



How orthopedic surgeons can impact opioid use and dependence in shoulder arthroplasty



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ARTICLE INFO

Keywords:

Opioid dependence
shoulder arthroplasty
risk factors
opioid

Level of evidence: Level III; Retrospective Case-Control Design; Prognosis Study

Background: Considering that the United States is facing a crisis with opioid misuse and orthopedists are the third largest provider of these prescriptions, it is important to delineate risk factors associated with use and dependence. Our purpose was to identify risk factors for and patient characteristics of increased opioid use and postoperative opioid dependence in total shoulder arthroplasty (TSA) patients.

Methods: This was a retrospective study of 752 TSA patients who underwent surgery in 1 health care system from 2012–2016. Recorded variables included demographics and opioid prescriptions from prescription drug monitoring programs. Preoperative and postoperative opioid dependence was defined as continuous opioid prescriptions for at least 3 months prior to or after surgery. Statistical analyses and odds ratio analyses were performed.

Results: Of the 752 patients in total, 241 (32%) became or remained postoperatively dependent whereas 68% (511) were able to wean off of opioids by 3 months. In the preoperatively dependent cohort, only 27% were able to wean off opioids at 1 month and 53%, by 3 months postoperatively. Odds ratio calculations showed that patients with preoperative opioid use had a 3.52 (95% confidence interval, 2.433–5.089) times increased risk of postoperative dependence compared with opioid-naïve patients. Of those receiving postoperative opioid refills, 69% were provided these refills by their orthopedic surgeons.

Discussion and conclusions: Although the majority of TSA patients weaned off of opioids after surgery, our results demonstrate a 3.5 times higher risk of postoperative dependence in patients who used preoperative opioids. Orthopedists were major contributors to continued postoperative opioid use, and increased efforts to minimize opioid prescriptions before, during, and after TSA may help curtail overuse and dependence. These results highlight the hazard that preoperative opioid use entails for shoulder arthritis patients.

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In 2016 alone, over 236 million opioid prescriptions were written in the United States, enough for each American adult to have his or her own bottle of opioids; not surprisingly, this has led to 130 Americans dying each day from opioid-related overdoses as of 2018. Although opioid-based medications have proved effective in managing both chronic arthritis and postoperative pain after orthopedic surgery, the statistics are mounting regarding this growing epidemic of prescription opioid abuse and dependence.^{9,11}

Sales of opioid-based pain medications quadrupled from 1999 to 2010, and overdose deaths related to opioid consumption have increased nearly 200% from 2000 to 2014.^{14,16,17} Many factors contribute to this problem, including a culture of increasingly aggressive pain management, access to opioid medications, a lack of prescribing guidelines for physicians, and inadequate disposal instructions for patients.⁷ This opioid epidemic is of particular concern for clinicians trying to manage immediate and long-term pain.

Glenohumeral osteoarthritis is a chronic, sometimes debilitating condition that can be treated with nonoperative pain management or ultimately surgical treatment for pain relief and improved function. The use of opioid pain relief for arthritis can be concerning because current literature suggests a positive correlation between preoperative opioid use and postoperative risk of

Institutional review board approval was received from Cleveland Clinic Florida (IRB 17-022).

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<https://doi.org/10.1016/j.jses.2019.10.113>

