative checks to be performed and functional knee measurements to be repeated. Those patients who had developed a technical failure in the knee that underwent UKA and needed a revision in the surgical area were excluded from the study.

Functional Measurements

The height and body-weight measurement of the patients received for clinical follow-up and control was performed using a mechanical scale with a height rod for adults (SECA 700, Germany). Then, body mass index (BMI) (kg/ m2) was calculated with the method proposed by the World Health Organization. The patients were divided into two groups based on their BMI, those with a BMI of below and above 30 kg/m2 (16). The clinical evaluations and questionnaires which were used to identify the functional status preoperatively were also repeated and recorded during the postoperative check.

A metal goniometer (Baseline Stainless, USA) was used for the joint range of motion measurement. It was determined that the patients could not make effective active knee flexion due to knee pain in the preoperative period. Therefore, the joint range of motion measurement was performed while the knee was in passive flexion and active extension in the preoperative and postoperative period (11). The Visual Analogue Scale (VAS) pain score was utilized to be able to grade the subjective pain (11).

'Knee Society Scores' (KSS), 'Oxford Knee Scores' (OKS), and 'Western Ontario and McMaster Universities osteoarthritis index' (WOMAC) scores were used to identify the patients' satisfaction and the functional status of their knees. The KSS is a questionnaire that evaluates patients in terms of pain, mobility, stability, and function (17). The OKS is a questionnaire that is used to evaluate pain and everyday functional capacity (18). The WOMAC Score is possible to evaluate a patient in terms of pain, joint stiffness, limitations, and physical functions with this questionnaire (19).

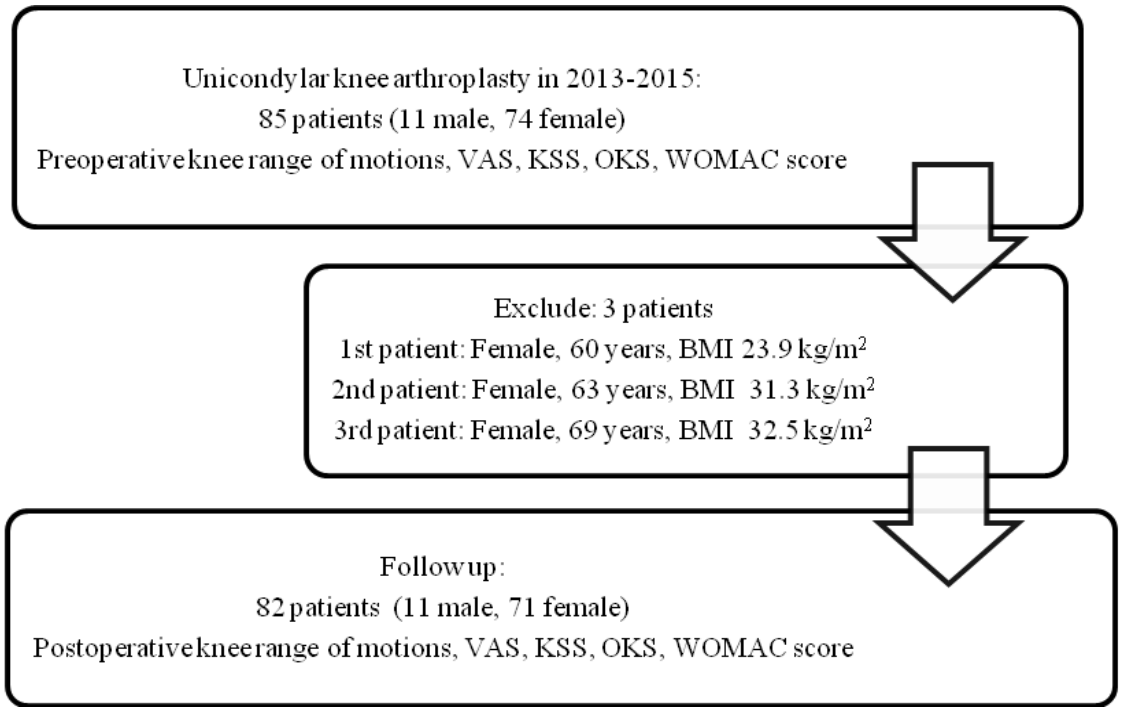
Statistical methods:

All the data was analysed using SPSS 22.0 package program. Descriptive statistics was utilized for the analysis of demographic data, independent sample t-test for the determination of the difference between independent groups, and paired sample t-test for the pretest-posttest evaluation of the groups. Statistical significance was set at $p<0.05$. The results were given as means ±standard deviation.

