

## **Dilute Peripheral Nerve Catheters: A Unique Method to Decrease Post-operative Narcotic Usage in Limb Reconstruction Patients**

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### **What was the question?**

The misuse and abuse of opioids in the United States has reached epidemic proportions. For orthopedic surgeons, it has become critical to find alternative pain management strategies that decrease the amount of narcotic pain medication used by our patients. Regional anesthesia has been shown to be a valuable adjunct to post-operative pain management but is difficult to use in limb reconstruction patients for the following reasons: 1) Nerve blocks can impede the motor function of the nerve which prevents the patient from being able to participate in physical therapy 2) Nerve blocks wear off before the acute pain from surgery has completely dissipated 3) Complete nerve blocks may not be safe after osteotomy if they mask symptoms of a developing compartment syndrome. This study evaluates a unique method of pain management after osteotomy surgery using a portable peripheral nerve catheter that administers a dilute solution to provide sensory block without affecting motor function.

### **How did you answer the question?**

Following IRB approval and waiver of the need for individual informed consent, we retrospectively analyzed the medical records of patients between 10 to 40 years of age who had undergone elective lower limb lengthening procedures under general anesthesia or general plus regional anesthesia over a 3-year period. The regional anesthetic technique included peripheral nerve catheters (PNC) with a continuous infusion of a local anesthetic agent. The primary outcome was opioid requirements during the first 48 hours after the surgical procedure. Opioid administration was converted to oral morphine equivalents (ME) for comparison between groups. Data analysis was performed in Stata/IC 14.2 (College Station, StataCorp, LP) with a two-tailed t-test with  $P < 0.05$  considered statistically significant. The regional anesthesia technique for the femoral osteoplasty subgroup included a postoperative suprainguinal fascia iliaca catheter while the tibial osteoplasty subgroup had adductor canal and sciatic nerve catheters placed. All catheters were inserted in the operating room under ultrasound guidance with sterile technique. After confirming proper position, a test dose of epinephrine 1:200,000, 0.5  $\mu\text{g}/\text{kg}$  to a maximum of dose of 15  $\mu\text{g}$  per catheter, was administered to rule out intravascular placement. A bolus dose of 0.2% ropivacaine (0.05 mL/kg of ideal body weight) was administered after proper bedside neurological exam was performed by the surgeon. For tibial osteoplasty patients each of the two catheters received an infusion of 0.1% ropivacaine was started at 0.05 mL/kg/hour per catheter. For the single catheter in the femoral osteoplasty patients an infusion of 0.1% ropivacaine was started at 0.1 mL/kg/hour. As part of the postoperative analgesia regimen, all patients received acetaminophen (intravenous or oral, 10 mg/kg every 4 hours) plus ketorolac (0.5 mg/kg every 6 hours).

### **What are the results?**

A total of 70 osteotomy patients were included in the study with an average age of 14.5 years. General anesthesia was used alone in 29 (42%) patients while general plus regional anesthesia

was used in 41 (58%) (Fig 1). Patients undergoing femoral osteotomies with subsequent adjustable intramedullary nail insertion accounted for a total of 37 subjects: 11

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(30%) received general anesthesia while 26 (70%) receive general plus regional anesthesia (Fig 2). In the tibial osteotomy subgroup with subsequent placement of a hexapod circular external fixator there were a total of 33 patients. Eighteen patients (54%) received general anesthesia and 15 (46%) received general plus regional anesthesia. (Fig 3)

There was a significant decrease in opioid consumption in the general plus regional anesthesia group compared to the general anesthesia only patients. In the entire study cohort, postoperative opioid use over the first 48 hours was 0.5 mg/kg of oral morphine equivalents (ME) in the general plus regional anesthesia group, compared to 1.7 mg/kg of ME in the general anesthesia only group ( $p < 0.001$ ). The same outcome was observed in the two subgroups; 48 hours opioid consumption in the femoral osteotomy group receiving general plus regional anesthesia was 0.4 mg/kg ME vs 2.1 mg/kg ME in the general anesthesia only subgroup ( $p = 0.006$ ). In the tibial-fibular osteotomies subgroup, the general plus regional anesthesia patients reported at 48 hours a total of 0.7 mg/kg ME compared to the general anesthesia only subgroup where the postoperative opioid requirements were 1.4 mg/kg ME ( $p = 0.002$ ). All patients maintained motor function in the treated limb and were able to complete inpatient physical therapy. There were no compartment syndromes.

### What are your conclusions?

This method of pain management produced an overall 3.4X reduction in the opioid usage by our patients in the peri-operative period with femoral patients getting 5X less and tibial patients 2X less. The patients were able to maintain motor function and complete inpatient physical therapy without restrictions. The peripheral nerve catheters were portable and could remain in use for up to five days post-operatively. This appears to be a safe and effective technique for decreasing narcotic pain medication use in limb reconstruction patients.

**Fig 1.** Opioid use among all patients undergoing procedure for lower extremity length discrepancy (N=70) (IQR = Interquartile range)

Opioid use in morphine equivalents	Regional anesthesia (N=41)	No regional anesthesia (N=29)	P
	Median (IQR)	Median (IQR)	
Intraoperative (mg/kg)	0.9 (0.6, 1.0)	0.7 (0.5, 1.0)	0.698
Postoperative 48 hours (mg/kg)	0.5 (0.3, 0.9)	1.7 (1.1, 3.1)	<0.001

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**Fig 2.** Opioid use among all patients undergoing femoral osteoplasty for lower extremity length discrepancy (N=37)

Opioid use in morphine equivalents	Regional anesthesia (N=26)	No regional anesthesia (N=11)	P
	Median (IQR)	Median (IQR)	
Intraoperative (mg/kg)	0.9 (0.6, 1.0)	0.6 (0.5, 1.2)	0.642
Postoperative 48 hours (mg/kg)	0.4 (0.2, 0.9)	2.1 (0.9, 3.1)	0.006

**Fig 3.** Opioid use among all patients undergoing tibial–fibular osteoplasty for lower extremity length discrepancy (N=33)

Opioid use in morphine equivalents	Regional anesthesia (N=15)	No regional anesthesia (N=18)	P
	Median (IQR)	Median (IQR)	
Intraoperative (mg/kg)	0.9 (0.5, 1.1)	0.9 (0.5, 1.0)	0.664
Postoperative 48 hours (mg/kg)	0.7 (0.3, 1.1)	1.4 (1.1, 3.3)	0.002