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An Analysis of Femoral Nerve Block Use for Pediatric ACL Reconstruction

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Introduction

Femoral nerve blocks (FNBs) are the most common form of regional anesthesia used for pediatric anterior cruciate ligament (ACL) reconstruction (ACLR). The use of these blocks has increased in recent years.¹⁻³ While some studies suggest that FNBs slow the return to sports and have implications on quadriceps and hamstrings strength,⁴ others demonstrate benefits, such as improving postoperative pain control.⁵ FNBs can be used as a single-shot injection or a catheter that provides continued infusion.

In this study we aim to (1) determine the rates of use for single-shot versus continuous-catheter FNBs and compare rates between ambulatory surgery centers (ASC) and the main hospital, (2) assess time needed for anesthesia administration by block technique to determine efficiency, and (3) analyze differences in postoperative pain control. We established two *a priori* hypotheses: (1) that on average the time used for single-shot FNBs would be less than the time for continuous-catheter FNBs, and (2) that there would not be a difference in postoperative pain, as measured by the self-reported 10-point pain scale at the patient's 1-week postoperative clinic visit.

Methods

This retrospective study was approved by the Institutional Review Board at Children's Hospital of Philadelphia (IRB #15-012614). Our patient cohort was identified from a tertiary referral center and affiliated ambulatory surgery centers and consists of pediatric patients (≤ 18 years of age) who underwent primary ACLR (CPT code 29888) and received a FNB in 2018 or 2019. Patients undergoing revision ACL reconstruction ($n = 7$) as well as those requiring multiligamentous reconstruction were excluded ($n = 48$). To achieve 80% power for our study, we calculated a needed sample size of 171.

The type of nerve block (single-shot vs. continuous-catheter) was recorded for each patient along with the location of surgery (Main vs. ASC), time required for anesthesia administration and pain scores at the first postoperative visit.

To compare the two cohorts, we used univariate statistics (t-tests and Mann-Whitney U for continuous variables; Chi-squared and Fisher Exact tests for categorical variables). A p-value of 0.05 was considered statistically significant. The analysis was completed using Stata 16.0 (Stata Corp, College Station, TX).

Results

In total, 256 ACLRs were reviewed. Patients received a single-shot FNB in 159 of these surgeries (62.1%) and a continuous-catheter in 97 surgeries (37.9%). One patient had a preoperative catheter FNB and a postoperative single-shot FNB and was excluded from further analysis. There was no difference in age or gender by nerve block technique (Table 1). Individuals who had surgery at Main were significantly more likely to have a continuous-catheter than those at an ASC. The time spent administering anesthesia was significantly longer among patients who received a continuous-catheter as compared to a single-shot (Figure 1). While Main had longer anesthesia times on average, continuous-catheter administration was still significantly longer than single-shot at both Main and ASCs individually. Pain scores were not significantly different between the FNB cohorts or between Main and ASCs.

Discussion

This study demonstrated that there was no difference in 1-week postoperative pain between patients receiving a continuous-catheter versus or single-shot FNB, but that increased time was spent administering the former. The rate of FNB use in ACLR has been increasing,^{1,2} and we believe that it is important to understand the rates of each FNB technique at our institution. Overall, single-shot FNBs were used for 159 surgeries (62.1%) and continuous-catheters were used in 94 surgeries (37.9%). Patients undergoing surgery at the main hospital were significantly more likely to have a continuous-catheter. The rates of use by age and sex did not differ.

Our study found no difference in 1-week postoperative pain between FNB types. While continuous-catheters have been associated with

Table 1. Patient and Procedure Characteristics for by Type of Femoral Nerve Block

Patient Demographics	Single-shot n (%)	Continuous-catheter n (%)	P-value
Age †	159 (62.1%)	97 (37.9%)	
	15 (13-17)	15 (14-17)	0.227
Sex			0.778
Male	84 (61.3%)	53 (38.7%)	
Female	75 (63.0%)	44 (37.0%)	
Location			< 0.001*
Main	14 (13.2%)	92 (86.8%)	
Ambulatory	145 (96.7%)	5 (3.3%)	
Anesthesia Start to Anesthesia Ready (in min) †	23 (20-29)	46 (42-56)	< 0.001*
Pain Level †	1 (0-3)	1 (0-4)	0.414

