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Mid-term Results of Unicondylar knee Arthroplasty for Medial Compartment Osteoarthritis

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Abstract

Background: The popularity of unicompartmental knee arthroplasty (UKA) for the treatment of isolated compartment osteoarthritis of the knee has risen over the past two decades. Currently, UKA covers 10% of all knee arthroplasties worldwide. The objective of this study was to present the clinical and radiological outcomes of unicondylar knee arthroplasty in patients with medial compartment osteoarthritis.

Materials and methods: Between January 2010 and January 2014, unicondylar knee prostheses were applied to 56 knees in 46 patients (3 men, 43 women) with isolated medial compartment osteoarthritis. The mean age, body mass index, and follow-up of the patients was 54 years (range, 42 to 73), 26.3 (range, 24 to 29), and 48 months (range, 20 to 84), respectively. The patients were evaluated clinically with Oxford Knee Score (OKS), Knee Society Score (KSS) and Visual Analogue Scale (VAS) before and after surgery and radiologically by Oxford Radiological Evaluation Criterias.

Results: Compared to the preoperative values, the knee flexion was increased from 116° to 123° ($p<0.001$). Statistically significant increase in OKS and KSS, and decrease in VAS was obtained postoperatively ($p<0.001$). All of the components were aligned within the acceptable ranges radiologically. In one patient, there has been an insert dislocation at the postoperative 6th week which was initially managed with closed reduction and then revised due to redislocation. No major complications including infection, deep vein thrombosis, pulmonary emboli, and neurovascular injury occurred.

Conclusion: The mid-term clinical and radiological outcomes of UKA were excellent in this study, and our results demonstrate that UKA in proper indication is effective with considerable success in the treatment of medial osteoarthritis.

Keywords: Unicompartmental knee arthroplasty; Medial compartment; Osteoarthritis

Abbreviations: OA: Osteoarthritis; TKA: Total Knee Arthroplasty; HTO: High Tibial Osteotomy; UKA: Unicompartmental Knee Arthroplasty; OKS: Oxford Knee Score, KSS: Knee Society Score

Introduction

There is still controversy about the best treatment option for patients with medial compartment-involved knee osteoarthritis (OA). İn cases of symptomatic medial compartment knee OA when conservative treatment is insufficient, correcting osteotomies such as high tibial osteotomy (HTO) and distal femoral osteotomy, total knee arthroplasties (TKA) or unicompartmental knee arthroplasties (UKA) are both utilized for surgical treatment [1-3]. Though TKA has been considered the gold standart of operative intervention for degenerative knee joint, many authors have shown better long-term results for the latter choice, UKA, as well as good knee kinematics and function with lower complication rates. Beside this, preserving the healthy joint structures of the knee and replacing the degenerative compartment alone are the main reason for its rising popularity and led the technique to further increase of the applied frequency [3-5], Since the first design was introduced by McKeever in 1957 [6], UKA technique had been developed with more anatomical implants and minimal invasive approach over the years.

Marmor reported %10 revision rates in two-years follow-up and %65 survivorship with first design implants in UKA at a mean follow-up of ten years [7,8], while Goodfellow's early results with Oxford phase II was reported by Murray as more than 90 % survivorship at ten years [9]. İncreased success had been achieved by understanding the isolated anteromedial arthritis which is identified as bone cartilage loss in the anterior

and mid portion of the medial compartment in association with intact ligamentous structures and normal lateral compartment cartilage [4,10]. In the late 1990s, more anatomical implants were manufactured, and superior outcomes were yielded with these anatomical designs and mini-invasive surgical techniques. In a review, Khanna reported that 10-year survivorships have been increased ranging from %91 to %100 in most series with %93 survival rate in fifteen years [11]. In some similar studies, UKA survivorship, with the use of most recent implants, has demonstrated greater than %90 (ranging from %83 to %95) for more than 15-year follow-up [12,13]. These scientific publications, even with good long-term survival rates by the designer surgeons, induced the resurgence in UKA's popularity over osteotomies and total knee artroplasties (TKA).

