Original article

Outpatient surgery feasibility in anterior cruciate ligament reconstruction: A prospective comparative assessment

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A L T E R N A T I V E I N F O

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A B S T R A C T

Introduction: The main objective of this study was to assess the feasibility of outpatient surgery in anterior cruciate ligament (ACL) reconstruction. We hypothesized that if the patient underwent the procedure within a dedicated organization, safety would be ensured.

Patients and methods: A non-randomized, prospective, comparative, single-operator study conducted in 2012–2013 included all patients undergoing first-line surgery for ACL arthroscopic reconstruction using a short hamstring graft. The outpatient group (OP) included patients who were eligible for outpatient surgery and provided consent; the conventional hospitalization group (CH) comprised those patients not suitable for outpatient surgery and those who refused it. The main evaluation criterion was failure of the admission modality defined as hospitalization of a patient who had undergone outpatient surgery or rehospitalization in the first week after discharge. The secondary evaluation criteria were the rate of postoperative complications, postoperative pain, use of analgesics, and patient satisfaction. A total of 138 patients were included: 71 in the OP group and 67 in the CH group, with a mean age of 29.6 ± 9 years. Twenty-nine percent of the patients refused outpatient surgery. In the CH group, the mean hospital stay lasted 2.7 ± 0.8 days.

Results: One patient in the OP group was hospitalized with localized bleeding and there were no rehospitalizations. Six early postoperative complications were noted in each group. The mean postoperative pain on D0–D4 and patient satisfaction were similar in the two groups.

Conclusion: This prospective study encountered no serious events after outpatient ACL reconstruction surgery. In a selected population, the risks are comparable to those in conventional hospitalization.

Level of evidence: Level III, comparative study.

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1. Introduction

The Public Health Code defines outpatient surgery as an alternative to hospitalization that allows the patient to be discharged on the same day as admission, after an identical surgical procedure as conventional hospitalization. The expected benefits for patients concern satisfaction and limited exposure to nosocomial infections [1], for healthcare institutions the optimization of technical platforms, and for health insurance entities a reduction in direct costs ranging from −25%[2] to −68% [3]. In 2009, 83% of surgical procedures in the United States, 79% in Great Britain, and 70% in northern European countries were performed in the outpatient setting versus only 36.2% in France [1].

In France between 2009 and 2010, outpatient surgery in orthopedics increased by +3%. In 2009, the proportion of day-case surgery was 71.8% for knee arthroscopy excluding ligament reconstruction[4].

In 2012, 41,122 anterior cruciate ligament (ACL) reconstructions were performed in France [5]. The median hospital stay of this diagnosis-related group (08C34) was 3–5.5 days depending on the level of gravity. A recent study showed the feasibility of a short 1-day hospital stay [6]. Patients experiencing short-stay hospitalization were significantly more satisfied and had less pain than those undergoing conventional hospitalization.

The main objective of this study was to assess the feasibility of outpatient surgery in ACL reconstruction. We hypothesized that if the patient underwent the procedure within a dedicated organization, ranging from the intention to undergo
surgery to early postoperative follow-up, safety would be ensured.

2. Material and methods

A prospective comparative non-randomized study was conducted from September 2012 to July 2013. An institutional review board gave its approval, informed consent was collected from the patients, and the database was declared at the National Commission for Data Protection (Commission nationale de l'informatique et des libertés, CNIL).

2.1. Inclusion and exclusion criteria

This study included a consecutive series of patients:

- presenting an isolated ACL tear;
- who were undergoing their first ACL arthroscopic reconstruction;
- performed by a single surgeon;
- using a single surgical technique: short hamstring grafting.

The exclusion criteria for outpatient surgery were:

- age over 60 years;
- ASA score of 3 and 4;
- patients who could not be managed in an outpatient setting such as those living far from the center and those with psychiatric conditions;
- medical cause warranting hospitalization (a history of phlebitis or septicemia, hemostasis problems, and neurological conditions).

Two groups were formed: an outpatient group (OP) including patients who were eligible for outpatient surgery and who had given their consent and a conventional hospitalization (CH) group including all patients who could not undergo day-case surgery and those who had refused.

