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Indications, outcomes, and complications of unicompartmental knee arthroplasty

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1. ABSTRACT

Improved prosthetic design and application of strict criteria in selection of patients have resulted in wide use of unicompartmental knee arthroplasty (UKA) in the surgical treatment of damaged joints. Here, we review the contemporary indications, outcomes, and complications of procedures, such as lateral and medial UKA and total knee arthroplasty (TKA), and compare the severity of complications in UKA and TKA. Patients with unicompartmental femorotibial osteoarthritis and patients who underwent UKA and ACL reconstruction for deficiencies in the anterior cruciate ligament (ACL) all had good clinical outcomes and survival. Reliable and successful options in the treatment of patients with isolated tibiofemoral osteoarthritis include lateral and medial UKA.

2. INTRODUCTION

Unicompartmental knee arthroplasty (UKA), which is less invasive and preserves bone stock, is an alternative treatment for unicompartmental osteoarthritis (OA); at least 25% of patients with knee OA have isolated medial compartment disease (1-2). In recent years, implant design and surgical technique improvements have resulted in the wide use of UKA in treating OA (3-5). UKA has many potential advantages over total knee arthroplasty (TKA), including a smaller incision, preservation of more native tissue, decreased blood loss, better proprioception, less peri-operative morbidity, reduced pain, greater range of motion (ROM), shorter hospitalization stays, and a more rapid rehabilitation course (6-9). Although authors have increasingly reported > 90% survival at 10 years, the role of UKA as a treatment option for knee monocompartmental OA remains controversial. Others have shown variability in the mid- and long-term follow-up failure rates. This variability continues to intensify the controversy regarding clinical outcomes in patients undergoing UKA.

The aim of this review was to further evaluate UKA based on the extant literature, including modern unicompartmental indications, outcomes and complications, such as lateral UKA, medial UKA, and UKA revised to TKA, and UKA versus TKA.

3. INDICATIONS AND CONTRAINDICATIONS

Relief of pain and restoration of function that interferes with a patient's quality of life are the primary indications for knee arthroplasty (8, 10-11). While technological advances have been made in UKA design to improve outcomes, patient selection has also evolved from the early years of UKA. The stringent criteria published by Kozinn and colleagues (12) have maintained relevance over the last several decades. Specifically, the criteria consist of the following: isolated medial or lateral compartment arthritis or osteonecrosis; low-demand activity with weight < 82 kg (181 lbs); and age > 60 years. The patient should have minimal pain at rest, a range of motion arc > 90°with < 5°flexion contracture, and an angular deformity of < 15° that is passively correctable. Initially, patients with anterior cruciate ligament (ACL) deficiency, young patients, and obese patients were not candidates for UKA. The advent of newer surgical techniques has extended the criteria for UKA, and these contraindications have come into question. Recent evidence suggests that patients with ACL deficiency, younger patients, and active patients are also good candidates for UKA.

3.1. ACL deficiency

The ACL is the primary restraint to anterior tibial translation in the native knee. UKA can provide disappointing long-term results when the ACL is deficient (13). Goodfellow and O'Connor (14) reported higher failure rates with mobile-bearing implants in knees with ACL deficiencies. The dominant mode of failure was aseptic loosening of the tibial component. Therefore, one of the traditional contraindications for UKA is a deficiency or absence of the ACL.

