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KNEE ARTHROPLASTY

# Unicompartmental knee arthroplasty in patients over 75 years: a definitive solution?

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**Abstract**
*Introduction* The purpose of this study was to perform a mid-long-term clinical and radiographic evaluation of the results obtained in patients older than 75 years treated with minimally invasive unicompartmental knee arthroplasty (UKA). The hypothesis was that UKA is a viable solution for the definitive treatment of localized disease in this age group, with good results and a low failure rate.
*Methods* An all-poly tibial component UKA was applied with a minimally invasive technique. Sixty-seven knees in patients with a minimum age of 75 years were evaluated at mean 9 years' follow-up. The Oxford knee score, Knee Society Score, WOMAC score, Visual Analogue Scale (VAS) for pain self-assessment and range of motion (ROM) were determined, as well as weight-bearing antero-posterior and laterolateral radiographs.
*Results* All clinical scores, as well as VAS and ROM, improved significantly at 9-year follow-up, and the outcome was considered good or excellent in 92.6 % of the patients. Radiographic results showed that both tibial plateau angle and posterior tibial slope angles were maintained, whereas femoro-tibial angle was significantly changed at follow-up. Further analysis showed no significant correlation between clinical scores and body mass index, whereas the clinical outcome was correlated with the ROM obtained. Only two failures and one major post-operative complication were observed.
*Conclusions* UKA is a viable option for treating unicompartmental knee osteoarthritis. With the proper indications and an accurate technique UKA may be indicated also in very elderly patients with reduced complications and morbidity, and excellent survivorship.

**Keywords** Unicompartmental knee arthroplasty · Knee · Osteoarthritis · Osteonecrosis · Elderly · Age

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## Introduction

Unicompartmental Knee Arthroplasty (UKA) continues to gain popularity as a viable treatment option for osteoarthritis or osteonecrosis isolated to one compartment of the knee, especially in patients older than 65 years [1–5]. UKA has potentially well-known advantages over total knee arthroplasty (TKA) because it involves a less aggressive surgical procedure. These advantages include preservation of bone stock and cruciate ligaments, early and complete knee range of motion (ROM), faster recovery, and reduced morbidity and complications [3, 6]. In addition, the risks of intra and postoperative bleeding, venous thrombosis, infection rates, costs, and development of medical complications are increased with TKA compared with UKA [7, 8]. Thus, in elderly patients who have a lower threshold for tolerance of alterations in hemodynamics and associated medical comorbidities, that make these patients more susceptible to peri-operative morbidity and complications, UKA should be considered as a viable alternative to TKA. However, whereas early clinical results of UKA are satisfactory and comparable with those of TKA, the key difference between the two procedures may be the revision rate and survival of the prostheses. In fact, studies comparing failures and revisions in UKA and TKA showed a trend for more revisions in UKA than in TKA at follow-up period between 5 and 10 years [9, 10]. Besides postoperative infection, reasons for failure are mainly attributed to overuse and aseptic mechanical loosening of the prosthetic components [11, 12]. However, although this is true for young active patients, it might not be the case in a much older population. Elderly patients have lower functional demands and, therefore, lower risks of mechanical failure, making UKA more likely to outlive the life expectations of these patients. Thus, since a less invasive surgery is desired in these patients, it is important to determine whether elderly patients may benefit from a UKA procedure without the risk of further prosthetic revision.

The purpose of this study was to perform a clinical and radiographic evaluation of 67 knees in patients older than 75 years treated with minimally invasive UKA and evaluated at a mean follow-up of 9 years. The hypothesis was that UKA is a viable alternative to TKA as definitive treatment of localized disease in this age group, with good results and a low failure rate.

## Materials and methods

UKA (Preservation Uni Knee System, De Puy, Warsaw, IN, USA) has been performed in our Institution since 1998. Patients treated up to the end of 2007 were considered in order to have a minimum follow-up evaluation of 6 years. Among the 315 patients who underwent medial UKA in this time frame, we identified 71 patients over 75 years old at the time of surgery. Among these, 64 were available for clinical and imaging evaluation. Three patients had bilateral staged unicompartmental osteoarthritis; thus, a total of 67 knees were considered for the study. The diagnosis was primary osteoarthritis limited to the medial compartment in 53 cases and primary osteonecrosis of the medial femoral condyle in 14 cases. Forty-two patients were ASA II (mild systemic disease) and twenty-two ASA III (severe systemic disease). More detailed patient data are summarized in Table 1.

