

PATIENTS' COMFORT WITH OPIOID USE AND DISPOSAL POST-OPERATIVELY AFTER OUTPATIENT ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A GENDER-BASED ANALYSIS

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BACKGROUND: Despite legislative efforts to curb inappropriate prescribing, opioid-related adverse events and deaths persist. Prior research has demonstrated that pain perception and response to analgesic medications may vary between genders, underlining the importance of a gender-based analysis in postoperative opioid management. Furthermore, orthopedic surgery remains a significant contributor to opioid prescriptions, however, little is known about patient-specific perspectives regarding opioid usage after knee surgery. This study aimed to assess patients' comfort with postoperative opioid use and explore pre-existing knowledge of opioid disposal, with a specific focus on analyzing differences between genders.

METHODS: All patients scheduled for outpatient anterior cruciate ligament (ACL) reconstruction by the senior author between August 2018 and July 2019 were identified and enrolled in the study. At ten days postoperatively a 7-question, multiple choice paper survey created by the authors was administered in person to each patient. The survey inquired about their use of the medications, any concerns, alternative pain control modalities, and their method of disposal of any remaining prescription pain medication. Patient survey responses were collected, and descriptive and inferential statistics of responses were performed for the overall cohort and per gender.

RESULTS: A total of 47 patients (15 males and 32 females) were included in the final study cohort with a 100% response rate. 100% of respondents reported having remaining medication 10 days after surgery. There were no significant differences in responses based on gender. The primary concern with opioid use was addiction risk (43%) while the second most common response was that they had no concerns (28%). 19% of females and 6.7% of males reported concerns regarding adequate disposal of leftover pills. 72% of patients discontinued medication due to no longer being in pain. Females more commonly discontinued use because they were no longer in pain while males more frequently discontinued due to other concerns. Various disposal methods were used, with 40% of males and 13% of females keeping medications in the house most commonly "just in case" they needed it.

CONCLUSION: Both males and females exhibited similar concerns and preferences regarding postoperative pain management, with observed but non-significant differences in medication use and disposal practices. These findings emphasize the value of gender-aware education in opioid misuse prevention efforts.

INTRODUCTION

Over the past 30 years, the United States has been experiencing an ongoing opioid epidemic resulting in millions of individuals suffering from preventable deaths, homelessness, joblessness, and

family disruption.¹⁻³ One of the key drivers of the opioid epidemic is the tripling of opioid prescriptions within the United States between the early 1990s and 2011.⁴ This increase in the volume of opioid prescriptions has been correlated to a rise

in adverse consequences such as opioid overdose, overdose-related deaths, and heroin use.^{5,6} However, despite the recent implementation of both state and national legislation aimed to reduce inappropriate prescribing practices, the occurrence of opioid-related adverse events and deaths continues to rise,⁷ thus emphasizing the importance of addressing additional drivers of the epidemic. One such secondary driver is patients limited prior knowledge of surplus opioid disposal coupled with a lack of education on proper methods of disposal.⁸ Amongst all medical specialties, 40% of prescription pain medications are not used completely and only 6.3% of these extra medications are disposed of.⁹ Furthermore, of individuals found to be misusing prescription pain medications, 53% obtained the medication from friends or family,⁷ therefore highlighting the importance of proper opioid disposal in reducing the occurrence of opioid misuse.

In orthopedic surgery, post-operative pain control is critical for restoring joint mobility and achieving patient satisfaction.¹⁰ While the use of multimodal analgesia including alternative post-operative pain management strategies such as nerve blocks, injections, and cryotherapy in addition to opioid prescription following orthopedic procedures is considered the standard of care, orthopedic surgeons still accounted for 7.7% of all opioid prescriptions in 2009, ranking them the third highest prescribers of opioids among United States physicians.¹¹⁻¹³ Numerous prior studies have analyzed opioid prescribing practices of orthopedic surgeons, however, there is a paucity of adequate literature regarding the patient perspective of postoperative opioid use and disposal of surplus pills.^{10,14,15} This gap in research is particularly pronounced in the context of outpatient surgeries, where the need for pain management is typically lower. While regulations on physician prescribing practices can aid in reducing the quantity of unconsumed and available opioids, quantitative data regarding patients' experience with opioids post-operatively can serve to reduce excess opioid availability by improving patient education regarding opioid use, designing innovative drug disposal options, and providing further evidence to develop opioid prescription guidelines.

