

General

Efficacy of Weight-Based Low-Dose Intravenous Dexamethasone for Pain Management Following Total Knee Arthroplasty: A Retrospective Case-Matched Study.

Varah Yuenyongviwat, M.D.¹, Peranut Kitjakrancharoensin, M.D.¹, Chirathit Anusitviwat, M.D.¹, Khanin Iamthanaporn, M.D.^{1a}

¹ Department of Orthopedics, Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand

Keywords: Total Knee Arthroplasty, Dexamethasone, Pain Management, Opioid Reduction, Postoperative Pain

<https://doi.org/10.52965/001c.143092>

Orthopedic Reviews

Vol. 17, 2025

Background

Effective management of postoperative pain is essential for promoting recovery and improving overall patient outcomes after total knee arthroplasty (TKA). Intravenous corticosteroids, especially dexamethasone, have become increasingly popular due to their strong anti-inflammatory effects, which can enhance pain control while minimizing side effects. However, the optimal dosing strategy for dexamethasone remains unclear, as most studies have primarily focused on fixed high doses.

Objective

This retrospective case-matched study aimed to evaluate the effectiveness of weight-based low-dose intravenous dexamethasone (0.1 mg/kg) in managing postoperative pain following TKA.

Methods

Patients who underwent unilateral TKA for primary osteoarthritis were retrospectively analyzed and divided into two cohorts based on the timing of their surgery. The control group, consisting of patients who underwent TKA between March 2019 and November 2020, did not receive dexamethasone. In contrast, patients operated on between December 2020 and May 2022 received a preoperative weight-based dose of 0.1 mg/kg intravenous dexamethasone. Postoperative pain was assessed using the Verbal Numerical Rating Scale (VNRS), and fentanyl consumption was recorded over the first 72 hours postoperatively.

Results

The dexamethasone group demonstrated significantly lower pain scores at all measured intervals up to 60 hours postoperatively ($p < 0.05$) compared to the control group. Additionally, patients receiving dexamethasone required significantly less fentanyl in the first 24 hours and had lower cumulative fentanyl consumption over the entire 72-hour postoperative period ($p < 0.001$). There were no significant differences between the two groups in terms of hospital stay, deep infection rates, or other complications.

Conclusion

Weight-based low-dose dexamethasone (0.1 mg/kg) appears to be an effective strategy for reducing postoperative pain and opioid use following TKA.

INTRODUCTION

Effective pain management after total knee arthroplasty (TKA) is critical, as it significantly influences patient recovery, clinical outcomes, and overall satisfaction with the procedure.¹ Poorly controlled postoperative pain can hinder rehabilitation, prolong hospital stays, and ultimately affect the success of the surgery.² Various approaches, including preoperative, intraoperative, and postoperative interventions, have been explored to optimize pain relief and facilitate recovery.³

Postoperative pain is often driven by the inflammatory response to surgical trauma. Traditionally, nonsteroidal anti-inflammatory drugs (NSAIDs) have been the cornerstone in managing this inflammation-induced pain.⁴ However, the use of corticosteroids has gained popularity in recent years due to their potent anti-inflammatory effects and ability to reduce pain more effectively in certain contexts.⁵ Corticosteroids can be administered in various forms, including periarticular injections, intravenous infusions, or oral formulations, providing flexibility in pain management strategies tailored to individual needs.^{6,7}

Intravenous corticosteroids have become a preferred option for managing postoperative pain following TKA. The intravenous route offers advantages including ease of administration, lower costs, and a reduced risk of local wound complications compared to periarticular injections.⁸ Among corticosteroids, dexamethasone is preferred for its potent anti-inflammatory properties and prolonged duration of action.⁹ While most studies on intravenous dexamethasone report favorable outcomes, there is still no consensus on the optimal dose and timing of administration. Many trials use a fixed dose ranging from 10 to 25 mg,¹⁰⁻¹² but our institution employs a weight-based protocol that adjusts dosing according to the patient's body weight.

To address these variations in dosing protocols, we conducted this study to assess the effectiveness of a single intravenous dexamethasone regimen, using a weight-based low dose, in managing postoperative pain following TKA. We compared the outcomes of patients who received this intervention with those who did not.