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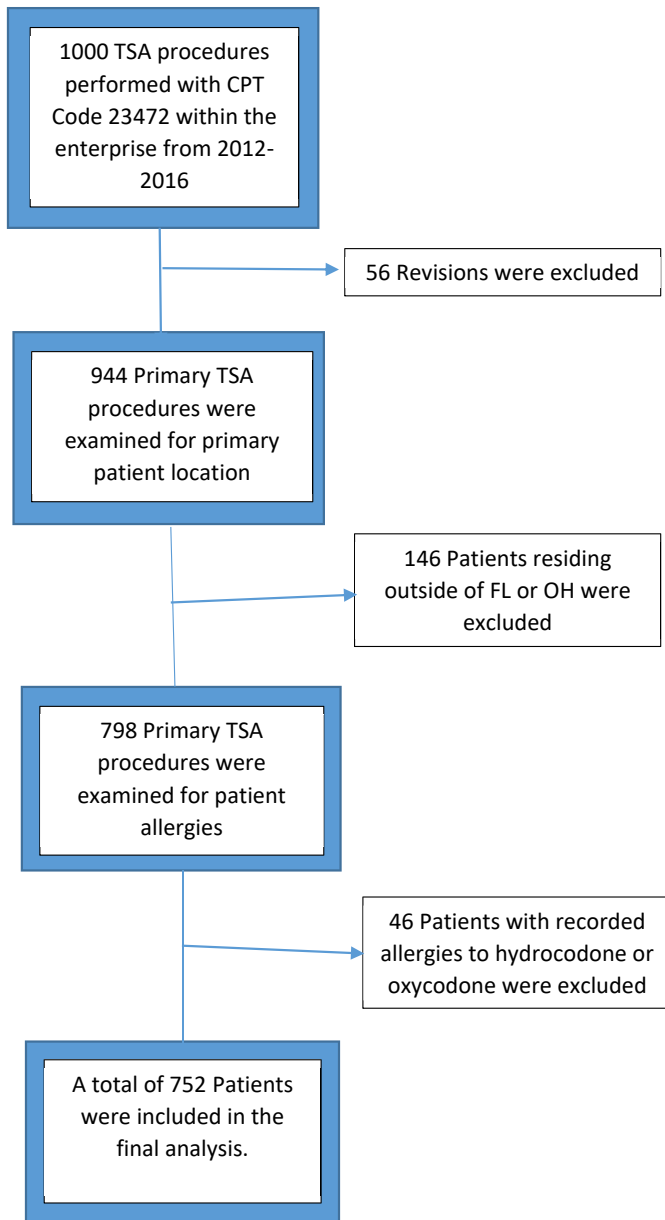


Figure 1 Patient inclusion and exclusion criteria for final analysis. TSA, total shoulder arthroplasty; CPT, Current Procedural Terminology; FL, Florida; OH, Ohio.

dependence for other surgical procedures.^{19,20} In particular, Westerman et al¹⁹ found that patients who received opioid prescriptions 1 month before rotator cuff repair were 3 times more likely to continue to need prescribed opioids at 3 months after rotator cuff repair and 7 times more likely to need opioid prescriptions after surgery despite the fact that the surgical procedure was intended to relieve chronic pain and reduce reliance on these medications. Previous studies also have found that persistent opioid use 6 weeks prior to total knee arthroplasty was associated with a longer postoperative hospital stay, greater risk of complications, and more painful prolonged recovery.²⁰

In research focused on patients with primary glenohumeral joint osteoarthritis who used opioid medications for pain control preoperatively, worse patient outcomes were reported, including patient satisfaction measures.⁴ In addition, patients with chronic pain (lasting ≥ 3 months) have also been found to have depression, anxiety, and sleep disturbances, all of which have been associated with increased opioid dependence risk.^{1,2,10} To date, several studies

Table 1

Patient characteristics compared between opioid-dependent and nondependent groups

Demographic variable	Opioid-naive group (n = 523)	Opioid-dependent group (n = 229)	P value
Sex, n (%)			.89
Male	228 (43)	117 (51)	
Female	295 (56)	112 (49)	
Mean age, yr	69.4	68.2	.10
Mean ASA class	2.71	2.74	.12
Race, n (%)			.06
White	478 (91)	211 (92)	
Black	36 (6)	13 (5)	
Asian	0 (0)	1 (0.5)	
Multiracial	6 (1)	2 (1)	
Ethnicity, n (%)			.56
Hispanic	18 (3)	6 (2)	
Non-Hispanic	505 (97)	223 (98)	
Mean procedure time, min	191.8	163.9	

ASA, American Society of Anesthesiologists.

have characterized opioid prescribing and consumption patterns for orthopedic surgery patients who plan to undergo surgery but not for total shoulder arthroplasty (TSA) patients.^{1–5,7,13,18} The purpose of this study was to identify risk factors for and patient characteristics of increased opioid use and postoperative opioid dependence in primary TSA patients.

