

Guidelines

Evidence-Based Orthopaedic Post-Operative Opioid Prescribing Recommendations Following Foot & Ankle Surgery

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The ongoing opioid epidemic in the United States is a pressing public health issue, with prescription opioids being a contributing factor, particularly among orthopedic surgeons identified as high-volume prescribers. Taking responsibility for opioid stewardship, especially among foot and ankle surgeons, can bring about positive changes in combating the epidemic. It is crucial to implement appropriate opioid dosing and postoperative multimodal analgesic strategies, including locoregional analgesia techniques, for effective pain management following foot and ankle surgery. The guidelines offer comprehensive, evidence-based, and user-friendly recommendations for analgesic regimens and opioid dosages for standard foot and ankle surgical procedures.

INTRODUCTION

Foot and Ankle Surgeons are generally high-volume surgeons who routinely prescribe opioids post-operatively.¹ One study estimated that orthopedic surgeons provide nearly 8% of all opioid prescriptions behind only primary care providers and internists.² Given the nature of surgery and degree of postoperative pain, opioid medications are often necessary following foot and ankle procedures. However, in 2018 over 10 million patients misused opioids, and the US found itself amid an opioid epidemic – creating a problem for prescribing physicians.³

There have been policies put in place by certain state legislatures to address the rise in opioid overdoses. A retrospective review of foot and ankle patients in Ohio showed significant decreases in milligrams of morphine equivalents (MME) and the average number of opioid pills consumed due to legislative intervention.⁴ Additionally, Cunningham et al. reported that states with opioid regulations had more considerable reductions in 90-day perioperative opioid consumption than states without.⁵ Another group reported promising results by providing a portable drug disposal device to help mediate the rising number of unconsumed pills.⁶

However, despite advances in opioid prescription legislation, many opioid pills remain unconsumed after foot

and ankle procedures, and the rate of overdoses nationwide continues to increase. In addition, risk factors such as mental health issues, history of drug use, and poor health literacy continue to contribute to persistent opioid use.⁷ Multimodal analgesia is effective across all orthopedic procedures, and foot and ankle surgeons must consider all avenues of postoperative pain management.⁸ Although tackling the opioid epidemic will require collaboration across multiple healthcare disciplines, foot and ankle surgeons can be a driving force behind post-operative analgesia reform.

PROBLEM STATEMENT

After standard foot and ankle surgeries, there exists the potential for inadvertent postoperative opioid prescribing leading to dependence, abuse, and untoward effects contributing to the current opioid epidemic. Despite the widespread use of postoperative opioid use and the potential magnitude of such unintended consequences, guidelines for appropriate opioid dosing and analgesic strategies are lacking.

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PROPOSED SOLUTION

Comprehensive, evidence-based guidelines for postoperative analgesic regimens for standard foot and ankle surgery procedures, based on published evidence on foot and ankle surgery and overall medical/surgical literature.

STRATEGIES

Following foot and ankle surgery, certain core principles must be considered when formulating a perioperative analgesic regimen. These principles are briefly outlined below, and a review of detailed, evidence-based regimen recommendations is presented in subsequent sections.

1. Non-pharmacologic treatment strategies should be utilized whenever possible. Such methods include rest, ice, elevation, and loosely compressive surgical dressings, splints, casts, or compression sleeves, which both protect the surgical wounds and can help reduce postoperative edema.^{9,10}
2. Perioperative administration of locoregional anesthetic agents in peripheral nerve blocks or local ankle blocks should be performed. Commonly utilized modalities in foot and ankle surgery include popliteal nerve blockade with a single injection or continuous catheter and local ankle block targeting distal sensory distributions of the tibial, superficial peroneal, deep peroneal, sural, and/or saphenous nerve distributions. Preoperative administration of such locoregional anesthesia is preferred, and the opioid-sparing effects of this intervention in the immediate postoperative period are well-established.^{11,12}
3. Non-opioid analgesics are a cornerstone of multimodal analgesia and should be considered the first-line pain management modality. These agents include acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs) and should be prescribed on a standing basis rather than an as-needed basis. Additionally, opioid-acetaminophen combination medications such as Percocet, Vicoden, etc., should be avoided to prevent acetaminophen overdose and promote scheduled acetaminophen usage without requiring additional opioids.
4. Opioids should be taken as needed for breakthrough pain not adequately controlled by non-opioid analgesic regimens. There is surgery-specific variability in postoperative opioid usage throughout foot and ankle surgery which must be considered (i.e., forefoot vs. hindfoot, bony vs. soft tissue involvement),^{6,13} but opioids must generally be prescribed at the lowest dose, duration, and quantity feasible.
5. Before the prescription of an opioid, relevant side effects, medication reactions, and risk factors for opioid abuse should be considered by the provider. Common side effects of opioid medications must be reviewed, and drug-drug interactions (i.e., tramadol interaction with other serotonergic agents) must be recognized. Risk factors for opioid dependence, such as younger