The purpose of this study was to assess the midterm clinical and radiologic results, survival rates and complications of 56 knees with medial compartment OA treated consecutively with cemented mobile UKA implants.

Material and Methods

A written informed consent was obtained from each patient. The study protocol was approved by the Institutional Review Board. The study was conducted in accordance with the principles of the Declaration of Helsinki. 56 consecutive knees of 46 patients who underwent UKA due to isolated medial compartment osteoarthritis between January 2010 and January 2015 in our clinic were included with no loss to follow up. 43 patients (%93) were female and 3 (%7) were male. The mean age was 54 years (range, 42 to 73 years), mean follow-up was 48 months (range, 20 to 84 months) and mean BMI was 26.3 (range, 24 to 29). Patients demographic data are summarized in Table 1. All surgeries were performed and the data was collected by the senior surgeon.

Table 1: Patients demographic data.

n	46 patients (56 knees)
Age	54 years (range, 42-73 years)
Side	10 bilaterally; 17 right; 19 left
Follow-up	48 months (range, 20 to 84 months)
Gender	43 female, 3 male
BMI	26.3 (range, 24-29)
Bearing type	56 mobile

BMI: Body Mass Index.

Patients were assessed clinically and functionally by using Oxford Knee Score (OKS) [14], Knee Society Score (KSS) [15] preoperatively and at further follow-ups postoperatively. Also, patient satisfaction regarding pain and perception of knee normality were assessed by subjective evaluation which is categorized as very satisfied, satisfied, uncertain and dissatisfied. Range of motion of the operated knee is recorded pre and postoperatively. Prosthesis were assessed using the Oxford radiological evaluation criterias.

Patient Selection

After medical history and physical examination, serial radiographs including anteroposterior (AP) standing up-right and lateral (L) knee graphies at 30° flexion and Rosenberg views (PA 10° caudal knee graphy in knee slightly flexion) are routinely taken. The inclusion criterias for this study were:

i. Anteromedial knee pain on one finger test with medial compartment osteoarthritis

ii. Intact lateral compartment (no loss of cartilage on lateral condyles weight-bearing surfaces and no meniscal tear) and intact anterior cruciat ligament some of which were revealed by magnetic resonance imaging (MRI) scans

iii. Varus deformity lower than 15° or correctable varus deformity at 20° flexion

iv. Flexion contracture lower than 15°

Furthermore, patellofemoral arthritis classified as lower than outer bridge grade 4, the patients' age, weight and activity level were not contraindications to the operation. However, patients with a history of surgery for osteoarthritis and previous fractures around the affected knee were excluded from the study.

Preoperative assessment; We used the templates of implants on anteroposterior and lateral x-rays to predict the implant size preoperatively. Also, the weight, height, and BMI of each patient had been recorded preoperatively. Preoperative patient information booklet was given to each patient including information's about the operation and medical care they will require during perioperative period.

Surgical Procedure

Patients were placed in the supine position after combined (spinal+epidural) anaesthesia in the operating room. The thigh was held in special leg holder to allow minimum 120 degrees knee flexion during the procedure (Figure 1). After the medial parapatellar incision, arthrotomy was performed. Appropriate bone cuts were done, and implants were placed (Figure 2). UKA was performed both knees in 10 patients simultaneously, while implanted unilaterally in 36 patients. Mobile-bearing implants in 56 knees (Biomet, Warsaw, IN, USA) were used. Jones bandage, Ranawat coctail and tranexamic acid were applied postoperatively.

