

# Comparison of Adductor Canal and Femoral Nerve Blocks in Primary TKA

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## Abstract

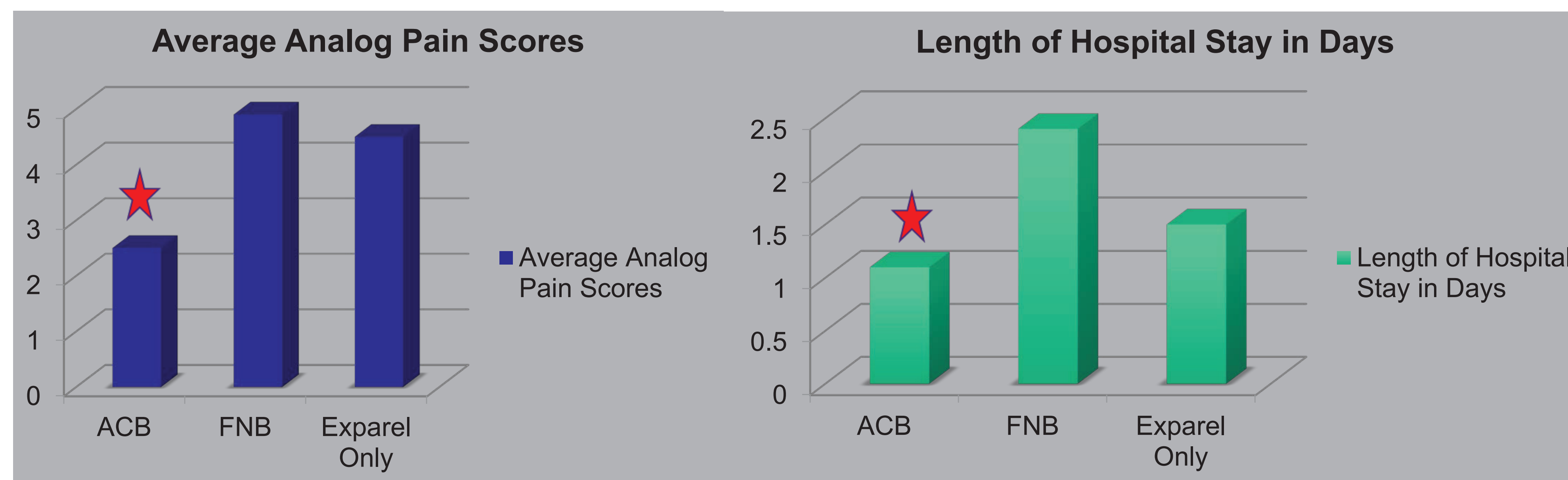
**BACKGROUND:** Pre-operative adductor and femoral nerve blocks have been used to decrease post-operative pain for total knee arthroplasty. No study to our knowledge evaluates the efficacy of these two pre-operative blocks with liposomal bupivacaine injection (Exparel) intra-operatively. We conducted a prospective study determining the efficacy of pain relief and early post operative function between adductor nerve blocks and femoral nerve blocks with intra-operative bupivacaine injection for total knee arthroplasty. **METHODS:** Data was prospectively collected and patients (N=55) that underwent total knee arthroplasty were divided into three groups: femoral nerve block, adductor nerve block, and control. Each block was administered by an anesthesiologist approximately 30 minutes pre-operatively. Exparel was injected within the surrounding tissue intraoperativley. Patients were measured post-operative day 1, day 2, and day 3 using the visual analog pain scale, gait distance, active and passive range of motion, and length of hospital stay. **RESULTS:** Adductor nerve block had a statistically significant decreased pain score (n=2.2) compared with femoral nerve block (4.8) and Exparel only (4.33) ( $p < 0.05$ ). Adductor nerve block patients also had a statistically significant decreased length of hospital stay (n=1.0) versus femoral nerve block (2.2) and bupicaine only (1.3) ( $p < 0.05$ ). There was no statistically significant difference in active range of motion, passive range of motion, or gait distance. **CONCLUSIONS:** Our data shows that adductor nerve blocks in combination with Exparel alleviate pain and decrease length of hospital stay more effectively than femoral blocks with Exparel or Exparel alone. Although not statistically significant, there was a trend with adductor nerve block patients having greater active and passive range of motion between the three groups.