*P-value < 0.05

†Median and Interquartile Range reported for continuous variables

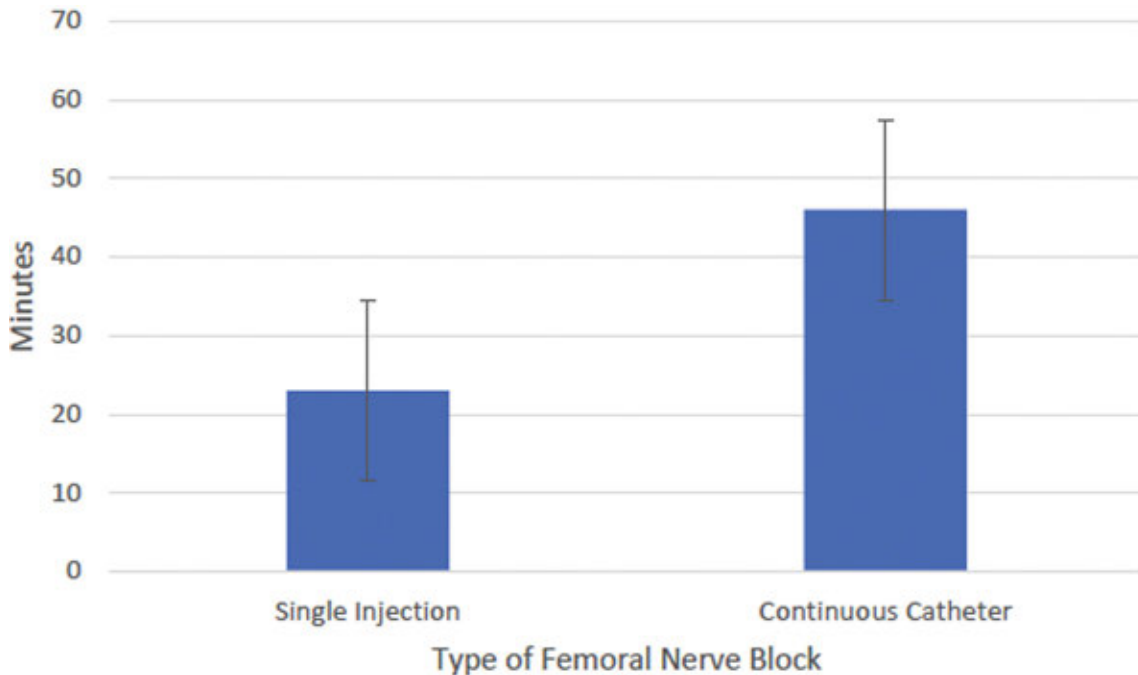


Figure 1. Average Time for Anesthesia Administration by Type of Femoral Nerve Block

decreased pain for other procedures, there is limited research in the pediatric ACLR population and both FNB techniques are considered highly effective for postoperative analgesia.⁸ Okorooha et al found that immediately postoperatively, a single-shot FNB decreased pain as compared to local liposomal bupivacaine.⁸ There is also some data to suggest that single-shot FNBs may improve long term functional outcomes, but the data is mixed.⁹⁻¹¹ We have found in prior studies quality outcomes and efficiency in the outpatient setting using single-shot nerve block for patients with isolated ACL injury.¹²⁻¹³ These quality outcomes, as well as the time and cost efficiency of single-shot relative to catheter FNBs noted in the current study may provide surgeons with optimism regarding single-shot block use as a supplement to general anesthesia.

Notably, the time spent administering a single-shot FNB was significantly shorter than the time spent for a continuous-catheter FNB. Previous research has shown that the use of continuous regional anesthesia increases the cost to the patient and the hospital.¹² The use of single-shot FNB in the case of isolated ACL reconstruction in pediatric patients may decrease hospital costs by decreasing time in the operating room, while providing quality analgesia for patients.

Strengths & Limitations

Our study is limited due to its retrospective nature, which limited the available outcomes data. We recognize that catheters are responsible for early pain control and while we did not include pain scores for the first 24 hours, there

was no return to the facility for pain in either group. We also could not definitively determine the cause of time differences. It is possible that the difference in time spent administering anesthesia in the tertiary referral center and the ambulatory surgery center may be due to the presence of trainees in the tertiary referral center. However, this is unlikely to be the only contributing factor.

Conclusion

Patients were more likely to undergo continuous-catheter FNB at Main compared to the ASC. While overall anesthesia time took longer at the Main hospital, at both the ASC and Main locations, single-shot FNB took significantly less time than placement of a continuous-catheter FNB, and the 1-week postoperative pain scores did not differ. Further studies should compare a more comprehensive postoperative pain course between these techniques and providers should consider the costs as well as risks and other benefits to the patient when choosing either a continuous-catheter or single-shot FNB.

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