

# A Prospective Study of Pain and Analgesic Use in Outpatient Endoscopic Anterior Cruciate Ligament Reconstruction

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**Summary:** A prospective study was undertaken to evaluate the postoperative pain and analgesic profiles of a group of 50 patients undergoing outpatient anterior cruciate ligament (ACL) reconstruction and to compare their profiles with those of a group of 50 patients undergoing outpatient non-ACL arthroscopic surgery. All patients received preoperative and postoperative ketorolac, intra-incisional/intra-articular bupivacaine, intraoperative ketorolac, and propofol anesthetic. The percentage of patients receiving supplemental analgesia in the recovery room was 49% (average, 2.2 mg intravenous morphine sulfate) for the ACL group and 31% (average, 1.2 mg intravenous morphine sulfate) in the non-ACL group. Narcotic use and pain scores peaked in both groups on postoperative days 1 and 2. The ACL group used significantly more narcotic and had higher pain scores in the first week after surgery than did the non-ACL group. However, there were no subsequent admissions, readmissions, or emergency room visits for pain. All were satisfied with the outpatient nature of this surgery. Patients tolerate outpatient endoscopic ACL reconstruction with moderate pain and narcotic use. Outpatient endoscopic ACL reconstruction can be performed safely, effectively, and with considerable cost savings. **Key Words:** ACL reconstruction—Pain—Analgesia—Outpatient—Endoscopic—Cost-containment.

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Cost-containment issues have had a major impact on orthopaedic practice. Many procedures previously performed in an inpatient setting are now being performed on an outpatient basis at a large cost savings. As surgical and pain control techniques have evolved, the ability to perform more complex surgeries on an outpatient basis has become feasible. Outpatient endoscopic anterior cruciate ligament (ACL) reconstructions (with or without meniscal repair) have been performed at our institution since April 1994 using our

current pain protocol. Kao et al.<sup>1</sup> were the first to report on the effectiveness of outpatient ACL reconstruction. Their study was limited by being retrospective and having inherent bias built in by giving patients the choice of inpatient versus outpatient ACL reconstructive surgery. The purpose of our study was twofold: first, to prospectively record the pain response (using a visual analog pain scale) and analgesic use in patients undergoing outpatient endoscopic ACL reconstruction; and second, to compare this group with a non-ACL outpatient knee arthroscopy group.

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## MATERIALS AND METHODS

Fifty patients scheduled to undergo outpatient endoscopic ACL reconstruction with or without concomitant arthroscopic procedures and 50 patients scheduled for non-ACL outpatient knee arthroscopy comprised the study groups. Middle third autogenous bone-patellar tendon-bone autograft was used in each

endoscopic ACL reconstruction. All surgeries were performed by the senior authors B.R.B. and C.B.J. and both used an arthroscopically assisted ACL reconstruction technique previously described by B.R.B.<sup>2</sup> The study met guidelines of and was approved by the hospital review board.

The specifics of the study were explained to each patient in the preoperative holding unit before surgery. The visual analog pain scale was a 10-cm horizontal line with one end labeled "no pain" and the other labeled "pain as bad as it could be" (Fig 1). Patients were told that they would need to place a vertical line along the horizontal line at the point that corresponded to their average pain level for each postoperative day. Also, daily accounts of the types, amounts, and times of analgesic use were to be recorded. While still in the preoperative unit, patients signed a consent form and recorded on their data sheets their pain level for the preceding night.