The utility of UKA in ACL-deficient knees has expanded over the last several decades. It is important to divide the ACL-deficient group into two subgroups (15), as follows: those patients with a prior, traumatic ACL tear and functional instability; and those patients with attrition of the ACL, without a concomitant capsule tear, and in many instances, some arthritis-associated capsule stiffness, and no functional instability related to the ACL deficiency. These two groups may explain why some series have reported poor results with ACL deficiency and no other differences. UKA with ACL reconstruction has been used to treat isolated compartment disease with ACL deficiency and functional instability in recent decades (15-20). In a study conducted by Srikrishna *et al*. (15), 9 patients with severe symptomatic osteoarthritis, ACL deficiency, and functional instability were treated with UKA and ACL reconstruction. UKA with ACL reconstruction was shown to be technically feasible and provided good results in functionally unstable knees. Tinius *et al*. (17) also obtained the same conclusion in their study. Improvement was demonstrated in the knee and function scores, and no revision was required at a mean follow-up time of 53 months. Weston-Simons *et al*. (16) reviewed 52 consecutive patients with a mean age of 51 years who underwent staged or simultaneous ACL reconstruction and Oxford UKA at a mean follow-up of 5 years and a maximum of 10 years. Weston-Simons *et al*. (16) reported that ACL reconstruction and Oxford UKR gives good results in patients with end-stage medial compartmental osteoarthritis secondary to ACL deficiency. Implant survival at 5 years was 93%. Recently, Gerard *et al*. (21) reported there was no difference in the revision rate between UKAs with and without intact ACLs in the absence of clinical instability. There were only 5 failures of UKAs in ACL-deficient knees (7%), and all were revised to TKAs. The survivorship at 6 years was 94% for UKAs in the ACL-deficient knees and 93% for UKAs in knees with intact ACLs (p = 0.8.9). Gerard *et al*. (21) suggested that ACL deficiencies in patients without clinical knee instability did not impact the survival of UKAs compared to UKAs with intact ACLs. Studies of UKA combined with ACL reconstruction are summarized in Table 1.

To summarize, patients with isolated unicompartmental OA and ACL deficiency are potential candidates for UKA; however, the follow-up periods in these studies were short in duration and the question of long-term viability of the procedure has yet to be answered. Additional studies should be conducted to further investigate these questions.

3.2. Younger patients

UKA has traditionally been recommended for patients > 60 years of age. Recently, the use of UKAs in younger, high-demand patients has been met with mixed results. Felts *et al*. (11) reported that the 12-year Kaplan-Meier survival was 94% in 62 patients < 60 (mean age, 54.7. years) at 11.2. ± 5 years of follow-up. The KOOS score was > 75 points in 90% of the patients for the quality-of-life categories and 90% of the patients reported no or slight limitations during sports activities. Cartier

Table 1. Studies of UKA combined with ACL reconstruction

Study (year)	Level of evidence	Number of patients	Follow-up time (months)	Procedure	Findings	Reference
Weston-Simons (2012)	4	51	69	Oxford UKA with ACL reconstruction	Implant survival at 5 years was 93% The mean Oxford knee score was 41. All but one patient reported satisfaction with the procedure	16
Tinius (2012)	4	27	53	UKA with ACL reconstruction	Knee Society Score of 166 points No revision surgery was required and no radiolucent lines were observed	17
Krishnan (2009)	4	9	24	UKA with ACLR	The average arc of flexion was 125° at final follow-up WOMAC, Knee Society Score, and Oxford Knee Score of 24, 196, and11, respectively, at final follow-up No signs of instability during the follow up	15
Pandit (2008)	4	10 VS. 10	40	UKA with ACLR VS. UKA with ACLI	Normal knee kinematics is achieved in the ACL-deficient arthritic knee following ACLR and UKA	18
Pandit (2006)	4	15 VS.15	30	UKA with ACLR VS. UKA with ACLI	Oxford Knee Scores for the ACLR and ACLI groups of 46 and 43, respectively Functional Knee Society scores of 96 and 96, respectively The radiological study showed no difference in the pattern of tibial loading between the groups	20
Tinius (2006)	2	7	12-28	UKA with ACLR	Average Knee Society Scores of 164.1 All patients were able to return to work after Rehabilitation	19

UKA: unicompartmental knee arthroplasty; TKA: total knee arthroplasty; WOMAC: Western Ontario and McMaster Universities; ACL: anterior cruciate ligament; ACLR: anterior cruciate ligament reconstruction; ACLI: intact anterior cruciate ligament

et al. (22) reported that survival was 94.5.0% at 10 years and 88.4.8% at 12 years using the Genesis prosthesis in patients with a mean age of 53 years (age range, 30–60 years); the Knee Society score at the latest follow-up was 94.0.2, and the average function score was 93.7.6. Heyse *et al*. (23) reported excellent survival and function outcomes in the subgroup of patients < 60 years of age. Survival for the entire cohort was 93.5.% at 10 years, and 86.3.% at 15 years; the implant survival rate was 94.3.% at the latest follow-up. Indeed, similar results of survival and good clinical outcomes is replete in the literature; however, a review of the literature by W-Dahl *et al*. (1), revealed poorer clinical results and higher revision rates in patients < 65 years of age. W-Dahl *et al*. (1) focused on > 16,000 patients < 65 years of age from the Australian and Swedish knee registries to determine usage and differences in the revision rate. Patients < 55 years of age had a significantly higher cumulative risk of revision than patients 55-64 years of age (19% and 12% at 7 years, respectively). The 7-year cumulative risk of revision of UKA in patients < 65 years was similar in the 2 countries. Though age and activity level clearly influence survivorship and clinical outcome in UKA, the surgeon's expertise also has a great impact. Precise and accurate implantation is vital to achieving reproducibly good outcomes in the young because current UKA implants are intolerant of malalignment (24).