age, substance abuse history, and psychiatric history,¹⁴ must be identified. Providers should utilize their state-specific Prescription Drug Monitoring System (PDMP) to verify a patient's prior opioid history before prescribing. Open communication between surgeons and other patient healthcare team members (i.e., primary care provider, pain management specialist) must be established to enhance safety and optimize analgesic strategies.¹⁵

MEDICATIONS

OPIOIDS

When ingested, opioids act upon the central and peripheral nervous system by targeting mu-opioid receptors.¹⁶ Agonists bound to mu-opioid receptors can not only result in analgesia but also sedation, nausea, vomiting, respiratory depression, and reduced gastric motility. The most commonly prescribed opioid medications are oxycodone, hydrocodone, tramadol, and other combinations of opioid and acetaminophen medications. Prolonged opioid use is typically defined as patients who consistently consume opioids for an extended time after the post-operative pain has been expected to dissipate. Hejna et al. found that prolonged opioid use is 8.9% after orthopedic foot and ankle surgeries, with the most prominent risk factors for prolonged opioid use including recreational drug use, greater alcohol consumption, and older age (>40 years of age).⁷

Despite the rise in concern regarding prolonged opioid consumption, foot and ankle surgeons have been reported to prescribe opioids in excess. One study of 988 patients undergoing outpatient foot and ankle surgery found that patients consumed a median of 20 out of the 40 opioid pills they were prescribed.¹⁷ This pattern has remained consistent among other orthopedic institutions. Bhashyam et al. found that a mean of 18.7 tablets were consumed out of the 37.4 pills prescribed.¹³ Kvarda et al. reported that 46.6% and 42.4% of prescribed pills were consumed for bony and soft tissue procedures, respectively—resulting in over 4,000 unconsumed pills.¹⁸ In a study of similar postoperative patients, there was a greater number of opioids prescribed, but still, patients took approximately 50% of prescribed medications.⁶ This finding suggests that the surgeons' prescribing practices alone may affect the total amount of opioids utilized postoperatively. In conclusion to a prospective analysis of opioid prescription patterns, Bhashyam et al. provided recommendations for postoperative opioid prescriptions. Specifically, they recommended a prescription of 20-30 5-mg Oxycodone tablets for the bony forefoot to ankle procedures, whereas they recommended 10-15 5-mg Oxycodone tablets for the nonbony forefoot to ankle procedures.¹³ Results of the literature review of opioid usage after standard foot and ankle bony and soft tissue procedures are included in Tables 1-4.

In addition to the side effects mentioned previously, activation of mu-opioid receptors also trigger the brain's reward pathway, resulting in dopamine release accompanied by pleasure.³¹ Activated reward pathways lead to cravings for opioids, and extended use eventually results in opioid