Moreover, as prior research has highlighted variations in pain perception and experience between genders, it is imperative to further assess these differences to tailor postoperative care.¹⁶⁻¹⁸ Recognizing that gender may influence both the

experience of pain and the behavior towards prescribed opioids, this study aims to contribute to the understanding of how gender impacts patient comfort with opioid use and knowledge of disposal practices, thus informing more personalized and effective postoperative pain management strategies and communication. The insight gained from these findings will enhance providers' understanding of patients' experiences and perceptions of postoperative opioid use as well as aid in the development of educational materials and policies that account for gender-based differences in patients' needs and preferences.

METHODS

Patient Cohort

Following approval from the institutional review board (IRB), we prospectively enrolled 47 patients scheduled for outpatient knee surgery under the care of the senior author (PDA). Between August 2018 and July 2019, the identification and selection of patients was overseen by the senior author's physician assistant (SMH). Prior to their surgical procedures, informed consent was obtained from all participants. Inclusion criteria for the study encompassed patients aged 15 or older who had undergone outpatient isolated anterior cruciate ligament (ACL) reconstruction, by the senior author, with no additional significant procedures such as a second ligament reconstruction or open surgery, and who subsequently completed the 10-day post-operative survey. The survey was not administered after 10 days post-operatively. Patients were excluded if they did not complete all 10 days of the survey or if their survey was not submitted at all. However, no patients were excluded, due to incomplete post-operative survey submissions, resulting in a final cohort of 47 participants.

Pre-operatively, all ACL patients received a single-shot adductor canal nerve block. In the postoperative phase, a uniform prescription of 40, 5mg pills of both oxycodone and tramadol was administered to all patients. Patients were instructed to employ these medications exclusively for instances of extreme breakthrough pain. Patients were not provided any specific instructions on how to dispose of the medications.

Variables and Outcome

Demographic variables including age, race, and body mass index (BMI) were collected, along with surgical details such as type of procedure and graft

choice for ACL reconstruction. Additionally, at ten days postoperatively a 7-question, multiple choice, paper survey was administered to each patient by SMH. The survey inquired about their use and disposal practices of prescription opioid pain medications (Appendix 1).

Statistical Analysis

The overall patient cohort was stratified into two cohorts based on the patient's self-identified gender. Baseline characteristics were reported for both the overall and gender-based cohorts using median and interquartile range or proportions. Furthermore, patient survey responses were collected, and answer selections were reported as the percentage of each answer choice per total responses among the respective genders for each individual question. Inferential statistics were performed to assess for differences in survey answers between the two cohorts. A two-sample t-test was used for continuous variables while a chi-squared analysis was done for categorical variables.

A *p*-value of <0.05 was defined as the threshold for statistical significance. All statistical analysis was performed using Microsoft Excel (Redmond, WA).

A post hoc sample size calculation was performed using G*Power (version 3.1.9.6; Düsseldorf, Germany) to evaluate the statistical power of the Chi-squared goodness of fit test in analyzing differences between male and female concerns. The input parameters set for the analysis were an effect size of 0.56, an alpha level of 0.05, a total sample size of 47 participants, and 6 degrees of freedom. Based on these inputs, the power was found to be 84%.

RESULTS

Forty seven patients completed the survey, of which all 47 were ACL reconstructions. The majority of the respondents were female (32 vs 15) with an average age of 33.0 ± 13 years and an average BMI of 24.6 ± 3.6 . A comprehensive demographic breakdown of respondents can be found in Table 1.

Table 1. Baseline parameters of the outpatient knee arthroscopy patient cohort stratified by gender

| <i>Parameter</i> | <i>Total (n = 47)</i> | <i>Males (n = 15)</i> | <i>Females (n = 32)</i> | <i>P-value</i> |
|------------------------------------|---------------------------|---------------------------|-----------------------------|----------------|
| Demographics | | | | |
| <i>Age (years)</i> | 33.0 ± 13y | 33.9 ± 12.8y | 32.1 ± 13y | 0.7 |
| <i>BMI (kg/m²)</i> | 24.6 ± 3.6 | 24.9 ± 2.4 | 24.4 ± 4.1 | 0.6 |
| <i>Race</i> | | | | 0.5 |
| <i>Asian</i> | 11% | 20% | 6.3% | |
| <i>Black or African American</i> | 4.3% | 6.7% | 3.1% | |
| <i>White</i> | 81% | 73% | 73% | |
| <i>More Than One Race</i> | 2.1% | 0% | 0% | |
| <i>Unknown/Unreported</i> | 2.1% | 0% | 0% | |
| Procedure | | | | |
| <i>ACL Reconstruction</i> | | | | 0.4 |
| <i>Allograft</i> | 34% | 27% | 38% | |
| <i>BTB Autograft</i> | 60% | 60% | 59% | |
| <i>Contralateral BTB Autograft</i> | 2.1% | 6.7% | 0% | |
| <i>Revision with Allograft</i> | 4.3% | 6.7% | 3.1% | |

