



Is Outpatient Reconstruction of the Anterior Cruciate Ligament a Safe Procedure? Experience with Two Years of Follow-up

¿Es segura la cirugía ambulatoria de reconstrucción de ligamento cruzado anterior? Experiencia a dos años de seguimiento clínico

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Abstract

Introduction Outpatient procedures allow for an important cost reduction in high-prevalence procedures; however, patient safety must always be ensured.

Objective To evaluate the early complications and functional scores of patients undergoing an anterior cruciate ligament reconstruction (ACLR) as an outpatient procedure. An estimated cost reduction is also analyzed.

Materials and Methods A retrospective study of patients undergoing outpatient ACLR with a bone-patellar tendon-bone (BPTB) technique in one center between 2016 and 2018. Patients with less than one year of follow-up were excluded. All patients were submitted to the same anesthetic protocol: spinal anesthesia, a one-shot echo-guided adductor canal nerve block, and outpatient analgesics. Upon discharge, all patients received instructions regarding postoperative care, physical therapy exercises, and red flags. A telephone survey was conducted on the third day to evaluate the general conditions and complications, as well as at the final follow-up, to collect pre- and postoperative Tegner and Lysholm functional scores. Patients who were not discharged on the same day, early non-scheduled visits, and re-interventions were recorded.

A cost-reduction analysis was performed for the inpatient versus outpatient procedures.

Results In total, 36 patients were submitted to an outpatient procedure, and 4 (11.1%) had an outside-in meniscal suture.

The survey was filled out by 23 patients (63.8%); all were in good general condition: 43% reported no pain and 57%, tolerable pain. No bleeding was observed.

Keywords

- ▶ anterior cruciate ligament
- ▶ reconstruction
- ▶ outpatient
- ▶ complications
- ▶ costs

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The survey at the end of the follow-up (average: 22.5 ± 7.9 months) was filled out by 20 patients (55.5%); the scores on the Tegner and Lysholm scales improved significantly, from 3 (range: 1 to 6) to 6 (range: 3 to 8) ($p = 0.0001$), and from 44 (range: 12 to 81) to 91 (61 to 100) ($p = 0.0001$) respectively.

All patients were discharged on the same day of surgery.

There were 2 (5.5%) early visits, one due to a fall at home with dehiscence of the surgical wound, and one due to a non-complicated hematoma. Two re-interventions at the end of the follow-up were recorded: traumatic surgical-wound dehiscence and a patellar fracture.

The cost reduction for the outpatient procedure was of 203,205 pesos per patient

Conclusion The outpatient ACLR with the BPTB technique was a safe procedure in the present series, with adequate pain management and satisfactory functional scores at the medium-term follow-up. It was also associated with a reduction in cost estimates.

Resumen

Introducción La cirugía ambulatoria permite una reducción importante del costo en procedimientos de alta prevalencia; no obstante, siempre debe resguardarse la seguridad del paciente.

Objetivo Evaluar las complicaciones operatorias tempranas y resultados funcionales en pacientes sometidos a reconstrucción de ligamento cruzado anterior (R-LCA) en cirugía ambulatoria. Se analiza además una estimación en la reducción de costos por programa ambulatorio.

Material y Métodos Estudio retrospectivo de pacientes sometidos a R-LCA con técnica hueso-tendón-hueso (HTH) en pabellón ambulatorio en un mismo centro, entre 2016 y 2018. Se excluyeron pacientes con menos de un año de seguimiento. Se utilizó el mismo protocolo anestésico: anestesia espinal y bloqueo sensitivo único, asociado a analgesia postoperatoria por vía oral. Se entregó a pacientes instructivo de cuidados postoperatorios, síntomas de alarma, y ejercicios de fisioterapia al alta. Se realizó encuesta telefónica al tercer día para evaluar el estado general y las complicaciones, y, al final del seguimiento, para evaluación funcional mediante las escalas de Tegner y Lysholm pre- y postquirúrgicos. Se identificaron a pacientes no dados de alta el mismo día, consulta precoz no programada, y reintervenciones. Se realizó un análisis de costo para evaluar el ahorro por procedimiento ambulatorio versus hospitalizado.

Resultados Se operaron 36 pacientes de forma ambulatoria. En 4 (11,1%) se asoció a sutura meniscal con técnica dentro-fuera.