TABLE 1. FOREFOOT/MIDFOOT BONY PROCEDURES

Author	Journal	LOE	Year	Procedures (# of patients)	Opioid Consumption (# of pills, MME; specified in comments)	Comments
Saini S, McDonald EL, et al. ¹⁷	FAI	II	2018	1) Hallux Valgus (169) 2) Ludloff (80) 3) Chevron (57) 4) Akin osteotomy (34) 5) 1st MTP Arthrodesis (70) 6) 1st MTP Cheilectomy (55) 7) Midfoot arthrodesis (25) 8) 5th metatarsal ORIF (55) 9) Lisfranc ORIF (19)	1) 20 (10,40) 2) 27 (16,44) 3) 20 (7,33) 4) 20 (10,30) 5) 18 (8,35) 6) 10 (4,24) 7) 24 (17,40) 8) 20 (7,38) 9) 21 (15,42)	5/325 mg oxycodone+acetaminophen pills: median (IQR); 50% utilization rate across all surgeries
Merril HM, Dean DM, et al. ¹⁹	FAI	IV	2018	1) Bony (91) 2) Forefoot (49)	1) 21.6 2) 18.7	pills: # of pills consumed
Bhashyam AR, Keyser C, et al. ¹³	FAI	II	2019	1) Bony bunion (21) 2) Cheilectomy (21) 3) 1st MTP Arthrodesis 4) Midfoot Fusion (8) 5) Midfoot ORIF (10)	1) 20.1 (19.13) 2) 10.4 (13.8) 3) 28.2 (8.7) 4) 28.4 (30.79) 5) 25.6 (12.37)	oxycodone pills: mean (SD); 47.6 opioid pill utilization: author recommendations 20 pills (5 mg oxycodone)
Chan JJ, Guzman JZ, et al. ²⁰	Orthopedics	II	2020	Percutaneous Foot and Ankle Surgeries: 1) Forefoot (36) 2) Midfoot (2)	1) 2.2 2) 3.5	oxycodone pills: average; no differentiation between bony and soft tissue
Rogero RG, Fuchs D, et al. ²¹	FAI	III	2019	1) chevron osteotomy w/concomittant procedure 2) chevron osteotomy 3) proximal osteotomy w/concomittant procedure 4) proximal osteotomy 5) 1st MTP Arthrodesis w/concomittant procedure	1) 33 (17-50) 2) 28 (9-40) 3) 22 (13-36) 4) 27 (15-39) 5) 24 (16-28)	oxycodone+acetaminophen pills: median (IQR); 3202 leftover pills
Vesely BD, Bonvillian JP, et al. ²²	J Foot Ankle Surg	IV	2022	Physician Survey: 1) hammertoe (62) 2) bunionectomy (108) 3) isolated midfoot arthrodesis 4) Lisfranc ORIF	1) 11-20 2) 21-30 3) 21-30 4) 21-30	1-2) hydrocodone+acetaminophen pills 3-4) oxycodone+acetaminophen pills; Surgeon Survey
Caolo KC, Marion C, et al. ²³	FAO	I	2022	Minimally Invasive Hallux Valgus 1) New prescribing protocol + pamphlet 2) traditional prescription protocol	1) 2.5 2) 25.2	oxycodone pills consumed; no difference in satisfaction
Jackson JB, Their Z ²⁴	FAO	II	2022	Hallux Valgus	22-24	hydrocodone pills

Appendix: LOE: Level of evidence; FAI: Foot and Ankle International; MTP: Metatarsophalangeal; ORIF: Open reduction internal fixation; mg: milligrams; IQR: Inter-quartile range; SD: Standard deviation; J Foot Ankle Surg: Journal of Foot and Ankle Surgery; FAO: Foot and Ankle Orthopaedics

TABLE 2. FOREFOOT/MIDFOOT SOFT TISSUE PROCEDURES

Author	Journal	LOE	Year	Procedures (# of patients)	Opioid Consumption (# of pills, MME: specified in comments)	Comments
Saini S, McDonald EL, et al. ¹⁷	FAI	II	2018	1) Soft (234) 2) Forefoot (408)	1) 16 (6, 32) 2) 16 (6, 30)	oxycodone+acetaminophen pills: median (IQR); 50% utilization rate across all surgeries
Merril HM, Dean DM, et al. ¹⁹	FAI	IV	2018	1) Soft (41) 2) Forefoot (11)	1) 19.72) 18.7	pills: # of pills consumed
Bhashyam AR, Keyser C, et al. ¹³	FAI	II	2019	1) cavovarus reconstruction (10) 2) Lesser Toe Procedures (18) 3) Morton neuroma (8) 4) soft tissue bunion (8)	1) 21.6 (12.17) 2) 5.7 (9.67) 3) 8.3 (12.62) 4) 23.1 (12.93)	oxycodone pills: mean (SD); 47.6% opioid pill utilization; author recommendations: 10 pills (5 mg oxycodone)
Vesely BD, Bonvillian JP, et al. ²²	J Foot Ankle Surg	IV	2022	Physician Survey: 1) digital soft tissue surgery 2) forefoot soft tissue 3) midfoot soft tissue	1) 11-202) 21-303) 11-20	1-3) hydrocodone + acetaminophen pills; surgeon Survey

Appendix: LOE: Level of evidence; FAI: Foot and Ankle International; IQR: Inter-quartile range; SD: Standard deviation; J Foot Ankle Surg: Journal of Foot and Ankle Surgery

