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Primary Knee

## A Case-Control Comparison of Single-Stage Bilateral vs Unilateral Medial Unicompartmental Knee Arthroplasty

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### ABSTRACT

**Background:** We aimed to compare postoperative pain, functional recovery, and patient satisfaction among patients receiving one-stage medial bilateral or medial unilateral UKA (unicompartmental knee arthroplasty). Our main hypothesis was that during the first 72 postoperative hours, patients who underwent medial bilateral UKA did not consume more analgesics than those who underwent medial unilateral UKA.

**Methods:** A prospective case-control study was undertaken involving 148 patients (74 one-stage medial bilateral vs 74 medial unilateral Oxford UKA). The primary outcome was evaluation of the postoperative total consumption of analgesics from 0 to 72 hours. Next, the postoperative evolution of pain scores and functional recovery were assessed. Oxford Knee Scores were assessed preoperatively at 6 and 12 months with the occurrence of clinical or radiological complications. Finally, patient satisfaction was evaluated at the final follow-up.

**Results:** The cumulative sums of analgesic consumption (0-72 hours) calculated in the morphine equivalent dose were  $21.61 \pm 3.70$  and  $19.11 \pm 3.12$  mg in the patient and control groups, respectively ( $P = .30$ ). Moreover, there were no significant differences in terms of pain scores ( $P = .45$ ), functional recovery ( $P = .59, .34$ ), length of stay ( $P = .18$ ), Oxford Knee Scores ( $P = .68, .60$ ), complications ( $P = .50$ ), patient satisfaction ( $P = .66$ ), or recommendations for intervention ( $P = .64$ ).

**Conclusion:** Patients who undergo one-stage medial bilateral UKA do not experience more pain and do not consume more analgesics than those who undergo medial unilateral UKA. A bilateral procedure is not associated with a lower recovery or a higher rate of complications, as functional outcomes at 6 and 12 months are similar to those of unilateral management.

The first cases of unicompartmental knee arthroplasty (UKA) were performed in the 1960s by MacIntosh and Hunter [1], Marmor [2], Cartier et al [3], and Rougraff et al [4], with mixed results. Therefore, these results were a source of mistrust and led to the

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poor reputation of UKAs. However, in recent years, owing to better patient selection and technical innovations, there has been a marked increase in interest in these prostheses. In addition, recent publications have shown excellent results [5–8].

The expected increase in gonarthrosis incidence, combined with the legitimate desire of patients to have a restored quality of life, has likely led to a strong increase in arthroplasty, particularly to operations on the second side, considering that the disease is often bilateral [8]. Well-documented, bilateral, 2-step procedures have the disadvantage of extended duration of care, thereby prolonging the return to a “normal” life. Despite a cautious initial period highlighting a greater number of complications [9], recent literature has shown that the bilateral UKA procedure provides benefits

| Indications for medial Oxford UKR  |              | Name:   |
|--|--------------|---|
| <ul style="list-style-type: none"> <li>Recommended X-rays: AP weight bearing, true lateral, valgus stress &amp; skyline. (Rosenberg or varus stress if bone-on-bone not seen on AP X-ray)</li> <li>Only proceed if <u>all</u> criteria are satisfied.</li> </ul> |              | Number:   |
| Criterion  |              | DoB:  |
| Example X-rays   |              | Conclusion <input checked="" type="checkbox"/>  |
| <b>(1) Medial bone-on-bone</b><br><br>X-ray:<br><ul style="list-style-type: none"> <li>AP weight bearing</li> <li>Varus stress (20° flexion)</li> <li>Rosenberg</li> </ul>   | <br><br><br> | Bone-on-bone (however severe)<br><b>Meets Indication</b><br><input checked="" type="checkbox"/><br><br>No bone-on-bone<br><b>Does not meet Indication</b><br><input type="checkbox"/>   |
| <b>(2) Functionally normal ACL</b><br><br>X-ray:<br><ul style="list-style-type: none"> <li>True lateral (femoral condyles overlapping)</li> </ul>  | <br>         | Functional ACL (preserved posterior tibia)<br><b>Meets Indication</b><br><input checked="" type="checkbox"/><br><br>Absent ACL (posterior erosion/subluxation)<br><b>Does not meet Indication</b><br><input type="checkbox"/> |
| <b>(3) Full thickness lateral cartilage</b><br><br>X-ray:<br><ul style="list-style-type: none"> <li>Valgus stress (20° flexion)</li> </ul>   | <br>         | Full thickness (ignore osteophytes)<br><b>Meets Indication</b><br><input checked="" type="checkbox"/><br><br>Lateral narrowing<br><b>Does not meet Indication</b><br><input type="checkbox"/>                                 |

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| Indications for medial Oxford UKR  |                | Name:   |
|--|----------------|---|
|  |                | Number:   |
|  |                | DoB:  |
| Criterion  | Example X-rays | Conclusion <input checked="" type="checkbox"/>  |
| <b>(4) Functionally normal MCL</b><br>(correctable intra-articular deformity)<br><br>X-ray:<br><ul style="list-style-type: none"> <li>Valgus stress (20° flexion)</li> </ul> | <br>           | Correctable deformity (Normal medial opening)<br><b>Meets Indication</b><br><input checked="" type="checkbox"/><br><br>Not correctable (Incomplete medial opening)<br><b>Does not meet Indication</b><br><input type="checkbox"/> |
| <b>(5) Acceptable patello-femoral joint</b><br><br>X-ray:<br><ul style="list-style-type: none"> <li>Skyline</li> </ul>   | <br>           | <b>Meets Indication</b><br><input checked="" type="checkbox"/><br><br><b>Does not meet Indication</b><br><input type="checkbox"/>   |

PFJ acceptable if:  
 • Normal  
 • Medial facet OA, however severe  
 • Lateral facet OA, no bone loss  
 PFJ not acceptable:  
 • Lateral facet OA, with bone loss

**Fig. 1.** Oxford Radiological Decision Aid. OA, osteoarthritis; UKR, unicompartmental knee replacement; AP, antero-posterior; ACL, anterior cruciate ligament; MCL, medio collateral ligament.