RESULTS

Three patients who were initially included in the study were later excluded from the study because a revision surgery decision was made in their postoperative control.

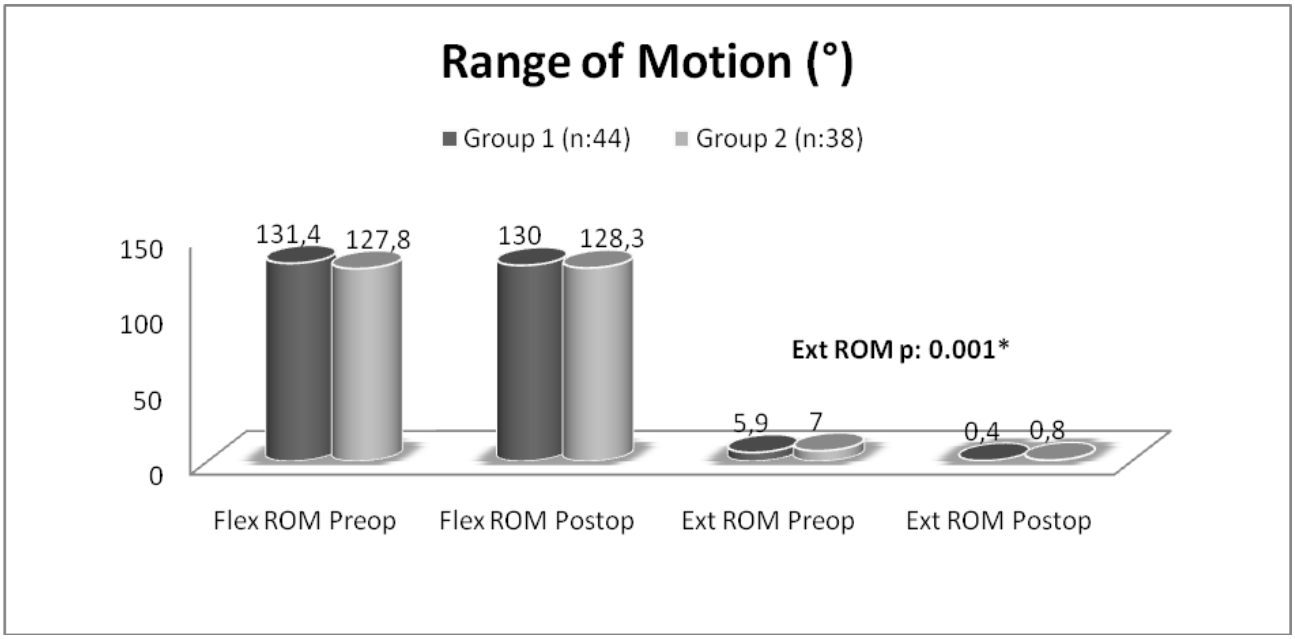
Figure: Study design



VAS: Visual Analogue Scale, KSS: Knee Society Scores, OKS: Oxford Knee Scores, WOMAC: Western Ontario and McMaster Universities osteoarthritis index, BMI: body mass index

Among the 82 patients were 44 patients (Group 1) with a body mass index below 30 kg/m2 and 38 patients (Group 2) with a body mass index above 30 kg/m2.
The age of the 44 patients (6 male, 38 female) in Group 1 was 63.1 ± 9 years, their height 161.8 ± 6.8 cm, their body weight 70.4 ± 8.9 kg, and their body mass index 26.8 ± 2 kg/m2. These values were 61 ± 7.4 years, 161.1 ± 5.1 cm, 89.9 ± 11.1 kg and 34.6 ± 3.7 kg/m2 Respectively in the 38 patients (5 male, 33 female) in Group 2. The postoperative length of follow-up of the patients in Group 1, 21 of whom were operated on their right knee and 23 on their left knee, was 24.1 months while this length; was 24.4 months in the patients in Group 2, 21 of whom were operated on their right knee and 17 on their left knee. There was no statistically significant difference between the groups in terms of their demographic data other than their body weights and body mass indexes, and their follow-up lengths (p>0.05).
When the joint range of motion measurements were evaluated, no difference was found between the groups in the preoperative and postoperative periods (p>0.05). When the intragroup differences were evaluated, however, the postoperative range of flexion motion values of the both groups did not differ from the preoperative period while their postoperative extension measurement values were found to have improved in a statistically significant way in comparison to the preoperative measurement values (Graphic).