MATERIALS AND METHODS

This retrospective analysis examined data from patients who underwent TKA at the University Hospital between March 2019 and May 2022. The data were retrieved from the hospital's medical records by the Digital Innovation and Data Analytics Department (DIDA) and systematically recorded using a standardized case record form for analysis. The study received approval from the local Ethics Committee and Institutional Review Board, which waived the need for individual patient consent.

This study included patients who underwent unilateral TKA for primary osteoarthritis, performed by a single surgeon using a conventional surgical technique. All patients received the same anesthetic protocol, including a spinal block and an adductor canal block. In cases where patients underwent bilateral TKA on separate occasions, each pro-

cedure was treated as a distinct case. Eligible participants were between 50 and 80 years of age, with a diagnosis of primary osteoarthritis classified as grade III or IV according to the Kellgren–Lawrence classification. Exclusion criteria included incomplete medical records, a history of prior surgery on the knee being studied, the use of steroids other than intravenous dexamethasone, or administration of NSAIDs outside the established postoperative protocol.

In our practice, intravenous dexamethasone was introduced as a standard treatment starting in December 2020. Consequently, we designated patients who underwent TKA before this date, from March 2019 to November 2020, as the control group, as they did not receive dexamethasone. Patients who had TKA from December 2020 to May 2022, when dexamethasone was routinely administered, were classified as the experimental group. Patients in the experimental group received a preoperative dose of dexamethasone at a dosage of 0.1 mg/kg immediately after spinal anesthesia.

Data collection encompassed both preoperative and postoperative patient information. Preoperative data included demographics such as gender, age, comorbidities, body mass index (BMI), preoperative hemoglobin and hematocrit levels, operative side, platelet count, and the American Society of Anesthesiologists (ASA) classification. Postoperative data included operative time, postoperative hematocrit levels, transfusion rates, pain scores at rest (measured using the Verbal Numerical Rating Scale: VNRS), opioid consumption, time to the first dose of analgesia, and complications such as superficial infections, deep vein thrombosis, pulmonary embolism, and reoperations. All data were recorded in a standardized case record form and subsequently analyzed.

All TKA procedures were performed by the same surgeon using a standardized technique.

Every case involved the use of a pneumatic tourniquet. The medial parapatellar approach was consistently used. The surgeon made the distal femoral cut with an intramedullary guide and the proximal tibial cut with an extramedullary guide. In all procedures, a cemented posterior stabilized knee prosthesis was employed. A periarticular anesthetic cocktail was injected in every case, consisting of a mixed solution of 20 mL of 0.5% bupivacaine and 0.3 mg of adrenaline diluted in saline to a total volume of 100 mL.

All patients followed a consistent postoperative pain control protocol, care, and rehabilitation plan. They were given oral celecoxib 200 mg twice daily and paracetamol 500 mg every 4 hours. For pain management, fentanyl was used exclusively as a rescue medication, administered at 1 micrograms per kilogram of body weight intravenously every 3 hours as needed. Postoperative patient-controlled analgesia was not used.

Rehabilitation began immediately with ankle pumping and quadriceps isometric exercises. Patients were encouraged to walk with a supportive device, and range of motion exercises started the day after surgery. To prevent venous thromboembolism, patients received aspirin 81 mg, two tablets daily. If a patient was allergic to aspirin, rivaroxaban 10 mg was used instead.

Table 1. Demographic data

Characteristic	Control group N = 33	Dexamethasone group N = 34	p value
Sex (male:female)	1:32	5:29	0.093
Age (years)	67.77 ± 6.89*	68.93 ± 6.98*	0.494
Side (left:right)	15:18	14:20	0.724
BMI (kg/m ²)	26.71 (2.97) [†]	27.78 (4.38) [†]	0.246
ASA classification (II:III)	30/3	28/6	0.305
Preop hemoglobin (g/dL)	12.93 ± 1.05*	13.15 ± 1.12*	0.41
Preop hematocrit (%)	39.68 ± 3.46*	40.78 ± 3.12*	0.177
Platelet count (x10 ³ /μL)	286.79 ± 90.88*	260.94 ± 60.94*	0.180
Diabetes (%)	6 (18%)	3 (9%)	0.261
Total operative time	156.36 ± 18.17*	163.82 ± 24.22*	0.16

* Values are expressed as mean ± SD

[†] Values are expressed as median (interquartile range)

The Verbal Numerical Rating Scale (VNRS, 0-10) was collected according to the standard protocol by nurses every 8 hours. The fentanyl consumption data were collected from the hospital information system, including dose and time of administration.