Source: Hamilton et al [17].

over time with excellent functional results and few or no complications [10–15]. Thus, subject to a satisfactory perioperative experience, particularly with regard to pain and early functional rehabilitation, this management would make it possible to limit the amount, duration, and cost of care.

The question of whether patients undergoing bilateral medial UKA in a single operation have more painful outcomes and impaired immediate functional rehabilitation than those undergoing unilateral medial UKA is still unanswered.

The aim of this prospective case-control study is to evaluate and compare postoperative analgesic consumption, pain, early functional rehabilitation, clinical outcomes, and satisfaction between one-stage medial bilateral UKA vs medial unilateral UKA.

Our main hypothesis was that during the first 72 hours post-operatively, patients who underwent medial bilateral UKA did not consume more analgesics (in morphine equivalents) than those who underwent medial unilateral UKA.

## Materials and Methods

### Population

This prospective case-control study was conducted at the University Hospital of BLINDED.

The control group (group A) consisted of patients who underwent medial Oxford UKA for medial end-stage osteoarthritis (OA) (symptomatic knee with Kellgren and Lawrence  $\geq 3$ ) between January 2017 and January 2018; their second knee was asymptomatic and OA-free (Kellgren and Lawrence  $< 3$ ) at inclusion. The case

group (group B) consisted of patients with medial bilateral end-stage OA who agreed to have one-stage bilateral Oxford UKA during the same period. The inclusion and exclusion criteria were consistent with the recommendations of Goodfellow et al [16] and following the Oxford Radiological Decision Aid published by Hamilton et al [17] (Fig. 1). Inclusion and exclusion criteria are detailed in Table 1. These procedures were performed by a single experienced senior surgeon (FD). The study was approved by the local ethics committee and was carried out in accordance with the medical code of ethics of the Helsinki Declaration. Each patient who participated in the study completed and signed an informed consent form.

### Surgical Protocol

The surgical and postoperative procedures were standardized and identical between the 2 groups and have already been published [10]. In bilateral procedures, the right side was operated before the left, and 2 instrumentation tables and sets were used. Pneumatic tourniquets were placed at the root of each operated limb and inflated to 280 mm Hg just before the incision and sequentially in the case of a bilateral procedure.

A minimally invasive medial parapatellar approach was systematically used without eversion of the patella, allowing the placement of an Oxford medial UKA (Zimmer Biomet, Warsaw, IN) using the microplasty instrumentation as recommended by Goodfellow et al [16]. Positioning of the femoral component required the introduction of an intramedullary rod inside the femoral canal.

In a bilateral procedure, the right knee was closed with the tourniquet deflated while the senior surgeon operated on the left

**Table 1**  
Inclusion and Exclusion Criteria.

| Inclusion Criteria  | Exclusions Criteria  |
|---|--|
| <ul style="list-style-type: none"> <li>Agreed to participate in the study</li> <li>Being able to fill-in the PROMS questionnaire</li> <li>Patient aged more than 18 y and less than 85 y with an indication of UKA regarding Goodfellow's recommendation [16] and the Oxford Radiological Decision Aid [17]: <ul style="list-style-type: none"> <li>• Medial bone on bone</li> <li>• Functionally normal ACL</li> <li>• Full-thickness lateral cartilage</li> <li>• Functionally normal MCL</li> </ul> </li> <li>• Acceptable patellofemoral joint</li> </ul> | <ul style="list-style-type: none"> <li>Refusal to participate in the study</li> <li>BMI &gt;40</li> <li>Bone tumor</li> <li>Varus &gt; 15°</li> <li>Previous knee surgery except meniscectomy (ligamentoplasty, HTO, arthroplasty, tibial plateau fracture)</li> <li>Chronic consumption of analgesic or drug: use of NSAID and/or opioid and/or weak opioid (WHO ladder 2) for more than 3 mo consecutively right before the surgery</li> <li>Bilateral knee OA refusing a bilateral procedure</li> </ul> |

UKA, unicompartmental knee arthroplasty; OA, osteoarthritis; HTO, high tibial osteotomy; PROMS, patient reported outcomes measurement; ACL, anterior cruciate ligament; MCL, medio collateral ligament; BMI, body mass index; HTO, high tibial osteotomy; NSAID, non steroid anti-inflammatory drug; WHO: World Health Organization.

knee. The second tourniquet was deflated at the beginning of the closing to limit the total duration of the tourniquet.

All patients in the study received general anesthesia combined with a 50-mg ropivacaine ultrasound-controlled adductor canal block [18,19].

Perioperatively, the operator performed periarticular local analgesic infiltration (LIA) before and after the implants were placed [20]. The LIA was defined in consultation with the anesthesia team and standardized so that the toxic dose of ropivacaine (3 mg/kg) was never exceeded and so that each operated knee could benefit from the same dose of anesthetics. Therefore, for each operated knee, we used a 100-mL anesthetic mixture in normal saline combining ropivacaine (100 mg), ketoprofen (50 mg), and adrenaline (0.5 mg).

This LIA was infiltrated into the posterior capsule and medial compartment (medial collateral ligament) of the operated knee.

No intra-articular suction drain or anesthetic catheter for analgesic reinjection was used in our protocol.

After the patients returned to their wards, nonopioid (paracetamol) in association with nonsteroidal anti-inflammatory drugs (ketoprofen) was administered for analgesia. Weak opioid drugs (paracetamol-codeine or tramadol) were also used if needed (World Health Organization [WHO] ladder 1 plus adjuvant and WHO ladder 2). Oral opioid drugs (oral morphine, Actiskenan) were only used as rescue if the pain was resistant to the standard protocol.