Graphic: Joint range of motion measurement results



Flex: flexion, ext: extension, ROM: range of motion, preop: preoperative, postop: postoperative.

A statistically significant improvement in the postoperative period was identified in both groups in the intragroup evaluation of the functional knee scores (p:0.001). However, no statistically significant difference was found in these parameters between the groups (p>0.05). The VAS pain, KSS, OKS, and WOMAC knee scores of the patients are presented in Table.

Table: Functional knee scores

		Group 1 (n:44)	Group 2 (n:38)	*p value*$^{\alpha}$
VAS pain score	Preop	7.5 ± 1.4	8 ± 1.2	0.2
	Post op	0.2 ± 0.4	0.3±0.4	0.9
	p value$^{\beta}$	*0.001**	*0.001**	
Objec-tive KSS / Function KSS	Preop	49.1±5/ 53.4±11.2	48.4±6.3 / 54.3±9.5	0.6 / 0.7
	Post op	97.9±3.1/ 99.2±2.8	97.9±3.2/ 98.8±3.4	1 / 0.6
	p value$^{\beta}$	*0.001**	*0.001**	
WOM-AC	Preop	46.3 ± 7.8	41.2±12.7	0.3
	Post op	98.7±1.6	97.8±2.5	0.2
	p value$^{\beta}$	*0.001**	*0.001**	
OKS	Preop	13.6±3	12.8±3.9	0.3
	Post op	47.2±0.9	46.8±1.3	0.2
	p value$^{\beta}$	*0.001**	*0.001**	

Pre op: preoperative, post op: postoperative, VAS: Visual Analog Scale, KSS: Knee Society scores, WOMAC: Western Ontario and McMaster Universities osteoarthritis index, OKS: Oxford knee scores,*: $p<0.05$,$^{\alpha}$:Independent t test, $^{\beta}$: Paired t test.

DISCUSSION

Many criteria have been defined for patient selection in UKA and a great majority of these criteria have gained acceptance. However, doubts persist over those criteria concerning body weight (11). While certain authors argue that an increased body mass index would affect the postoperative results of a patient in a negative way, another group of authors state that this parameter would not have a positive or negative effect on the results (13-15).

In a multicentre study where the postoperative results of UKA were evaluated, the rate of failure of the cases' implants was identified as 3.6%. No correlation was found between this situation and body mass index (11). The revision rate found in our monocentric study (3.6%) was coherent with the literature. That we have a limited number of cases does not allow us to statistically correlate body mass index with the revision rates. However, two out of the three patients for whom a revision surgery decision was made are known to have a body mass index of above 30 kg/m2.

While the joint flexion range of motion of the patients in our case series was maintained in the postoperative period, their joint extension contractures have reduced to a minimal level. The postoperative joint flexion range of motion values reached the level of 118°-128° presented in the literature in both groups (3,11). Although it is stated in some studies that the postoperative joint range of motion of obese individuals is lower, trying to explain this situation with a limitation by soft tissues and an increased inhibition in the knee, there is no loss in the joint motion in the direction of flexion in the results of this study (11). A knee flexion of 50°-60° is needed when climbing up stairs and 90°-120° when standing up from a chair. It is stated in the literature that those patients who attained an average knee flexion range of motion of 125° (95°-145°) after arthroplasty had increased KSS scores. These studies in the literature have emphasized the contribution of ensuring joint range of motion to the functional condition (2).