STATISTICAL ANALYSES

Characteristics and outcomes between the control group and the dexamethasone group were analyzed using R, version 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria). A p-value of ≤ 0.05 was considered statistically significant. Continuous variables such as age, preoperative hemoglobin, hematocrit, and platelet count were compared using an independent t-test. Categorical variables, including sex, side, American Society of Anesthesiologists (ASA) classification, and the presence of diabetes, were analyzed using the chi-square test. Non-normally distributed continuous variables, including BMI, post-operative pain scores, fentanyl consumption, and hospital stay, were analyzed using the Mann-Whitney U test.

RESULT

A total of 67 patients who met the study criteria were included in the study, with 33 patients in the control group and 34 patients receiving dexamethasone. The demographic characteristics of both groups are summarized in [Table 1](#). There were no significant differences between the control group and the dexamethasone group in terms of sex distribution, age, side preference, BMI, ASA classification, total operative time, preoperative hemoglobin, hematocrit, or platelet count. Additionally, the prevalence of diabetes did not show significant differences between the groups.

Post-operative pain scores indicated significantly lower pain levels in the dexamethasone group compared to the control group at multiple time points: 8 hours, 16 hours, 24 hours, 36 hours, 48 hours, and 60 hours post-operatively. Detailed results and statistical analyses are presented in [Table 2](#).

Post-operative opioid consumption, measured by cumulative fentanyl dosage, is summarized in [Table 3](#). The dexamethasone group demonstrated significantly lower fen-

tanyl consumption compared to the control group at various time intervals, particularly within the first 24 hours post-operatively (0-12 hours and 12-24 hours). The cumulative fentanyl consumption over the entire 72-hour period was also significantly lower in the dexamethasone group. However, no significant differences were observed between the two groups during the 24-48 and 48-72-hour intervals. The linear mixed-effects model found a significant main effect of treatment group, with the dexamethasone group showing significantly lower VNRS and fentanyl consumption compared to the control group ($p < 0.01$).

The median hospital stay was 3.4 days (IQR 0.37) in the control group and 3.39 days (IQR 0.98) in the dexamethasone group, with no statistically significant difference between the two groups ($p = 0.25$). One patient in the dexamethasone group developed a superficial infection, which was successfully treated with a one-week course of oral antibiotics, with no recurrence or further complications noted after two years of follow-up. No cases of venous thromboembolism, pulmonary embolism, or reoperation were observed in either group.

DISCUSSION

Effective pain management after TKA is essential for optimizing recovery and patient satisfaction.¹³ While NSAIDs have traditionally been used, corticosteroids like intravenous dexamethasone are gaining favor due to their potent anti-inflammatory effects and low risk of complications.¹⁴ Despite most studies focusing on higher doses, our institution utilizes a weight-based, low-dose protocol. This study found that patients receiving low-dose dexamethasone had significantly lower pain scores and reduced opioid consumption compared to those not receiving it, supporting the use of low-dose dexamethasone in TKA pain management.

Our study demonstrates that low-dose dexamethasone (0.1 mg/kg) effectively reduces post-operative pain following TKA, consistent with various other studies that have explored a range of doses. For instance, Nielsen et al. found that higher doses of dexamethasone (1 mg/kg) and intermediate doses (0.3 mg/kg) were both effective in reducing moderate-to-severe pain at 24 hours post-operatively, as

Table 2. Post-operative pain (Verbal numerical score)