Despite a perfect method of surgical treatment for this kind of patient remains intangible, a reliable approach is one that takes the individual patient characteristics and needs into account. Moreover, a comprehensive understanding of the limitations and expectations of UKA in the young patient is necessary for the surgeon and patient.

3.3. Obese patients

Obesity increases an additional level of complexity in UKA, including excessive tibiofemoral loads and premature compartment degeneration. Obese patients, as candidates for UKA, still lack consensus in the literature. Overweight translates to greater implant interface stress and increases the potential for early implant loosening, especially in the setting of component malposition (9). Bonutti *et al*. (25) compared 40 fixed-bearing UKA cases with a body mass index (BMI) > 35 kg/m² and 40 cases with a BMI < 35 kg/m². Bonutti *et al*. (25) reported that 5 knees were revised to TKA in the high-BMI group compared with none in the low-BMI group. Two patients were revised to a TKA because of progression of painful arthritis, 2 patients had tibial component loosening, and 1 patient had intractable pain. The Bonutti *et al*. (25) study revealed a higher failure rate (12.5.%) in the more obese group at a minimal 2-year follow-up. Bonutti *et al*. (25) suggest that patients with a higher BMI have an increased risk for early failure.

Contrary results of successful UKAs in higher-weight patients have been reported as well. Cavaignac and colleagues (26) showed that weight does not influence the long-term rate of UKA survival. Cavaignac *et al*. (26) undertook a retrospective study involving 212 UKAs distributed according to BMI (< vs. ≥ 30 kg/m²) and weight (< vs. ≥ 82 kg) at a mean follow-up of 12 years. The 10-year rates of survival were similar in the 2 weight and 2 BMI subgroups. Naal *et al*. (7) also reported the BMI had no significant association with KSS values, UCLA levels, and implant failure. Naal *et al*. (7) found a weak negative correlation between BMI and post-operative knee flexion (r=-0.2.85, P= 0.0.09), and a moderate positive correlation between BMI and the intensity of anterior knee pain (r= 0.5.25, P< 0.0.01). Kuipers and colleagues (27) studied 437 Oxford III UKAs and observed a > 2-fold risk of revision in patients < 60 years of age. Kuipers *et al*. (27) did not conclude that a BMI > 30 kg/m^2 affected clinical outcome or implant survival.

4. RESULTS AND COMPLICATINOS

4.1. Results of Lateral UKA

Unicompartmental femorotibial OA affects the lateral compartment less often than the medial compartment. Of all unicompartmental femorotibial arthroplasties, the lateral compartment is affected in only 5%–10% (28-29).

Recently, an increasing number of studies have shown that lateral compartment arthroplasty is a reliable and successful option in the treatment of patients with isolated lateral tibiofemoral OA (28-36). Smith and colleagues (30) reviewed 100 patients who underwent lateral fixed-bearing unicompartmental arthroplasties over a 9 year period. Smith *et al*. (30) reported an implant survival rate of 98.7.% and 95.5.% at 2 and 5 years, respectively. The median AKSS, OKS, and modified WOMAC scores were 182, 41, and 16, respectively. Weston-Simons *et al*. (37) evaluated 265 consecutive knees with isolated lateral compartment disease; survival at 8 years was 92.1.%. Weston-Simons *et al*. (37) suggested that the Domed Lateral Oxford UKR gives good clinical outcomes, low re-operation and revision rates, and a low dislocation rate in patients with isolated lateral compartmental disease. Volpi *et al*. (38) reported that the mean HHS score for 25 knees among 28 lateral UKAs was improved from 59.9.2 to 88.0.4 and “excellent” results (scores = 85–95) and ‘‘good’’ results (scores = 71–83) were achieved in 19 and 6 knees, respectively. There was a positive increase in the pain, function, and ROM components of the score. Patient self-selected walking speed changed from 0.5.8 to 0.7.3 m/s (p< 0.0.5) (39). Knee abduction and hip adduction also had significant advancements. Moreover, the time and length of strides of all 19 patients improved significantly, as did the clinical scores (American Knee Society Score, Oxford-12, FFb-H-OA, and Devane Score). Berend *et al*. (40) suggested that complete lateral cartilage loss and correctible deformity with maintenance of the medial joint on varus stress radiographs were reasonable indications for lateral unicompartmental arthroplasty. The studies which have been published on lateral UKA are summarized in Table 2.

