ORIGINAL ARTICLE

Complications, Reasons for Reoperation, and 5-Year Prosthesis Survival Compared between the Cemented and Cementless Oxford Unicompartmental Knee Arthroplasty in Thai Patients

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Background: Oxford unicompartmental knee arthroplasty (OUKA) yields favorable outcomes in patients with medial compartmental knee osteoarthritis. However, it remains unknown whether cemented or cementless OUKA fixation delivers better outcomes in Asian population.

Objective: To investigate the complications, reasons for reoperation, and 5-year prosthesis survival compared between cemented and cementless OUKA in Thai patients.

Materials and Methods: Four hundred sixty-six cemented and 36 cementless OUKA performed between 2011 and 2015 with a minimum follow-up of five years were included. With reoperation for any reason as the endpoint, Kaplan-Meier analysis was performed to compare 5-year implant survival between groups. Complications, reasons for reoperation, and 90-day morbidity and mortality were compared between groups. Cox proportional hazards model was used to identify independent predictors of implant survival.

Results: There was no significant difference in 5-year implant survival between the cemented and the cementless groups at 96.4% versus 94.4% (p=0.375). The mean implant survival time was 113.0±0.8 and 70.8±1.9 months in the cemented and the cementless groups, respectively (p=0.383). The most common reason for reoperation was bearing dislocation, and only one patient had 90-day morbidity. There was no significant difference between groups for complications or reasons for reoperation. No independent predictors of implant survival were identified in multivariate analysis.

Conclusion: OUKA was shown to be a safe and durable reconstructive procedure in Thai patients with medial compartmental knee osteoarthritis. There was no significant difference in implant survival between the cemented and the cementless groups during the 5-year follow-up, and no independent predictors of implant survival were identified.

Trial registration: Thai Clinical Trials Registry, TCTR20200427004, registered 27 April 2020, retrospectively registered

Keywords: Complications; Reasons for reoperation; 5-year implant survival; Oxford unicompartmental knee arthroplasty (OUKA); Thailand

Received 13 June 2022 | Revised 9 January 2023 | Accepted 16 January 2023

J Med Assoc Thai 2023;106(2):207-12

Website: http://www.jmatonline.com

Unicompartmental knee arthroplasty is an effective treatment for medial compartmental osteoarthritis knee patients that failed conservative treatment[1-3]. Oxford unicompartmental knee arthroplasty (OUKA) is a fully congruent mobile bearing prosthesis with spherical femoral and flat tibial components. After design modifications, the OUKA phase 3 design was introduced in 1998, and it was reported to deliver good outcomes and longevity[4,5].

There are two types of fixations that can be employed to implant the OUKA prosthesis. Cemented fixation was initially the only option for implantation. Later, to achieve biologic fixation, a cementless version with a porous coating of titanium and hydroxyapatite, and an additional peg in the femoral component was introduced in 2004. The cementless version can facilitate avoidance of cementing error, and it can reduce radiographic radiolucent lines that may be misinterpreted as a sign of loosening[6,7].

Comparing the implant survival, some studies reported no significant difference between cemented

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How to cite this article:

Paugchawee J, Ruangsomboon P, Narkbunnam R, Chareancholvanich K, Pornrattanamaneewong C. Complications, Reasons for Reoperation, and 5-Year Prosthesis Survival Compared between the Cemented and Cementless Oxford Unicompartmental Knee Arthroplasty in Thai Patients. J Med Assoc Thai 2023;106:207-12.

DOI: 10.35755/jmedassocthai.2023.02.13785

and cementless OUKA in short to midterm survival[8,9]. While, the longer-term studies reported cemented OUKA had a significantly lower survivorship than cementless OUKA[3,5]. However, all of the studies mentioned above were conducted in Western populations, and no comparative study has yet been reported from Asian countries.

Several studies have reported differences in knee morphology between Caucasians and Asians[10-12]. These differences may be due to differences in lifestyle, including high knee flexion and floor activity in Asian cultures, and these factors may influence the rates of implant failure and survival. The aim of the present study was to investigate the complications, reasons for reoperation, and the 5-year implant survival compared between the cemented and the cementless OUKA fixation techniques in Thai medial compartmental knee osteoarthritis patients.