TABLE 3. HINDFOOT/ANKLE BONY PROCEDURES

Author	Journal	LOE	Year	Procedures (# of patients)	Opioid Consumption (# of pills, MME: specified in comments)	Comments
Saini S, McDonald EL, et al. ¹⁷	FAI	II	2018	Subtalar Arthrodesis	39 (17,51)	5/325 mg oxycodone+acetaminophen pills: median (IQR); 50% utilization rate across all surgeries
Merril HM, Dean DM, et al. ¹⁹	FAI	IV	2018	1) Bony (91) 2) Hindfoot (15)	1) 21.62) 21.7	pills: # of pills consumed
Skibicki H, Saini S, et al. ²⁵	FAS	III	2021	Ankle fractures: 1) medial malleolus (12) 2) lateral malleolus (34) 3) bimalleolar (77) 4) trimalleolar (43)	1) 30 (6, 51) 2) 23 (10, 38) 3) 24 (10, 37) 4) 27 (16, 38)	oxycodone+acetaminophen pills: median (IQR); 60% utilization rate across all surgeries
McDonald EL, Daniel JN, et al. ²⁶	CORR	I	2020	Ankle Fractures w/postop ketorolac; 1) ketorolac+oxycodone 2) ketorolac only	1) 14.0 (11.8) 2) 19.3 (13.9)	oxycodone+acetaminophen pills: median (95% CI)
Bhashyam AR, Keyser C, et al. ¹³	FAI	II	2019	1) Ankle/hindfoot fusion (12) 2) ankle ORIF (23) 3) Hindfoot ORIF (6)	1) 48.3 (20.85) 2) 28.0 (26.58) 3) 59.3 (55.75)	1-3) 5 mg oxycodone pills: mean (SD); 47.6% opioid pill utilization; author recommendations 30-35 pills (5 mg oxycodone)
Chan JJ, Guzman JZ, et al.	Orthopedics	II	2020	Percutaneous Foot and Ankle Surgeries: Hindfoot (9)	3.5	5 mg oxycodone pills: average; no differentiation between bony and soft tissue
Chuckpaiwong B, Harnroongroj T, et al.	FAI	I	2021	Hindfoot Arthrodesis: 1) w/popliteal sciatic nerve block 2) w/ local ketorolac injection	1) 3.2 (4.0) 2) 2.3 (3.1)	1-2) morphine mg equivalents; Randomized control study comparing sciatic popliteal blocks and local ketorolac injection
Christenson KP, Moller AM, et al. ²⁷	Clinical Journal of Pain	IV	2015	Ankle Fractures: 1) GA 2) GA + PNB 3) SA 4) SA + PNB	1) 21.9 (14.9) 2) 3) 16.3 (14.4) 3) 17.1 (11.1) 4) 14.6 (12.9)	mg morphine in the first 24 hours postop
Vesely BD, Bonvillian JP, et al. ²²	J Foot Ankle Surg	IV	2022	Physician Survey: 1) isolated rearfoot arthrodesis 2) tibiocalcaneal arthrodesis 3) calcaneal osteotomy 4) ankle fracture ORIF 5) calcaneal fracture ORIF	1) 21-302) 31-403) 21-304) 31-405) 21-30	1-5) # of 5 mg oxycodone pills; Surgeon Survey
Glogovac G, Fitts J, et al. ²⁸	FAO	III	2019	Ankle Fractures pre-/post- Ohio law: 1) Pre-law 2) Post-law	1) 47.9, 382.12) 36.2, 275.2	1-2) pills, MME per prescription; Pre- and post-Ohio Opioid Law Analysis of Ankle fractures
Kvarda P, Hagermeijer, NC, et al. ²⁹	FAI	II	2019	Moderate Bony Procedures (161)	16.6 (15.7)	pills: mean (SD); 46% opioid consumption rate

Appendix: LOE: Level of evidence; FAI: Foot and Ankle International; CORR: Clinical Orthopaedics and Related Research; ORIF: Open reduction internal fixation; IQR: Inter-quartile range; SD: Standard deviation; GA: General anesthesia; SA: Spinal anesthesia; PNB: Peripheral nerve block; mg: milligram; J Foot Ankle Surg: Journal of Foot and Ankle Surgery; FAO: Foot and Ankle Orthopaedics; MME: Morphine milligram equivalents