All continuous variables are presented as median ± interquartile range

When asked about their biggest concern with taking medication after surgery, the most cited answer among both genders was concern surrounding the risk of addiction (43%), and the second most common answer was that they had no concerns (28%). Other concerns included method of disposal (15%), non-compliance (8.5%) inappropriate access by others (4.3%), lack of knowledge (2.1%), and other (11%). 31% of females and 20% of males reported having no concerns, while 19% of females and 6.7% of males reported concerns regarding adequate disposal of leftover pills. Males expressed concern regarding the risk of addiction (47%) similarly to females (41%). Additionally, 76% of both males and females would have preferred to have been prescribed a different medication if they had any risk factors for complications or addiction to the prescribed medication. No statistically significant differences were found between the cohorts concerning their apprehensions about taking pain medication.

With regards to taking the prescription medication, 72% of patients reported discontinuing use due to no longer being in pain, while 26% discontinued use due to other concerns despite still experiencing pain. 78% of women and 58% of men reported discontinuing medication use because they were no longer in pain. 42% of men and 19% of women cited other concerns as their reason for stopping medication use. Of the 47 patients who responded, only 2 patients (4.3%), 1 male and 1 female, received an additional refill of their prescription medication. All 47 patients (100%) had remaining prescription pain medication 10 days after surgery, with the majority having 0-40 pills remaining (0-10: 12.3%, 11-20: 19.3%, 21-30: 12.3%, 31-40: 22.8%). 43.8% of females and 26.7% of males reported having between 0-20 pills remaining. 53% of males and 37.5% of females were found to have between 21-40 pills remaining. There were no statistically significant differences in the practices of discontinuing medication observed between the cohorts.

Patients used a variety of methods to dispose of additional medication, with 44% intentionally saving the pills in their house, 21% returning them to a medication disposal kiosk (police station for

63% of patients), 15% forgetting about them and having them remain in their house, 13% flushing them down the toilet, and 5.1% throwing them in the trash. 23% of females and 15% of males returned medication to a disposal kiosk, whereas 38% of females and 54% of males chose to intentionally keep medications at home. Among those who kept the medication, 6.3% of females and 0% of males kept them for the convenience of family or friends. Conversely, of those who kept the medication, 40% of males and 13% of females reported saving them "just in case." Out of the 35 responses, 90% of patients felt they had selected the appropriate option for the disposal of the medication with no significant difference between genders. There were no statistically significant differences observed in the medication disposal methods between the cohorts. A complete breakdown of respondent answers to questions can be found in Table 2.

DISCUSSION

Understanding patients' perspectives on opioid use and disposal is crucial in developing effective strategies to address opioid misuse, which continues to be a major public health challenge in the United States. Our study's observations show that patients' attitudes toward opioid use and disposal following outpatient knee surgery can vary in some cases by gender, although direct comparisons were not statistically significant in this study. This is in line with broader research indicating that men and women may approach pain and medication management differently due to a variety of biological, psychological, and sociocultural factors.¹⁶⁻¹⁸ As the opioid epidemic continues to challenge public health in the United States, marked by over 40 daily deaths from prescription opioid overdose, it becomes increasingly important to understand these gender-related nuances. Although our study does not imply that these differences are statistically significant, our findings emphasize the need to consider gender as a factor in developing targeted interventions for opioid misuse prevention, which may include more personalized patient education and communication.

Table 2. Breakdown of survey responses of the outpatient knee arthroscopy patient cohort stratified by gender