2.2. Patients' clinical pathway

2.2.1. Before surgery

All the exclusion criteria for outpatient surgery were verified by the study's surgeon and then the anesthesiologist during the preoperative consultations (Fig. 1). During the preoperative consultation with the surgeon, after the patient had been informed of how the surgery would take place and the expected results, both hospitalization modalities were proposed to the patients who were eligible for outpatient surgery: either conventional hospitalization lasting 2–3 days or outpatient surgery with discharge the evening of the procedure. If the patient accepted the outpatient surgery, the family physician was informed by mail. The patient was then scheduled for the surgery and an appointment was made with a visiting nurse for the home care the day after the intervention. The preoperative consultation with the anesthesiologist was as usual, including assessment of the risk of bleeding, screening for a risk of abnormal infection, the choice of antibiotic, and assessment of the postoperative risk of venous thromboembolism so as to adjust thromboprophylaxis. Particular attention was paid to the information provided to the patient concerning the different anesthesia techniques as well as the multimodal postoperative analgesia.

The patients in the OP group arrived at 7:30 am on an empty stomach and were operated on before noon. The CH patients arrived the day before or the morning of the surgery.

2.2.2. Surgical technique

This arthroscopic surgery followed the TLS® technique (FH Orthopedics, Mulhouse, France) [7], with systematic drainage.
2.2.3. Anesthesia and analgesia protocols

The surgery took place either under general anesthesia or spinal anesthesia. An ultrasound-guided femoral block with 20 mL of ropivacaine 0.475% was given in the induction room in both settings. Antibiotic prophylaxis was administered systemically.

Patients undergoing general anesthesia were not premedicated. Induction consisted of propofol 2–3 mg/kg, sufentanil 0.2–0.3 μg/kg and atracurium 0.5 mg/kg, maintained by inhalation of sevoflurane (1 MAC) and a 02/N2O (50/50) mix, or intravenously with propofol and reinjection of sufentanil. In the postanesthesia care unit (PACU), analgesics were administered intravenously (paracetamol 1 g and naproxen 100 mg when there were no contraindications for non-steroid anti-inflammatory drugs [NSAIDs]). A titration of morphine was initiated in case of severe pain evaluated on a visual analog scale (VAS), and antiemetic treatment (dexamethasone or ondansetron) for patients with nausea or vomiting.

Patients given spinal anesthesia received oral premedication 1 h before surgery including analgesics (paracetamol 500 mg, tramadol/paracetamol 37.5 mg/325 mg, and naproxen 550 mg associated with omeprazole when there were no contraindications to NSAIDs). The spinal anesthesia was unilateral, given in the induction room or the operating room with the patient in the lateral decubitus position by injection of 2.5–3.5 mL of hyperbaric bupivacaine 0.5% with a cone-shaped needle (25 or 27 gauge). The patient was then monitored in the PACU.

At discharge, an analgesic was systematically prescribed for 48–72 h including paracetamol 500 mg two tablets every 6 h associated with one tablet of naproxen 550 mg morning and evening, when there were no contraindications to NSAIDs, with a gastric antisecretory drug: omeprazole one 20 mg tablet in the evening. In case of residual pain, the patient could replace the paracetamol tablet with one tablet of tramadol/paracetamol 37.5 mg/325 mg or paracetamol/codeine 500 mg/30 mg.

2.2.4. Postoperative care

All patients remained in the PACU for 30–60 min. In the outpatient surgery unit, the patient stood for the first time 4–5 h after the intervention with complete weight bearing, protected by a long-leg brace to lock the extension in place. The Redon drain was removed before the patient was discharged, approximately 6 h after the intervention and the bandage placed in the operating room was left in place.

After validation of the “Return home after outpatient anesthesia and surgery” checklist (Fig. 2), half-dose preventive thromboembolic low-molecular-weight heparin was given and a new dose of analgesics was given per os (paracetamol 500 mg, one tablet of tramadol/paracetamol 37.5 mg/325 mg, and one tablet of naproxen 500 mg for patients with no contra-indications for NSAIDs). The patient was discharged around 7:00 pm with a protective knee brace and crutches, and returned home with a third party driving. The patient’s discharge was not authorized if there was significant pain (VAS > 5) requiring morphine treatment or a postoperative complication requiring medical surveillance or surgical treatment.

The patient was contacted twice by telephone: the evening of the intervention by the study’s anesthesiologist and the next day by the surgeon. They verified the following points: good tolerance of the analgesic treatment, any adverse event or complication, and the nursing care provided.

The rehabilitation protocol was standard, carried out by outside caregivers or in a day hospital specialized rehabilitation center beginning on the 5th to 10th postoperative day.

2.3. Evaluation criteria

The main evaluation criterion was failure of the admission modality defined as hospitalization of a patient who had undergone outpatient surgery or rehospitalization within 1 week after discharge. The secondary evaluation criteria were:

- postoperative complications;
- moderate postoperative pain on D0 to D4 assessed on a Likert scale (from 0 no pain to 10 maximum pain);
- taking analgesics from J0 to J4 (yes/no);
- difficulty falling asleep (from “very easy” to “very difficult”), and night-time waking because of pain (yes/no) the night of the intervention;
- patient satisfaction on the admission modality onD4 (from “very satisfied” to “dissatisfied”);
- the admission modality that they would choose for a future operation (outpatient or conventional hospitalization).