TABLE 4. HINDFOOT/ANKLE SOFT TISSUE PROCEDURES

Author	Journal	LOE	Year	Procedures (# of patients)	Opioid Consumption (# of pills, MME; specified in comments)	Comments
Saini S, McDonald EL, et al. ¹⁷	FAI	II	2018	1) Achilles Rupture Repair (161)	1) 21 (8,36)	5/325 mg oxycodone+acetaminophen pills: median (IQR); 50% utilization rate across all surgeries
Merril HM, Dean DM, et al. ¹⁹	FAI	IV	2018	1) Soft (41) 2) Hindfoot (23)	1) 19.7 2) 21.7	1-2: # of pills consumed
Bhashyam AR, Keyser C, et al. ¹³	FAI	II	2019	1) peroneal reconstruction (11) 2) Soft Tissue Ankle (71) 3) Achilles (24) 4) isolated strayer (8)	1) 25 (12.7) 2) 14.1 (12.35) 3) 18.6 (12.94) 4) 10.6 (14.98)	1-4) oxycodone pills: mean (SD); 47.6 opioid pill utilization
Vesely BD, Bonvillian JP, et al. ²²	J Foot Ankle Surg	IV	2022	Physician Survey: rearfoot soft tissue [achillies, ankle stabilization]	21-30	hydrocodone pills; surgeon Survey
Sayed ³⁰	Ain-Shams Journal of Anesthesia	I	2015	Achilles Rupture: 1) bupivacaine group 2) bupivacaine + magnesium group	1) 237.86 (25.8) 2) 190.67 (21.8)	mg tramadol (SD)
Kvarda P, Hagermeijer, NC, et al. ²⁹	FAI	II	2019	Moderate Soft Tissue Procedures (48)	12.6 (14.5)	pills: mean (SD); 47.7% opioid consumption rate

Appendix: LOE: Level of evidence; FAI: Foot and Ankle International; mg: milligrams; IQR: Inter-quartile range; SD: Standard deviation; J Foot Ankle Surg: Journal of Foot and Ankle Surgery

receptors becoming less responsive to agonists. A combination of withdrawal symptoms, desires, and tolerance are common signs of opioid substance use disorder. Addiction to opioids are a result of neurobiological changes in areas of the brain that impact judgment, decision-making, memory, learning, and behavior control. These side effects perpetuate the cycle of addiction, contribute to opioid-related adverse drug events, and further the struggle to reduce opioid consumption.^{32,33}

NSAIDS

NSAIDs primarily function by impacting the function of the cyclooxygenase (COX) enzyme, of which two have been described: COX-1 and COX-2. When inhibited, both enzymes reduce inflammation by preventing the production of prostaglandins.^{8,34} NSAIDs can selectively target COX-2 or nonspecifically act upon both COX enzymes. Ibuprofen and ketorolac are common nonspecific COX inhibitors, while celecoxib and etoricoxib are common selective COX-2 inhibitors prescribed after foot and ankle surgeries. Multiple studies have reported on the effectiveness and safety of administering NSAIDs as a part of a post-operative orthopedic pain management protocol. McDonald et al. performed a randomized controlled trial (RCT) among ankle fracture patients who received ketorolac and oxycodone-paracetamol or the standard oxycodone-paracetamol prescription postoperatively. They found that patients in the ketorolac group had reduced postoperative pain scores and opioid consumption.²⁶ Brattwall et al. found that patients prescribed etoricoxib after elective hallux valgus surgeries experienced greater reductions in pain relief, higher levels of satisfaction, and fewer complications compared to patients treated with postoperative tramadol.³⁵ NSAIDs have also been found to reduce opioid consumption after total joint arthroplasty procedures. Patients who received ibuprofen + acetaminophen in conjunction with opioid pain medications consumed significantly less morphine equivalents than those who only received acetaminophen.³⁶

Evidence in animal models indicates that NSAIDs can lead to delayed or impaired bone healing. However, the cumulative evidence in human studies has been inconclusive. A meta-analysis of RCTs found that a short-duration course (<2 weeks) of NSAID use has no significant impact on bone healing.^{37,38} Hassan et al. prospectively followed patients taking ibuprofen or ketorolac after various foot and ankle procedures and found no significant relationship between NSAID consumption and osseous non-union.³⁹ Furthermore, a retrospective review of 281 patients who received perioperative ketorolac at the time of their ankle fracture ORIF procedures reported no significant effect of ketorolac on fracture union.⁴⁰ Ultimately, more research needs to be performed to elucidate the ultimate effect, if any, of NSAIDs on bone healing. Still, NSAIDs will continue to play an integral role in multimodal analgesia practices.