4.2. Results of Medial UKA

Medial UKA has been widely used clinically and achieved good outcomes (Figure 1). Fixed- and mobile-bearing UKAs are the two different methods used to treat medial unicompartmental OA. A number of studies have compared the results between mobile- and fixed-bearing UKAs (4, 10, 41-44). Parratte *et al*. (42) described 79 knees following fixed-bearing UKAs and 77 knees following mobile-bearing UKAs at a mean follow-up of 17.2. years. Considering revision for any reason as the end point, 20-year survival was 83% in the fixed-bearing group with 10 patients revised for wear and/or arthritis progression, and 80% in the mobile-bearing group with 12 patients revised for aseptic loosening, dislocation, and/or arthritis progression. This long-term study did not demonstrate any difference in survival between fixed- and mobile-bearing UKAs.

Table 2. Studies published on lateral UKA

Study (year)	Level of evidence	Number of patients	Follow-up time	Findings	Reference
Smith (2014)	2	100	9	Survival was 98.7.% and 95.5.% at 2 and 5 years, respectively Median AKSS, OKS, and modified WOMAC scores were 182, 41, and 16, respectively	30
Seeger (2014)	2	19	0.6.	Mean velocity changed from 0.5.8 to 0.7.3 m/s Knee abduction and hip adduction had significant advancement	39
Weston- Simons (2014)	2	265	4	The mean Oxford Knee Score was 40 of 48 Survival at 8 years, with failure defined as any revision, was 92.1.%	37
Altuntas (2013)	4	58	2	The mean OKS improved from 24 to 42 No cases of bearing dislocation occurred in this series	31
Schelfaut (2013)	4	25	1	The Oxford Knee Score improved from 23.3. to 42.1 Patient satisfaction was excellent in 84%, good in 12%, and fair in 4% Mechanical alignment correction averaged 4.0.°	32
Berend (2012)	4	93	2-7	Knee Society Scores averaged 46 for pain, 94 for clinical, and 89 for function, and ROM averaged 124°	40
Lustig (2012)	4	13	3-22.1.	Mean Knee Society Knee Score improved from 51 to 88 points Mean function score improved from 51 to 87 points. Prosthesis survival was 100% at 5 and 10 years, and 80% at 15 years	33
Argenson (2008)	4	39	3-23	Prostheses survival was 92% at 10 years and 84% at 16 years	34
Sah (2007)	4	49	5	The Knee Society Knee Score improved from 39 to 89 points The function scores improved from 45 to 80 points No revisions and no notable soft tissue complications were reported	29
Pennington (2006)	NC	29	12.4.	The average pre- and post-operative HSS knee scores were 60and 93, respectively The average post-operative femoral-tibial alignment was 5° of valgus, and the average posterior tibial slope was 6°	28
Robinson (2002)	4	79	4	No significant difference in patellar tendon angle was found between the normal knee and the Oxford lateral UKA	35
Ohdera (2001)	4	38	5	No radiolucent lines were seen under the tibial component, but the femoral component was loose in 1 joint	36

AKSS: American Knee Society Score; OKS: Oxford Knee Score; WOMAC: Western Ontario and McMaster Universities; ROM: range of motion; HSS: hospital for special surgery; UKA: unicompartmental knee arthroplasties; NC: not clear