La encuesta postoperatoria inicial fue respondida por 23 pacientes (63,8%); todos presentaron buen estado general: 43% sin dolor y 57% con molestias tolerables. No hubo sangrados.

La encuesta al final del seguimiento (promedio: $22,5 \pm 7,9$ meses) fue respondida por 20 pacientes (55,5%): la puntuación en las escalas de Tegner y Lysholm aumentó significativamente, de 3 (rango: 1 a 6) a 6 (rango: 3 a 8) ($p = 0,0001$) y de 44 (rango: 12 a 81) a 91 (rango: 61 a 100) ($p = 0,0001$), respectivamente.

Todos fueron dados de alta el mismo día de la operación.

Hubo 2 (5,5%) consultas precoces, una por caída en domicilio con dehiscencia de herida operatoria, y otra por hematoma no complicado. Se registraron dos reintervenciones: una dehiscencia de herida operatoria y una fractura de patela.

La reducción de costos por realizar el procedimiento de forma ambulatoria fue de 203.205 pesos/paciente.

Conclusión La cirugía ambulatoria de R-LCA mediante la técnica HTH fue un procedimiento seguro en esta serie, con un manejo adecuado del dolor y resultados funcionales satisfactorios al mediano plazo. Se asoció además a una reducción en estimación de costos.

Palabras clave

- ligamento cruzado anterior
- reconstrucción
- ambulatorio
- complicaciones
- costos

Introduction

Anterior cruciate ligament reconstruction (ACLR) is one of the most prevalent surgeries in orthopedics, with significantly higher numbers in recent decades. In the United States alone, it increased from 86,687 surgeries per year in 1994 to 129,836 in 2006.¹ In France, in 2013, 41,937 ACLRs were performed,² and, in Australia, more than 10 thousand ACLRs occurred annually, with an increase of 14% for each year from 2003 to 2008.³ Traditionally, ACLR has been carried out on an inpatient basis.⁴ However, during the last decade, to reduce the procedural costs, ACLR started to be performed more frequently on an outpatient basis.

This modality has become more popular in countries such as the United States, with an increase from 57.3% to 95.1% between 1997 and 2006,⁵ and a 300% increase in the number of outpatient cases from 1994 to 2007.⁶ A similar trend has been witnessed in northern European countries, with 79% of ACLR procedures performed on an outpatient basis in Denmark.⁷ Nevertheless, this is not observed in other countries, such as England,⁸ Germany, Austria, and Brazil.^{9,10} In France, from virtually 42 thousand surgeries carried out in 2013, only 3% were performed on an outpatient basis,¹¹ while the median hospital stay ranged from 3 to 5.5 days.¹²

The literature¹³⁻¹⁵ shows that the cost of outpatient ACLR is significantly lower when compared to the inpatient procedure, with savings ranging from USD 1,371 to 7,390 per patient.

There are no current Chilean data on outpatient programs for ACLR and their effectiveness, which could have a significant economic impact. The hypothesis of the present study is that outpatient ACLR presents a low rate of early postoperative complications, and improved clinical scores.

Therefore, the present study aims to evaluate the early postoperative complications and their functional outcomes. A secondary objective is to estimate the cost reduction associated with outpatient ACLR.

Material and Methods

The present is a retrospective study of patients undergoing ACLR with the bone-patellar tendon-bone (BPTB) technique at the outpatient ward of the same center from 2016 to 2018. Patients with less than one year of follow-up were excluded. The same anesthetic protocol was used, consisting of spinal anesthesia and single sensory block associated with postoperative analgesia with paracetamol and oral non-steroidal antiinflammatory drugs (NSAIDs) at every hour, plus tramadol, 15 drops if required. All patients received instructions regarding postoperative care, red flags, and were prescribed exercises upon discharge. On the third day, a telephone survey was carried out by a nurse from the outpatient service to evaluate general condition, pain, and complications reported by the patients. At the end of the follow-up, a functional evaluation was performed to compare the pre- and postoperative scores on the Tegner and Lysholm scales. Patients who could not be discharged on the same day of surgery and cases of early unscheduled visits or reinterventions were identified through the clinical records.

The present study was approved by the ethics committee of the institution.