ACETAMINOPHEN/PARACETAMOL

Acetaminophen and paracetamol are among the most commonly prescribed pain medications after foot and ankle

procedures.^{8,34} Although the mechanism of action of acetaminophen is still relatively unknown, it is believed to have an effect at the central nervous system level through serotonergic and COX enzyme interactions.⁴¹ While few studies directly evaluate the direct effect of acetaminophen on pain relief and opioid consumption in foot and ankle surgeries, a recent meta-analysis demonstrated that morphine consumption was significantly reduced when taken in conjunction with acetaminophen after various major surgical procedures.⁴² Today, acetaminophen is commonly prescribed as a combination drug with opioids (Percocet, Norco, Vicodin, etc.), but certain providers prefer prescribing acetaminophen separately to allow for more control over opioid consumption.³⁴ There is evidence that high doses of acetaminophen can lead to impaired liver function and patient history of liver disease should be considered.⁴³

REGIONAL/LOCAL ANESTHESIA

A recent survey demonstrated that over 90% of foot and ankle surgeons use peripheral nerve blocks.⁴⁴ To apply various forms of regional anesthesia, an anesthetic agent is injected directly into the target nerve, bathing the entire nerve in anesthetic and providing a localized sensory blockade.⁴⁵ Types of peripheral nerve blocks include popliteal, femoral, sciatic, saphenous, adductor canal, and ankle blocks—which are successful at reducing pain and decreasing opioid consumption.¹¹

An RCT compared patients who received a bupivacaine block of the posterior tibial and sural nerve to patients receiving normal saline injection while undergoing open reduction and internal fixation of calcaneal fractures. Patients in the treatment group consumed significantly less morphine in the first 24 hours after surgery and reported greater satisfaction than those in the control group.¹² Jarrell et al. prospectively compared combined popliteal and saphenous continuous-flow catheter nerve block with a single-shot nerve block. Patients in the continuous catheter group consumed fewer opioids, reported less pain, and were more satisfied with their pain management than patients in the single shot group.⁴⁶ In a study on utilizing regional anesthesia as a long-acting popliteal block consisting of dexamethasone and bupivacaine in outpatient foot and ankle surgeries, patients utilized less than half (mean 22.5 pills used of 55.5 pills prescribed) of the opioid medications prescribed postoperatively.⁴⁷ In a systematic review of randomized controlled trials, there was no clear analgesic superiority with the use of proximal peripheral nerve blocks (i.e., At the hip) compared to popliteal nerve blocks, and popliteal sciatic nerve blocks provided a longer duration of analgesia compared to distal blocks at the ankle.⁴⁸ Technological advancements have improved the efficacy and efficiency of certain nerve blocks, as ultrasound-guided injections have significantly reduced time and needle redirects when applying lateral popliteal blocks.⁴⁹

Documented complications with the use of peripheral nerve blocks include persistent pain, numbness, foot drop, and other neurological issues.⁵⁰ Kahn et al. performed a retrospective review of over 2,500 foot and ankle surgery patients and reported a 7.2% complication rate and 0.7%

serious complication rate for popliteal nerve and ankle blocks. There were no significant differences in complication rates between popliteal and ankle blocks. Most serious complications were related to numbness, tingling, or burning pain, with only one patient experiencing foot drop. Another retrospective review from 2013-2018 reported a short-term complication rate of 10.1% and long term-complication rate of 4.1%. Epidemiological factors such as older age, underweight BMI, and current tobacco use contribute to significantly higher odds of complications with peripheral nerve blocks.⁵¹

NEUROMODULATORY AGENTS

Gabapentin and pregabalin are both neuromodulatory medications that act upon voltage-gated calcium channels in the central and peripheral nervous system, slowing down the transmission of pain signals.⁸ Pregabalin, although the more expensive drug, is known to have a quicker onset and fewer side effects compared to gabapentin. A prospective study compared opioid consumption and pain levels between patients who received gabapentin and those who did not receive gabapentin after various foot and ankle surgeries. VAS-pain scores and opioid consumption was significantly reduced, and satisfaction with post-operative pain management was higher among patients who received gabapentin.⁵² McKissac et al. performed a retrospective review highlighting that patients receiving gabapentin after foot and ankle procedures consumed significantly fewer opioids than patients treated with opioids alone.⁵³ While more randomized clinical trials are needed to analyze further the effect of gabapentin on pain and opioid consumption after foot and ankle surgery, the current literature supports its potential role in multimodal analgesia strategies.