Although it is knee joint flexion range of motion that has mostly been examined in studies, it is known that a flexion/extension gap imbalance should not occur so that prosthesis or implant failure will not develop. In addition, ensuring complete knee functionality depends on the presence of extension and flexion movement without limitation (9). Naal et al. have expressed that the percentage of cases with extension limitation had declined from 28.9% to 15.7% in the post-operative year 2 follow-up of UKA (11). The data obtained at the end of this study suggests that the pre-operative extensor contractures of the patients were eliminated after surgery.

The improvement in pain and functional knee outcomes in our study is obvious in both groups. On the other hand, no adverse effect of a body mass index exceeding the obesity threshold on these parameters was identified.

In the studies conducted using clinical evaluation questionnaires, when outcomes of UKA and total knee arthroplasty were compared, patient satisfaction, clinical and functional outcomes were found to be better in a statistically significant way in the group undergoing UKA and it was emphasized that UKA can be safely administered, particularly in patients with an expectation to returning to activity (4). Lisowski et al reported in their study in which they evaluated the success of UKA that the VAS pain score had reduced, that the KSS, OKS, and WOMAC knee scores had risen in the postoperative period, and that the medium-term results of this operation were successful. However, the impact of body mass index on clinical and functional outcomes was not assessed (9).

Murray et al found no difference in the objective KSS scores of the groups at the end of a 5-year follow-up in their study where they examined the impact of body mass index on UKA results. However, the functional KSS

score, OKS score, and Tegner activity score decreased as the body mass index increased. On the other hand, the preoperative-postoperative OKS score change was higher in those with a higher body mass index (13). Naal et al found no correlation between body mass index and the KSS score, University of California at Los Angeles (UCLA) activity level and implant failure while they identified a negative correlation with postoperative knee flexion and a positive correlation with postoperative anterior knee pain (11). Cavaignac et al reported that body weight and body mass index (>30kg/m2) would have no adverse effect on long-term UKA implant lifetime and KSS results (20). Berend et al argued that a body mass index of over 32 kg/m2would shorten implant lifetime while Bonutti et al defended the opinion that having a body mass index of over 35 kg/m2 would reduce the KSS results (21).

The results of the other knee scores used in the studies are also similar to those of the above-discussed functional scores. In a study conducted using the International Knee Society (IKS) scores in two groups of above and below 30 kg/m2,it was reported that although the IKS scores of obese individuals were lower in the preoperative period, this difference disappeared in the postoperative period (3).

The impact of age, gender, body mass index, patellofemoral osteoarthritis, and anterior cruciate ligament rupture were investigated in the meta-analysis of van der List et al. In the final report of this meta-analysis, being younger than 60 years of age and having female gender was found to be in correlation with revision surgery and lower functional results. On the other hand, no negative effect of body mass index, preoperative patellofemoral osteoarthritis, and anterior cruciate ligament rupture was found on the results (16). Tabor et al also stated that obesity would not constitute a contraindication for the application of UKA (14).

Several limitations are noted in this study. The sample size and is the follow up time relatively small. Other groups of body mass index were not evaluated.

Most current studies report that a body mass index reaching the level of obesity would not affect postoperative clinical results (3,13,14). This study also supports these current information. Although it is ideal to apply surgery after the patients' obesity is eliminated, that the postoperative knee functional results of obese individuals, it should not be ignored that the postoperative knee functional outcomes of obese individuals will not be adversely affected.

REFERENCES

1. Reijman M, Pols HAP, Bergink AP, Hazes JMW, Belo JN, Lievense AM, Bierma-Zeinstra SMA. Body mass index associated with onset and progression of osteoarthritis of the knee but not of the hip: the Rotterdam Study. Ann Rheum Dis 2007;66(2):158-62.

2. Saccomanni B. Retracted Article: Unicompartmental knee arthroplasty: a review of literature. Clin Rheumatol 2010;29(4):339-46.

3. Sebilo A, Casin C, Lebel B, Rouvillain JL, Chapuis S, Bonnevialle P. Clinical and technical factors influencing outcomes of unicompartmental knee arthroplasty: Retrospective multicentre study of 944 knees. Orthop Traumatol Surg Res 2013;99 (4):227-34.

4. Matthews DJ, Hossain FS, Patel S, Haddad FS. A cohort study predicts beter functional outcomes and equivalent patient satisfaction following UKR compared with TKR. HSS J 2013;9 (1):21-4.