Whittaker *et al*. (43) obtained similar results. Whittaker *et al*. (43) retrospectively reviewed 150 knees following fixed-bearing UKAs and 79 knees following mobile-bearing UKAs between 1990 and 2007. Patients with mobile-bearing UKAs had a minimum follow-up of 1 year (range, 1–11.3. years), and patients with fixed-bearing UKAs had a minimum follow-up of 1 year (range, 1–17.8. years). At the last follow-up, there were no differences between the two groups according to the Knee Society clinical rating score and WOMAC index. Both bearing designs provided excellent relief of pain and improved function in the treatment of medial compartment arthritis. Whittaker *et al*. (43) also reported that the 5-year cumulative survival rates were 96% and 89% for the fixed- (MG) and mobile-bearing (Oxford) designs, respectively, using TKA as the endpoint of revision. A study published in 2013 also showed no difference in quality of life outcomes after mobile- and fixed-bearing medial unicompartmental knee replacement (10). These survival data are similar to the survival data reported in the literature for mobile- (45-47) and fixed-bearing designs (48-52).

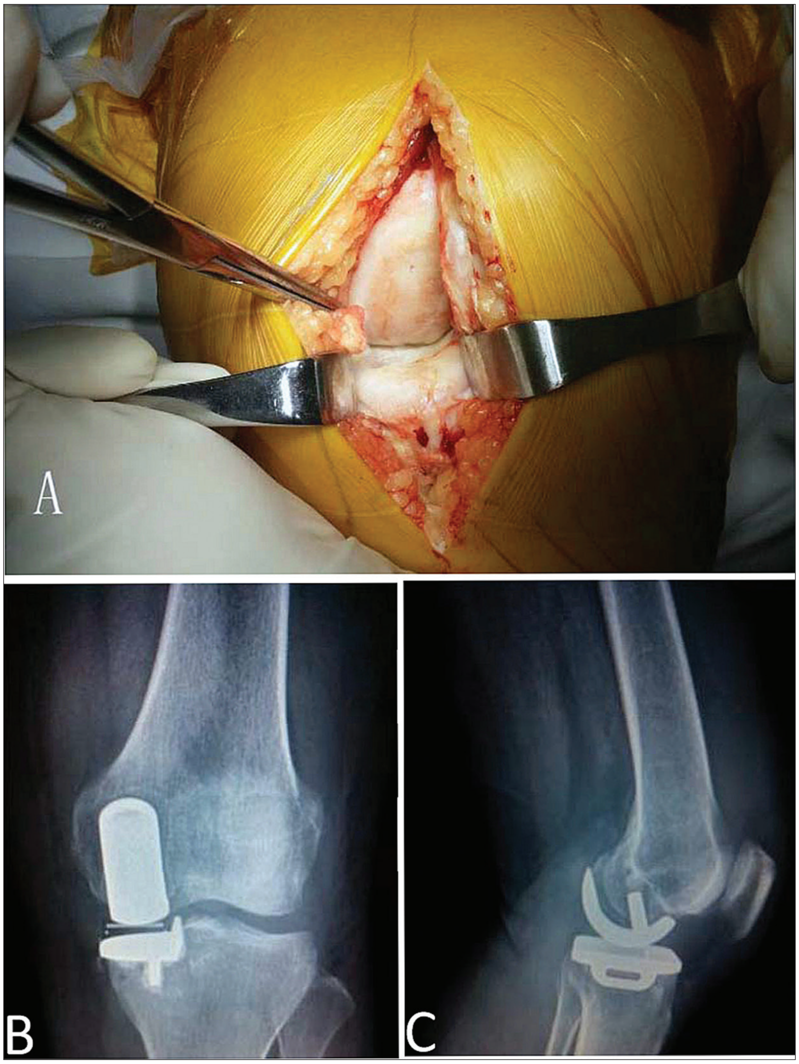

Figure 1. (A) Intra-operative photograph showing severe cartilage defects in the medial femoral condyle. (B and C) Post-operative anteroposterior and lateral views after successful medial unicompartmental arthroplasty.

An earlier report by Lewold *et al*. (53) suggested that the mobile-bearing Oxford prosthesis had a revision rate two times higher than the fixed-bearing Marmor prosthesis. Additionally, Emerson *et al*. (54) reported that the fixed-bearing Brigham prosthesis had a poorer survival than the mobile-bearing Oxford prosthesis. Progression of arthritis, aseptic loosening, and polyethylene wear are the common reasons for failure leading to revision. A recent study by Weber *et al*. (55) reported that wear was significantly reduced with an increasing tibial slope. This investigation indicated that increasing the tibial slope will lead to a reduced translation between the inlay and the prosthesis in the analyzed mobile-bearing unicondylar knee arthroplasty and reduced backside wear.