Study Design

The present study is a retrospective analysis of a casuistry of patients with an anterior cruciate ligament injury submitted to surgical reconstruction at an outpatient unit from the same public hospital in Santiago, Chile, from 2016 to 2018. The patients were interviewed at least two days prior to surgery by a ward nurse to assess their current general status and history, and to be given instructions for the day of surgery. All patients were operated on using the same surgical technique and anesthetic protocol. They were discharged at the same day, 2 to 4 hours after surgery, reporting pain in the visual analog scale (VAS) ≤ 3 and being able to stand up with the aid of canes. They were contacted prospectively to fill out a telephone survey in the early postoperative period and then retrospectively for remote functional surveys.

Selection Criteria

We included patients:

- With anterior cruciate ligament injury (with or without meniscal and/or chondral injury);
- Older than 15 years of age
- With American Society of Anesthesiologists (ASA) scores of 1 or 2;
- From the same center and operated on by the same surgical team;
- Operated on using the BPTB technique;
- Submitted to the same perioperative anesthetic and analgesic protocols; and
- With a minimum follow-up of 12 months at the time of the study.

We excluded patients:

- With multiple ligamentous lesions;
- With incomplete clinical records;
- Submitted to other reconstruction techniques; and
- In whom outpatient surgery was not feasible due to a medical condition.

Perioperative Analgesic and Anesthetic Protocols

All patients were orally premedicated 2 hours before surgery with paracetamol 1 g, and pregabalin 75 mg. The anesthetic procedure consisted of spinal anesthesia with 0.75% bupivacaine (11.25 mg) plus fentanyl (15 mcg). After surgery, a single sensory block of the adductor canal was performed under ultrasound guidance with 0.33% bupivacaine (30 mL).

In the early postoperative period, anti-inflammatory agents (diclofenac 50 mg, associated with paracetamol 1 g) were prescribed to be taken orally, every 8 hours, for 7 days. Pregabalin 150 mg was added every night for the first 2 nights, along with tramadol, 15 drops, if required. Famotidine was prescribed to some patients for gastric protection and thromboprophylaxis according to the Caprini score.