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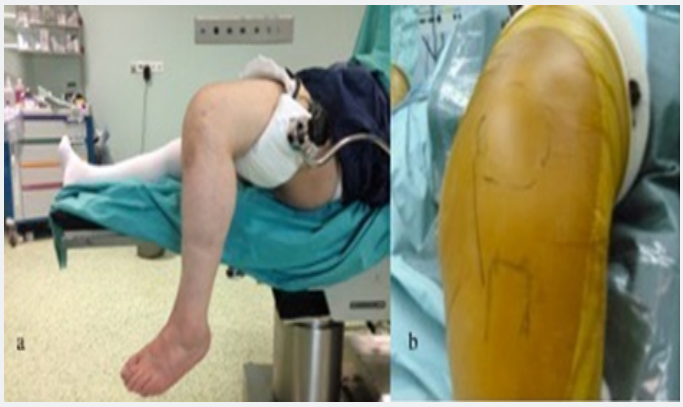

Figure 1:

a. Extremity position allows at least 120 degrees knee flexion.

b. incision was drawn after draping.

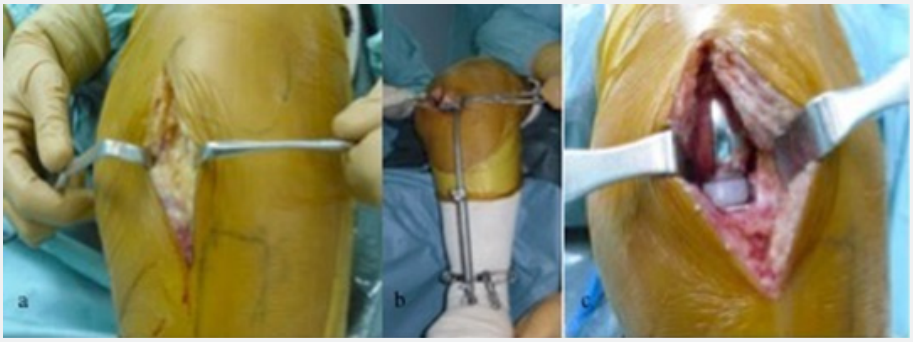

Figure 2:

a. Medial parapatellar incision

b. tibial cutting guide placement

c. postoperative picture of the implants.

All patients had the same physiotherapy with starting Continuous Passive Motion (CPM) at the same day after operation and mobilized with crutches the day after surgery. Follow-up clinical and radiological interventions were planned at 6 weeks, 3 months, 6 months and 1 year postoperatively at our outpatient clinic. Further follow-ups were then set at yearly intervals. All data was analysed statistically using SPSS ver.22.0. For statistical analysis the t test of comparison of means for paired data was used, and $p<0.05$ was considered significant.

Results

Preoperative mean range of motion was increased from 116° (range, 100-126°) flexion to 123° flexion (range 115-135°), whereas there was no limitation in knee extension pre- or postoperatively. The mean KSS was increased from 54.6 ± 7.5 to 90.1 ± 6, the mean OKS increased from 24.1 ± 3.2 to 52.8 ± 4.6, and the mean VAS was decreased from 7.96 ± 1.02 to 2.29 ± 0.89.

Regarding the radiological assessment, no femoral or tibial component showed radiological loosening. Postoperatve short to mid-term radiographic measurements showed that the position of the femoral components was within acceptable ranges with a mean of 1.8° varus (range 7° varus to 3° valgus), whereas the position of the tibial component was within acceptable ranges with a mean of 0.5° varus (range 2° varus to 4°valgus) and a mean slope of 84.5° (range 79°-88°). All the tibial components, except an overflow of 1mm. in three and 2mm. in one, showed full congruency with medial plane.