Inclusion criteria were: age over 75 years at the time of surgery, pain and tenderness localized to the medial joint line, active and passive flexion greater than 90°, fixed flexion contracture less than 10°, isolated medial compartment osteoarthritis with loss of cartilage on pre-operative radiographs (Ahlback grade 3–4), varus deformity less than 15° on pre-operative radiographic evaluation, no radiographic evidence of Ahlback grade 3–4 osteoarthritis on lateral and patello-femoral compartments, intact cruciate ligaments, absence of inflammatory arthritis or chondrocalcinosis, and no anamnestic evidence of osteoporotic condition.

### Surgical technique

All operations were performed by two senior authors (MM, IF) with a minimally invasive quadriceps-sparing technique [2, 13]. In all cases, a cemented implant with an all-poly tibial component was used (Preservation Uni Knee System, De Puy, Warsaw, IN, USA).

### Clinical and radiographic evaluation

Pre-operative evaluation included the collection of demographic data, medical history, primary diagnosis, and concurrent medical problems. Operative notes and medical records were examined for blood loss, any complications, readmissions and presence of comorbidity before surgery categorized by an anesthetist according to the American Society of Anesthesiologists physical status classification system. The Oxford knee score (OKS), Knee Society Score

**Table 1** Demographic data

| Age in years | mean (SD) 78 (±3) |
|---|---|
| Sex: male/female | 17/47 |
| Side: right/left | 34/33 |
| Unilateral/bilateral | 61/3 |
| BMI | mean (SD) 26 (±3) |
| Follow-up in years | mean (range) 9 (6–13) |

(KSS), WOMAC score, Visual Analogue Scale (VAS) for pain self-assessment and range of motion (ROM) were also determined as part of the normal patient pre-operative assessment and repeated at the final follow-up. All patients were asked if they were satisfied with the procedure and if they would recommend the procedure or undergo the surgery again.

Each patient underwent pre-operative weight-bearing antero-posterior (AP) and latero-lateral (LL) radiographs. Standard weight-bearing AP and LL radiographs were taken at follow-up to assess the correction obtained according to the anatomical femoro-tibial angle (FTA) as well as the presence of prosthetic component loosening or radiolucent lines. In addition, the tibial plateau angle (TPA), and posterior tibial slope (PTS) were measured (Figs. 1, 2, 3) [2].

Revision for any reason or a painful knee with a poor KSS score or radiological signs of loosening were considered as failures.

Ethical Committee approval was obtained and all patients gave their informed consent prior to their inclusion in the present study.

### Statistical analysis

The comparison between pre-operative and post-operative data was performed for clinical scores under analysis with un-paired Student's $t$ test. A Pearson correlation analysis was performed to evaluate the correlation between clinical scores, Body Mass Index (BMI) and ROM. Statistical significance was set at 95 % ($p < 0.05$) for all tests.

## Results

There were two failures (2/67–3 %) according to the clinical definition of a KSS poor score (i.e., <score); one of these two patients also required revision surgery. There were no major intraoperative complications, and only one major postoperative complication (deep vein thrombosis with pulmonary embolism). No other complications, such as infections or perioperative deaths, were observed. The mean total post-operative drainage was 210 ml (range 150–350 ml).

All clinical scores, as well as VAS and ROM, improved significantly at 9-year follow-up with respect to preoperative values. The outcome was considered good or excellent in 92.6 % of the patients (KSS: 50 excellent, 12 good, 3 fair, and 2 poor). More detailed clinical results are reported in Table 2.

Radiographic results showed that both TPA and PTA angles were maintained (86° ± 3 pre-operatively vs 85° ± 3 at follow-up and 7° ± 3 pre-operatively vs 8° ± 4 at follow-up, respectively), whereas FTA was significantly changed from 182° ± 3 pre-operatively to 178° ± 3 ($p < 0.05$) at follow-up.