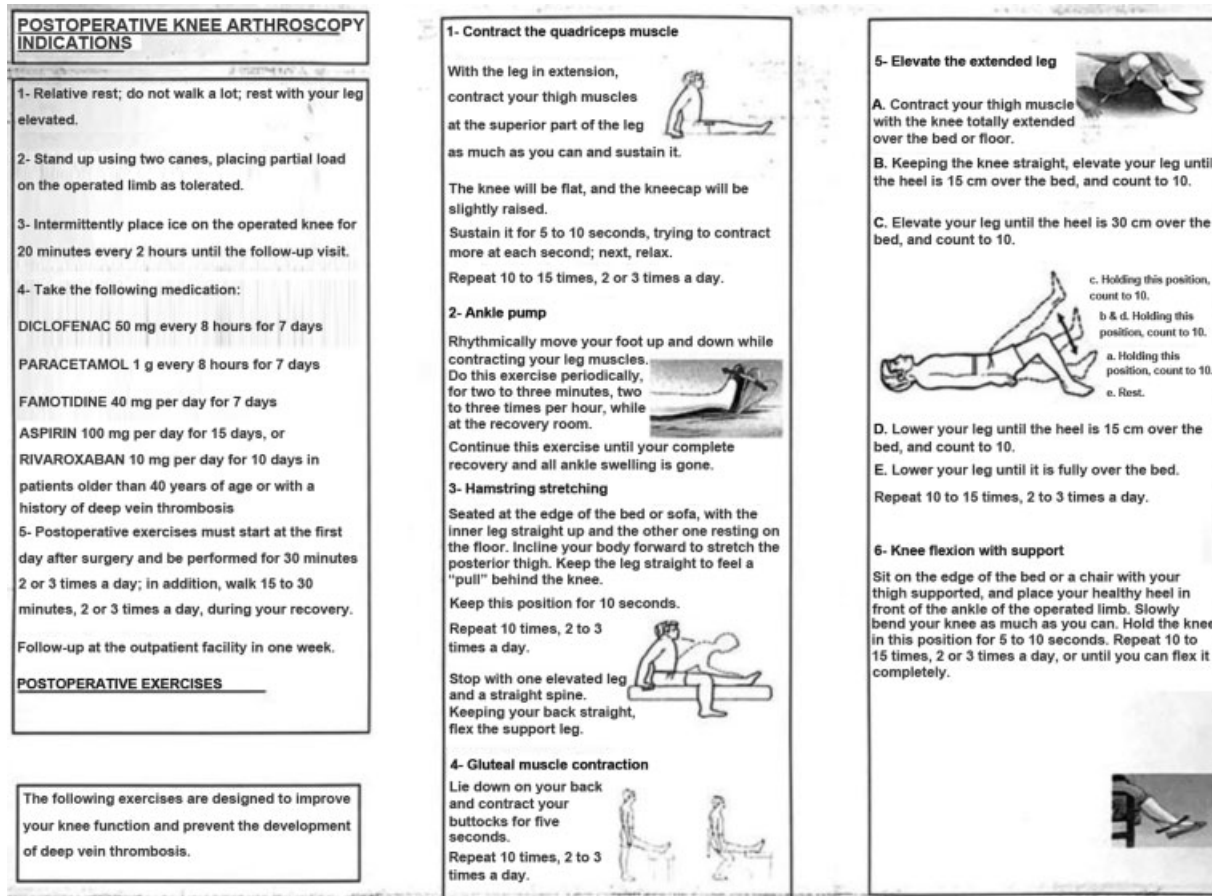


Fig. 1 Instructions to be followed by the patients at home.

In addition, the patients received an instruction manual with red flags for an emergency room visit and exercises to practice at home (→ Figure 1).

Surgical Technique

All patients were operated on arthroscopically, using an ischemia cuff and the BPTB technique. All procedures started with a physical examination under anesthesia. A graft was obtained, with the final diameter from 9 mm to 10 mm, according to the classic technique and prepared on a dedicated table. Under arthroscopic visualization, potential associated lesions (chondral and meniscal injuries) were evaluated and treated at the discretion of the first surgeon (chondroplasty/chondral microfracture, meniscal resection/suture). Tunnels were created at the area of the anatomical footprint using the anteromedial portal technique, starting with the femoral tunnel at 120° of flexion, and then proceeding to the tibial tunnel using a guide. The graft was fixed at 20° of flexion with interference titanium screws (Arthrex Corporation, Naples, FL, US), restoring knee stability with no need for anterolateral reinforcement.

Drainage was not used in any patient. The surgical area was covered with a Robert Jones-type bandage, with no immobilizer.

Outpatient Follow-up

A telephone survey was conducted on the third day to determine the patient’s general condition, pain, and complications, and at the end of the follow-up period for a functional assessment comparing the pre- and postoperative scores on the Tegner and Lysholm scales. Early unscheduled visits and reoperations were recorded.

The subjects were contacted by telephone by a ward nurse on the third day after surgery to fill out a dedicated outpatient survey (→ Figure 2) evaluating overall parameters, including condition, pain, and any complication that may have occurred. Answers to the survey questions were quantified using a scale, which enables the establishment of a computerized record and decision-making (→ Figure 3). The emergency department was also queried about potential early visits. At the time of the study, a new telephone survey was performed to compare the pre- and postoperative scores on the Tegner and Lysholm scales and remotely determine the functional outcomes.

Complications were recorded, including patients who could not be discharged the same day, early visits to the emergency department (in less than 7 days after surgery), and reoperations. This data was obtained reviewing electronic records and surgical protocols from the hospital.