All the self-evaluation criteria were entered by the patient using the welesurvey.fr® software after having received an e-mail on D4 with a link to the electronic version of the questionnaires.

2.4. Statistical analyses

When the distributions were normal, the quantitative variables were tested using the Student t test or the Mann-Whitney test. The differences between the two groups were tested using the Kruskal-Wallis test. The qualitative variables were tested using the Chi² or the Fisher exact test. A P-value less than 0.05 was considered to be statistically significant.

3. Results

3.1. Patients

During the study period, a continuous series of 138 patients was included, 71 in the OP group and 67 in the CH group, with a mean age of 29.6 ± 9 years. The patient’s refusal of outpatient surgery was the most frequent cause of inclusion in the CH group: 29/67 (43.3%) (Fig. 3) but with a decrease in this rate as the study advanced in time (Fig. 4) and a significant difference between the first 5 and last 6 months: 22/42 (52.4%) vs 7/25 (28%), P = 0.0001. Considering only those patients eligible for outpatient surgery (100), the refusal rate was 29%.

The two groups were comparable at inclusion in terms of gender, age, body mass index (BMI), the time between the accident and surgery, the type of anesthesia, and the associated surgical procedures (Table 1). However, the patients in the OP group had a significantly better preoperative objective IKDC score and KOOS “symptoms and stiffness” and “daily life” subscales. The quantities of fluids drained by the Redon drain on the evening of the intervention were comparable (P = 0.18) between the two groups. In the CH group, the drainage volume was significantly higher if the Redon drain was removed on D1 or D2 rather than D0 (80.1 ± 44.2 vs 95.9 ± 57.2; P < 0.00001), with a mean difference of 15.6 ± 22.1 mL. The mean hospital stay for the CH group was 2.7 ± 0.8 days.

3.2. Main evaluation criterion

In the OP group, one out of 71 (1.4%) patients was not allowed to return home on the evening of the intervention because of superficial bleeding in the bandage along the anteromedial arthroscopic approach, with no hemarthrosis. This required a simple compression treatment and monitoring for 24 h. No rehospitalization was noted in the 7 postoperative days.
## Return Home After Ambulatory Anesthesia and Surgery

Return home allowed by the anesthetist and the surgeon at ..........h.........

<table>
<thead>
<tr>
<th>Criteria of return home</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stable vital signs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Satisfactory mental state</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Satisfactory motor activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Diet without vomiting or nausea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. No headache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Can urination or absence of bladder distension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. No bleeding (surgical wound)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. No significant pain (VAS&lt;5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Presence of an accompanying person (Name, telephone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Postoperative documents given to patient</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Taxi or ambulance contact

- Return home at the scheduled time ☐ YES ☐ NO Signature.........................
- If NO, please indicate:
  - The reason for not returning home at the scheduled time (criterion No. ..... not validated)
  - The name of the surgeon contacted (if criterion 7 or 10 not validated) and / or the name of the anesthetist (if other criteria not validated) and time of the call
  - The actions recommended by the surgeon and / or anesthetist
  - The patient outcome
    - Output at.......... h........
    - Hospitalized in room N°. ........
    - Return in the operating room or recovery room at.......... h........
    - Transfer to another care facility........ h........

**Fig. 2.** "Return home after outpatient anesthesia and surgery" checklist.

### 3.3. Secondary evaluation criteria

Six early postoperative complications were noted in each group ($P = 1$): ten cases of diffuse hematoma with no hemarthrosis treated medically (five in each group), one case of bleeding in the bandage (OP group), and one case of phlebitis (CH group).

The self-assessment criteria were not collected in five of the 138 (3.6%) patients, one in the OP group and four in the CH group. Postoperative pain was comparable in the two groups (Table 2). No significant difference was found in terms of pain on the evening of the intervention ($3.5 \pm 2.5$ vs $3.9 \pm 2.7; P = 0.42$) and the mean pain level on D0–D4 ($3.1 \pm 2.1$ vs $3.1 \pm 2; P = 0.95$) depending on whether
Table 1
Demographic data and comparability of the two groups.