Methods

In this retrospective case-control study, we identified 1000 patients who underwent anatomic TSA performed within a multisite hospital system from 2012 to 2015 by use of Current Procedural Terminology code 23472 and verified via recorded procedure descriptions. Patients who did not have opioid prescription data available (residing outside of the state of Florida or Ohio), patients undergoing revision arthroplasty, and patients with a recorded allergy to hydrocodone or oxycodone were excluded from this study, resulting in a total of 752 patients (Fig. 1). Of these 752 patients, 229 were preoperatively opioid dependent based on 3 months of opioid use prior to surgery (POD group) and 523 were preoperatively opioid naive or nondependent (PON group) (Fig. 1).

Demographic variables collected for each patient included age, sex, American Society of Anesthesiologists (ASA) class, laterality, body mass index, race, and ethnicity. Patient-filled narcotic-based prescriptions up to 6 months prior to surgery and 1 year postoperatively were recorded based on state drug monitoring registries in Florida and Ohio.^{6,12} Data regarding number of pills, dosage, type of opioid, and opioid dependence were recorded for all patients. Total morphine equivalents (TMEs) were calculated for each filled prescription. Preoperative exposure was defined as opioid prescriptions recorded in the month before surgery. Dependence was defined as continuous opioid prescriptions for the 3 months leading up to surgery (preoperatively) or after surgery. Dose and number of pills prescribed were compared between groups. Prescribers were classified into 2 groups: orthopedic surgeons and other providers.

Statistical analysis

Descriptive statistics were used to summarize opioid consumption patterns within both cohorts. Student *t* tests were used to compare demographic variables between the preoperatively dependent and opioid-naive cohorts. Odds ratio (OR) calculations were performed for each predictor of postoperative narcotic dependence. All statistical analyses were performed using SPSS software (version 23.0; IBM, Armonk, NY, USA).

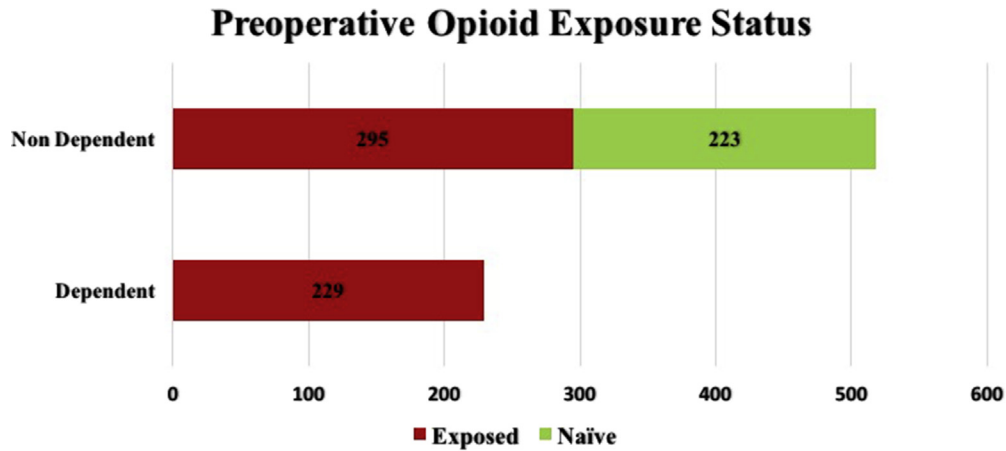


Figure 2 Preoperative opioid dependence and exposure rates.