Both groups received the same postoperative rehabilitation protocol and standardized follow-up, with consultations and radiographs at 6 months, followed by 12 months and then every year until the final follow-up.

### Evaluation Methodology

For each patient, all data were compiled blindly by an independent operator in a specific database. The demographic data included age, gender, operated side, American Society of Anesthesiologists classification, and medical/surgical history. All clinical, pain, and analgesic consumption data were recorded in a standardized form and exported blindly into the study database.

### Primary Outcome

The consumption of analgesics is traditionally considered a reliable measure of pain assessment in postoperative patients [21].

We evaluated postoperative pain by calculating the morphine equivalent of the total doses of analgesics (according to the Société Française d'Accompagnement et de soins Palliatifs and the Société Française Anesthésie et Réanimation; <http://www.sfaf.org/rubrique/equianalgesie>) received by the patient from the recovery room up until 72 hours. The following 5 distinct periods were evaluated: recovery room at 6 hours, then 6-12, 12-24, 24-48, and 48-72 hours postoperatively.

### Secondary Outcome

Pain was also monitored with the visual analog pain scale (VAS) starting at the time of return to the recovery room (2 hours) and then at 6, 12, 24, 48, and 72 hours to highlight a possible painful peak. The total pain experienced was assessed by summing the recorded VAS scores.

All patients benefited from a standardized postoperative rehabilitation protocol: chair positioning, lifting, and gentle mobilization from 6 hours onward. The use of an arthrometer and immobilization splint was prohibited. Two main data points were analyzed: the postoperative time required to complete a round trip in the corridor (25 m × 2) with or without crutches (walking exercise) and the time required to complete the ascent and descent of 8 steps (stair exercise).

Since the duration of hospitalization is very strongly influenced by administrative variables independent of the medical condition, we evaluated the real medical lengths of stay by using the discharge criteria [21] reflecting the patient's autonomy, thereby indicating when the patient was medically fit to leave the hospital.

Discharge criteria:

- Pain score VAS <3 (3/10).
- Controlled by oral analgesics (WHO ladder 1).
- Ability to walk with elbow crutches.
- Ability to climb 8 stairs.
- Ability to eat and drink.
- No nausea or vomiting.
- No evidence of any surgical complication.

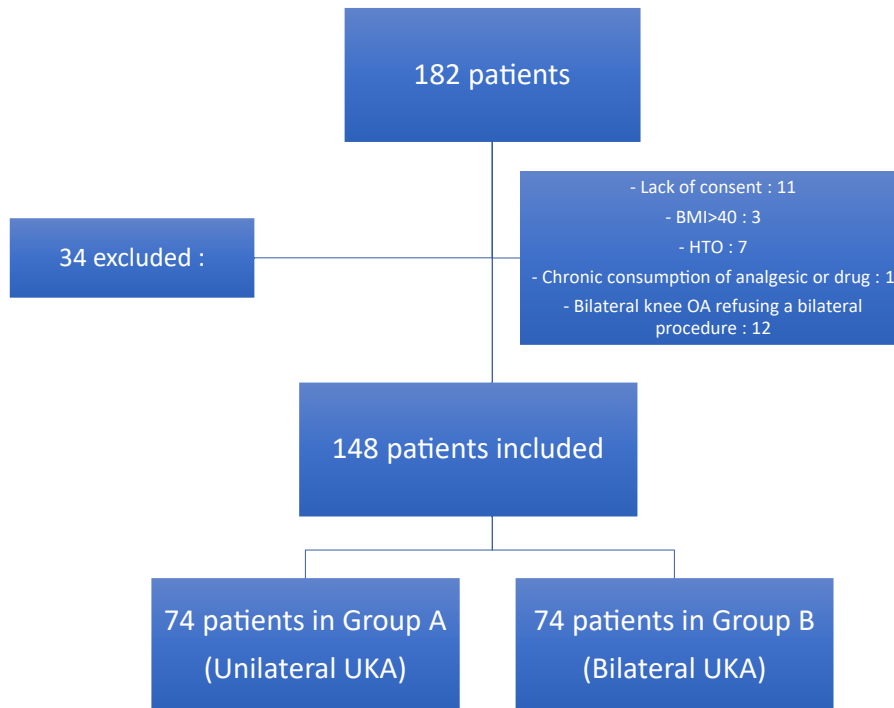
### Third Outcome

The evaluation of clinical outcomes was performed using the Oxford Knee Score (OKS validated French version) [22], both preoperatively and at the 6-month and 12-month postoperative follow-up visits. The occurrence of postoperative clinical complications was investigated and reported for each patient in both groups. A radiological check for implant misplacement, fracture, migration, or loosening was performed by an independent operator during immediate postoperative care and at 6 (M6) and 12 months (M12) postoperatively. Patient satisfaction regarding their operation and the postoperative experience was assessed with a two-question questionnaire (Likert scale) completed at the final follow-up:

1. "What is your overall level of satisfaction with the operation?" (very bad, bad, average, good, good, excellent).
2. "Would you recommend the operation, or would you agree to benefit from it again?" (yes or no).

### Statistical Analysis

Essving et al [20] found that in the first 72 hours after UKA, the consumption of analgesic equivalent for the control group (General



**Fig. 2.** Flow chart. UKA, unicompartmental knee arthroplasty; BMI, body mass index; OA, osteoarthritis.

anesthesia without LIA) was  $67 \pm 40$  mg of morphine vs  $21 \pm 30$  mg for the LIA group. This difference was considered clinically relevant. As our protocols are similar, we assumed an average morphine consumption of  $20 \pm 30$  mg between the recovery room and 72 hours in the control group.