Materials and Methods

The present study was a retrospective chart review that identified 572 patients who underwent OUKA for treatment of medial compartmental osteoarthritic knee between 2011 and 2015 at the authors' institute. Seventy knees were subsequently excluded due to incomplete data or follow-up time of less than five years. The remaining 502 knees were categorized into the cemented or cementless groups. Five experienced arthroplasty surgeons performed all procedures. The protocol for the present study received approval from Siriraj Institutional Review Board, and written informed consent was waived due to our study's retrospective design (879/2562 IRB3).

Baseline characteristics, including age, gender, weight, height, body mass index (BMI), and the American Association of Anesthesiologists (ASA) classification, were collected and recorded. For intraoperative parameters, tourniquet time and implant component sizes were collected. Postoperative complications, 90-day morbidity including infection, fracture, venous thromboembolism, cerebrovascular, and cardiovascular events, and 90-day mortality were also recorded and analyzed. During the follow-up period, the reoperation rate for any reason and reasons for reoperation were also collected and included in the present study analysis.

Statistical analysis

Data were analyzed using PASW Statistics, version 18.0 (SPSS Inc., Chicago, IL, USA). Continuous data were presented as mean ± standard deviation, and categorical data were presented as number and percentage. Kaplan-Meier survival analysis was used to compare OUKA implant survival between the cemented and cementless fixation groups. The starting point was the date of operation, and the endpoint was the date of reoperation for any reason. Log-rank test was used to compare the survival curves between groups. Univariate analysis was performed using Student's t-test for continuous data and chi-square or Fisher's exact test for categorical data. Cox proportional hazards model was used to identify independent predictors of OUKA implant survival. A p-value less than 0.05 was considered statistically significant.

Results

Patient demographic data, clinical characteristics, and intraoperative parameters are shown in Table 1. The cemented group was significantly older than the cementless group at 65.4±8.2 versus 56.6±3.8 years ($p<0.001$). Significant differences in ASA classification and femoral component sizing were also observed between groups ($p=0.018$ and 0.036, respectively). The cemented group had significantly longer tourniquet time than the cementless group at 66.0±20.7 versus 58.0±11.5 minutes ($p=0.001$).

Regarding in-hospital complications, 90-day morbidity, and 90-day mortality, one patient in the cemented group had an acute-on-chronic pulmonary embolism on the first postoperative day with subsequent medical treatment success. There were no in-hospital complications or 90-day mortality in the present series. The cemented group had a significantly longer follow-up time than the cementless group at 84.6±18.7 versus 64.4±10.5 months, respectively ($p<0.001$) (Table 2).

Regarding the primary outcome, the 5-year OUKA implant survival rate in the cemented and the cementless groups was 96.4% and 94.4%, respectively. There was no significant difference between groups ($p=0.375$). The overall reoperation rate of OUKA in the present series was 3.6%, and the overall mean survival time of OUKA series was 112.8±0.7 months. Kaplan-Meier survival analysis compared between the two fixation groups was shown in Figure 1. There was no significant difference in the mean implant survival time between the cemented and the cementless groups at 113.0±0.8 months (95% CI 111.5 to 114.5) versus 70.8±1.9 months (95% CI 67.2 to 74.4), respectively ($p=0.383$). There was also no significant difference in the reasons for reoperation between groups (Table 2). Details specific to cases that required reoperation are described in Table 3.

Table 1. Patient demographic data, clinical characteristics, and intraoperative parameters compared between the cemented and cementless OUKA groups