In sum, fixed- and mobile-bearing UKAs demonstrated excellent pain relief and restoration of function with durable implant survival. Which bearing design is used depends largely on the surgeon's choice and the patient's requirements. It should be noted that obese and older patients, and patients with lower scores at baseline are more likely to have worse results, and they should be informed accordingly.

4.3. Results of UKA Revised to TKA

As the number of unicompartmental knee arthroplasties performed continues to rise, so too will the number of failures. When UKA failure occurs, a revision procedure to TKA is often necessary. Revision of a failed UKA is considered technically more difficult than a primary TKA, but easier than revising a TKA (56-60). A better understanding of the outcomes after revision of a UKA to a TKA is warranted; however, the literature pertaining to the results of UKA revised to TKA is limited (56, 61-67). Converting a UKA to a TKA may be challenging because of bone loss, the need for augmentation, restoring the joint line, and rotation (64). Levine *et al*. (62) considered that a failed contemporary UKA can be successfully converted to a TKA. The results of revising failed UKA are superior to failed TKA and failed high tibial osteotomy and comparable to the results of primary TKA with follow-up periods of similar length. Saldanha *et al*. (56) suggested that the clinical outcome of Oxford medial UKA revision compared favorably with TKA revision. Saldanha *et al*. (56) retrospectively reviewed 1060 primary Oxford medial UKA procedures performed at three centers (Robert Jones and Agnes Hunt Orthopaedic Hospital, Macclesfield District General Hospital, and Skaraborgs Sjukhus Karnsjukhuset), 36 of which were revised to TKA for aseptic failure. After a mean follow-up of 2 years, the mean total knee score was 86.3. and the mean functional score was 78.5. Of the patients, 70% and 60% had good or excellent results for the total knee functional scores, respectively. Persistent moderate-to-severe pain following revision occurred in only 1 patient (2%). Châtain *et al*. (57) reported good mid-term results with revision total knee prostheses after unicompartmental prostheses. Subjective outcome was very satisfactory for 56% of the patients, satisfactory for 36%, and unsatisfactory for 8%. The mean function score was 62 points, the mean knee score 85 points, and the mean flexion was 113 degrees at a mean follow-up of 4 years after revision. No laxity existed for 90% of the knees. Sierra *et al*. (61) described 175 revisions of medial UKAs in 168 patients (81 males and 87 females; average age, 66 years) performed between 1995 and 2009 in 3 institutions (Mayo Clinic, Joint Implant Surgeons, and Midwest Orthopedics at Rush). The 4 most common reasons for UKA failure were femoral or tibial loosening (55%), progressive arthritis of the lateral or patellofemoral joints (34%), polyethylene failure (4%), and infection (3%). The revision implant choice was based on surgeon preferences. The pre-operative Knee Society Pain and Function Score was 53 and 52, respectively, and improved to 75 and 66, respectively, at the final follow-up. Complications after revision of the knee occurred in 24 knees (13%). Johnson *et al*. (59) reported a survival of 91% at 10 years for UKAs revised to TKA in their series, and concluded that revision rates were no different than revision rates for primary TKA.

Several studies compared the results of revision knee replacement after UKA to primary TKA and showed that UKA conversion to TKA was associated with poorer clinical outcome. Järvenpää and colleagues (63) compared the results of 21 patients who underwent UKA conversion to TKA with 28 primary TKA patients of the same age, gender, and operative time; the mean follow-up period of the patients was 10.5. years. As measured by the WOMAC Scale the UKA revision patients were more dissatisfied than primary TKA patients. Improvement in range of motion (ROM) was better in the TKA patients than the UKA revision patients. Oduwole *et al*. (68) also reported that the results of conversion of UKA to TKA was less satisfactory than primary TKA; there was no significant improvement in post-operative functional scores. The clinical outcomes of studies involving UKAs revised to TKA are summarized in Table 3.

In summary, revision of UKA to TKA is not a universally straightforward procedure comparable to standard primary replacement. Despite several studies showing poorer clinical outcome as compared to primary TKA, a UKA is a viable option in the treatment of unicompartmental OA.