Preoperative and postoperative scores were summarized in Table 2, and radiological scores were summarized in Table 3. During follow-up, 1 male patient had insert dislocation at 6 weeks postoperatively. İnitially, insert was replaced with the manuplation of closed reduction under sedative anaesthesia. He returned to his pre-dislocation level of activity, however he had insert dislocation again after 4 weeks of reduction. 4-mm. insert was replaced with a thicker and more anatomical 6-mm one. Furthermore, 2 female patients had persistent anterior and medial knee pain postoperatively without any sign of insert dislocation or implant-related problems, however complete pain relief was achieved with continuous physiotherapy at 1 year

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postoperatively. None of the patients had deep vein trombosis, infection, implant loosening, osteolysis, implant-related fracture or opposite compartment osteoarthritis. The overall satisfaction in this study was noted as very satisfied in 36 patients' 42 knees (75 %), satisfied in 6 patients' 9 knees (16 %), uncertain in 3 patients' 4 knees (7 %), and dissatisfied in one patients' knee (2 %). The overall survival rate of implants was %100 at 5 years postoperatively.

Table 2: Pre and postoperative results of pain and function scores.

	Preoperative	Postoperative	p*
Function	52 ± 8.5	87 ± 7	< 0.001
Mean Score	54.6 ± 7.5	90.1 ± 6	< 0.001

Pre and postoperative Knee Society Scores.

**paired samples t test*

	Preoperative	Postoperative	p*
Mean Score	24.1 ± 3.2	52.8 ± 4.6	< 0.001

**paired samples t test*

Pre and postoperative Oxford Knee Scores.

	Preoperative	Postoperative	p*
VAS score	7.96 ± 1.02	2.29 ± 0.98	< 0.001

**paired samples t test*

VAS (Visual Analog Scala).

Table 3: Postoperative radiological scores

Patient/Sex	Side	Femur Varus/Valgus	Flexion/ Extansion	Medial/ Lateral	Tibia Varus/Valgus	Slope	Medial Fit
1 (F)	Bilateral	3°/0° varus	0°/0°	Central	0°/0°	87°/88°	Central
2 (F)	Bilateral	1°/0° varus	0°/0°	Central	0°/0°	86°/86°	Central
3 (F)	R	2° varus	0°	Central	0°	88°	Central
4 (F)	L	1° varus	3° fleks.	Central	2° varus	87°	Central
5 (F)	L	5° varus	4° fleks.	Central	0°	86°	Central
6 (F)	L	0°	0°	Central	0°	84°	1 mm.
7 (F)	Bilateral	3°/4° varus	1° ekst./0°	Central	0°/0°	83°/82°	Central
8 (F)	R	2° valgus	3° ekst.	Central	0°	82°	Central
9 (F)	L	0°	0°	Central	0°	85°	Central
10 (F)	L	5° varus	0°	Central	0°	86°	2 mm.
11 (F)	L	4° varus	5° ekst.	Central	3° valgus	85°	Central
12 (F)	L	4° valgus	3° ekst.	1mm. L	1° varus	87°	Central
13 (F)	R	2° varus	0°	Central	0°	88°	Central
14 (F)	Bilateral	6°/4° varus	0°	Central	2°/3° varus	83°/80°	Central
15 (F)	Bilateral	2/2° valgus	0°	Central	0°/0°	84°/80°	Central
16 (M)	R	3° valgus	3° ekst.	Central	3° varus	84°	Central
17 (F)	R	0°	0°	Central	0°	83°	1 mm.
18 (K)	Bilateral	0°	0°	Central	0°/0°	84°/82°	Central
19 (F)	L	7° varus	5° fleks.	Central	4° valgus	85°	Central