## Background

Pain relief is essential for functional recovery following total knee arthroplasty. Regional anesthesia using ultrasound guidance, including femoral, obturator, sciatic, saphenous, and lateral cutaneous nerve blocks, have become increasingly more prevalent over the last decade [1]. The ideal nerve block should provide adequate pain relief, decrease dependence on opioids post-operatively, and maintain motor function. The femoral nerve block was first introduced nearly a century ago and has become one of the most commonly used nerve blocks for total knee arthroplasty [2]. It has been shown to improve analgesic outcomes and decrease length of hospital stay after total knee arthroplasty [3-4]. Femoral nerve blocks can also improve pain control in comparison with epidural or intravenous patient-controlled analgesia (PCA) alone [5-7]. However, there is an increased risk of falls in patients receiving femoral nerve blocks likely due to sensory prolonged anesthetic effects following surgery [8-9]. The saphenous nerve block was first described in the 1990s and is thought to target more specific sensory regions of the lower extremity versus the general sensory and motor distribution of the femoral nerve block [10]. Due to the saphenous nerve being a pure sensory block, it is thought to decrease the risk of falls. It has been shown to decrease muscle strength by only 8% whereas the femoral nerve block decreases muscle strength by 49% [11]. Saphenous nerve blocks have also shown a reduction in VAS pain scores on movement, earlier ambulation, and reduced opioid requirements [12-13]. The use of long-acting liposomal bupivacaine injection (Exparel) was approved by the U.S. Federal Drug Administration in 2011 for analgesic use. Exparel has since been studied in prospective studies for post-operative pain control in procedures such as total knee arthroplasty, hemmorrhoidectomy, bunionectomy, and breast augmentation [14]. In a phase 2 trial of healthy volunteers receiving Exparel femoral nerve blocks, it showed partial motor and sensory nerve block for >24 hours [15]. Following total knee arthroplasty, Exparel injected intra-operatively into the posterior capsule was effective in reducing postsurgical pain for up to 72 hours while reducing the need for opioids for pain relief [16]. Currently, there is no literature studying the use of Exparel with saphenous versus femoral nerve blocks. We conducted a prospective clinical trial determining the efficacy of pain relief and early post-operative function between saphenous nerve blocks and femoral nerve blocks with intra-operative Exparel injection for total knee arthroplasty

## Materials and Methods

The current study is a part of a prospective clinical trial to evaluate CPM use during TKA. Data was collected prospectively and analyzed with respect to the use of Exparel in conjunction with adductor canal or femoral nerve blocks to decrease the length of hospital stay and pain. The duration of the study was from January 2013 to May 2014. The subjects were placed into three different groups. Study group A received a pre-operative femoral nerve block with Exparel injected into the posterior capsule intra-operatively. Study group B received a pre-operative adductor canal nerve block with Exparel injected into the posterior capsule intra-operatively. Study group C received only Exparel injected into the posterior capsule intra-operatively. A total of ninety subjects were enrolled in the study. Subjects received femoral nerve blocks until December 2013 where a change in practice occurred and the remainder of subjects until the end of the study received adductor canal nerve blocks. Of the ninety subjects selected for the study, twenty-five were not included in the final data analysis: seven subjects were excluded for receiving nerve block without Exparel intraoperatively; fifteen subjects were not included due to clerical errors in completing the data sheet; two refused to participate in the study after initially agreeing; one patient had post-operative infection and was removed from the study. A total of sixty-five patients were included in the final data analysis. Study group A had a total of 23 patients included in the final data analysis. Study group B had a total of 35 patients included in the final data analysis. Study group C had a total of 7 patients included in the final data analysis. The inclusion criteria included subjects with a diagnosis of osteoarthritis, all subjects receiving a primary or revision total knee arthroplasty. Exclusion criteria excluded subjects with medical diseases or conditions that could interfere with testing performance, subjects with an infection of the knee, subjects with comprehension problems, and subjects who had intraoperative or postoperative complications.