Considering a noninferiority analysis with a clinically relevant difference of  $45 \pm 30$  mg, the number of subjects required was 23 per group for 90% power and an alpha risk of 0.05 (bilateral nature,  $2 \times 0.025$ ). Thus, the total number of patients to be included was set at a minimum of 50.

The quantitative variables are presented as the means and standard deviation, and after verifying their independence, they were analyzed by Student's *t*-test or the Mann-Whitney test (inequality of variance). Categorical variables are expressed as numbers and percentages and were compared using Fisher's exact test or the Z-test (contingency table).

The statistical analysis was performed with SPSS 24 software (IBM Inc, Armonk, NY). The significance threshold was arbitrarily set at  $P < .05$ .

## Results

During the study period, 182 patients underwent Oxford UKA, and 34 were excluded for the following reasons (Fig. 2):

- 11 patients for lack of consent.
- 7 for an hight tibial osteotomy history.
- 3 patients with a body mass index >40.
- 1 patient for chronic morphine consumption.
- Twelve patients with medial bilateral end-stage OA refused the simultaneous procedure and benefited from staged bilateral UKA (separated by 3-16 months).

Ultimately, 148 patients were included:

- 74 subjects who had an unilateral UKA: group A.

- 74 subjects who volunteered for a simultaneous procedure: group B.

No patients were lost to follow-up, and they all attended the 12-month postoperative clinic. The mean follow-up period was  $16.5 \pm 4.1$  months:  $16.8 \pm 4$  months for group A and  $16.3 \pm 4.2$  months for group B ( $P = .11$ ). Apart from a lower preoperative OKS in group B, there was no significant difference between the 2 groups, especially regarding comorbidities. The detailed demographic characteristics of both study groups are presented in Table 2.

The cumulative sums of analgesic consumption (0-72 hours) calculated in morphine equivalent dose were  $19.11 \pm 3.12$  mg for group A and  $21.61 \pm 3.70$  mg for group B. The difference was not significant ( $P = .30$ ). Except for the 12-hour to 24-hour period, analgesic consumption did not differ between the 2 groups. No oral opioid drugs were used. The results are detailed in Table 3.

**Table 2**  
Demographics, Mean  $\pm$  SD.

|                               | Population<br>(n = 148) | Group A<br>(n = 74) | Group B<br>(n = 74) | P Value          |
|-------------------------------|-------------------------|---------------------|---------------------|------------------|
| Age                           | 67.10 $\pm$ 9.84        | 67.15 $\pm$ 9.45    | 67.04 $\pm$ 10.32   | .99              |
| Weight (kg)                   | 81.54 $\pm$ 15.01       | 80.64 $\pm$ 16.18   | 82.77 $\pm$ 14.57   | .40              |
| BMI (kg/m)                    | 28.46 $\pm$ 5.36        | 28.14 $\pm$ 5.08    | 28.83 $\pm$ 5.68    | .45              |
| Gender ratio<br>(male/female) | 77/148                  | 38/74               | 39/74               | .49              |
| DEVANE score                  | 2.53 $\pm$ 0.61         | 2.57 $\pm$ 0.60     | 2.47 $\pm$ 0.62     | .60              |
| Preop OKS                     | 37.80 $\pm$ 5.47        | 38.33 $\pm$ 4.97    | 36.59 $\pm$ 5.71    | .04 <sup>a</sup> |
| ASA score<br>(mean $\pm$ SD)  | 1.80 $\pm$ 0.15         | 1.78 $\pm$ 0.34     | 1.82 $\pm$ 0.12     | .43              |
| I                             | 63 (42.6%)              | 33 (44.6%)          | 30 (40.5%)          | .357             |
| II                            | 56 (37.8%)              | 26 (35.2%)          | 30 (40.5%)          | .3               |
| III                           | 23 (15.5%)              | 12 (16.2%)          | 11 (14.9%)          | .5               |
| IV                            | 6 (4%)                  | 3 (4%)              | 3 (4%)              | .66              |

BMI, body mass index; OKS, Oxford Knee Score; SD, standard deviation; ASA, American Society of Anesthesiologists.

<sup>a</sup> Statistically significant.

There were no significant differences between the 2 groups in terms of pain scores for the 5 periods of interest or cumulative pain scores (0-72 hours). The detailed results are described in Tables 3 and 4.

The "walking exercise" was completed by 68.9% (51/74) and 62.2% (46/74) of patients within the first 24 hours and by 91.9% (68/74) and 87.8% (65/74) of patients within the first 48 hours in groups A and B, respectively. At 72 hours after surgery, 100% of patients in both groups completed the walking exercise. At no time a difference was found between the groups ( $P = .59$ ).

The "staircase exercise" was completed by 33.8% (25/74) and 24.3% (18/74) of patients within the first 24 hours and by 79.7% (59/74) and 71.6% (53/74) of patients within the first 48 hours in groups A and B, respectively. At 72 hours after surgery, 100% of patients in both groups completed the staircase exercise. At no time a difference was found between the groups ( $P = .34$ ).

The discharge criteria were complete for 36.5% and 27% of patients at 24 hours and for 92% and 89.2% of patients at 48 hours in groups A and B, respectively. At 72 hours after surgery, 100% of patients in both groups completed all the discharge criteria. At no time a difference was found between the groups ( $P = .18$ ).

The detailed results are described in Table 5. There was no significant difference in mean OKS scores at 6 ( $P = .68$ ) and 12 months ( $P = .60$ ) postoperatively. However, there was a significant difference in favor of group B in the analysis of the OKS gain between preoperative and M12 ( $P = .03$ ). The results are detailed in Table 6.