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20 (F)	R	3° valgus	0°	Central	0°	85°	Central
21 (F)	L	2° varus	0°	Central	0°	86°	Central
22 (F)	L	0°	0°	Central	0°	85°	Central
23 (F)	R	3° valgus	0°	1mm.M	2° varus	86°	Central
24 (F)	R	1° valgus	0°	Central	0°	87°	Central
25 (F)	R	4° valgus	1° fleks.	Central	3° valgus	88°	Central
26 (F)	L	0°	0°	Central	0°	81°	Central
27 (F)	R	3° valgus	4° fleks.	1mm. L	1° valgus	80°	Central
28 (F)	R	3° varus	2° ekst.	Central	1° valgus	84°	Central
29 (F)	L	2° varus	3° ekst.	Central	3° valgus	86°	Central
30 (F)	L	3° valgus	2° fleks.	Central	0°	84°	1 mm.
31 (F)	L	0°	0°	Central	0°	83°	Central
32 (F)	Bilateral	3° varus	2° fleks./ 0°	Central	0°/0°	83°/83°	Central
33 (F)	Bilateral	0°	0°/0°	Central	0°/0°	84°/84°	Central
34 (F)	L	0°	0°	Central	0°	85°	Central
35 (F)	L	1° valgus	2° fleks.	Central	0°	85°	Central
36 (F)	R	0°	0°	Central	0°	80°	Central
37 (F)	L	2° varus	0°	Central	0°	81°	Central
38 (M)	R	1° valgus	2° ekst.	Central	1° varus	80°	Central
39 (F)	L	2° varus	3° ekst.	Central	2° varus	79°	Central
40 (F)	Bilateral	0°/0°	0°/0°	Central	0°/0°	82°/85°	Central
41 (M)	L	2° valgus	4° ekst.	1mm. L	0°	83°	Central
42 (F)	Bilateral	0°/0°	0°/0°	Central	0°/0°	82°/84°	Central
43 (F)	R	1° valgus	2° ekst.	Central	0°	82°	Central
44 (F)	R	1° varus	2° ekst.	Central	1° varus	83°	Central
45 (F)	R	2° varus	3° fleks.	1mm. L	0°	84°	Central
46 (F)	R	0°	0°	Central	0°	85°	Central

Discussion

The survival rate after UKA depends on many factors. In the current study, the survival rate of prosthesis was 100 % at 4-year follow-up in patients with the mean age of 54 years, results of which is found better than the aforementioned studies. In similar studies, Cepni et al. [1] reported 95.6 % survival rate of UKA implants at 5.5 years with the mean age of 61 ± 7.3 years, while Tadros et al. [16] reported 93 % survival rate at a mean follow-up of 4.7 years with the mean age of older than 57.9 years, Clement et al. [17] reported 87.7 % survival rate at 5 years with a mean age of 69.5 years, and Pandit et al. [18] 97.3% at seven years with a mean age of 66.4 years. In these studies, younger age (<60 years) was accepted a predictor of failure, at the end they explain the reason as younger and males expect greater improvement in knee function than the prosthesis can offer. However, our study group has disproved those scientific publications.

Many complications dedicated to UKA has been reported such as progression of lateral compartment osteoarthritis, periprosthetic fracture (mostly medial tibial plateau), and polyethylene insert dislocation of mobile implants [8,11-13,19-21]. All these problems occurred due to non-anatomical implant designs, inappropriate patient selection, overcorrection and malposition of the implants. Depending on the increase in the incidence of complications, more anatomical and minimally invasive implant designs were produced by manufacturers which contributed less soft tissue injury, more bone stock preservation, early postoperative rehabilitation due to less blood loss and pain, and shorter hospital stay resulting with rapid recovery [2,10,22,23]. Bearing dislocations in mobile design implants are considered higher and the most important cause of this complication would be inappropriate gap balancing between flexion and extension. Lewold et al. [24] reported that the reason of the bearing dislocation is mostly attributed to implant malposition and soft tissue imbalancing. Other possible reasons are the posterior impingement by remaining meniscus, osteophytes and excessive release of medial collateral ligament, respectively [25].

In our study, all implants were mobile, however we had only one insert dislocation as a major complication. Probably the reason of our complication is considered the use of early-designed non-anatomical mobile bearing implants. In terms

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of higher incidence of dislocation, Oxford group developed a new anatomical bearing which had an extended length of medial wall to protect further dislocations. Moreover, the new implant increased the amount of rotation that the bearing had to undergo, and the anteromedial corner of the bearing has been reduced to decrease anterior overhang in extension.

