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Original Research

# Self-Reported Cannabis Use Is Associated With a Lower Rate of Persistent Opioid Use After Total Joint Arthroplasty

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ABSTRACT

*Background:* Legalization of cannabis, along with concern over prescription opiate use, has garnered interest in cannabis for adjuvant pain control. This study examines the relationship between cannabis and opioid consumption after total hip (THA) or knee (TKA) arthroplasty.
*Methods:* Patients undergoing primary THA or TKA with minimum 6-month follow-up who self-reported cannabis use were retrospectively reviewed. A total of 210 patients (128 TKAs and 82 THAs) were matched by age; gender; type of arthroplasty; Charlson Comorbidity Index; and use of nicotine, antidepressants, or benzodiazepines to patients who did not self-report cannabis use. Patients receiving an opioid prescription after 90 days postoperatively were classified as persistent opioid users (POUs). Duration of opioid use (DOU) was calculated for non-POU patients as the time between surgery and their last opioid prescription. Differences in inpatient morphine milligram equivalents (MMEs), outpatient MMEs, POU, and DOU were analyzed.
*Results:* Cannabis users required equivalent inpatient and outpatient MMEs. There was no difference in DOU. There was a significant difference in POU between cannabis users and matched controls (1.4% [n = 3] vs 9.5% [n = 20], $P < .001$, respectively). Grouping patients by TKA or THA, there remained a difference in POU for TKA (1.5% [n = 2] vs 10.9% [n = 14], $P = .002$) and THA (1.2% [n = 1] vs 7.3% [n = 6], $P = .04$). There was no difference in inpatient or outpatient MMEs or DOU for THA and TKA patients.
*Conclusions:* There is a reduced rate of POU in patients who self-report perioperative cannabis use. Prospective studies are needed to clarify the role of cannabis as an adjunct to perioperative pain control.


## Introduction

As prescription opiate use has come under increased scrutiny due to the potential for abuse, there is increasing interest in adjuvant medications to reduce opioid requirements for pain control after total joint arthroplasty (TJA). One such alternative that has been considered as part of a multimodal pain regimen is cannabis (eg, marijuana) [1–3]. Due to purported benefits in the literature, natural cannabis and synthetic cannabinoid derivatives are already being used for a variety of applications including chronic pain, nausea and vomiting, appetite stimulation, spasticity, anxiety, and seizure disorders [3,4].

As legalization efforts have made cannabis more available throughout the United States, the self-reported use of cannabis products has increased among patients undergoing TJA [5]. Additionally, states with medical cannabis laws have been associated with an almost 20% decrease in annual opioid prescriptions by orthopedic surgeons [6]. There is also growing patient awareness of

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the use of cannabis to potentially treat postoperative pain and anxiety; in 1 survey of patients who used cannabis during their recovery at 2 orthopedic trauma centers in Massachusetts, 90% believed cannabis reduced pain symptoms, and 81% believed it reduced the amount of opioid medication they consumed [7]. Despite this rapidly increasing interest, there are currently very little data examining cannabis use and acute postoperative pain and opioid consumption after TJA.

The purpose of this study was to examine self-reported perioperative cannabis use and opioid consumption after TJA, including differences in (1) inpatient morphine milligram equivalents (MMEs), (2) outpatient MME, (3) duration of opioid use, and (4) persistent opioid use for greater than 90 days postoperatively.

## Material and methods

This study was approved by our institutional review board prior to initiation. The study period was from May 2013 to November 2019. Recreational cannabis use has been legal in the state of Colorado, where this study took place, since November 2012. We utilized our institution's longitudinally maintained TJA database to identify all patients who underwent unilateral primary TJA with a minimum 6-month follow-up duration. The patients of 5 different surgeons in our practice were included in this study. Outpatient electronic medical records were retrospectively reviewed for any self-reported use of cannabis, both medicinal or recreational and prescribed or unprescribed. Patients were excluded if they did not have adequate follow-up or had incomplete data for analysis. Additional exclusion criteria included patients with a history of preoperative opioid use, illicit drug use, or alcohol abuse. Out of a total of 2797 patients with complete records, approximately 270 patients (9.7%) self-reported cannabis use throughout the study period. Of these patients, 48 (17.8%) were excluded due to chronic opioid use.