There was no significant difference in postoperative complications (Table 7) between the 2 groups (4.05% in group A vs 4.41% in group B;  $P = .50$ ). Moreover, none of the 148 patients required transfusions. For radiological assessment, there was no significant difference at M6 and M12 ( $P = .99$ ). Radiographic analysis revealed some cases of fracture of the tibial plateau (1.4%) and loosening of the tibial component (1.4%) in each of the groups.

Regarding the level of overall satisfaction (Table 8), no significant differences were found ( $P = .66$ ): 85.2% of controls and 82.5% of patients rated their satisfaction as "good" or "excellent."

Similarly, 95.9% of controls and 97.3% of patients answered "yes" for recommending the intervention ( $P = .64$ ).

**Table 3**  
Mean and Median Analgesic Consumption in Milligram of Morphine Equivalent and Mean VAS Score.

| Postop Time Period                          | Group A (n = 74) | Group B (n = 74) | P Value          |
|---|------------------|------------------|------------------|
| Analgesic consumption (mg), mean $\pm$ SD   |                  |                  |                  |
| H0-H6                                       | 3.18 $\pm$ 0.80  | 3.16 $\pm$ 1     | .98              |
| H6-H12                                      | 5.10 $\pm$ 1.27  | 5.81 $\pm$ 1.29  | .43              |
| H12-H24                                     | 4.34 $\pm$ 1.10  | 6.15 $\pm$ 1.38  | .04 <sup>a</sup> |
| H24-H48                                     | 4.31 $\pm$ 1.50  | 4.67 $\pm$ 1.62  | .75              |
| H48-H72                                     | 2.19 $\pm$ 1.02  | 1.82 $\pm$ 1.48  | .68              |
| H0-H72                                      | 19.11 $\pm$ 3.12 | 21.61 $\pm$ 3.70 | .30              |
| Analgesic consumption (mg), median (CI 95%) |                  |                  |                  |
| H0-H6                                       | 5 (0.8)          | 0 (1.0)          | .57              |
| H6-H12                                      | 5 (1.28)         | 5 (1.29)         | .37              |
| H12-H24                                     | 5 (1.1)          | 5 (1.38)         | .08              |
| H24-H48                                     | 0 (1.5)          | 0 (1.62)         | .9               |
| H48-H72                                     | 0 (1.0)          | 0 (1.48)         | .17              |
| H0-H72                                      | 15 (3.12)        | 20 (3.69)        | .26              |
| VAS score, mean $\pm$ SD                    |                  |                  |                  |
| H0-H6                                       | 1.68 $\pm$ 0.35  | 2.00 $\pm$ 0.37  | .20              |
| H6-H12                                      | 2.14 $\pm$ 0.37  | 2.18 $\pm$ 0.34  | .87              |
| H12-H24                                     | 2.77 $\pm$ 0.35  | 3.04 $\pm$ 0.41  | .31              |
| H24-H48                                     | 2.18 $\pm$ 0.35  | 2.57 $\pm$ 0.38  | .13              |
| H48-H72                                     | 1.15 $\pm$ 0.26  | 1.42 $\pm$ 0.29  | .17              |
| Sum: 0-72 h                                 | 9.90 $\pm$ 0.99  | 11.24 $\pm$ 1.11 | .07              |

VAS range from 0 to 10, 10 being the most painful.

VAS, visual analog pain scale; SD, standard deviation; CI, confidence interval.

<sup>a</sup> Statistically significant.

**Table 4**  
Number of Patients per VAS Group Regarding the Postop Period.

| VAS Regarding Postop Period | Group A (n = 74) |      | Group B (n = 74) |      | P Value |
|-----------------------------|------------------|------|------------------|------|---------|
|                             | n                | %    | n                | %    |         |
| H0-H6                       |                  |      |                  |      |         |
| 0-3                         | 67               | 90.5 | 65               | 87.8 | .39     |
| 4-6                         | 7                | 9.5  | 9                | 12.2 | .39     |
| >7                          | 0                | 0    | 0                | 0    | N/A     |
| H6-H12                      |                  |      |                  |      |         |
| 0-3                         | 63               | 85.1 | 65               | 87.8 | .4      |
| 4-6                         | 11               | 14.9 | 8                | 10.8 | .31     |
| >7                          | 0                | 0    | 1                | 1.4  | N/A     |
| H12-H24                     |                  |      |                  |      |         |
| 0-3                         | 54               | 73   | 46               | 62.2 | .10     |
| 4-6                         | 19               | 25.7 | 26               | 35.1 | .14     |
| >7                          | 1                | 1.3  | 2                | 2.7  | .5      |
| H24-H48                     |                  |      |                  |      |         |
| 0-3                         | 60               | 81.1 | 54               | 73   | .14     |
| 4-6                         | 13               | 17.6 | 18               | 24.3 | .16     |
| >7                          | 1                | 1.3  | 2                | 2.7  | .5      |
| H48-H72                     |                  |      |                  |      |         |
| 0-3                         | 72               | 97.3 | 69               | 93.3 | .22     |
| 4-6                         | 2                | 2.7  | 5                | 6.7  | .22     |
| >7                          | 0                | 0    | 0                | 0    |         |

VAS 0-3: no to light pain; VAS 4-6: light to mild pain; VAS >7: severe pain; VAS range from 0 to 10, 10 being the most painful.

VAS, visual analog pain scale; N/A, non applicable.

Except for a better OKS at M12 and no complication there was no difference between the Good/Excellent patient and the other ( $P = .04$ ). Moreover, patients' level of overall satisfaction and recommendation have not been influenced by pain score, analgesic consumption, rehabilitation progress, and hospital length of stay ( $P = .67$ ).