Variables	Cemented group (n=466)	Cementless group (n=36)	p-value
Age (years); mean±SD	65.4±8.2	56.6±3.8	<0.001*
Female; n (%)	397 (85.2)	32 (88.9)	0.544
Weight (kg); mean±SD	67.1±11.4	69.8±13.8	0.179
Height (cm); mean±SD	156.1±6.9	155.7±5.5	0.736
BMI (kg/m^2); mean±SD	27.5±4.3	28.8±5.6	0.188
Right side; n (%)	232 (49.8)	22 (61.1)	0.190
ASA classification; n (%)			0.018*
I	52 (11.2)	7 (19.4)	
II	357 (76.6)	20 (55.6)	
III	57 (12.2)	9 (25.0)	
Tourniquet time (minutes), mean±SD	66.0±20.7	58.0±11.5	0.001*
Femoral component sizing; n (%)			0.036*
Extra small	113 (24.2)	2 (5.6)	
Small	250 (53.7)	27 (75.0)	
Medium	86 (18.5)	5 (13.8)	
Large	17 (3.6)	2 (5.6)	
Tibial component sizing; n (%)			0.295
AA	136 (29.2)	10 (27.8)	
A	166 (35.6)	19 (52.8)	
B	83 (17.8)	5 (13.8)	
C	62 (13.3)	1 (2.8)	
D	18 (3.9)	1 (2.8)	
E	1 (0.2)	0 (0.0)	
Polyethylene thickness; n (%)			0.996
3 mm	198 (42.5)	14 (38.9)	
4 mm	165 (35.4)	13 (36.1)	
5 mm	71 (15.2)	6 (16.6)	
6 mm	20 (4.3)	2 (5.6)	
7 mm	11 (2.4)	1 (2.8)	
8 mm	1 (0.2)	0 (0.0)	

OUKA=Oxford unicompartmental knee arthroplasty; SD=standard deviation; BMI=body mass index; ASA=American Association of Anesthesiologists

* p<0.05 indicates statistical significance

Table 2. Postoperative outcomes compared between the cemented and cementless OUKA groups

Outcomes	Cemented group (n=466)	Cementless group (n=36)	p-value
In-hospital complications; n (%)	0 (0.0)	0 (0.0)	NA
90-day morbidity; n (%)	1 (0.2)	0 (0.0)	1.000
90-day mortality; n (%)	0 (0.0)	0 (0.0)	NA
Follow-up period			
Follow-up time (months); mean±SD	84.6±18.7	64.4±10.5	<0.001*
Reoperation; n (%)	16 (3.4)	2 (5.6)	0.375
Reasons for reoperation; n (%)			0.723
• Aseptic loosening	3 (18.8)	0 (0.0)	
• Bearing dislocation	5 (31.3)	0 (0.0)	
• Periprosthetic joint infection	3 (18.8)	1 (50.0)	
• Lateral compartmental OA	2 (12.5)	1 (50)	
• Patellofemoral OA	1 (6.3)	0 (0.0)	
• Unexplained pain	1 (6.3)	0 (0.0)	
• Periprosthetic fracture	1 (6.3)	0 (0.0)	
Prosthesis survival time (months); mean±SD	113.0±0.8	70.8±1.9	0.383

OUKA=Oxford unicompartmental knee arthroplasty; SD=standard deviation; OA=osteoarthritis

* p<0.05 indicates statistical significance

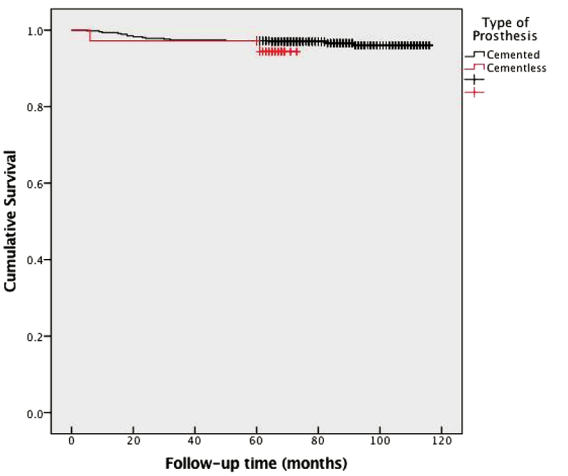

Figure 1. Kaplan-Meier analysis of Oxford unicompartmental knee arthroplasty (OUKA) cumulative survival during the follow-up period compared between the cemented and cementless OUKA groups (p=0.383).