TRAMADOL

Tramadol is an analgesic medication that acts on opioid receptors while inhibiting serotonin and norepinephrine reuptake in the central nervous system. As a result of its multiple mechanisms of action, tramadol has been shown to have fewer respiratory depressant side effects and a lower probability of developing tolerance and dependence.⁵⁴ Singla et al. performed a randomized, double-blind, placebo-controlled study evaluating the impact of intravenous tramadol during bunionectomy surgeries and found that 50 mg of tramadol every 6 hours was well-tolerated and effectively minimized pain levels in the 48 hours after surgery. While some patients reported nausea after taking tramadol, there were no significant differences in complication rates or other adverse side effects between those who received tramadol on those who did not.⁵⁵ For total hip and knee arthroplasties, pre-operative tramadol use has been associated with lower postoperative complication rates and risk of prolonged opioid use.⁵⁶⁻⁵⁸ While few papers address the role of tramadol in foot and ankle surgery, a survey of 64 foot and ankle surgeons collected data on post-operative narcotic prescription practices by responding to 4 common patient scenarios. Throughout the four scenarios, surgeons chose to use tramadol as a supplement to opi-

oids 18-24% of the time, with surgeons with <5 years of experience more likely to prescribe tramadol.⁵⁹ tramadol's most common side effects include nausea, vomiting, sweating, drowsiness, and fatigue. Compared to traditional opioids, tramadol has shown a low incidence rate of constipation, respiratory depression, and tolerance/dependence.⁵⁴ Despite its lower usage rate among foot and ankle surgeons, tramadol has significant upsides compared to traditional opioids and should be further evaluated as another tool in foot and ankle post-operative pain management.

RECOMMENDATIONS

REGIONAL AND LOCAL ANESTHESIA

The potential efficacy of long-acting popliteal block use in foot and ankle surgery stems from minimizing pain in the crucial initial postoperative period, which should reduce opioid use.⁴⁷ In one study, patients undergoing outpatient foot and ankle surgery augmented with long-acting popliteal block utilized less than half (mean 22.5 pills) of the average prescribed opioid pills (55.5 pills) postoperatively.

At our institution, we utilize some form of regional anesthesia in nearly all cases to minimize postoperative pain and, thus, reduce postoperative opioid consumption. Generally, less extensive or minimally invasive procedures spanning the forefoot receive a long-acting local ankle block specifically targeting anatomically relevant nerve distributions. More proximal procedures involving the mid-foot, hindfoot, and ankle typically receive a long-acting popliteal block consisting of bupivacaine performed preoperatively by the anesthesia team. [\[Figure 1\]](#)

Suppose a patient is intolerant to conscious administration of popliteal block for any reason (ex., Pain, anxiety, intellectual disability) in the preoperative holding area. In that case, this intervention should be performed preferably preoperatively after induction of anesthesia or immediately postoperatively while the patient remains under anesthesia. In cases of total ankle replacement, patients receive a popliteal catheter to stay in place for two days. After this time, patients receive detailed instructions and a home phone call to delineate steps for home removal of the catheter.

MULTIMODAL ANESTHESIA

We recommend a multimodal analgesia strategy for all foot and ankle procedures regardless of type. Such a strategy includes the utilization of acetaminophen and NSAIDs postoperatively as medically tolerated. Specifically, we prescribe Ibuprofen 400 mg every 4-6 hours and Acetaminophen 500 mg every 4 hours after all foot and ankle procedures and encourage diligent adherence to this regimen. Despite animal studies suggesting an association between NSAID exposure and delayed bone healing or nonunion,⁶⁰ such findings in human research with short-term NSAID use have not been consistently substantiated.³⁹ Therefore, we believe the potential benefit of min-

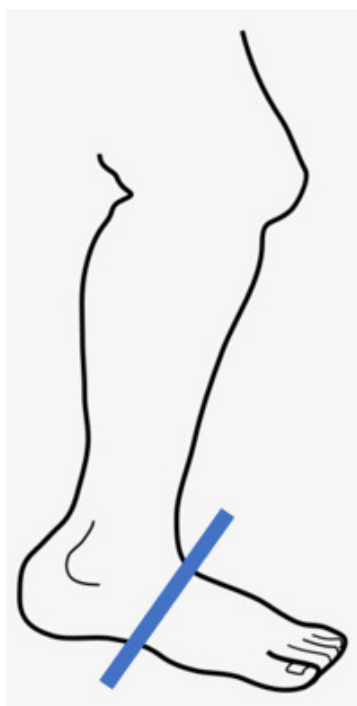


Figure 1. procedures and anatomic distribution where regional block vs. local/ankle block is performed, i.e., proximal to the blue line procedures like ORIF ankle, TAR, etc. get popliteal blocks/catheter whereas distal MICAs, HTCs get local block).