VARIABLES FROM THE TELEPHONE FOLLOW-UP		
GENERAL CONDITIONS GC: Patient's health status during the call	2	Calm and/or euphoric. Fully satisfied with his/her well-being. Normal urinary rhythm. Normal sleep
	1	Worried for his/her health. No full satisfaction. Mild headache. The patient has been sleeping, but not enough. Normal urinary rhythm
	0	Moderate anxiety. Nauseated or distressed. Intense headache. Not satisfied. The patient cannot rest and reports difficult micturition/ abnormal urinary rhythm
	-8	Dyspnea, stupor, or paleness with an urgency sensation. The patient has not been able to sleep. The patient could not urinate, and feels an intense discomfort related to the urinary bladder
PAIN P: Pain intensity during the call	2	No pain or mild pain, both at rest and during movement
	1	Bearable pain which does not prevent movement or sleep
	0	Moderate pain, bearable at rest, but significant during movement and which alters sleep patterns
	-8	Intense pain, including during rest, under correctly-administrated pain medication, accompanied by paleness, sweating, bradycardia or tachycardia, and hypo/hypertension
TOLERANCE T: Normality of the patient's diet	2	No diet restrictions
	1	Diet determined by the surgery
	0	Malaise, nausea or vomiting after a reasonable period of bland diet. The patient complies with the diet proposed at discharge
	-8	Uncontrolled vomiting, including after bland diet. Oral rehydration is not possible
BLEEDING B: Bleeding intensity after surgery	2	No bleeding
	1	Bleeding is deemed normal in amount and rate according to the procedure
	0	The amount of bleeding at the dressing increases during the afternoon
	-8	The wound bleeds in copious amounts, soaking the dressing up to overflow
FEVER	0	Body temperature lower than 38°C
	-8	Body temperature higher than 38°C
WOUND ABNORMALITIES	0	Normal wound
	-8	Ischemic abnormalities at the operated limb, abruptly broken suture, or any changes apparently requiring immediate medical care
TREATMENT COMPLIANCE	0	The patient complies with the treatment and diet
	-2	The patient does not comply with the treatment or hygienic measures

Fig. 2 Early telephone survey.

Cost Analysis

Costs from a usual one-night hospitalization in a ward bed were recorded, considering the daily cost per day of a hospital bed, intravenous medications, kinetic care, and

- 8-4: evolution within normal parameters
- 3-0: a new call, within one hour, is required to determine patient improvement
- Negative: the patient needs assistance at home or the hospital

Fig. 3 Telephone survey scores.

medical evaluation at the next day according to the values provided by the Financial Department of the institution.

Statistical Analysis

Differences between the pre- and postoperative evaluations were compared. For the functional scores (Tegner and Lysholm scales), differences in pre- and postoperative data were calculated; the Shapiro-Wilks test determined data distribution. The Student *t*-test was used for paired samples with normal distribution, whereas the Wilcoxon-Rank test was used for the non-parametric variables. Statistical significance was set at $p < 0.05$.

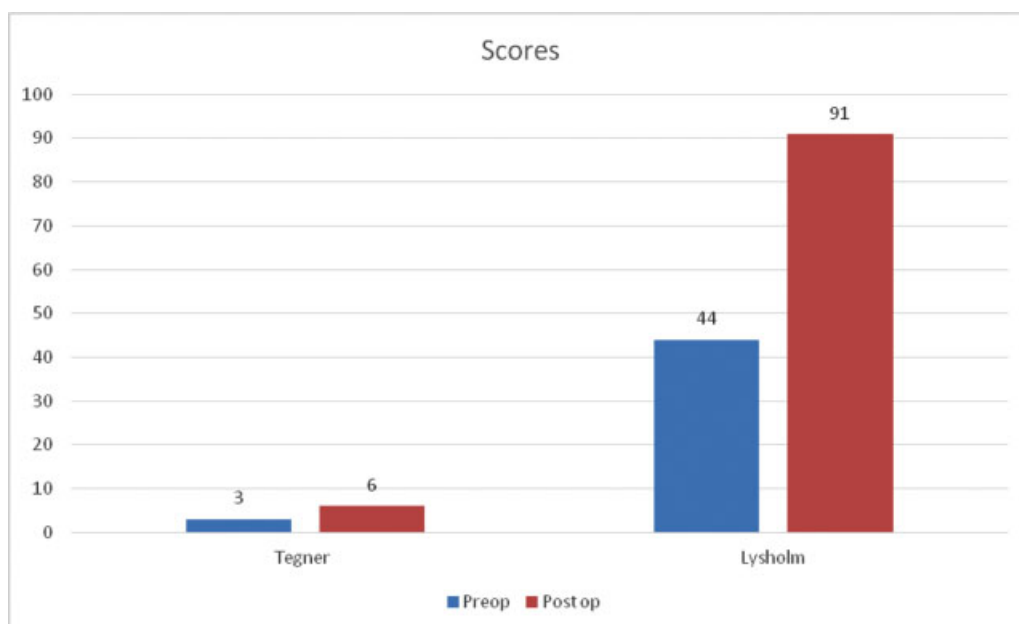


Fig. 4 Functional outcomes at the end of the follow-up period (22.5 months).