The type of prosthesis and statistically significant factors from univariate analysis including age, ASA, and femoral component sizing were entered into Cox proportional hazards model to identify independent predictors of OUKA implant survival. The results of that analysis revealed no independent associations (all p>0.05).

Discussion

To the authors' knowledge, this is the first study to compare implant survival between cemented and cementless OUKA in Asian patients. The most important finding of the present study is that there is no significant difference in 5-year implant survival between the two fixation methods. This result is similar to the findings of studies reported from the West. Akan et al.[12] performed a retrospective study that found no significant difference in the revision

Table 3. Reasons for reoperation and management in the cemented and cementless OUKA groups

Months since operation	Type of prosthesis	Reasons for reoperation	Management
5	Cemented	Periprosthetic joint infection	Arthrotomy, debridement, and bearing exchange
6	Cementless	Periprosthetic joint infection	Arthrotomy, debridement, and bearing exchange
9	Cemented	Periprosthetic joint infection	Arthrotomy, debridement, and bearing exchange
10	Cemented	Aseptic loosening of tibial component	Revision to TKA
15	Cemented	Bearing dislocation	Bearing upsize
16	Cemented	Patellofemoral osteoarthritis	Patellofemoral joint arthroplasty
18	Cemented	Aseptic loosening of tibial component	Revision to TKA
18	Cemented	Aseptic loosening of femoral component	Revision to TKA
20	Cemented	Bearing dislocation	Revision to TKA
23	Cemented	Bearing dislocation	Bearing upsize
24	Cemented	Bearing dislocation	Revision to TKA
30	Cemented	Bearing dislocation	Revision to TKA
32	Cemented	Unexplained pain	Revision to TKA
50	Cemented	Periprosthetic joint infection	Arthrotomy, debridement, and bearing exchange
61	Cementless	Lateral compartmental osteoarthritis	Revision to TKA
65	Cemented	Lateral compartmental osteoarthritis	Revision to TKA
83	Cemented	Medial tibial plateau fracture	ORIF with plate and screws
92	Cemented	Lateral compartmental osteoarthritis	Revision to TKA

OUKA=Oxford unicompartmental knee arthroplasty; TKA=total knee arthroplasty; ORIF=open reduction and internal fixation

rate between cemented and cementless OUKA at 7.1% versus 4.9% (p=0.155) at a mean follow-up time of 42 and 30 months, respectively. The multicenter retrospective study of Kerens et al.[8] revealed no significant difference in the implant survival rates between cemented (84% at 54 months) and cementless OUKA (90% at 34 months). Pandit et al.[13] conducted a randomized controlled trial of 33 cemented and 30 cemented OUKA. At the 5-year follow-up, no revision cases were reported in their study. Stempin et al.[14] collected data from a prospective cohort study with an average follow-up time of seven years and found no significant difference in the revision rate between cemented (3.4%) and cementless OUKA (2.0%). In South Africa, Campi et al.[15] performed a survival analysis in a prospective cohort of 522 cemented and 598 cementless OUKA. Their results showed no significant difference in 5-year implant survival between cemented and cementless OUKA at 95.1% versus 95.8% (p=0.97).

However, contradictory results were reported from larger or longer-term studies. Knifsund et al.[16] collected data from the Finnish Arthroplasty Register, and they found the 5-year survival of cemented OUKA to be significantly shorter than that of cementless OUKA at 88.9% versus 92.3% (p<0.05). Mohammad et al.[5] conducted a large propensity-matched study from the National Joint Registry for England, Wales, Northern Ireland, and the Isle of Man (NJR) data. They found the 10-year cumulative survival of cemented OUKA at 90% (95% CI 88 to 92) to be significantly lower than that of cementless OUKA at 93% (95% CI 90 to 96). Gupta et al.[3] performed a 19-year analysis of data from the New Zealand Joint Registry (NZJR), and found that cemented OUKA had a significantly higher rate of revision over time compared to cementless OUKA, and the risk of revision was greater than 1.8-fold (hazard ratio of 1.82, 95% CI 1.27 to 2.60). Additionally, a recent meta-analysis of 901 patients revealed cementless OUKA to be associated with a lower revision rate after follow-up for at least two years (odds ratio of 1.83, 95% CI 0.90 to 3.73)[17]. In the reasons for reoperation, the rate of bearing dislocation from the present study was higher than the rates from Western registry-based data[5,15]. A meta-analysis by Ro et al.[18] found the mean reoperation rate per 100 observed component years for bearing dislocation after OUKA to be higher in Asians at 0.53 (95% CI 0.41 to 0.64), than in Westerners at 0.14 (95% CI 0.12 to 0.17). There are factors that may explain this problem. Hyperflexion knee or floor activities are commonly performed in Asian populations, and these activities resulted in anterior tibial subluxation and strained anterior cruciate ligament that increased the risk of bearing dislocation[19]. Another possible explanation is that repetitive hyperflexion activity might cause impingement between the polyethene bearing and the