4.4. Complications of UKA

The more common complications of UKA include polyethylene wear, progression of arthritis to the adjacent compartment, aseptic loosening, dislocations, peri-prosthetic fractures, and infections. Based on a comprehensive review of the literature, aseptic loosening, polyethylene wear, and progression of arthritis are the most commonly reported modes of complications for UKA (56, 61-62, 69-72). Sierra and colleagues (61) reported the reasons for revision of UKAs to TKA were component loosening (55%) and progressive arthritis (34%) among 175 knees. Bergeson *et al*. (73) also concluded that aseptic loosening and progressive arthritis were the primary factors for failure of UKA.

Park *et al*. (74) reported that polyethylene wear particles may play a role in development of OA via detrimental effects on cartilage, meniscii, and

Table 3. Clinical outcomes of UKAs revised to TKA

Study (year)	Level of evidence	Number of patients	Follow-up time	Procedure	Findings	Reference
O'Donnell (2013)	NC	55 VS.55	39.2. months	rev-UKA VS. PTKA	No significant difference between the 2 groups in terms of range of motion, functional outcome, or radiologic outcomes	60
Järvenpää (2010)	NC	21 VS.28	10.5. years	rev-UKA VS. PTKA	The UKA revision patients were more dissatisfied, as measured by the WOMAC scale comparing the primary TKA patients (pain=18.1./7.8., stiffness=25.7./14.4., and physical function=19.0./14.8.) Improvement in range of motion (ROM) was better in the TKA patients compared to the UKA revision patients	63
Saragaglia (2009)	NC	27	8-153 months	rev-UKA	The mean knee score was 86.3.±10.6. points. The mean function score was 80.4.±16 points. The global score was 166.7.2±21.3. points The mean flexion was 103.8.°±19.2.°	66
Dudley (2008)	2	68 VS 112	NC	rev-UKA VS. rev-TKA	Rev-TKA was predictably more complex than rev-UKA Rev-UKAs were associated with lower implant costs and hospital charges compared with rev-TKAs	67
Johnson (2007)	NC	77	10.5. years	rev-UKA	An average Bristol Knee Score of 78.5 Survival of 91% at 10 years	59
Springer (2006)	NC	18	64.5. months	rev-UKA	Knee Society Knee and Functional Scores at latest follow-up were 93 and 78, respectively	65
Châtain (2004)	NC	54	2-12 years	rev-UKA	The revision procedure was considered easy in 82% of the cases The mean function score was 62 points, the mean knee score 85 points, and the mean flexion was 113 degrees No laxity was found in 90% of the knees	57

WOMAC: Western Ontario and McMaster Universities; TKA: total knee arthroplasty; UKA: unicompartmental knee arthroplasties; rev-UKA: UKA revision; rev-TKA: TKA revision; NC: not clear

synovia. Park *et al*. (74) determined that polyethylene wear particles increase pro-inflammatory cytokine and mediator (IL-1β, IL-6, TNF-α, nitric oxide, and prostaglandin E2) production, phagocytosis of particles, and apoptosis in all cell types. Moreover, such activities also lead to UKA failure.

Progression of arthritis can be caused by overcorrection of varus or valgus deformities (54). There is a significant relationship between the post-operative tibio- femoral angle and the implant failure rate. Kim *et al*. (75) reported a correlation between the post-operative tibiofemoral angle and implant failure; the cumulative survival rate was highest in the group with a post-operative tibio-femoral angle of 4°- 6°of valgus and lowest in the group with≥10°of valgus.

Bearing dislocation is a complication of unicompartmental knee arthroplasty using mobile-bearing prostheses (32). Bearing dislocation can be diagnosed by radiography. Displacement of radio-opaque markers, two small marker balls in the back of the bearing and a transverse wire in the front of the bearing, is diagnostic of bearing dislocation in the Oxford prosthesis (76).

Peri-prosthetic joint infections are a rare, but serious and challenging complication of UKAs. There is limited literature available to guide the diagnosis of peri-prosthetic joint infections in the population requiring an alternative to TKA. Schwartz *et al*. (77) reported optimal cut-off values among patients with peri-prosthetic joint infections, as follows: 27 mm/h for the erythrocyte sedimentation rate; 14 mg/L for the C-reactive protein; 6200/µL for the synovial fluid WBC count; and 60% for the differential. Schwartz *et al*. (77) suggested that these tests are useful for diagnosing peri-prosthetic joint infections after UKA with optimal cut-off values.