All patients in this cohort underwent a preoperative medical history and physical with our institution's internal medicine physicians, as well as routine postoperative visits at 2, 6, and 12 weeks with the operating surgeon. A social history which included a drug screen (intake form and questioning by a provider) is standard practice at all visits. Patients were considered perioperative cannabis users if they self-reported cannabis use both preoperatively and during the 12-week postoperative period. No attempt was made to determine the frequency of cannabis use; this was simply documented as a binary yes or no throughout the study period. Patients were considered benzodiazepine or antidepressant users if they were documented as actively taking these medications at the time of their preoperative medical history and physical. A 1:1 matched control study was conducted based on the type of TJA (total knee arthroplasty [TKA] vs total hip arthroplasty [THA]), age (±5 years), gender, smoking status, preoperative benzodiazepine use, preoperative antidepressant use, and Charlson Comorbidity Index (±2). These matching criteria were chosen due to their association with increased opioid use postoperatively after TJA in the literature [8]. Patients were matched to those with a unilateral TJA who did not self-report cannabis use throughout the perioperative period. Twelve patients (5.4%) were unable to be matched using the established matching criteria and were therefore excluded, resulting in 210 self-reported cannabis users being included in the study.

Detailed demographic and clinical data were collected, including opioids administered while in the hospital, as well as the amount prescribed as an outpatient postoperatively in MMEs (a standardized unit of opioid dosage that allows for comparison across different opioid types). Prescribed MMEs were calculated based on outpatient prescriptions from the date of discharge onwards after TJA, as well as cross-referencing with the Colorado Prescription Drug Monitoring Program (PDMP). The PDMP is a statewide database where pharmacies upload prescription data for controlled medications dispensed to Colorado patients. Cross-referencing the PDMP enabled inclusion of MMEs prescribed to patients in the study postoperatively by providers outside our institution that may have otherwise not been captured. Due to the comprehensive nature of the PDMP, this better captures the true postoperative opioid requirements of patients in the study.

Persistent opioid users were defined as those patients who required additional opioid prescriptions after 90 days postoperatively. This timepoint was chosen as it is the standardized definition utilized for surgical opioid research [9–13]. For those patients who were not persistent users, duration of opioid use was calculated as the duration between the first prescription given at discharge and the last prescription given (less than 90 days postoperatively). The choice to exclude persistent users from this analysis was based on prior literature; the goal was to prevent persistent opioid users from biasing this outcome, as their inclusion would skew the data toward larger values [14].

Outcomes evaluated included the number of inpatient and prescribed MMEs, as well as duration of opioid use and percentage of patients classified as persistent opioid users. Continuous variables were analyzed using the student's t-test. Categorical variables were analyzed using the Chi-squared test. All statistical analyses were performed using SPSS, version 26.0 (SPSS Inc., Chicago, IL).

## Results

The self-reported cannabis group included 210 patients, including 128 (60.9%) who underwent TKA and 82 (39.1%) who underwent THA, matched 1:1 with 210 patients who did not self-report cannabis use. There was no difference in age, gender, body mass index, smoking status, preoperative benzodiazepine use, or preoperative antidepressant use between the groups (Table 1).

**Table 1**
Demographic data.

| Demographics | Cannabis users | Matched controls | *P* value |
|---|---|---|---|
| Age | 60.1 ± 8.6[a] | 60.2 ± 8.6[a] | .87 |
| Gender | Male: 132 (62.9%)<br>Female: 78 (37.1%) | Male: 132 (62.9%)<br>Female: 78 (37.1%) | 1.0 |
| BMI | 28.3 ± 5.3[a] | 28.8 ± 5.1[a] | .27 |
| CCI | 1.8 ± 1.0[a] | 1.8 ± 1.0[a] | .68 |
| Smoking status | Current: 35 (16.7%)<br>Previous: 71 (33.8%)<br>Never: 104 (49.5%) | Current: 35 (16.7%)<br>Previous: 71 (33.8%)<br>Never: 104 (49.5%) | 1.0 |
| Benzodiazepines | 19 (9.0%) | 19 (9.0%) | 1.0 |
| Antidepressants | 39 (18.6%) | 39 (18.6%) | 1.0 |

BMI, body mass index; CCI, charlson comorbidity index.
a Values are presented as mean ± standard deviation.

