A retrospective case series of prophylactic neurectomy during total knee arthroplasty

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Abstract

Introduction: Total knee arthroplasty is a common operation performed to relieve pain and restore functional activity. While overall widely successful, a subset of patients has continued pain postoperatively with no identifiable cause. Neuroma formation has been identified as a possible contributor to this unexplained pain, often necessitating an additional procedure for neuroma removal. The purpose of our study was to evaluate if prophylactic neurectomy could reduce the occurrence of postoperative pain.

Methods: A total of 112 patients were compared, 44 control patients and 68 neurectomy patients. Demographic information, Numerical rating pain scale (NRS) and Knee Society Scores (KSS) were collected pre- and post-operatively. Patients were additional asked if they were overall satisfied with the operation.

Results: There were no differences between groups with respect to age (Median: 71 vs 69 years, p = 0.28), male sex (41% vs 44%, p = 0.85), or body mass index (Median: 32.2 vs 31.3, p = 0.80). When comparing the degree of change following surgery there were no statistically significant differences observed in NRS pain scores (Median change: /C0 7 vs /C0 6, p = 0.89) or KSS scores (Median change: +44 vs +40, p = 0.14). Similarly, there was no statistically significant difference in overall patient-reported satisfaction with the knee replacement (82.5% vs 86.6%, p = 0.59).

Conclusion: We did not find a statistically significant difference in NRS, KSS, or overall patient satisfaction between the prophylactic neurectomy and control patient groups. Larger studies with evaluation of the nerve diameter will be needed to determine which patients are at risk for symptomatic neuroma development following total knee arthroplasty.

Keywords
Total knee arthroplasty, pain, neuroma, neurectomy

Introduction

Total knee arthroplasty (TKA) is commonly used to relieve pain and restore functional activity in patients suffering from osteoarthritis.¹ ² While most are satisfied following the procedure, there is a subset of patients who have continued pain postoperatively. Reasons for this pain are numerous and can be attributed to both intra-articular and extra-articular causes.³ ⁴ Often, postoperative pain necessitates an extensive evaluation with 20% of patients ultimately

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unsatisfied following the replacement due to continued pain with no identifiable cause.5–7

Neuroma formation is often overlooked as a reason for unexplained postoperative pain. Neuromatous knee pain, mild or severe, can limit daily functions and interfere with patient outcomes.8 The infrapatellar branch of the saphenous nerve (IPSN) is a cutaneous sensory nerve that innervates the anterior aspect of the knee. It has previously been reported that the IPSN is often encountered during primary TKA exposures, and there is no consistent method for preservation.6–13

Damage to the IPSN may be more common than initially thought. It has been shown that neuroma formation occurs in up to 10% of patients following primary TKA.14 Surgical excision of the neuroma has demonstrated improvements in pain and patient satisfaction in the majority of patients diagnosed with a postoperative neuroma, but unfortunately this requires an additional procedure for the patient.10,11,14–19 It is currently unknown if preventative measures can be employed during the total knee replacement procedure to decrease the rate of postoperative neuroma formation.

In this study we evaluated prophylactic neurectomy of the IPSN at the time of initial TKA on postoperative knee function, pain, and subsequent patient satisfaction. We hypothesized that prophylactic neurectomy would reduce the rate of chronic knee pain and increase patient satisfaction following surgery.

Methods
Following Institutional Review Board approval, a total of 112 consecutive patients who underwent a TKA at the Mayo Clinic in Jacksonville, Florida were included in the study. All procedures were performed by a single author (BW), using a cemented, posterior stabilized prosthesis design (Stryker Triathlon, Mahwah NJ). There were 44 control patients who underwent surgery between March and November 2018. These were compared to 68 neurectomy patients who underwent surgery between November 2018 and December 2019.

In the control patients the dominant branch of the IPSN was identified during the initial dissection, prior to a standard medial parapatellar arthrotomy. No neurectomy was performed prior to the arthrotomy, and the surgery was performed in routine fashion.

In the neurectomy cohort the nerve was similarly identified during the initial exposure. Prior to the arthrotomy the nerve was placed under tension and transected sharply to allow the stump to retract away from the incision, as previously described.20–22 Following the neurectomy the surgery was completed in an identical fashion to the control cohort.

Demographic information was collected from chart review including: age, sex, body mass index (BMI), numerical rating pain scale (NRS), and Knee Society Score (KSS). Postoperative NRS and KSS scores were obtained from the most recent clinical note. Patients were additionally contacted via phone by a member of the research team to evaluate their overall satisfaction with the total knee replacement.

Statistical analysis
Continuous variables were summarized using the sample median and range. Categorical variables were summarized with the number and percentage of patients. Comparisons of baseline characteristics and outcomes between the neurectomy and control groups were made using a Wilcoxon rank sum test (continuous variables) or Fisher’s exact test (categorical variables). p-values <0.05 were considered as statistically significant. All statistical tests were two-sided. Statistical analysis was performed using R Statistical Software (version 3.6.2; R Foundation for Statistical Computing, Vienna, Austria).