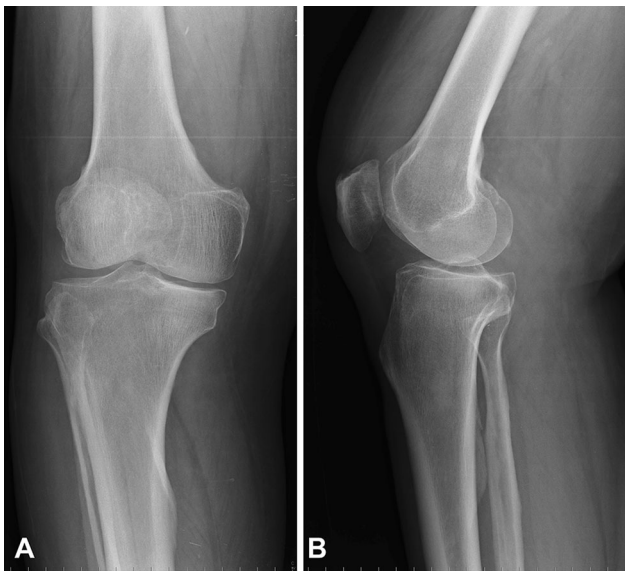


**Fig. 1** Pre-operative radiograph. **a** Frontal view, **b** lateral view

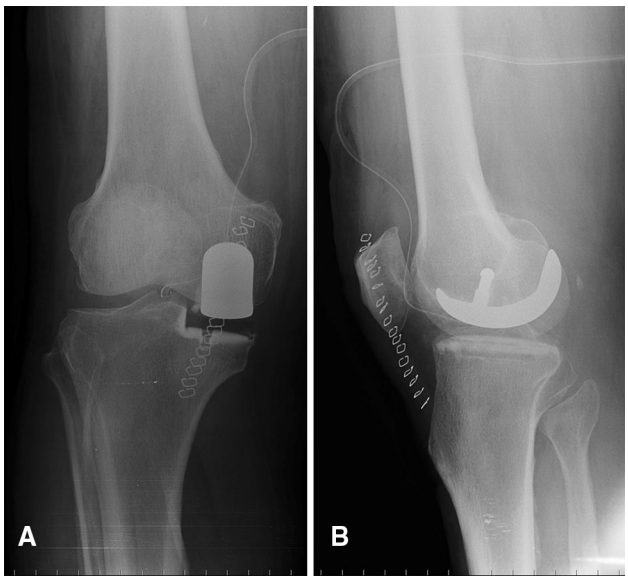


**Fig. 2** Post-operative radiograph: **a** frontal view, **b** lateral view

Further analysis was performed to evaluate factors that might have influenced the clinical outcome. No significant correlation was found between clinical scores and BMI at final follow-up. A positive correlation ($R = 0.77$) was found between KSS, WOMAC and ROM at final follow-up ($R = 0.77$ and $R = 0.75$, respectively). A negative correlation ($R = -0.76$) was found between OXFORD, VAS and ROM at final follow-up ($R = -0.76$ and $R = -0.54$, respectively). All correlations were statistically significant ($p < 0.05$).

## Discussion

The main finding of the present study was that patients older than 75 years treated with a unicompartmental knee replacement had excellent functional results at a mean follow-up of 9 years with only 3 % of failures. Only one UKA was revised, no major intra-operative complications were observed and only one major post-operative complication was documented. Furthermore, 92.6 % of patients rated their joint as good/excellent according to the KSS score.

These data suggest the appropriateness of UKA also in this patient population, where TKA is considered the gold standard procedure based on the assumption that it may avoid the need for a further operation [14, 15]. TKA presents a solid literature which shows reliable results and an excellent relief of pain and restoration of knee function also in an octogenarian population [16–18]. However, this procedure has potential complications that are increased in elderly patients with a higher risk of mortality [19–22].

**Fig. 3** Radiograph control at 9-year follow-up

Therefore, less aggressive surgery, such as UKA would be ideal in this population because of the lower morbidity, less blood loss, faster recovery and more physiologic motion than TKA [2, 4, 21, 23]. Although elderly patients with knee osteoarthritis are most often treated with TKA [9, 15, 20], numerous studies in the general population have shown good and comparable results after both UKA and TKA. Patients were very satisfied concerning fulfilling their expectations and the likelihood of undergoing surgery again [3, 24–26]. In addition, a better post-operative ROM was achieved in a higher percentage of UKAs compared with TKAs [3, 6, 9, 10, 27, 28], which can be expected since UKA preserves more soft tissues and cruciate ligaments, thus resulting in more normal knee kinematics compared with TKA [2, 29]. Although the clinical results of UKA are comparable with those of TKA, the key difference between the two procedures may be the revision rate and survival of the prostheses. In terms of survival of the implant, the results of UKA are poorer compared with those of TKA at follow-up period of between 5 and 10 years [9, 10, 30, 31]. However, besides studies reporting a trend of more revisions in UKA than in TKA, the literature also presents contrasting data, with 90 % of survivorship and a good function and persistence of knee pain relief at 10- to 15-year follow-up with UKA [3, 6, 32], which is comparable with a survivorship of approximately 90 % or more of TKA [33–35].

Furthermore, recent reports have shown a survival of UKA of up to two decades and more [32, 36, 37]. W-Dahl et al. [38] even reported that the risk of revision for UKA is affected by age and the cumulative rate of revisions decreases with increasing age with a rate of 5.6 % for patients aged over 75 years. Thus, assuming that UKA surgery is preferable in patients over 75 years due to the reduced risk rate of complications, if the survival rate and clinical outcome are also comparable with those of TKA, UKA might be considered as an ideal indication for elderly patients.