Thirty minutes before surgery, patients received 1 mg of intravenous (IV) midazolam hydrochloride. In the operating room, propofol with nitrous oxide (anesthetic), sufentanil (narcotic, 12.5 to 25 µg), and rocuronium bromide (muscle relaxant, 0.6 to 0.8 mg/kg) were used. Before the start of surgery, patients received 60 mg intramuscular ketorolac and all potential incision sites were injected with one half the maximal dose (based on body weight in kilograms) of a 0.25% bupivacaine and 1:300,000 epinephrine solution. At the conclusion of surgery, 30 mg IV ketorolac was administered, intra-incisional and intra-articular injection of the remaining half of the maximal dose of bupivacaine/epinephrine solution was performed, and a cryotherapy unit (Polar Care, Carlsbad, CA) was applied to the knee. Patients were then transferred to the recovery room where the cryotherapy unit was connected, and all supplemental analgesics administered were recorded. After 1 hour in the recovery room, patients were transferred back to the holding unit where they received physical therapy. Drains (if present) were removed, a hydrocodone prescription (5 to 10 mg every 4 to 6 hours) was given with follow-up instructions, and pain study data sheets were re-reviewed. Patients were seen on postoperative day (POD) 1 for wound check, dressing change, and referral to therapy. For patients who were unable for follow-up on POD 1, telephone contact was made by senior surgeons within 24 hours of the surgery and

**TABLE 1.** Day of Surgery Pain and Analgesic Protocol Used for Outpatient Arthroscopic Knee Surgery

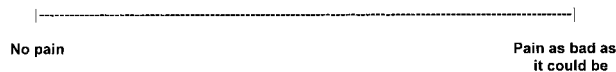
Preoperative Holding Unit
Midazolam HCl 1 mg IV 30 min before surgery
Anesthetic
Propofol 2-2.5 mg/kg induction, maintenance 75 µg/kg to 160 µg/kg and nitrous oxide (66% nitrous and 33% oxygen)
Sufentanil (narcotic) 12.5-25 µg
Rocuronium bromide (muscle relaxant) 0.6-0.8 mg/kg
Prior to Surgical Start
Ketorolac 60 mg IM
Cefazolin 1 g IV
Bupivacaine (.25%) and epinephrine (1:300,000)—half maximal dose (based on body weight) injected intra-incisionally
Conclusion of surgery
Ketorolac 30 mg IV
Bupivacaine (.25%) and epinephrine (1:300,000)—remaining half of maximal dose injected intra-incisionally and intra-articularly.
Cryotherapy—application*
Recovery Room
Morphine sulfate IV supplementally if needed
Midazolam IV supplementally if needed
Cryotherapy*
At Discharge
Hydrocodone prescription
Cryotherapy*

\*Not used for the non-ACL knee arthroscopy patients.

patients were seen on POD 3. Data sheets were collected POD 7 to 14 or mailed in at a later date. The pain and analgesic protocol in the non-ACL knee arthroscopy group differed from the ACL reconstruction group protocol only in that no cryotherapy unit was used and patients did not receive physical therapy (Table 1). Data analysis was performed using a paired Student's *t* test. Significance was defined as  $P \leq .05$ .

## RESULTS

Fifty outpatient endoscopic ACL reconstruction patients and 50 non-ACL knee arthroscopy patients comprised the study groups (Table 2). Average age was 28 years for the ACL group and 40 years for the non-ACL group. Average surgical time was 118 minutes for the ACL group and 34 minutes for the non-ACL group. Only 23% of the ACL group and 5% of the non-ACL group required tourniquet inflation, with average times of 13 minutes and 3 minutes, respectively. There were no intraoperative or immediate postoperative complications. Supplemental recovery room analgesia was required in 49% of the ACL group and 31% of the non-ACL group. The average recovery room IV morphine sulfate dose was 2.2 mg in



**FIGURE 1.** Visual analog pain scale.

TABLE 2. Study Groups

Characteristic	ACL	Non-ACL
No. of patients	50	50
Avg age	28.5 y	40.4 y
Avg surgery time	118 min	34 min
Avg tourniquet time	13 min	3 min
Tourniquet use (%)	23%	5%
RR morphine sulfate (%)	49	31
RR morphine sulfate (mg)	2.2	1.2

the ACL group and 1.1 mg in the non-ACL group. No antiemetic medications were required in the recovery room. Recovery room time averaged 53 minutes.

No patient required postoperative admission, readmission, or visited an emergency room for pain control or complications from the surgery. Telephone calls by patients complaining about pain or requesting additional pain medication were rare.