Results

In total, 36 subjects were operated on an outpatient basis, including 23 (63.8%) who completed the early survey, and 20 (55.5%) who answered the late survey (functional scores). All patients could be discharged at the same day and complied with their medical follow-up visits during the first month.

Associated chondral and meniscal injuries were detected in 33% and 69% of the patients respectively. A meniscal suture was performed in 4 cases (11.1%), all using the outside-in technique.

At the third postoperative day, an early survey was conducted and answered by 23 patients. All reported good general conditions; in addition, 43% said they had no pain, and 57% presented only mild discomfort, which did not prevent movement or sleep. No patient complained of surgical wound bleeding.

Regarding the functional scores at the end of the follow-up period (remote survey), the score on the Tegner scale had a significant increase from level 3 (range: 1 to 6) to 6 (range: 3 to 8) ($p=0.0001$), while the score on the Lysholm scale increased from 44 (range: 12 to 81) to 91 (range: 61 to 100) points ($p=0.0001$) (► **Figure 4**). The mean follow-up period at the time of the survey was of 22.5 ± 7.9 months.

Complications

No patient required hospitalization after surgery (all subjects presented with tolerable pain and no wound bleeding).

There were 2 (5.5%) early visits to the emergency department (during the first postoperative week):

- One patient sustained a fall from his own height during the first postoperative day when getting up with no canes. He suffered a direct blow to his operated knee, with

complete dehiscence of the surgical wound, requiring an urgent surgery by the emergency traumatologist to clean and reclose it.

- The second patient went to the emergency department on the fifth day after surgery concerned about a hematoma at the operative area (under treatment with rivaroxaban for thromboprophylaxis). Since there was no complication and no surgical wound bleeding, the patient was sent home with no specific treatment.

There were 2 cases (5.5%) of reoperations, including the patient with traumatic dehiscence of the surgical wound. The second case is that of a patient who sustained a fall from own height on the wet floor of the bathroom at home, 12 days after surgery. The patient suffered a direct blow to the operated knee, resulting in a displaced patellar fracture, which was operated by the same surgical team with reduction and osteosynthesis (► **Figure 5**). There were no reoperations due to reconstruction failure until the end of the follow-up period.

The hospital's Financial Department provided the value of everything not required by a subject operated on an outpatient basis; therefore, the cost of a ward bed per day, intravenous medications, kinetic care, and medical evaluation the next day were considered, totaling 203,205 pesos per patient.

Discussion

In contrast to other countries that have been developing ACLR outpatient programs for some decades, there is no published literature evaluating these initiatives in Chile.^{1,6} The present study is the first national report on outcomes and complications of outpatient ACLR surgery.

The potential disadvantages of an outpatient ACLR include poor pain management and early complications at home,



Fig. 5 Patellar fracture operated with screws and a circular tension band wire.

which could result in a high rate of early readmission and worse functional outcomes. In the present series, patients reported being pain-free or presented with mild pain on the third day; in addition, there was no record of visits due to pain. This is consistent with the literature from the last decade, which shows that it is possible to achieve adequate analgesic management in patients submitted to outpatient ACLR surgery. In this regard, studies such as the one published by Talwalkar et al.¹⁶ stand out, in which only 2 out of 51 patients could not be discharged the same day of surgery, although this occurred not because of poor pain management, but rather due to copious drainage. For De Beule et al.,¹⁷ in a cohort of 355 patients, the readmission rate during the first postoperative month was of 1.4%, whereas Tierney et al.⁴ (227 ACLRs), Williams et al.¹⁸ (50 ACLRs), and Lunebourg et al.¹⁹ (30 ACLRs) did not report any procedure-related postoperative readmissions. In addition, Lunebourg et al.¹⁹ compared the satisfaction of 30 subjects submitted to the outpatient procedure to that of 30 subjects operated on an inpatient basis, revealing better outcomes in the outpatient group at the first postoperative month.