| <i>Survey Question</i> | <i>Total (n=47)</i> | <i>Male (n=15)</i> | <i>Female (n=32)</i> | <i>P-value</i> |
|---|-------------------------|------------------------|--------------------------|----------------|
| <i>Biggest Concern</i> | | | | 0.7 |
| <i>Lack of Knowledge</i> | 2.1% | 6.7% | 0% | |
| <i>Non-Compliance</i> | 8.5% | 6.7% | 9.4% | |
| <i>Inappropriate Access by Others</i> | 4.3% | 6.7% | 3.1% | |
| <i>Risk of Addiction</i> | 43% | 47% | 41% | |
| <i>Disposure</i> | 15% | 6.7% | 19% | |
| <i>Other</i> | 11% | 6.7% | 13% | |
| <i>No Concern</i> | 28% | 20% | 31% | |
| <i>Preference for Another Medication</i> | | | | 0.4 |
| <i>Yes</i> | 76% | 67% | 79% | |
| <i>No</i> | 24% | 33% | 21% | |
| <i>Reason for Discontinuation</i> | | | | 0.3 |
| <i>No Longer in Pain</i> | 72% | 58% | 78% | |
| <i>Other Concern</i> | 26% | 42% | 19% | |
| <i>Assessment of Quantity/Usage</i> | | | | |
| <i>Got an Additional Refill</i> | 4.3% | 6.7% | 3.1% | |
| <i>Ran Out and Wished to Continue</i> | 0% | 0% | 0% | |
| <i>Altered Dosing Trying Return Quicker</i> | 0% | 0% | 0% | |
| <i>Took for Reason Other than Pain</i> | 0% | 0% | 0% | |
| <i>Leftover Pills at 10 Days</i> | | | | |
| <i>Yes</i> | 100% | 100% | 100% | |
| <i>No</i> | 0% | 0% | 0% | |
| <i>Number of Leftover Pills</i> | 25 (13) | 27.0 (11.4) | 24.8(14.5) | 0.6 |
| <i>0-10</i> | 12.3% | 6.7% | 18.8% | |
| <i>11-20</i> | 19.3% | 20% | 25% | |
| <i>21-30</i> | 12.3% | 20% | 12.5% | |
| <i>31-40</i> | 22.8% | 33% | 25% | |
| <i>41-50</i> | 5.3% | 6.7% | 6.3% | |
| <i>51-60</i> | 1% | 0% | 3.1% | |
| <i>Method of Disposal</i> | | | | 0.9 |
| <i>Forgot and Remain in House</i> | 15% | 7.7% | 19% | |
| <i>Intentionally Remain in House</i> | 44% | 54% | 38% | |
| <i>Flushed Down the Toilet</i> | 13% | 15% | 12% | |
| <i>Returned to Kiosk</i> | 21% | 15% | 23% | |
| <i>Threw in Trash</i> | 5.1% | 7.7% | 3.8% | |
| <i>Other</i> | 2.6% | 0% | 3.8% | |
| <i>If Kiosk, Return Location</i> | | | | |
| <i>Police Station</i> | 63% | 50% | 67% | |
| <i>Pharmacy</i> | 25% | 50% | 17% | |
| <i>Hospital</i> | 13% | 0% | 17% | |
| <i>Motivation to Save Pills</i> | | | | |
| <i>Financial</i> | 0% | 0% | 0% | |
| <i>Convenience for Family/Friend</i> | 4.3% | 0% | 6.3% | |
| <i>Wanted "Just in Case"</i> | 21% | 40% | 13% | |
| <i>Believe You Selected Most Appropriate Disposal Method</i> | | | | 0.5 |
| <i>Yes</i> | 90% | 100% | 85% | |
| <i>No</i> | 10% | 0% | 15% | |

Percentages represent the proportion of answers per total responses for each individual question for total, male, and female cohorts respectively.

The results of our survey highlighted several important issues related to patients' knowledge and attitudes toward opioid use and disposal. Our findings underscore the primary concern among patients regarding opioid use is the potential risk of addiction. This concern is well-founded, given the known association between opioid medications and the risk of addiction and misuse.^{19,20} However, while both male and females primary concern was risk of addiction, gender-based differences may stem from variations in risk perception and aversion between genders, as studies suggest females are generally more risk-averse than males in various contexts.^{21,22} In the case of opioid disposal, females may exhibit greater caution due to an increased awareness of potential consequences, such as accidental ingestion by children, diversion for non-medical purposes, or environmental harm through improper disposal methods. Providers' understanding of these gender-based differences in risk perception is crucial, as they can play a pivotal role in addressing these concerns by engaging in open communication with patients, discussing the importance of proper opioid disposal, and alleviating any confusion patients may have. Additionally, implementing tailored educational interventions can empower patients to make informed decisions and adopt appropriate disposal practices. Ensuring that both male and female patients are well-informed about the risks and proper methods of opioid disposal can collectively contribute to reducing the availability of surplus opioids and curbing the risk of misuse and diversion.