Postoperative oral narcotic use peaked on POD 1 in the non-ACL group and on POD 2 in the ACL group (Fig 2). Narcotic use was significantly higher on PODs 2, and 5 to 8 in the ACL group ( $P < .05$ ). Non-narcotic analgesic use peaked on POD 4 in the ACL group and on PODs 7 to 8 in the non-ACL group (Fig 3). There was no significant difference in non-narcotic analgesic use between the two groups. Visual analog pain scores peaked on POD 1 in both groups and remained higher in the ACL group throughout the study (Fig 4). Preoperative pain scores were significantly higher in the non-ACL group. However, patients in the ACL group had significantly higher pain scores on PODs 1 to 8.

DISCUSSION

Improvements in surgical technology and techniques coupled with improved pain control and the ongoing push for cost containment in the health care

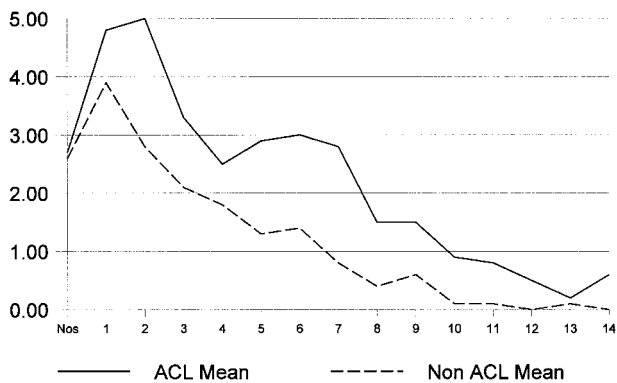


FIGURE 2. Narcotic use.

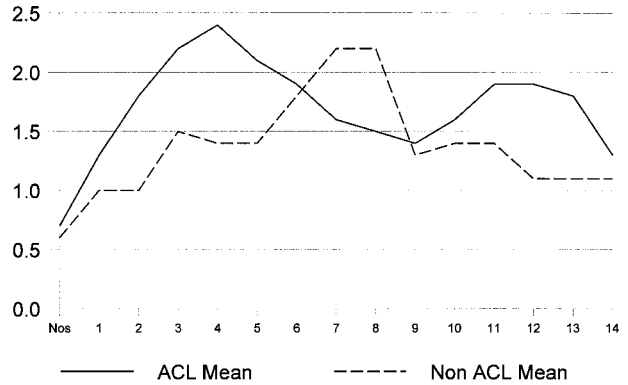


FIGURE 3. Non-narcotic analgesic use.

industry have resulted in an ever increasing number of outpatient surgeries. Surgical treatment of the ACL-deficient knee has evolved from open and extra-articular procedures to endoscopic reconstruction techniques. Improvements in surgical instrumentation and technique, stronger graft constructs and fixation methods, and improved understanding of graft healing and maturation have resulted in more aggressive rehabilitation programs and faster return to activity.

Our clinical experience with outpatient endoscopic ACL reconstruction has been that patients tolerate the procedure well. The purpose of this study was to prospectively evaluate postoperative pain (using a visual analog pain scale) and analgesic use in outpatients undergoing endoscopic ACL reconstruction and to compare the results with a non-ACL outpatient arthroscopy group.

We defined mild pain as 1 to 3, moderate as 4 to 7, and severe as 8 to 10 on the visual analog scale. The maximum daily dose of hydrocodone is 12 tablets. We defined taking 0 to 4 tablets per day as infrequent, 5 to 8 tablets per day as moderate, and 9 to 12 tablets per day as frequent narcotic usage. Pain scores peaked on POD 1 in the moderate range for both groups; how-