In the literature, there are some reports about this subject which was managed with revision surgeries. Clement et al. reported 3 revisions due to unexplained persistant symptomatic knee pain in the second postoperative year. They emphazised that unnecessarily revisions before two-year follow-up may result higher early revision rates [17]. In a similar study, Lewold et al. reported 6 revisions of 1000 UKA due to unexplained pain three of which were reported as unhappy after the second operations. In our study, two patients had unexplained anterior knee pain after the operation which was managed by further physiotherapy at postoperative first year. In our study we had also 100% survivorship with the careful preoperative planning and patient selection at 4 years follow-up. Supporting our results, Andrew et al. reported %91 survival for the Oxford mobile implants by following the correct indications in appropriate selected patients at 20 years follow-up [12], and Bell et al. [20] reported 100% survivorship at a mean of 24 months follow-up with the accurate preoperative plan and patient selection.

Comparison of the survivorship and functional results of mobile and fixed bearing implants is another subject that should be discussed. Arthroplasty registries suggested no conclusive advantage of one bearing design over another, however this is an individual subject that should be discussed. Inoue et al. [26] reported that some laxity should be provided in medial collateral ligament (MCL) in fixed bearing implants, whereas there must be appropriate tension in MCL in mobile bearing implants to prevent dislocation. We considered this feature in our study which resulted without any revision. In a study, Aldinger et al. [27] reported higher wear and failure rates of fixed bearings than mobile bearings. In a review by Ko et al. [28]. While the progression of arthritis and dislocation were the main reasons of complications for the mobile bearing implants, wear was the only main complication requiring reoperation with fixed bearing implants. There is a limited follow-up of comparative studies between fixed and mobile bearing implants in terms of survivorship, however they found no difference [29,30]. On the other hand, in a long-term study, comparing the results of fixed and mobile bearing designs of UKA, Parratte et al. [31] found no difference in survivorship and function between two bearing designs. The meniscal mobile bearing moves to posterior with the knee fully flexed which permits and restores isometric function of the ligaments. Regarding this subject, we therefore used only mobile-bearing implants.

To our knowledge, there are no reports on the outcomes of the radiological positioning and congruency of the UKA. Optimal positioning between components in terms of tibial slope, medial fit, varus/valgus, and flexion/extension angle resulting neutral alignment of the knee was achieved in all cases. Few limitations should be noted. First, the study was retrospective with the risk of attendence of selection bias. Second, 3 of 46 patients, included in this study, were male, so we could not compare the gender demografic, clinical and radiological effects on survivorship. Lustig et al. [32] reported that the gender effect on outcome of UKA has no difference in terms of range of motion, radiologic progression of arthritis and alignment. There is no comprehensive study about gender effect on results of UKA, there may be further investigations requiring this subject. Third this study has a short- to midterm follow-up, thus we can comment on whether our intervention provides outcomes superior to those provided by nonoperative treatment, TKA or HTO or if the surgical procedure provides an advantage over these procedures. More prospective randomised trial would be the best method to determine this.

However, we can comment on performing the surgeries experienced team could provide significant contribution to achieve the success. Because the level of experience of the surgeon is considered a key factor to the overall survival of the implants and satisfactory outcomes in many scientific reports. Also, It is reported that low volume UKA performing centers have caused higher revision rates in many reports [17,20,33,34]. Bini et al. [33] evaluated the surgeon volume effects on revision rates and declared the yearly volume of less than twelve UKA had been significant risk for failure. In a high-volume study reported by Baker et al., 23400 UKA were evaluated and concluded that high volume centers and surgeons specialized in UKA showed superior outcomes, and the minimum number of UKA's per surgeon should be more than thirteen per year [34]. Nevertheless, we are encouraged by our short to midterm results using UKA for the treatment of medial compartment osteoarthritis of the knee, with 100 % of our patients reporting satisfaction with the outcome of their surgery at the last interventions.

Competing Interest

The authors declare that they have no competing interests.

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Conflict of Interest

There is no conflict of interest.

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