Furthermore, in line with current guidelines and recommendations from the Centers for Disease Control and Prevention, the majority of patients in our study, irrespective of gender, expressed a preference for non-opioid pain medication if they were identified to have risk factors associated with addiction.²³ This aligns with the overall push towards non-opioid alternatives as the first-line treatment for pain management following outpatient arthroscopic knee procedures.²⁴⁻²⁶ Common non-opioid pain management options such as acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), lidocaine patches, injectables such as bupivacaine and morphine, and regional nerve injections may be effective for managing pain and have a lower risk of dependence compared to opioids.^{11,27} However, it is crucial to address the challenges related to cost, accessibility,

and ease of administration that hinder the widespread adoption of these alternatives. Compared to the cost of the opioid hydrocodone (\$0.16 per unit dose), injectables can range from \$6.35 to \$0.68 per unit dose and regional nerve injections can range from \$139.15 to \$70.43 per unit dose, therefore, highlighting a drastic financial burden on patients that deny opioids in favor of more costly yet safe pain medications.¹¹ Additionally, the convenience factor of an oral medication that patients can take on their own opposed to the need to visit a hospital to receive an injection plays a key role in why opioids are frequently prescribed over other forms of pain management for ACL surgeries. Therefore, future work to balance cost-effectiveness and safety is essential to promote the adoption of alternative pain management strategies.

Another noteworthy finding was that most patients discontinued opioid medication use when they were no longer in pain, rather than consuming the full prescribed quantity. This finding is consistent with prior studies that have reported that between 67%-92% of patients having unused opioids leftover after surgery.²⁸ While both findings suggest responsible medication management, they also raise concerns about the surplus of prescription opioids that may contribute to misuse if not properly disposed. Our survey further revealed that the majority of patients stored their extra pills at home, possibly highlighting a lack of awareness regarding the importance of proper disposal and available disposal programs or services. Such accumulation of unused opioids in households can potentially facilitate diversion and misuse. Furthermore, while statistically insignificant, our study suggests that gender-based differences may exist in certain medication disposal behaviors, and further studies are needed to identify these differences. By recognizing and addressing these issues, healthcare providers and policymakers can play a pivotal role in reducing the availability of surplus opioids and subsequently curbing the risk of diversion and misuse.

The clinical implications of our findings highlight the need for healthcare providers and policymakers to develop effective interventions to educate patients about the importance of proper opioid disposal, while also considering gender-specific perspectives. Incorporating information on appropriate excess opioid disposal options into patient education materials can play a pivotal role

in increasing awareness and adherence to safe disposal practices. In addition, healthcare providers should engage in comprehensive discussions with patients about the potential risks and benefits of prescription pain medication and the significance of proper disposal methods beyond their own personal health. Previous research has shown that educational interventions targeting healthcare providers can positively impact patients' knowledge and attitudes toward opioid disposal. For instance, educational interventions aimed at emergency department nurses have resulted in improved patient knowledge about opioid use and disposal.²⁹ Expanding such interventions to various healthcare settings and professionals may yield further positive outcomes. Providers should also consider non-opioid pain management strategies whenever feasible and always assess for the risk of addiction on an individual basis, tailoring treatment plans accordingly.

Despite the findings of the present study, there are still significant gaps in our understanding of patients' knowledge and attitudes toward opioid disposal. Future research should build on these findings by examining the effectiveness of different educational interventions in promoting proper opioid disposal among patients. Furthermore, further research should explore the impact of different disposal policies (e.g., prescription limits, and take-back programs) on patient disposal behaviors. Additionally, most of the existing research has relied on self-reported measures, which may be subject to social desirability bias or other limitations. As such, future research should consider using more objective measures, such as observed disposal behaviors, or surveys administered anonymously to better assess patients' knowledge and attitudes toward opioid disposal.

Limitations

The findings of this study must also be interpreted with consideration of its limitations. First, our sample size was relatively small and consisted solely of patients who underwent outpatient arthroscopic knee surgery from a single surgeon at a single hospital in a suburban setting; thus, our findings may not be representative of and generalizable to the wider population in other healthcare settings or geographic regions. Additionally, our study relied on self-reported measures of knowledge and attitudes, which may be subject to bias or error. However, despite these

limitations, our study provides important insights into the current knowledge and attitudes of patients toward opioid use and disposal.

CONCLUSION

Males and females shared similar concerns and preferences on post-operative medication use. However, our study suggests that differences in usage or disposal of unused medications may exist, and larger studies are needed to identify such gender-based differences. Our study highlights the importance of considering gender perspectives in patient education and communication strategies about opioid use and disposal after outpatient orthopedic surgery.

Conflict of Interest Statement

The authors declare no conflicts of interest with the contents of this study.

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