**Table 2** Pre- and 9-year follow-up clinical scores

| | VAS | KSS | WOMAC | Oxford | ROM |
|---|---|---|---|---|---|
| Pre-operative | 8 (± 1) | 45 (± 9) | 31 (± 10) | 14 (± 3) | 115 (± 8) |
| Post-operative | 2* (± 2) | 90* (± 11) | 85* (± 11) | 22* (± 7) | 121* (± 10) |

Values are reported as mean (standard deviation)

* $p < 0.05$

The results of the present study support the use of UKA as an excellent long-term option for the elderly population. In fact, a significant improvement according to the KSS score and excellent or good results in 92.6 % of the cases was observed, with a safe recovery, pain relief, and a ROM of more than 120°. More important, only 3 % of the knees failed at 9 years' follow-up. The successful outcome that we observed may be due to several reasons. Elderly patients have a sedentary life style and less demand on their prosthetic knee that reduces the risks of loosening and may offer better tolerance of any slight residual pain when compared to younger patients. In fact, in a previous study on patients younger than 60 years at the time of surgery, treated for medial OA with the same UKA design used in the present study, a Kaplan–Meier survivorship of 83 % was observed at 8 years [39], and similar data were confirmed by the study of W-Dahl et al. [38] with a 7-year cumulative risk of revision of 19 % in patients younger than 55 years.

Besides the reduced physical demands of this patient category, successful results depend also on some key surgical aspects. Surgical technique has to be as accurate as possible to achieve a correctly implanted UKA prosthesis [40, 41]. In all cases we performed a slight under-correction, preserving a moderate residual deformity with a tibial cut perpendicular to the epiphyseal axis without changing the posterior slope, as described by Cartier et al. [42]. In fact, a small amount of under-correction with a residual varus deformity of 2°–5° is the goal to be achieved to avoid both rapid degeneration of the nonreplaced compartment and early loosening of the implant [2, 43, 44]. A posterior slope of more than 7° also has to be avoided [45]. Furthermore, all ligaments around the knee need to be preserved to maintain kinematics of the knee after UKA as similar as possible to that of a normal knee [46].

With an accurate technique, good results have been obtained in this patient population, and all patients reported to be satisfied with their decision to undergo this surgical treatment. Moreover, a further analysis of the results obtained showed that elderly patients may benefit from this procedure regardless of their body weight. In fact, no correlation was found between BMI and clinical outcome in the present series. In the patient cohort of the present study, 88 % of prosthetic knees (59 out of 67) were implanted in patients with a BMI of lower than 30, whereas the other 12 % were implanted in heavier patients who did not show any difference either in terms of functional outcome or failures. This result is in line with other literature findings. Other studies [47, 48] reported that a BMI of more than 30 was not associated with a reduced survival rate of the implant or worse clinical outcome. Cavaignac et al. [47] evaluated the long-term impact of BMI on the outcome of 212 UKAs at a mean follow-up of 12 years. They found no difference in clinical outcome and survival rate in patients with a mean BMI of 27 (19–29) and a mean age of 66.5 years (39–92) compared to patients with a mean BMI of 34 (30–43.2) and a mean age of 65.8 (55–84). Thus, BMI is not a limitation for the indication of UKA treatment in elderly patients. The only factor that was found to be correlated with the clinical outcome was the ROM achieved after the procedure, which is expectable and consistent with the literature [23, 49].

This study has some weaknesses that need to be pointed out. Bone mineral density is an important factor to consider before giving a surgical indication for UKA, since low values could be a risk factor for fractures and implant failure. Although we performed an anamnestic evaluation to exclude patients with history of osteoporosis, we did not perform specific exams and therefore we could not document the exact bone mineral density around the knee, which could have influenced the final outcome and the failures in our patients. However, the overall good results suggest that the patient population presented a marked clinical benefit and, therefore, was suitable for the unicompartmental implantation. The main limitation of this study is the retrospective design; patients were not randomized and not compared to a control group. However, its main strength is the high number of elderly patients and the follow-up period and the standardized surgical technique which was performed by two senior surgeons of the same surgical team. A few studies in the literature have assessed the outcome of patients over 75 years old who underwent a UKA, with either a short-term outcome or with a small number of patients evaluated [25, 26]. In this light, the study results confirmed the advantages of UKA in terms of good outcome, low complication rate and high implant survival, thus supporting the indication of UKA also for elderly patients. In fact, due to the low physiological activity level and lowered life expectancy of these patients, fears of revision surgery are minimized and return to activities of daily living is safe and satisfactory.

## Conclusions

UKA is a viable option for treating unicompartmental knee osteoarthritis or osteonecrosis. For a good clinical result, the two most important factors to be considered are a very strict patient selection and an accurate surgical technique, with an under-correction of varus deformity while maintaining a posterior slope similar to the pre-pathological condition and no ligaments release. With the proper indications and an accurate technique, UKA may be indicated also in very elderly patients with low complications and morbidity, and excellent survivorship.

**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest.

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