Results
A comparison of baseline characteristics between the 44 control and 68 neurectomy patients is provided in Table 1. There were no differences between these two groups regarding age (Median: 71 vs 69 years, p = 0.28), male sex (41% vs. 44%, p = 0.85), or BMI (Median: 32.2 vs 31.3, p = 0.80). Length of follow-up was substantially longer for the control group compared to the neurectomy cohort (Median: 26 vs 17 months, p < 0.001), which is a result of the aforementioned consecutive nature of patient inclusion.

Outcomes are compared between the control patients and neurectomy cohort in Table 1. When comparing the degree of change following surgery there were no statistically significant differences observed in NRS pain scores (Median change: −7 vs −6, p = 0.89) or KSS scores (Median change: +44 vs +40, p = 0.14). Similarly, there was no statistically significant difference in overall patient-reported satisfaction with the knee replacement (82.5% vs 86.6%, p = 0.59).

A total of six patients in the control group (13.6%) and four patients in the neurectomy group (5.9%) reported pain in the distribution area of the IPSN following surgery. (p = 0.19)

Discussion
Total knee arthroplasty is one of the most common elective procedures in the United States, with utilization projected to continue to grow rapidly over the next two decades.23,24
While it has been shown to be an effective treatment for knee arthritis, there is a subset of patients who have persistent pain following surgery. Common sources of pain include infection, joint instability, and prosthetic loosening. However, even after an often-extensive evaluation, up to 20% of patients remain dissatisfied following surgery due to pain with no identifiable cause. There is a need to recognize additional generators of pain following total knee arthroplasty to continue to improve patient outcomes and satisfaction as demand increases.

Neuroma formation has previously been thought to be an uncommon occurrence following total knee arthroplasty. Recently, studies have demonstrated the anatomic distribution of the infrapatellar branch of the saphenous nerve. These have shown that transection of one or more branches of the IPSN is inevitable during a standard parapatellar approach to the knee, which can lead to neuroma formation. Further supporting this, a study by Shi et al. reported development of a painful neuroma following surgery in 10% of their primary total knee arthroplasty cohort. This new evidence suggests that neuroma formation may be more common than previously thought, emphasizing the multifactorial causes of postoperative knee pain.

A limitation of prior studies that have diagnosed and treated postoperative neuroma formation is the retroactive nature of treatment. Given the reported 10% rate of postoperative neuroma development, our sample size may be too low to detect a significant difference in the cohorts. Additionally, our study did not evaluate the caliber of the nerve branches. It is possible that patients with larger diameter nerve branches will be at higher risk for development of a symptomatic postoperative neuroma. It is also possible that a traction neurectomy is not the optimal procedure for the IPSN, given the superficial location. An alternative treatment, such as targeted muscle reinnervation may provide more benefit. The infrapatellar branch of the saphenous nerve often has multiple branches. It is quite possible that persistent pain was due to a branch that was missed during the initial exposure.

**Conclusion**

In conclusion, we did not find a statistically significant improvement in pain, Knee Society Scores, or overall patient satisfaction following prophylactic neurectomy of the

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**Table 1. Comparison of baseline characteristics and outcomes between neurectomy and control patients.**

|                          | Control (N = 44) | Neurectomy (N = 68) | p-value |
|--------------------------|-----------------|---------------------|--------|
| Age (years)              | 71 (48, 85)     | 69 (38, 89)         | 0.28   |
| Sex (male)               | 18 (40.9%)      | 30 (44.1%)          | 0.85   |
| BMI                      | 32.2 (20.3, 44.3)| 31.3 (23.6, 46.7)   | 0.80   |
| Length of follow-up (months) | 26 (15, 31) | 17 (12, 24)         | <0.001 |
| NRS pain score          |                 |                     |        |
| Pre-operative           | 8 (3, 10)       | 7 (3, 10)           | 0.52   |
| Post-operative          | 0 (0, 8)        | 0 (0, 7)            | 0.77   |
| Change                  | −7 (−10, −1)    | −6 (−10, 0)         | 0.89   |
| KSS Score               |                 |                     |        |
| Pre-operative           | 44 (24, 65)     | 45 (31, 64)         | 0.056  |
| Post-operative          | 89 (64, 100)    | 89 (60, 100)        | 0.32   |
| Change                  | 44 (15, 75)     | 40 (9, 59)          | 0.14   |
| Satisfied with result of TKA | 33 (82.5%) | 58 (86.6%)          | 0.59   |

p-values result from a Wilcoxon rank sum test (continuous variables) or Fisher’s exact test (categorical variables).
IPSN during total knee arthroplasty. Larger studies with evaluation of the nerve diameter will be needed to determine which patients are at risk for symptomatic neuroma development following total knee arthroplasty.

Declaration of Conflicting Interests
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