There was no difference in inpatient MMEs (109.0 vs 99.7, $P = .23$) or outpatient prescribed MMEs (160 vs 147, $P = .35$) between the self-reported cannabis group and matched controls (Table 2). There was also no difference in DOU (12.7 vs 10.1 days, $P = .12$) between the groups. When examining rates of POU, there was a significant difference between self-reported cannabis users and matched controls (1.4% [n = 3] vs 9.5% [n = 20], respectively, $P < .001$).

When examining THAs (n = 82) separately as a group, there remained no difference in inpatient MMEs (99.9 vs 90.1, $P = .44$) or outpatient prescribed MMEs (110.4 vs 130, $P = .32$) between the self-reported cannabis users and matched controls (Table 3). There was also no difference in the DOU (8.4 vs 7.8 days, $P = .81$). There did remain a significant difference in the rate of POU (1.2% [n = 1] vs 7.3% [n = 6], $P = .04$).

When examining TKAs (n = 128) separately as a group, there was also no difference in inpatient MMEs (114.9 vs 105.9, $P = .36$) or outpatient prescribed MMEs (191 vs 158, $P = .06$) between the self-reported cannabis users and matched controls, respectively, although the outpatient prescribed MMEs did trend toward significance. There remained no difference in the DOU (15.5 vs 11.6 days, $P = .08$) postoperatively between the self-reported cannabis users and matched controls, respectively, although this also trended toward significance. There did continue to be a significant difference in the percentage of POU between the self-reported cannabis group and the matched control group (1.6% [n = 2] vs 10.9% [n = 14], respectively, $P = .002$).

## Discussion

As the interest in opioid-sparing pathways for TJA continues to grow due to the opioid crisis in the United States, there is a need to study alternative medications for perioperative pain control. This need arises in the context of increasing legalization and patient belief in cannabis products as an adjuvant for pain control. It is thus important that the orthopedic surgeon community understand the impact of perioperative cannabis use on opioid consumption after TJA, to better counsel patients. In the present study, patients who self-reported cannabis use during the perioperative period were significantly less likely to become persistent opioid users at 90 days postoperatively. In addition, there was a trend toward a significantly increased outpatient MMEs prescribed and duration of opioid use in the TKA subset of the self-reported cannabis user cohort. It may be that although patients who use cannabis in the perioperative period end up consuming more opioids or consume them for a longer duration, they are much less likely to continue to consume them for more than 90 days postoperatively. These findings help clarify the role of cannabis both as an adjuvant medication for acute postoperative pain and as a medication to prevent persistent opioid use for patients suffering from chronic postoperative pain after TJA.

Within the United States, orthopedics continues to be the third highest specialty in opioid prescribing rates and is one the leaders in providing chronic opioid therapy [15–18]. This has led to a justifiable push to continue developing refined multimodal opioid-sparing analgesia protocols, to reduce opioid prescribing while continuing to address patient postoperative pain requirements. At the same time, the potential for cannabinoids to contribute to the mitigation of the opioid crisis has been demonstrated in states where cannabinoid use has been legalized, leading to decreased rates of opioid prescriptions, opioid abuse, hospital admissions, and overdose mortality rates [19–21]. A survey of cannabis users in Washington state demonstrated 35.8% were substituting cannabis for narcotics/opioids [2]. Adults with symptomatic hip and knee arthritis are also increasingly turning to cannabis-containing products to help with pain relief, with 20%-24% of patients self-reporting cannabis use prior to undergoing TJA [22–24]. This interest also extends to the perioperative period, where 1 survey demonstrated that 75% of patients in a TJA clinic are interested in using cannabis if prescribed by a physician for acute or chronic postoperative pain [24]. Another survey of patients who used cannabis during their recovery from musculoskeletal trauma demonstrated that 90% believed cannabis reduced their pain symptoms, and 81% believed it reduced the amount of opioid medication they used [7]. This combination of purported analgesic potential and patient interest has made cannabis a prime candidate for incorporation into multimodal opioid-sparing pain protocols.