Results

The 752 patients in the total cohort had an average age of 69.1 years and an average ASA class of 2.72 and included 417 female patients (55%). In the POD group, the average age was 68.2 years, the average ASA class was 2.74, and there were 112 female and 117 male patients. In the PON group, the average age was 69.4 years, the average ASA class was 2.71, and there were 295 female patients (56.6%). No significant differences in sex, age, ASA class, race, ethnicity, or procedure time were seen between groups ($P > .05$) (Table 1). Patients who had a preoperative prescription were prescribed an average of 69.7 pills with average TMEs of 368.6. Postoperatively, patients were prescribed an average of 79 pills with average TMEs of 488.3 per patient. The average number of pills prescribed postoperatively for the POD group was 85 (average TMEs, 635) compared with 69 pills (average TMEs, 514) for the PON group, which was not significantly different ($P > .05$).

Postoperatively, 32% of the overall population ($n = 241$) met the criteria for opioid dependence. Of the patients in the POD group, 73% were still taking opioids at 1 month postoperatively; 47%, at 3 months; and 22%, at 6 months (Fig. 2). In the PON group, 46% were still taking opioids at 1 month postoperatively; 26%, at 3 months; and 12%, at 6 months (Fig. 3). OR calculations showed a 3.54 times (95% confidence interval [CI], 2.43-5.09) increased risk of dependence postoperatively for patients in the POD group ($P < .0001$). Moreover, among patients who had any exposure to opioids preoperatively, the risk of postoperative dependence was increased 2.55 (95% CI, 1.86-3.50) times compared with those with no preoperative exposure ($P < .0001$).

When we evaluated other risk factors for opioid dependence, ASA class 3 and 4 patients demonstrated no significantly increased risk of postoperative opioid dependence. There was also no increased risk based on sex (OR, 0.97 for women to men; 95% CI, 0.718-1.33; $P = .8889$) or age, except in patients 75 years or older, who were less likely to be postoperatively narcotic dependent (OR, 0.75; $P = .1002$). No significant differences were seen in the amounts of opioids prescribed between groups, with the PON group having been prescribed average TMEs of 423 compared with average TMEs of 448 in the POD group ($P > .05$). Among patients receiving refills at 3 months postoperatively, 69% were prescribed these refills by orthopedic surgeons.

Discussion

Our results suggest that for patients undergoing shoulder arthroplasty, preoperative opioid use and dependence are significant risk factors for postoperative continued opioid use and dependence. This finding is consistent with findings of previous reports and highlights the need for awareness of exposure and chronic opioid use prior to surgery, which can impact a patient's ability to wean off of opioids after surgery.^{1,3,13} Of note, the majority of our TSA patients (68%) were able to wean off of opioids by 3 months postoperatively; however, this is much longer than many current regulatory allowances, and repeated refills can contribute to higher rates of dependence even a successful surgical procedure with preoperative opioid exposure. Surprisingly, regardless of preoperative exposure or dependence, surgeons prescribed the same postoperative opioid amounts to all patients. Perhaps

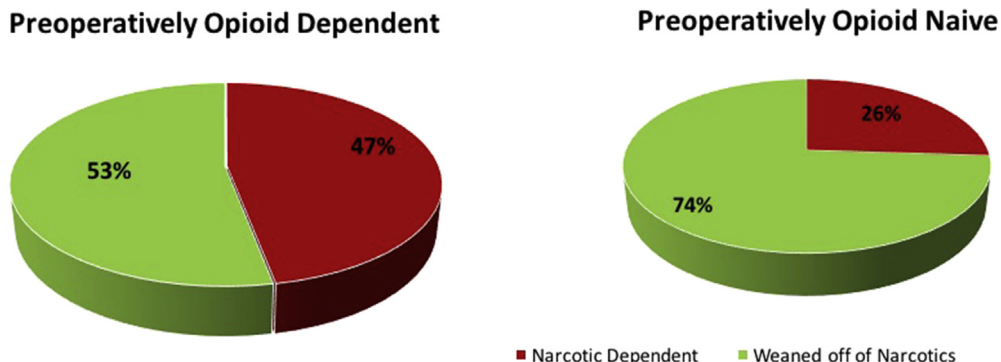


Figure 3 Postoperative opioid dependence rates for opioid-naïve group and opioid-dependent groups.

surgeons can use risk assessments and become more familiar with risk factors to customize postoperative pain protocols better and identify the small segment of patients (12%) in whom chronic dependence developed after TSA or closely work with pain management specialists for this population. Perhaps implementing screening for risk factors and closely monitoring postoperative prescriptions should be implemented to avoid even these low rates of dependence.