An adequate anesthetic protocol is essential for successful pain management and to avoid pain-related visits. The literature has several protocols, such as general anesthesia (Lefevre et al.²⁰), spinal anesthesia, sometimes with local infiltration at the graft harvesting area (Talwalkar et al.¹⁶) and/or surgical incisions (Tierney et al.;² Williams et al.¹⁸), in addition to femoral nerve or adductor canal block (Lunebourg et al.¹⁹), and some studies even use different protocols

in the same cohort. This lack of uniformity makes it difficult to compare outcomes from several studies, but it shows that a good result can be achieved with multiple schemes. Our protocol consisted of oral premedication and spinal anesthesia plus a single sensory block of the adductor canal with ultrasound support at the end of the surgery, in addition to dedicated analgesic management at home. This protocol was agreed with the team of anesthetists based on the literature and their professional experience. As we have described, this technique prevented any early unscheduled visits due to poor pain management.

Our casuistry presents 2 cases of unscheduled visits (5.5%) and 2 reoperations (5.5%) within the first 30 days. The surgical wound dehiscence requiring cleaning and suturing in one patient was deemed an early complication; although a regional sensory block was performed, some motor block effect secondary to the anesthetic procedure or medication could play a role in this event. The other patient who required reoperation had an ipsilateral patellar fracture due to a fall 12 days after the original procedure, that is, after the analgesic medication was terminated. The rate of ACLR-related complications is variable, and it may reach 9%;¹ the outpatient procedure is not associated with a higher intercurrent rate. Andrés-Cano et al.²¹ reported 13.2% of emergency room visits after outpatient ACLR surgeries, mostly due to pain, with 2.3% of readmissions associated with the surgical wound. Liu²² reported 3.9% of hospital readmissions after outpatient ACLR procedures in New York State, United States, highlighting that subjects operated on in high-volume hospitals were less likely to require new procedures. We believe that our reintervention rate, which was higher compared to those reported on the literature, was partially due to our low number of patients (including 1 individual who sustained a fall at 12 days, an event unrelated to an outpatient program); in addition, since this is an initial experience, we will reinforce fall prevention at the therapeutic protocol for our patients.

Regarding functional outcomes, some of the aforementioned publications (Williams et al.,¹⁸ Lunebourg et al.,¹⁹ and Lefevre et al.²⁰) compared data from outpatient and inpatient procedures, and found no differences between groups; moreover, Valkering et al.²³ published a study in which they compared these two groups prospectively and randomly, and did not observe any difference one year after surgery. As such, although we did not have a control group, our study showed an improvement in functional outcomes for an average follow-up period of 22.5 months, without any case of failure or revision until the end of the follow-up.

Outpatient ACLR surgery has many other advantages, including lower use of hospital supplies and resources, resulting in significantly reduced costs. The cost reduction achieved in this outpatient ACLR program corresponded to 203,205 pesos for each operated patient. This reduction is much lower compared to that of other series.²⁴ This occurred because our study was performed at a public hospital in Chile, with healthcare expenses much lower compared to those of private institutions, in which a ward bed may cost

more than 600 thousand pesos per day,^{25,26} considerably increasing savings. However, these savings will become considerable as an outpatient program is maintained over time; our 36 patients alone saved more than 7 million pesos for the healthcare system. It is also important to highlight the fact that since a bed is not required for the operated patient, the surgery is not conditioned to bed availability, resulting in vacancies that can be filled by another subject; this solves another healthcare problem, providing a very relevant, difficult-to-measure added value.

The limitations of the present study include its retrospective design and the small casuistry, with a high percentage of patients who did not complete all early and late evaluations. The loss to follow-up during the early survey resulted from a registry failure, since all patients were duly contacted by phone on the third day and submitted to the early medical check-up, without reporting any complication. Unfortunately, the lack of available beds at the central ward of our center because of the high demand due to other conditions forces us to opt for ACLR only as an outpatient procedure; as such, we do not have a comparative group of patients submitted to the inpatient procedure.

As strengths, we highlight the fact that all patients were operated on by the same surgical and anesthetic teams, which results in a more uniform work. Our outpatient program had good outcomes and generated significant savings to the healthcare system. In addition, we were the first group in Chile to publish their experience with an outpatient ACLR program.

Conclusion

Outpatient ACLR surgery using the BPTB technique was a safe procedure in the present series, with adequate pain management and satisfactory functional outcomes during a medium-term follow-up. It was also associated with a reduction in cost estimates.

Conflict of Interests

The authors have no conflict of interests to declare.

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