5. UKA VERSUS TKA

TKA replaces both tibiofemoral surfaces, while UKA only replaces the medial or lateral tibiofemoral surface. TKA is the primary choice in the treatment of OA of the knee. The reasons for selecting TKA over UKA as the treatment of choice include the presence of arthritis in two or three compartments, instability in the ligaments, a less complex surgical procedure, correction of alignment, and long-term survival (78-79); however, the advantages of UKA have made UKA widely used clinically with a good treatment effect comparable to TKA.

Keudell *et al*. (80) reported that younger patients who were treated with UKA demonstrated higher satisfaction scores when compared with patients of the same age group who underwent TKA. The average satisfaction with pain, ROM, and ability to kneel for patients < 55 years of age was higher for UKA than TKA. Patients < 55 years of age with UKA were up to 2.9. times more likely to have their expectations met when compared to patients undergoing TKA. Of the UKA patients, 96.0.% rated their joints as good/excellent in 96.0.% compared to 81.0.% of TKA patients in the same age group. In a series of 68,603 patients with arthritic knees requiring arthroplasty, Bolognesi and colleagues (81) demonstrated that patients who underwent UKA had higher revision rates, but shorter durations of stay and tended to have lower rates of peri-operative complications. Although the 5-year revision rate was 3.7.% for TKA and 8.0.% for UKA, the mean length of stay was 2.4. ± 1.7. days for UKA and 3.9. ± 2.1. days for TKA. The return to sports activities rate for UKA was higher than TKA (97% vs. 64%) (82). Moreover, the UKA group was engaged in more sports activities and for a longer period of time. In a randomized trial, Newman and colleagues (83) reported survival to be higher in UKA compared to TKA (89% vs. 79%) at 15 years and revisions of UKA could be performed with standard primary TKA designs.

Jung and colleagues (84) compared knee kinematics during stair walking in patients with a simultaneous TKA and UKA. Jung *et al*. (84) reported that UKA may allow greater degree of rotation freedom, which resembles normal knee kinematics during stair walking; the main limitation to the study was enrollment of only six patients. Further studies with a larger patient enrollment should be pursued. Sweeney *et al*. (85) evaluated the health-related quality of life (HRQL) of patients following UKA compared to TKA for OA treatment. Sweeney *et al*. (85) showed that patients had a significant improvement at 3 and 6 months following UKA and TKA, and that there was no significant difference in outcomes between the two groups over time as measured by the Western Ontario and McMaster Osteoarthritis index (WOMAC) and the Oxford Knee Score (OKS). Lim *et al*. (86) retrospectively reviewed the pain, function, and Total Knee Society (KSS) Scores for 602 UKAs and age- and gender-matched TKAs between 2001 and 2013. Lim *et al*. (86) showed that the change in function scores was not significantly different between these two groups and the total KSS for both groups were not significantly different. Winder and colleagues (87) compared the 90-day complication rate of 28 patients who underwent simultaneous UKAs with 56 patients who underwent simultaneous TKAs, and found that the bilateral UKA group had a similar risk of complications to a matched group of bilateral TKA patients.

6. SUMMARY

There has been a resurgence in the UKA due to the proposed benefits and the lower morbidity of the procedure over TKA in appropriately selected patients. Patients' expectations with respect to the surgery success rate and post-operative activity levels have increased with the change in patient population and improvement in surgical outcomes. The literature involving patients < 60 years of age has reported good clinical outcomes and survival. Patients with unicompartmental femorotibial OA and ACL deficiencies can anticipate good results following treatment with UKA and ACL reconstruction. Although obese patients in several investigations have not shown an influence in the long-term rate of survival of UKA, further studies are warranted. Thus, the success of unicompartmental replacement depends on proper patient selection and surgical technique. Distinct surgical considerations exist depending on the choice of UKA implant used and which compartment is replaced. Although previously considered a staging procedure while awaiting definitive TKA, mid- and long-term studies have shown that UKA is an acceptable alternative to TKA.

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Abbreviations: UKA, unicompartmental knee arthroplasty; ACL, anterior cruciate ligament; TKA, total knee arthroplasty OA, osteoarthritis; ROM, range of motion

Key Words: Unicompartmental Knee Arthroplasty, Anterior Cruciate Ligament Reconstruction, Total Knee Arthroplasty, Review

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