<table>
<thead>
<tr>
<th></th>
<th>OP group (n = 71)</th>
<th>CH group (n = 67)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>29 ± 8</td>
<td>30 ± 10</td>
<td>0.36</td>
</tr>
<tr>
<td>Gender</td>
<td>21 F/50 H</td>
<td>21 F/46 H</td>
<td>0.82</td>
</tr>
<tr>
<td>BMI</td>
<td>24 ± 3</td>
<td>24 ± 3</td>
<td>0.87</td>
</tr>
<tr>
<td>Time from 1st accident to surgery (months)</td>
<td>17 ± 24</td>
<td>14 ± 31</td>
<td>0.59</td>
</tr>
<tr>
<td>Subjective IKDC</td>
<td>60 ± 15</td>
<td>57 ± 17</td>
<td>0.35</td>
</tr>
<tr>
<td>Objective IKDC</td>
<td>A 0/71</td>
<td>A 0/67</td>
<td>&lt;10⁻⁴</td>
</tr>
<tr>
<td>KOOS symptom and stiffness</td>
<td>75 ± 15</td>
<td>69 ± 18</td>
<td>0.04</td>
</tr>
<tr>
<td>KOOS pain</td>
<td>77 ± 14</td>
<td>74 ± 18</td>
<td>0.38</td>
</tr>
<tr>
<td>KOOS dailylife</td>
<td>87 ± 12</td>
<td>81 ± 20</td>
<td>0.03</td>
</tr>
<tr>
<td>KOOS sports</td>
<td>47 ± 28</td>
<td>42 ± 30</td>
<td>0.26</td>
</tr>
<tr>
<td>KOOS quality of life</td>
<td>32 ± 23</td>
<td>34 ± 25</td>
<td>0.64</td>
</tr>
<tr>
<td>GNBB differential, 250N</td>
<td>4 ± 2</td>
<td>4 ± 2</td>
<td>0.27</td>
</tr>
<tr>
<td>Telos differential, 25 kg</td>
<td>6 ± 3</td>
<td>6 ± 3</td>
<td>0.86</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>General 16</td>
<td>General 22</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Locoregional 55</td>
<td>Locoregional 45</td>
<td></td>
</tr>
<tr>
<td>Femoral nerve block</td>
<td>48</td>
<td>48</td>
<td>0.60</td>
</tr>
<tr>
<td>Associated surgical procedures</td>
<td>11 partial meniscectomies</td>
<td>7 partial meniscectomies</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>2 meniscal repairs</td>
<td>3 meniscal repairs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 chondral microfracture</td>
<td>2 chondral microfracture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 chondroplasty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redon duration, CH (days)</td>
<td>0</td>
<td>0d ± 38</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1d ± 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2d ± 1</td>
<td></td>
</tr>
<tr>
<td>Redon drainage volume the evening of the procedure (mL)</td>
<td>71 ± 33</td>
<td>80 ± 44</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96 ± 57</td>
<td>0.002</td>
</tr>
</tbody>
</table>

OP: outpatient; CH: conventional hospitalization; BMI: body mass index; IKDC: international knee documentation committee score; KOOS: knee injury and osteoarthritis outcome score.

Table 2
Postoperative pain the evening of the procedure to D4.

<table>
<thead>
<tr>
<th></th>
<th>Postoperative pain</th>
<th>Outpatient surgery (n = 70)</th>
<th>Conventional hospitalization (n = 63)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evening of procedure</td>
<td>3.3 ± 2.4</td>
<td>4 ± 2.7</td>
<td></td>
<td>0.10</td>
</tr>
<tr>
<td>D1</td>
<td>2.9 ± 2.2</td>
<td>3.8 ± 2.9</td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td>D2</td>
<td>3.3 ± 2.1</td>
<td>3.6 ± 2.6</td>
<td></td>
<td>0.46</td>
</tr>
<tr>
<td>D3</td>
<td>2.9 ± 2.2</td>
<td>3.2 ± 2.3</td>
<td></td>
<td>0.46</td>
</tr>
<tr>
<td>D4</td>
<td>2.7 ± 1.9</td>
<td>2.9 ± 2.3</td>
<td></td>
<td>0.51</td>
</tr>
<tr>
<td>Mean D0–D4</td>
<td>2.9 ± 1.8</td>
<td>3.4 ± 2.3</td>
<td></td>
<td>0.21</td>
</tr>
</tbody>
</table>

Fig. 3. Reasons for exclusion of outpatient group. IML: medial collateral ligament. ELL: lateral collateral ligament.

Fig. 4. Changes in the number of refusals for outpatient surgery by eligible patients and trend curve.

or not the patients had had a femoral nerve block. No significant difference was found in terms of mean postoperative pain between the patients who had refused outpatient surgery and those who had accepted it (3.7 ± 0.4 vs 2.9 ± 1.8, P = 0.13).