It has been reported that primary care physicians are more likely to recommend replacement surgery to patients with hip or knee arthritis compared with patients with shoulder arthritis, especially in the geriatric population.⁸ As seen in our cohort, these practices may lead to patients experiencing chronic shoulder arthritis pain for extended periods, resulting in the higher rates of long-term opioid use to manage their shoulder pain prior to surgery.⁸ These opioid prescriptions lead to increased rates of preoperative opioid dependence, putting patients at higher risk of chronic dependence even before being offered a surgical consultation. Although prescription drug monitoring services enable physicians to track opioid use better and prevent multiple-provider prescriptions, their effectiveness is still limited as they are aimed at mitigation instead of prevention of this problem. Perhaps increased education and communication with primary care physicians need to be implemented with new guidelines to avoid opioids in osteoarthritis patients; this may decrease or prevent opioid dependence in these orthopedic patients.

Interventions cannot just focus on the primary care community; they also must be integrated into our orthopedic community because orthopedic surgeons provided the majority of opioid refill prescriptions (69%) postoperatively for more than 3 months. As outlined by Morris and Mir⁹ (2015), identifying risk factors, using a standardized pain management protocol, and adjusting patient expectations of pain after surgery may help reduce the number of patients who move from taking opioids for pain after surgery to dependence. Orthopedic surgeons need to implement these practices into a standard of care given the increasing scrutiny and legislation limiting access to postoperative opioids for our patient population.¹⁵

Although our results demonstrate several important patterns in narcotic consumption in TSA patients, this study is not without limitations. One limitation is that this study was based on the prescribing patterns of physicians with the assumption that patients consumed all opioid medications as prescribed. Patients may not have consumed all prescribed pills or followed instructions on appropriate use, which was not assessed in this study. Another limitation is that preoperative comorbidities and reasons for opioid dependence prior to TSA were not taken into consideration, which may allow for a clearer understanding of which patients are most at risk, as well as overprescribing patterns. Future studies may address these particular issues. However, we did try to account for as many comorbidities and available factors as possible using appropriate statistical analyses to minimize bias.

Conclusion

With over 130 deaths per day due to opioid overdoses, it is important for orthopedic surgeons to increase awareness of how they are contributing to the crisis and what risk factors exist in their patient populations. Although the majority of TSA patients weaned off of opioids after surgery, our results demonstrate a 3.5 times higher risk of postoperative dependence for preoperatively dependent patients. Orthopedists were major contributors to