## Discussion

The expected increase in the number of UKA cases, particularly among the younger and more active population, raises the question of routine bilateral procedures. Although one previous study [10] established that this procedure did not increase the surgical risk, few other studies dealing with this subject are found in the literature [9–11,14,23], none of which have evaluated pain and postoperative experience. Therefore, we wanted to compare the pain and early postoperative function of patients receiving one-stage medial bilateral Oxford UKA vs patients undergoing medial unilateral UKA.

**Table 5**  
Accomplishment of the Walking, Stair Exercises, and Discharge Criteria Regarding Postop Time Period (Cross-Tabulation Test).

| Postop Time Period     | Group A (n = 74) |      | Group B (n = 74) |      | P Value |
|------------------------|------------------|------|------------------|------|---------|
|                        | n                | %    | n                | %    |         |
| Walking exercise (h)   |                  |      |                  |      |         |
| 12                     | 1                | 1.4  | 0                | 0    | .59     |
| 24                     | 50               | 67.6 | 46               | 62.2 |         |
| 48                     | 17               | 22.9 | 19               | 25.7 |         |
| 72                     | 6                | 8.1  | 9                | 12.2 |         |
| Stair exercise (h)     |                  |      |                  |      |         |
| 24                     | 25               | 33.8 | 18               | 24.3 | .34     |
| 48                     | 34               | 46   | 35               | 47.3 |         |
| 72                     | 15               | 20.3 | 21               | 28.4 |         |
| Discharge criteria (h) |                  |      |                  |      |         |
| 24                     | 27               | 36.5 | 20               | 27   | .18     |
| 48                     | 41               | 55.4 | 46               | 62.2 |         |
| 72                     | 6                | 8.1  | 8                | 10.8 |         |

**Table 6**  
Mean OKS Functional Score.

| OKS (Mean ± SD) | Group A (n = 74) | Group B (n = 74) | P Value          |
|-----------------|------------------|------------------|------------------|
| Preop           | 3833 ± 4.97      | 36.59 ± 5.71     | .04 <sup>a</sup> |
| M6              | 47.31 ± 6.17     | 46.91 ± 5.68     | .68              |
| M12             | 48.89 ± 5.65     | 49.47 ± 6        | .60              |
| Delta preop/M6  | 9 ± 6.71         | 10.3 ± 7.18      | .24              |
| Delta preop/M12 | 10.5 ± 5.99      | 12.9 ± 6.7       | .03 <sup>a</sup> |

OKS, Oxford Knee Score; SD, standard deviation; M6, 6 months; M12, 12 months.  
<sup>a</sup> Statistically significant.

Our main hypothesis was confirmed. Indeed, patients who underwent one-stage medial bilateral UKA did not consume more analgesics during the first 72 postoperative hours than those who underwent medial unilateral UKA: 21.60 mg vs 19.10 mg, respectively ( $P = .3$ ). These results are in agreement with the literature, wherein Essving et al [20] found a consumption of 20 mg morphine equivalent analgesic in a similar framework (infiltrated unilateral UKA).

In the more specific analysis of the 5 postoperative periods, only the period from 12 to 24 hours showed a significant difference in consumption between the 2 groups. We explained this by the gradual lifting of the combined effects of the block and LIA, which are potentially more painful in patients undergoing bilateral surgery. However, this was not reflected in the difference in the VAS pain scale within the same period (12-24 hours). Moreover, the analysis of VAS over the 5 postoperative periods did not show any significant difference between the 2 groups. However, the detailed analysis of the VAS pain scale found a score of <3 (classically treated with WHO level 1 analgesics) in 90.5% of patients from group A and 87.8% of patients from group B between 0 and 6 hours and in 85.1% of patients from group A and 87.8% of patients from group B between 6 and 12 hours.

The postoperative VAS analysis confirms the trend that the 12-hour to 24-hour period is more painful.

Even if the result in terms of postoperative functional recovery did not show a significant difference, there was still a tendency for the stair exercise to be performed more quickly within the first 24 hours in group A than in group B (33.8% vs 24.3%;  $P = .14$ ). This is probably because there is no “healthy” supporting member on which to rely when performing flexion, bearing, and quadriceps locking maneuvers.

This trend was less pronounced with regard to the time required to complete the walking exercise within the first 24 hours (68.9% vs 62.2%;  $P = .21$ ), a test that is nevertheless considered less discriminating. These postoperative functional recovery data could not be compared with those in the literature because of the lack of similar studies conducted.

There was no significant difference in OKS scores at 6 and 12 months ( $P = .68$ ;  $P = .60$ ), but functional progression at 12 months after the operation was significantly better ( $P = .03$ ) in group B, although this difference was not significant at the 6-month follow-up ( $P = .24$ ). This more significant functional evolution in patients

**Table 7**  
Complications (Cross-Tabulation Chi-Squared Test).

| Complications | Group A (n = 74) |     | Group B (n = 74) |      | P Value |
|---------------|------------------|-----|------------------|------|---------|
|               | n                | %   | n                | %    |         |
| None          | 71               | 96  | 70               | 94.6 | .50     |
| Fracture      | 1                | 1.4 | 1                | 1.4  |         |
| Hematoma      | 2                | 2.7 | 1                | 1.4  |         |
| DVT           | 0                | 0   | 1                | 2.7  |         |
| Infection     | 0                | 0   | 0                | 0    |         |

DVT, deep vein thrombosis.

**Table 8**  
Two Questions' Satisfaction Questionnaire Results (Likert Scale).

|                | Group A (n = 74) |      | Group B (n = 74) |      | P Value |
|----------------|------------------|------|------------------|------|---------|
|                | n                | %    | n                | %    |         |
| Satisfaction   |                  |      |                  |      | .66     |
| Very bad       | 0                | 0    | 0                | 0    |         |
| Bad            | 1                | 1.4  | 2                | 2.7  |         |
| Average        | 10               | 13.5 | 11               | 14.9 |         |
| Good           | 56               | 75.7 | 50               | 67.6 |         |
| Excellent      | 7                | 9.5  | 11               | 14.9 |         |
| Recommendation |                  |      |                  |      | .64     |
| Yes            | 71               | 95.9 | 72               | 97.3 |         |
| No             | 3                | 4.1  | 2                | 2.7  |         |

undergoing simultaneous surgery of both knees over time probably reflects their preoperative disability but is in accordance with our expectations and literature data, particularly those of Clavé et al [10], Ma et al [24], and Akhtar et al [13].