Most patients took analgesics for the first 4 days with consumption significantly higher in the CH group at D1 (57/63 vs 47/70, P = 0.001). In the CH group, 36 out of 63 (57.1%) patients took morphine the evening of the intervention, 18 of 63 (28.6%) on D1, 7 of 63 (11.1%) on D2, and five of 63 (7.9%) on D3. The patients in the OP group had significantly greater use of paracetamol/codeine the evening of the procedure (P = 0.0001) as well as naproxen the evening of the procedure (P = 0.02), on D2 (P = 0.005) and D3 (P = 0.02).

The evening of the intervention, problems falling asleep were comparable between the two groups (P = 0.15), but the CH group patients were wakened significantly more often by pain than those in the OP group (31/63 vs 17/70, P = 0.004).

Patient satisfaction assessed on D4 was comparable in the two groups (P = 0.67).

Most frequently, the patients in each group declared they would choose the same admission modality for a future intervention (62/70 vs 56/63, P = 1). In the OP group, eight of 70 (11.4%) patients would request conventional hospitalization and seven of 63 (11.1%) patients in the CH group would request outpatient surgery (P = 1).
4. Discussion

To our knowledge, this is the first study in France evaluating the feasibility of outpatient ACL reconstruction. It has shown that in certain conditions, ACL reconstruction can be done in an outpatient setting and does not present greater risk than conventional hospitalization. No serious event occurred: 98.6% of the patients in the OP group left the unit on the evening of their surgery and none were readmitted in the 7 postoperative days.

A national study conducted in 2006 in the United States on outpatient surgery showed that more than 99% of knee arthroplasty procedures were performed in the outpatient setting (12.9% were reconstruction surgeries) [8]. An analysis of the data from the United Kingdom’s National Health Service (NHS) observed that between 2008 and 2010, 20% of patients underwent this surgery as outpatient patients, most of them (79.6%) hospitalized less than 2 days [9]. In our continuous series, more than half the patients (71/138, 51.4%) underwent surgery on an outpatient basis, which shows that the 50% provisional ceiling set by the General Treatment Provision Department (Direction générale de l’offre de soins, DGOS) for 2016 is realistic for ACL reconstructions [10].

One of the main brakes on the development of outpatient surgery, all specialties included, is patient refusal. In a 2002 survey by the French health insurance organization, 22–55% of patients hospitalized full time would have refused outpatient surgery if they had the choice [11]. The current study found a 25% refusal rate but also a significant reduction in this rate between the beginning and the end of the study. One hypothesis would be that the first encouraging results of the study contributed to reassuring patients and probably reinforced the medical team’s confidence in this type of care.

The protocollization of the clinical pathway is the cornerstone of treatment organization. Khan et al. [12] showed that 80% of patients who had followed a detailed clinical pathway with standard operating procedures during ACL reconstruction were discharged the evening of their admission, whereas this rate was only 16% in the “standard” group of patients who had no specific organization. Close collaboration between the surgeon, anesthesiologist, the department’s head nurse, the patient’s general practitioner, and the visiting nurse is indispensable.

The amount of fluids drained was comparable between the two groups on the evening of the procedure. In the CH group, this volume was significantly higher on D1 and D2 compared to D0. However, the mean difference seems relatively insignificant clinically speaking, since no deep hematoma was noted.

Postoperative pain was comparable between the two groups, but more than half of the patients in the CH group received morphine the first night after the intervention. All patients were satisfied with the treatment modality, but, contrary to other studies [13], no significant difference was found between the two groups. The majority of the patients would request the same type of admission for a future surgery, which shows that the hesitations on the part of some patients for the outpatient procedure are real and that patient information must be refined by providing clinical data backed by statistics.

The main weakness of this study is the absence of randomization. This study compared patients who were eligible for outpatient surgery with a group including both those who were eligible but refused this admission modality and others excluded by the surgeon or the anesthesiologist for medical-surgical or social reasons. This study would have had a higher level of evidence if only patients eligible for outpatient surgery had been randomized. However, given the absence of earlier studies concerning this surgery, it seemed difficult to convince the patient to accept outpatient surgery and finally randomize them into the CH group.

The study has several strong points: its prospective design, the presence of a comparison group (with the above-cited reservations), the continuous series, the use of a single surgical technique performed by a single surgeon, and the high response rate for the database made possible because the patients automatically received e-mails sending them to the online questionnaires to complete.

5. Conclusion

This first prospective french study assessing the safety of outpatient ACL reconstruction surgery encountered no serious incidents. In a selected population, the risks are comparable to those with conventional hospitalization.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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