remaining osteophytes or meniscus[12,17]. Furthermore, a relatively smaller tibia in Asians compared to Westerners result in tibial component size mismatch that could lead to mediolateral overhang of the tibial component. This overhang creates more space for bearing motion and might cause an imbalance in soft tissue tension. This hypothesis may also increase the chance of bearing dislocation. Considering the different types of OUKA failure in the present study, the most common reason for reoperation in cemented OUKA was bearing dislocation. While, the most common reasons in cementless OUKA were osteoarthritis progression and infection, no bearing dislocation was found in cementless group. This finding might be explained by the avoidance of impingement from cementing error and the use of newly microplasty instrumentation[20]. However, a larger and longer-term follow-up study is required.

The results of the present study also demonstrated either cemented or cementless OUKA to be a safe procedure for treating medial compartmental knee osteoarthritis in Asians relative to complications, morbidity, and mortality. The authors had only one patient with 90-day morbidity in our series, with no complications and no mortality. This is similar to the results from a study in 2,316 OUKA from the National Surgical Quality Improvement Program that reported an overall complication and 90-day morbidity rate of 3.2% with no mortality[21].

Limitation

The present study has limitations. First, the present study had a comparatively small number of cases enrolled in the cementless group because the cementless prosthesis was introduced in Thailand in 2014. It is possible that the small number of cementless cases could have limited the statistical power of the present study to detect the difference of reoperation rate and identify independent predictors of OUKA implant survival. From post-hoc power analysis, the present study had only 8% of power to detect the distinction of reoperation rate between groups. Second, there are some unbalanced outcomes between groups in the present study. For age difference, the present recent surgical trend was frequently performed in younger patients. The reason for other unbalanced outcomes might be explained by small sample size of cementless group. Third, the present study reported only short- to mid-term implant survival, and study of longer-term outcomes is needed. Fourth, all procedures were performed by medium- to high-volume surgeons. As such, different outcomes might be observed in low-volume surgeons. From the NJR database, the 10-year survival rate for cemented and cementless OUKA was 86.8% and 81.8% in low-volume surgeons (<10 cases/year), 94.3% and 92.5% for medium-volume surgeons (10 to <30 cases/years), and 97.5% and 94.2% for high-volume surgeons (≥30 cases/year), respectively[22]. Fifth and last, because of retrospective design, the authors were not able to evaluate functional or patient-reported outcomes. Implant survivorship was the only outcome that could be confidently assessed. However, many of these outcomes have already been studied in the previous trials.

Conclusion

OUKA was shown to be a safe and durable reconstructive procedure in Thai patients with medial compartmental knee osteoarthritis. There was no significant difference in implant survival between the cemented and the cementless groups during the 5-year follow-up, and no independent predictors of implant survival were identified. The most common reason for reoperation was bearing dislocation.

What is already known on this topic?

Either cemented or cementless OUKA is an effective treatment for medial compartmental osteoarthritis knee patient. Several studies have reported the survivorship compared between cemented and cementless OUKA in Caucasian.

What this study adds?

To the authors' knowledge, this is first study to compare the survivorship between cemented and cementless OUKA in Asian patients. Because of the difference of knee morphology and lifestyles between Caucasian and Asian peoples, the survivorship of cemented and cementless OUKA may be distinctive.

Conflicts of interest

The authors declare no conflict of interest.

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