Unfortunately, there is currently limited evidence examining perioperative cannabis use in patients undergoing TJA. There have been 3 retrospective cohort studies and 1 prospective cohort study that examined perioperative opioid consumption in patients who were using cannabis products. Liu et al. and Jennings et al. both compared patients who self-reported cannabis use (155 and 71 patients in each study, respectively) to a matched cohort who did not self-report cannabis use and found no difference in hospital MMEs consumed between the 2 groups [25,26]. Hickernell et al. found that in 81 patients undergoing TJA who received 5 mg of dronabinol, a synthetic cannabinoid, twice per day while in hospital postoperatively, there was no significant difference in hospital MMEs consumed per length of stay when compared to controls [27]. The current study similarly did not show any difference in MMEs consumed in the hospital between the self-reported cannabis group and controls. Finally, Runner et al. in a prospective cohort of 32 patients who self-reported cannabis use found no difference in total MMEs taken or duration of opioid use [28]. The current study also did not find a difference in the duration of opioid use or MMEs prescribed although, with the larger numbers in this study, there was a trend toward significance in the subset of patients who underwent TKA.

Another important consideration when evaluating perioperative cannabis use in TJA is the risk of increased complications postoperatively. In the study by Jennings et al. [26], there was no difference in functional scores, readmissions, or reoperations between patients who self-reported cannabis use and those that did not. Another study Denduluri et al. retrospectively examined the rate of complications in 201 patients with positive cannabinoid

**Table 2**
Opioid consumption in self-reported cannabis users vs matched controls.

| Opioid consumption | Cannabis users | Matched controls | *P* value |
|---|---|---|---|
| Inpatient MMEs | 109.0 ± 5.5[a] | 99.7 ± 5.4[a] | .23 |
| Outpatient MMEs | 160 ± 8.4[a] | 147 ± 10[a] | .35 |
| Duration of use | 12.7 ± 1.2 d[a] | 10.1 ± 1.2 d[a] | .12 |
| Persistent users | 3 (1.4%) | 20 (9.5%) | **<.001** |

Bold *P* values of less than .05 indicate statistical significance.
[a] Values are presented as mean ± standard error of the mean.

**Table 3**
Opioid consumption by total hip vs total knee arthroplasty.

| Opioid consumption | Cannabis users | Matched controls | *P* value |
|---|---|---|---|
| THA (n = 82) | | | |
| Inpatient MMEs | 99.9 ± 9.5[a] | 90.1 ± 8.4[a] | .44 |
| Outpatient MMEs | 110.4 ± 8.8[a] | 130 ± 17[a] | .32 |
| Duration of use | 8.4 ± 1.8 d[a] | 7.8 ± 1.7 d[a] | .81 |
| Persistent users | 1 (1.2%) | 6 (7.3%) | **.04** |
| TKA (n = 128) | | | |
| Inpatient MMEs | 114.9 ± 6.7[a] | 105.9 ± 7.0[a] | .36 |
| Outpatient MMEs | 191 ± 12[a] | 158 ± 12[a] | .06 |
| Duration of use | 15.5 ± 1.6 d[a] | 11.6 ± 1.6 d[a] | .08 |
| Persistent users | 2 (1.6%) | 14 (10.9%) | **.002** |

Bold *P* values of less than .05 indicate statistical significance.
[a] Values are presented as mean ± standard error of the mean.

urine toxicology screens who underwent TJA and found cannabinoid use was not associated with increased complications, including rates of 90-day readmission, infection, or reoperation [29]. This is in contrast to 3 database studies which have demonstrated an increased risk of complications, readmissions, and costs after TJA in patients with cannabis use disorder [30–32]. It is important to note that these database studies examined a small and distinctly separate population of cannabis users, by identifying patients with an International Classification of Diseases code for cannabis use disorder. There is obviously a large distinction between patients who use cannabis and those that have been diagnosed with a misuse disorder, and so caution should be exercised in extrapolating these data to the 20%-24% of patients with symptomatic hip and knee arthritis who use cannabis.