In our study, we did not find any difference in terms of postoperative complications (4.05% in group A vs 4.41% in group B). These results are in agreement with the complication rates reported by Clavé et al [10] (8%), Siedlecki et al [23] (4.5%), Winder et al [25] (3.6%), Ma et al [24] (5.3%), Chen et al [14] (2.9%), and Berend et al [11], who found no significant difference in his study on 176 patients, including 35 operated upon bilaterally.

A thromboembolic complication was reported in group B and none in group A ( $P = .5$ ), which is also consistent with the literature [10,11,13,24]. Only Chan et al's study [9] found a higher number of distal deep vein thrombosis cases in bilaterally operated upon patients, but they did not benefit from postoperative drug thromboprophylaxis. No infectious complications were found in our study, which is also consistent with the literature [26,27].

In addition, radiological follow-up of patients in the 2 groups did not reveal any significant difference; fracture of the tibial plateau and loosening of the tibial component were reported in each group. These results are in line with the literature. Clavé et al [10], in his study on 50 bilateral UKAs with an average 3.7-year follow-up, found no fractures or early loosening, and Siedlecki et al [23] found good radiological results in 98% of cases at 6 months postoperatively in their series of 44 bilateral UKAs. These clinical and radiological data confirmed that there was no increase in the surgical risk associated with the bilateral and simultaneous nature of the procedure.

The analysis of the hospital length of stay showed that at 24 hours postoperatively, the criteria for discharge were met in 36.5% of the subjects in group A compared with 27% in group B. The higher consumption of morphine equivalent analgesics in group B found in our study during the 12-hour to 24-hour period may explain this difference. At 48 hours, 9 out of 10 patients (92% of controls and 89.2% of patients) were potentially discharged.

Thus, the extrapolated hospitalization time of a patient operated on bilaterally but sequentially over time would be twice as long as that of the patients in our study. These data are also in agreement with recent studies, particularly Siedlecki et al [23], who found a significant difference in terms of hospitalization duration (16.7 vs 13.4 days), Chen et al [14], Romagnoli et al [12], Winder et al [25], and Akhtar et al [13], who reported a lower total hospitalization duration during simultaneous treatment.

The excellent and comparable levels of overall satisfaction (95.9% in group A vs 97.3% in group B) and recommendation (85.2% in group A vs 82.5% in group B) confirm the positive experiences of these procedures. These levels of satisfaction are consistent with those reported by Clavé et al [10] and Lustig et al [6], with 96% and 97% of study subjects showing high satisfaction in the bilateral group vs 86% and 87% in the unilateral group, respectively.

Our study has some limitations. First, the absence of randomization may have introduced a first-order bias, potentially reinforced by the inclusion of volunteers in group B, and therefore potentially “more” motivated subjects. Nevertheless, the comparability of groups was good, and only the preoperative OKS was different, depending on the patients, which strongly reinforces the interpretation of our results. In addition, only 12 patients out of 86 (in total) refused bilateral treatment in a single operation, indicating that the majority of the cohort was comfortable with the procedure. Surprisingly, the mean American Society of Anesthesiologists score was low; thus, we cannot be sure that our results can be translated to a less healthy population. Second, because of the absence of blinded patients, enrollment bias may have existed, but the use of independent observers for data processing should have limited this bias. Furthermore, the monocentric, monooperator nature of our study reinforces the homogeneity of data and therefore their comparability. Moreover, our final sampling (much larger than expected) and all included subjects completing the follow-up make it possible to validate our results due to a statistical power greater than that envisaged, meaning that a smaller difference than the one initially planned could be detected in the sample.

## Conclusion

This study shows that healthy patients undergoing single-stage, medial bilateral Oxford UKA have no more pain and do not consume more analgesics than those who undergo medial unilateral UKA. The bilateral procedure is not associated with a lower recovery of early function or a higher rate of complications and functional outcomes at 6 and 12 months and is similar to unilateral management. In addition, 82.5% of bilaterally operated patients had overall satisfaction levels of “good” or “excellent,” and 97.3% of patients were likely to recommend the intervention.