imizing postoperative opioid consumption outweighs this theoretical risk.⁶¹

Preoperative local/regional nerve blocks and catheters are also a staple of multimodal pain management, and opioids should be prescribed as a supplement to be utilized on an as-needed basis. Kvarda et al. identified variations in pain levels and opioid consumption after different foot and ankle surgeries. Specifically, they found a significant correlation between minor surgeries such as ankle arthroscopy or single hammertoe correction and soft tissue procedures such as Achilles tendon repair, tendon transfers, or ligament reconstruction, generally necessitating lower opioid consumption compared to larger, bony procedures such as hallux valgus correction, ankle fracture fixation, or total ankle replacement.¹⁸ Based on this finding, we have stratified standard foot and ankle procedures into three major “types” of surgery (Table 5), which largely dictates the prescription of opioid-based pain medications. For Minor/Soft tissue procedures, we recommend 15 pills of Tramadol 50 mg to be taken every 6 hours on an as-needed basis. For bony procedures of the forefoot, we recommend 20 pills of Oxycodone 5 mg to be taken every 4 hours as needed. For bony hindfoot procedures, we recommend 25-30 pills of Oxycodone 5 mg every 4 hours. The current literature suggests variations in mean opioid requirements between forefoot, midfoot, and hindfoot procedures (i.e., ORIF ankle vs. Ankle fusion). However, we recommend that the above prescriptions be provided initially postoperatively with the clear understanding that patients may call the office if an additional refill prescription is needed. Additionally, we

recommend non-acetaminophen-containing narcotic pain medications, allowing patients to take and receive acetaminophen on an as-needed basis without additional narcotics.

NEUROMODULATORY AGENTS

Tricyclic antidepressants (TCAs), Selective Serotonin Reuptake Inhibitors (SSRIs), Serotonin and Norepinephrine Reuptake Inhibitors (SNRIs), and Gabapentinoids are not routinely prescribed postoperatively. However, these agents can particularly effectively manage nerve-related surgeries or pain.⁶² Common agents utilized in our practice are pregabalin, gabapentin, and amitriptyline. However, it should be emphasized that these medications’ side effects can include drowsiness, headache, dizziness, and serotonin syndrome for TCAs, SSRIs, and SNRIs taken in conjunction or in addition to other serotonergic agents, including Tramadol.

CONCLUSIONS

Foot and ankle surgeons, through responsible opioid stewardship, have the potential to bring about positive transformations in combating the US opioid epidemic. Optimal pain management after foot and ankle surgery requires appropriate opioid dosing and implementing postoperative multimodal analgesic strategies, including locoregional analgesia techniques. The guidelines present comprehensive, evidence-based, and user-friendly recommendations for analgesic regimens and opioid dosages specific to standard foot and ankle surgical procedures.

DECLARATION OF CONFLICT OF INTEREST

The authors do not have any potential conflicts of interest in the information and production of this manuscript.

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DECLARATION OF ETHICAL APPROVAL FOR STUDY

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DECLARATION OF INFORMED CONSENT

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TABLE 5. SUMMARY OF ANALGESIA RECOMMENDATIONS

Surgery Type	Representative Procedures	Recommended Perioperative Management
Minor/Soft tissue Surgeries of the Foot and Ankle	Neuroma Excision Peroneal tendon transfer Achilles repair Modified Brostrom Ankle Arthroscopy	Naproxen 500 mg BID, dispense #20 Acetaminophen 500 mg q4, dispense #60 Tramadol 50 mg q6 PRN, dispense #15
Bony Procedures of the Forefoot	Hallux valgus correction/ MICA 1 st Metatarsophalangeal fusion Hammertoe Correction	Local ankle block Naproxen 500 mg BID, dispense #20 Acetaminophen 500 mg q4, dispense #60 Oxycodone 5 mg q4-6 PRN, dispense #20
Bony procedures of the midfoot, hindfoot, and ankle	Tarsometatarsal fusion Hindfoot Fusion Calcaneal osteotomy Total Ankle Replacement ORIF Calcaneus/Ankle Fracture	Popliteal Nerve Block +/- Catheter Naproxen 500 mg BID, dispense #20 Acetaminophen 500 mg q4, dispense #60 Oxycodone 5 mg q4-6 PRN, dispense #30



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