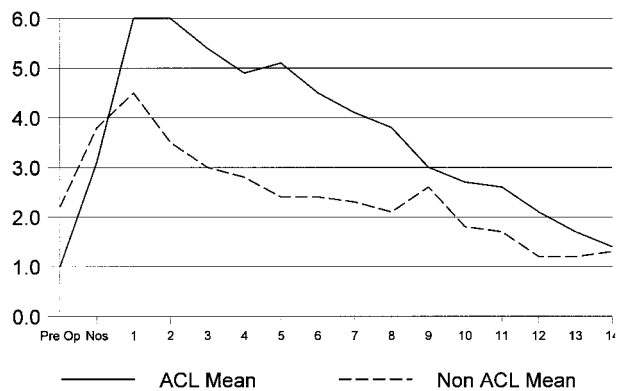


FIGURE 4. Visual analog pain scores.

ever, scores stayed significantly higher in the ACL group reaching significance on PODs 5 to 8. In the non-ACL group, narcotic use was never higher than the infrequent category, which was reflected by a pain score that remained in the mild category except for POD1 (which bordered on the moderate category). In the ACL group, narcotic use and pain scores were higher. They remained in or bordering on the moderate category for 1 week after their surgery. These differences reflect longer surgical times, additional incisions, osseous work, and an overall increased complexity of endoscopic ACL reconstructions over non-ACL arthroscopic procedures.

In a retrospective study comparing two-incision autogenous middle third bone patellar bone ACL reconstruction in inpatients versus outpatients, Kao et al.<sup>1</sup> found no significant difference in pain level and analgesic frequency between the two groups. However, selection bias was built into their study as they gave patients the choice of outpatient or inpatient surgery. Their study was also limited by the patients' need to recall their pain frequency, severity, and relief for the first 5 days after surgery some 2 to 6 weeks after surgery. Frey et al.<sup>3</sup> reported on pain level and analgesic use for the first 48 hours after outpatient ACL reconstruction using a combination of femoral nerve block, intra-articular analgesia, nonsteroidal and anti-inflammatory agents (naproxen), opiates (subcutaneous patient-controlled anesthesia with imipramine initially, which was changed to oral acetaminophen with hydrocodone half way through the study), and cryotherapy (Polar Care). Although their study differs from ours in the use of a femoral nerve block, failure to inject incisional sites before surgery, use of ketorolac at the discretion of the anesthesiologist, and follow-up of only 48 hours, their results were similar to ours in that patients tolerated outpatient ACL reconstruction well.

Postoperative pain management following knee arthroscopy continues to evolve. Cold therapy, corticosteroids, local anesthetics, and regional blocks alone or in combination have all been shown to be beneficial in redirecting postoperative pain.<sup>4-9</sup> Using our current pain/anesthesia endoscopic ACL reconstruction protocol, we have successfully performed over 140 such surgeries since April 1994 without a single postoperative admission, readmission after discharge, or emergency room visit for pain. Our day-of-surgery pain protocol results in low pain scores and infrequent narcotic use the night of surgery. Although narcotic use and pain scores in the ACL group remain moderate and are significantly higher than the non-ACL group during the first postoperative week, patients tolerate this procedure well on an outpatient basis with oral

pain medication and cryotherapy. This study shows a discrepancy between pain scores (moderate category) and narcotic use (infrequent category) in the ACL group. As a result, we now encourage patients to take their pain medicine as prescribed during the first postoperative week.

In previous work,<sup>10</sup> we have shown average total surgical charge (excluding surgical and anesthesiology fees) for inpatient ACL reconstruction performed in the main operating room patients to be \$11,791 for an overnight stay and \$13,503 for a 2 night stay between 1989 and 1991. In 1991, with the advent of endoscopic ACL reconstruction, a decreased need for postoperative hospitalization was noted. Average charges for endoscopic outpatient ACL reconstruction in the main operating room were \$8,834 and reflected à la carte pricing. Since April 1994, an average set fee of \$3,855 has been charged for outpatient endoscopic ACL reconstruction performed in our free-standing surgical center. In conclusion, outpatient endoscopic ACL reconstruction using our pain and analgesic protocol can be done safely, effectively (from a pain standpoint), and with considerable reduction in hospital charges.

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