## References

- [1] MacIntosh DL, Hunter GA. The use of the hemiarthroplasty prosthesis for advanced osteoarthritis and rheumatoid arthritis of the knee. *J Bone Joint Surg Br* 1972;54:244–55.
- [2] Marmor L. Unicompartmental arthroplasty of the knee with a minimum ten-year follow-up period. *Clin Orthop Relat Res* 1988;228:171–7.
- [3] Cartier P, Cheaib S, Vanvooren P. [Unicompartmental prosthetic replacement of the knee. Apropos of 159 cases—a maximum follow-up of 10 years]. *Rev Chir Orthop Reparatrice Appar Mot* 1987;73:130–3.
- [4] Rougraff BT, Heck DA, Gibson AE. A comparison of tricompartmental and unicompartmental arthroplasty for the treatment of gonarthrosis. *Clin Orthop Relat Res* 1991;157–64.
- [5] Campi S, Pandit HG, Dodd CAF, Murray DW. Cementless fixation in medial unicompartmental knee arthroplasty: a systematic review. *Knee Surg Sports Traumatol Arthrosc* 2017;25:736–45.
- [6] Lustig S, Paillot J-L, Servien E, Henry J, Ait Si Selmi T, Neyret P. Cemented all polyethylene tibial insert unicompartmental knee arthroplasty: a long term follow-up study. *Orthop Traumatol Surg Res* 2009;95:12–21.
- [7] Pandit H, Jenkins C, Gill HS, Barker K, Dodd CAF, Murray DW. Minimally invasive Oxford phase 3 unicompartmental knee replacement: results of 1000 cases. *J Bone Joint Surg Br* 2011;93:198–204.
- [8] Murray DW, Goodfellow JW, O'Connor JJ. The Oxford medial unicompartmental arthroplasty: a ten-year survival study. *J Bone Joint Surg Br* 2004;80:983–9.
- [9] Chan WCW, Musonda P, Cooper AS, Glasgow MMS, Donell ST, Walton NP. One-stage versus two-stage bilateral unicompartmental knee replacement: a comparison of immediate post-operative complications. *J Bone Joint Surg Br* 2009;91:1305–9.
- [10] Clavé A, Gauthier E, Nagra NS, Fazilleau F, Le Sant A, Dubrana F. Single-stage bilateral medial Oxford Unicompartmental Knee Arthroplasty: a case-control study of perioperative blood loss, complications and functional results. *Orthop Traumatol Surg Res* 2018;104:934–47.
- [11] Berend KR, Morris MJ, Skeels MD, Lombardi AV, Adams JB. Perioperative complications of simultaneous versus staged unicompartmental knee arthroplasty. *Clin Orthop Relat Res* 2011;469:168–73.
- [12] Romagnoli S, Zacchetti S, Perazzo P, Verde F, Banfi G, Viganò M. Onsets of complications and revisions are not increased after simultaneous bilateral unicompartmental knee arthroplasty in comparison with unilateral procedures. *Int Orthop* 2015;39:871–7.
- [13] Akhtar KSN, Somashekar N, Willis-Owen CA, Houlihan-Burne DG. Clinical outcomes of bilateral single-stage unicompartmental knee arthroplasty. *Knee* 2014;21:310–4.
- [14] Chen JY, Lo NN, Jiang L, Chong HC, Tay DKJ, Chin PL, et al. Simultaneous versus staged bilateral unicompartmental knee replacement. *Bone Joint J* 2013;95-B:788–92.
- [15] Phillips JH, Rondon AJ, Gorica Z, Fillingham YA, Austin MS, Courtney PM. No difference in total episode-of-care cost between staged and simultaneous bilateral total joint arthroplasty. *J Arthroplasty* 2018;33:3607–11.
- [16] Goodfellow JW, O'Connor J, Dodd CAF, Murray DW. Unicompartmental arthroplasty with the Oxford Knee. Oxford, UK: Goodfellow Publishers Ltd; 2016. [www.goodfellowpublishers.com](http://www.goodfellowpublishers.com).
- [17] Hamilton TW, Pandit HG, Lombardi AV, Adams JB, Oosthuizen CR, Clavé A, et al. Radiological Decision Aid to determine suitability for medial unicompartmental knee arthroplasty: development and preliminary validation. *Bone Joint J* 2016;98-B:3–10.
- [18] Reinhardt KR, Duggal S, Umunna B-P, Reinhardt GA, Nam D, Alexiades M, et al. Intraarticular analgesia versus epidural plus femoral nerve block after TKA: a randomized, double-blind trial. *Clin Orthop Relat Res* 2014;472:1400–8.
- [19] Koh HJ, Koh IJ, Kim MS, Choi KY, Jo HU, In Y. Does patient perception differ following adductor canal block and femoral nerve block in total knee arthroplasty? A simultaneous bilateral randomized study. *J Arthroplasty* 2017;32:1856–61.
- [20] Essving P, Axelsson K, Otterborg L, Spannar H, Gupta A, Magnuson A, et al. Minimally invasive surgery did not improve outcome compared to conventional surgery following unicompartmental knee arthroplasty using local infiltration analgesia: a randomized controlled trial with 40 patients. *Acta Orthop* 2012;83:634–41.
- [21] Essving P, Axelsson K, Kjellberg J, Wallgren O, Gupta A, Lundin A. Reduced hospital stay, morphine consumption, and pain intensity with local infiltration analgesia after unicompartmental knee arthroplasty. *Acta Orthop* 2009;80:213–9.
- [22] Jenny JY, Diesinger Y. Validation of a French version of the Oxford knee questionnaire. *Orthop Traumatol Surg Res* 2011;97:267–71.
- [23] Siedlecki C, Beaufils P, Lemaire B, Pujol N. Complications and cost of single-stage vs. two-stage bilateral unicompartmental knee arthroplasty: a case-control study. *Orthop Traumatol Surg Res* 2018;104:949–53.
- [24] Ma T, Tu Y-H, Xue H-M, Wen T, Cai M-W. Clinical outcomes and risks of single-stage bilateral unicompartmental knee arthroplasty via Oxford phase III. *Chin Med J* 2015;128:2861–5.
- [25] Winder RP, Severson EP, Trousdale RT, Pagnano MW, Wood-Wentz CM, Sierra RJ. No difference in 90-day complications between bilateral unicompartmental and total knee arthroplasty. *Am J Orthop* 2014;43:E30–3.
- [26] Hutt JRB, Sur A, Sur H, Ringrose A, Rickman MS. Outcomes and early revision rate after medial unicompartmental knee arthroplasty: prospective results from a non-designer single surgeon. *BMC Musculoskelet Disord* 2018;19:172–6.
- [27] Alnachoukati OK, Barrington JW, Berend KR, Kolczun MC, Emerson RH, Lombardi AV, et al. Eight hundred twenty-five medial mobile-bearing unicompartmental knee arthroplasties: the first 10-year US multi-center survival analysis. *J Arthroplasty* 2018;33:677–83.