continued postoperative opioid use, and increased efforts to minimize opioid prescriptions before, during, and after TSA may help curtail dependence rates. These results highlight the hazard that preoperative opioid use entails for shoulder arthritis patients.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Aasvang EK, Lunn TH, Hansen TB, Kristensen PW, Solgaard S, Kehlet H. Chronic pre-operative opioid use and acute pain after fast-track total knee arthroplasty. *Acta Anaesthesiol Scand* 2016;60:529–36. <https://doi.org/10.1111/aaas.12667>.
2. Bartels K, Mayes LM, Dingmann C, Bullard KJ, Hopfer CJ, Binswanger IA. Opioid use and storage patterns by patients after hospital discharge following surgery. *PloS One* 2016;11:e0147972. <https://doi.org/10.1371/journal.pone.0147972>.
3. Berglund DD, Rosas S, Kurowicki J, Mijic D, Levy JC. Effect of opioid dependence or abuse on opioid utilization after shoulder arthroplasty. *World J Orthop* 2018;9:105–11. <https://doi.org/10.5312/wjo.v9.i8.105>.
4. Cheah JW, Sing DC, McLaughlin D, Feeley BT, Ma CB, Zhang AL. The perioperative effects of chronic preoperative opioid use on shoulder arthroplasty outcomes. *J Shoulder Elbow Surg* 2017;26:1908–14. <https://doi.org/10.1016/j.jse.2017.05.016>.
5. Clarke H, Soneji N, Ko DT, Yun L, Wijesundera DN. Rates and risk factors for prolonged opioid use after major surgery: population based cohort study. *BMJ* 2014;348:g1251. <https://doi.org/10.1136/bmj.g1251>.
6. E-FORCSE, Florida's prescription drug monitoring program. Tallahassee, FL: Florida Department of Health; 2018.
7. Kim N, Matzon JL, Abboudi J, Jones C, Kirkpatrick W, Leinberry CF, et al. A prospective evaluation of opioid utilization after upper-extremity surgical procedures: identifying consumption patterns and determining prescribing guidelines. *J Bone Joint Surg Am* 2016;98:e89. <https://doi.org/10.2106/jbjs.15.00614>.
8. Mitchell C, Adebajo A, Hay E, Carr A. Shoulder pain: diagnosis and management in primary care. *BMJ* 2005;331:1124–8. <https://doi.org/10.1136/bmj.331.7525.1124>.
9. Morris BJ, Mir HR. The opioid epidemic: impact on orthopaedic surgery. *J Am Acad Orthop Surg* 2015;23:267–71. <https://doi.org/10.5435/jaas-d-14-00163>.
10. Morris BJ, Sciascia AD, Jacobs CA, Edwards TB. Preoperative opioid use associated with worse outcomes after anatomic shoulder arthroplasty. *J Shoulder Elbow Surg* 2016;25:619–23. <https://doi.org/10.1016/j.jse.2015.09.017>.
11. Morris BJ, Zumsteg JW, Archer KR, Cash B, Mir HR. Narcotic use and post-operative doctor shopping in the orthopaedic trauma population. *J Bone Joint Surg Am* 2014;96:1257–62. <https://doi.org/10.2106/jbjs.m.01114>.
12. Ohio Automated Rx Reporting System. Columbus, OH: State of Ohio Board of Pharmacy; 2018.
13. Rao AG, Chan PH, Prentice HA, Paxton EW, Navarro RA, Dillon MT, et al. Risk factors for postoperative opioid use after elective shoulder arthroplasty. *J Shoulder Elbow Surg* 2018;27:1960–8. <https://doi.org/10.1016/j.jse.2018.04.018>.
14. Rudd RA, Aleshire N, Zibbell JE, Gladden RM. Increases in drug and opioid overdose deaths—United States, 2000–2014. *MMWR Morb Mortal Wkly Rep* 2016;64:1378–82. <https://doi.org/10.15585/mmwr.mm6450a3>.
15. Seymour RB, Ring D, Higgins T, Hsu JR. Leading the way to solutions to the opioid epidemic: AOA critical issues. *J Bone Joint Surg Am* 2017;99:e113. <https://doi.org/10.2106/jbjs.17.00066>.
16. Vital signs: overdoses of prescription opioid pain relievers and other drugs among women—United States, 1999–2010. *MMWR Morb Mortal Wkly Rep* 2013;62:537–42.
17. Volkow ND, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. *JAMA* 2011;305:1299–301. <https://doi.org/10.1001/jama.2011.401>.
18. Welton KL, Kraeutler MJ, McCarty EC, Vidal AF, Bravman JT. Current pain prescribing habits for common shoulder operations: a survey of the American Shoulder and Elbow Surgeons membership. *J Shoulder Elbow Surg* 2018;27: S76–81. <https://doi.org/10.1016/j.jse.2017.10.005>.
19. Westermann RW, Anthony CA, Bedard N, Glass N, Bollier M, Hettrich CM, et al. Opioid consumption after rotator cuff repair. *Arthroscopy* 2017;33:1467–72. <https://doi.org/10.1016/j.arthro.2017.03.016>.
20. Zywił MG, Stroh DA, Lee SY, Bonutti PM, Mont MA. Chronic opioid use prior to total knee arthroplasty. *J Bone Joint Surg Am* 2011;93:1988–93. <https://doi.org/10.2106/jbjs.j.01473>.