5. Pearse AJ, Hooper GJ, Rothwell A, Frampton C. Survival and functional outcome after revision of a unicompartmental to a total knee replacement. J Bone Joint Surg Br 2010;92(4):508-12.

6. Liddle AD, Judge A, Pandit H, Murray DW. Adverse outcomes after total and unicompartmental knee replacement in 101 330 matched patients: a study of data from the National Joint Registry for England and Wales. Lancet 2014;384(9952):1437-45.

7. Sikorski JM, Sikorska JZ. Relative risk of

different operations for medial compartment osteoarthritis of the knee. Orthopedics 2011;34 (12):847-54.
8. Seyler TM, Mont MA, LaiLP, Xie J, Marker DR, Zywiel MG, Bonutti PM. Mid-term results and factors affecting outcome of a metal-backed unicompartmental knee design: a case series. J Orthop Surg Res 2009;4(1):39.
9. Lisowski LA, Van den Bekerom MP, Pilot P, Van Dijk CN, Lisowski AE. Oxford Phase 3 unicompartmental knee arthroplasty: medium-term results of a minimally invasive surgical procedure. Knee Surg Sports Traumatol Arthrosc 2011;19 (2):277-84.
10. Willekens P, Victor J, Verbruggen D, Kerckhove MV, Van Der Straeten C. Outcome of patellofemoral arthroplasty, determinants for success. Acta Orthop Belg 2015;81(4):759-67.
11. Naal FD, Neuerburg C, Salzmann GM, Kriner M, von Knoch F, Preiss S, Drobny T, Munzinger U. Association of body mass index and clinical outcome 2 years after unicompartmental knee arthroplasty. Arch Orthop Trauma Surg 2009;129(4):463-8.
12. Kerkhoffs GM, Servien E, Dunn W, Dahm D, Bramer JA, Haverkamp D. The influence of obesity on the complication rate and outcome of total knee arthroplasty: a meta-analysis and systematic literature review. J Bone Joint Surg. Am 2012;94(20):1839-44.
13. Murray DW, Pandit H, Weston-Simons JS, Jenkins C, Gill HS, Lombardi AV, Dodd CAF, Berend KR. Does body mass index affect the outcome of unicompartmental knee replacement?. Knee 2013;20(6):461-5.
14. Tabor Jr OB, Tabor OB, Bernard M, Wan JY. Unicompartmental knee arthroplasty: long-term success in middle-age and obese patients. J Surg Orthop Adv 2005;14(2):59-63.
15. Berend KR, Lombardi Jr AV, Adams JB. Obesity, young age, patellofemoral disease, andanterior knee pain: identifying the unicondylar arthroplasty patient in the United States. Orthopedics 2007;30(5 Suppl):19-23.
16. van der List JP, Chawla H, Zuiderbaan HA, Pearle AD. The role of preoperative patient characteristics on outcomes of unicompartmental knee arthroplasty: a meta-analysis critique. J Arthroplasty 2016;31(11):2617-27.
17. Dinjens RN, Senden R, Heyligers IC, Grimm B. Clinimetric quality of the new 2011 Knee Society score: high validity, low completion rate. Knee 2014;21(3):647-54.
18. Tuğay BU, Tuğay N, Güney H, Kinikli GI, Yuksel I, Atilla B. Oxford Knee Score: cross-cultural adaptation and validation of the Turkish version in patients with osteoarthritis of the knee. Acta Orthop Traumatol Turc 2016;50(2):198-206.
19. Tüzün EH, Eker L, Aytar A, Daşkapan A, Bayramoğlu M. Acceptability, reliability, validity and responsiveness of the Turkish version of WOMAC osteoarthritis index. Osteoarthritis Cartilage 2005;13(1):28-33.
20. Cavaignac E, Lafontan V, Reina N, Pailhé R, Warmy M, Laffosse JM, Chiron P. Obesity has no advers eeffect on the outcome of unicompartmental knee replacement at a minimum follow-up of seven years. Bone Joint J 2013;95(8):1064-8.
21. Berend KR, Lombardi Jr AV, Mallory TH, Adams JB, Groseth KL. Early failure of minimally invasive unicompartmental knee arthroplasty is associated with obesity. Clin Orthop Relat Res 2005;440:60-6.