## Results

We found that adductor canal nerve blocks in conjunction with Exparel had a statistically significant decrease in length of hospital stay (1.0 day) versus femoral nerve blocks in conjunction with Exparel (2.2 days) or Exparel alone (1.3 days) ( $p$ -value  $< 0.0039$ ). Adductor canal blocks in conjunction with Exparel also had a statistically significant decrease in pain scores (2.2) versus femoral nerve blocks in conjunction with Exparel (4.8) or Exparel alone (4.3) ( $p$ -value  $< 0.008$ ). There was no statistical significance when comparing any of the three groups in regards to active and passive range of motion. However, we did see an increased range of motion both actively and passively in the adductor canal nerve blocks in conjunction with Exparel. There was also no statistical significance when comparing any of the three groups in regards to gait distance.

## Discussion and Conclusion

This was a novel comparison of femoral nerve blocks versus adductor canal nerve blocks in combination with Exparel. Exparel has been used in trials previously for post-operative pain relief, but we could not find any trials where it was used in conjunction with a pre-operative femoral or adductor canal nerve block [14-15]. The adductor canal block targets the saphenous nerve as it courses through the adductor canal that is the terminal branch of the femoral nerve composed mostly of sensory fibers. It provides sensory innervation to the medial, anteromedial, and posteromedial aspects of the lower extremity from the distal thigh to the medial malleolus. The decrease in pain noted with using adductor nerve blocks with Exparel in our study could be due to anesthesia to the vastus medialis nerve, medial femoral cutaneous nerve, articular branches from the obturator nerve, or medial retinacular nerve [17-19]. Horn et al. also showed that sensory changes are not limited to the distribution of the saphenous nerve which includes when injecting through the adductor canal. The decreased length of stay seen in our patients receiving adductor canal nerve blocks in conjunction with Exparel could be attributed to the sensory blockade seen when targeting the saphenous nerve. Jaeger et al showed better preservation in quadriceps strength with adductor canal blocks compared to femoral blocks following total knee arthroplasty. This preservation in strength in theory should help to decrease the risk of falls that are commonly seen following total knee arthroplasty when using nerve blocks [9,8,20]. Kim et al showed that saphenous nerve blocks provided adequate analgesia and significantly preserved motor strength in comparison with the femoral nerve block. This preservation in strength is important in providing early ambulation and rehabilitation in the immediate post-operative period that we believe decreased the length of hospital stay for our patients. The use of Exparel has been studied as a single-injection peripheral nerve block in healthy individuals and has also been evaluated for pain control following total knee arthroplasty [15-16]. We were not able to find previous publications where Exparel was used in conjunction with adductor canal nerve blocks or femoral nerve blocks following total knee arthroplasty. The combination of Exparel with adductor canal nerve blocks proved beneficial for our patients post-operatively. Our data shows that adductor nerve blocks in combination with Exparel alleviate pain and decrease length of hospital stay more effectively than femoral blocks or Exparel alone. Although there is no statistically significant difference in range of motion, adductor nerve block also had greater active and passive range of motion between the three groups in the inpatient setting. This study is important because increased pain and longer length of hospital stays are associated with infection, deep venous thrombosis and pulmonary embolism due to immobilization, increased opioid consumption, and cost. These results show that adductor canal nerve blocks with Exparel are a beneficial alternative to femoral nerve blocks with Exparel or Exparel alone.

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