Although the number of patients who were classified as persistent opioid users in the control group would appear surprisingly large at 9.5%, this percentage is comparable to other published reports in the literature. A database study by Varady et al. comparing opioid use in patients undergoing inpatient vs outpatient TJA found rates of persistent opioid use after 90 days postoperatively of 11.4% and 9.0% in the inpatient and outpatient cohorts, respectively, [9]. Another metanalysis by Wu et al. found that 12% of patients had persistent opioid use 90 days after TJA [33]. The significant reduction in the rate of persistent opioid use in patients who self-reported cannabis use in this study, with only 1.4% using opioids after 90 days postoperatively, is potentially a reflection of the efficacy of cannabis in treating chronic pain.

This study does have several limitations. As a retrospective review of prospectively collected data, this study may be prone to bias. Cannabis use can be associated with comorbidities such as depression and anxiety and the use of other drugs such as alcohol, nicotine, benzodiazepines, and antidepressants [28,34,35]. These are also factors that are associated with increased opioid use [8,36]. The adoption of strict matching criteria between the 2 groups was thus intended to minimize this bias as much as possible. One such criterion that was not matched in this study is socioeconomic status, which may also be associated with both cannabis use and persistent opioid use postoperatively [8]. In addition, more specific variables about patients' self-reported cannabis use, such as dose, frequency, route (edible, inhalation, topical), and type (delta-9-tetrahydrocannabinol, cannabidiol) of cannabis preparation, were not recorded as a part of this study. As further research on cannabis use and perioperative pain is performed, examining these variables and their effect on opioid consumption will be critical in advising patients how best to incorporate cannabis into a multimodal pain protocol. The reason for the use of cannabis (medicinal vs recreational) was also not examined as a part of this study. Yet, studies show a significant overlap between medicinal and recreational cannabis users, with previous recreational cannabis use reported by many current medicinal users, clouding the distinction in many patients [37,38]. Finally, the length of follow-up in this study was only 6 months although this was sufficient time to classify patients as persistent users. Further follow-up would not have appreciably changed the results of the study.

## Conclusions

This study helps to shed light on what role if any cannabis should play as a part of an opioid-sparing multimodal pain protocol after TJA. Self-reported perioperative cannabis use appeared to significantly reduce the number of patients that persistently used opioids greater than 90 days after TJA from 9.5% to 1.4%. Although there was no difference in the group as a whole or in the THA subset, there was a trend toward significance of increased DOU and prescribed MMEs in the TKA subset of self-reported cannabis users. This may indicate that cannabis users respond to acute pain with either increased MME consumption, duration of use, or both but are more likely to eliminate their opioid consumption long term as the postoperative pain becomes more chronic. As cannabis becomes more widely available and patient interest in its use for pain management continues to increase, further research with higher quality, prospective studies are required to clarify its role in perioperative pain management, including the examination of different preparations (delta-9-tetrahydrocannabinol vs cannabidiol), dosages, routes of administration (edible, inhalation, topical), and frequency of use.

## Conflicts of interest

D. A. Dennis receives royalties from DePuy, a Johnson & Johnson Company; is in the speakers' bureau of or gave paid presentations for DePuy, a Johnson & Johnson Company; is a paid consultant for Corin USA and DePuy, a Johnson & Johnson Company; has stock or stock options with Joint Vue; receives research support as a principal investigator from Porter Adventist Hospital and DePuy, a Johnson & Johnson Company; receives royalties from Wolters Kluwer Health-Lippincott Williams & Wilkins; and is in the editorial or governing board of *Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery, and Orthopedics Today*. J. M. Jennings receives royalties from Total Joint Orthopedics; is a paid consultant for Total Joint Orthopedics and Xenex; has stock or stock options with Xenex; and receives research support as a principal investigator from DePuy, a Johnson & Johnson Company. All other authors declare no potential conflicts of interest.

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