Post-operative time (hours)	Control group N = 33		Dexamethasone group N = 34		Mean difference	p value*
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)		
8	3 (2)	3.33 (1.61)	1.5 (3)	1.79 (1.97)	1.54	0.001
16	3 (2)	2.27 (1.49)	0 (3)	1.47 (1.83)	0.80	0.023
24	3 (2)	2.61 (1.75)	0 (2)	0.76 (1.30)	1.85	<0.001
36	2 (3)	1.67 (1.38)	0 (2)	0.79 (1.47)	0.88	0.004
48	2 (3)	2.00 (1.44)	0 (2)	0.74 (1.26)	1.26	<0.001
60	2 (3)	1.39 (1.27)	0 (0)	0.32 (0.81)	1.07	<0.001

IQR; interquartile range, SD; standard deviation

* Mann-Whitney U test

Table 3. Fentanyl consumption (microgram)

Post-operative time (hours)	Control group N = 33		Dexamethasone group N = 34		p value*
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	
0 - 12 h	160 (40)	151.82 (36.001)	80 (72.5)	86.77 (57.93)	< 0.001
12 - 24 h	120 (75)	110.00 (51.05)	40 (80)	48.53 (43.00)	< 0.001
24 - 48 h	30 (55)	47.27 (73.11)	0 (40)	31.77 (58.95)	0.22
48 - 72 h	0	6.06 (28.49)	0	0	0.148
Total cumulative dose (microgram)	300 (120)	321.21 (144.54)	140 (150)	167.06 (115.72)	< 0.001

IQR; interquartile range, SD; standard deviation

* Mann-Whitney U test

well as pain during leg raises at 24 and 48 hours.¹⁵ Similarly, Saini et al. observed that intravenous dexamethasone (8 mg) significantly lowered pain scores and reduced nausea, especially when administered as a single dose.¹⁶ Furthermore, Tammachote et al. reported that a slightly higher dose of 0.15 mg/kg reduced pain both at rest and during movement across various time points up to 21 hours post-surgery.⁸ These findings, along with our own, support the notion that low-dose dexamethasone can provide effective early pain relief following TKA. However, further studies are required to evaluate the long-term pain control and overall recovery outcomes.

Regarding postoperative opioid consumption, our study demonstrated that low-dose dexamethasone (0.1 mg/kg) was associated with a reduction in opioid use following TKA. This finding is consistent with the results of Gasbjerg et al., which showed that administering two doses of dexamethasone (24 mg each) significantly reduced morphine consumption within the first 48 hours postoperatively compared to a placebo, with a reduction of approximately 10.7 mg.¹² Similarly, Koh et al. found that preemptive low-dose dexamethasone (10 mg) in combination with ramosetron decreased both postoperative pain and opioid consumption during the 6- to 24-hour period after surgery.¹⁷ Both studies highlight the opioid-sparing effect of dexamethasone, although Koh et al. observed that the primary benefit was within the first 24 hours postoperatively. On the other hand, Tammachote et al. reported lower pain levels with dexamethasone (0.15 mg/kg) but did not observe a signif-

icant reduction in morphine consumption compared to a placebo.⁸ These findings suggest that while dexamethasone consistently demonstrates pain-relieving and opioid-sparing effects in the immediate postoperative period, its impact on overall opioid consumption may vary depending on the dosage and multimodal analgesic protocols used.

In our study, no patients developed a deep infection requiring reoperation. This result is consistent with other studies evaluating the safety of perioperative dexamethasone in total joint arthroplasty. For instance, Godshaw et al. studied 2317 patients undergoing total hip or knee arthroplasty and found no significant increase in prosthetic joint infection rates with the use of dexamethasone, even in diabetic patients who are typically at higher risk for infections.¹⁸ Similarly, Vuorinen et al., in their analysis of 18,872 arthroplasty surgeries, reported no significant difference in PJI incidence between patients who received dexamethasone and those who did not (1.1% vs. 1.0%).¹⁹ Additionally, Xu et al. investigated the impact of multiple doses of dexamethasone in a cohort of 425 TKA patients, reporting no increase in the incidence of surgical site infections or periprosthetic joint infections.²⁰ In their study, dexamethasone was given both preoperatively and postoperatively, underscoring its effectiveness in managing postoperative pain and inflammation without compromising infection control. These results further validate the safety of dexamethasone use in TKA, even with repeated dosing.

This study has some limitations. First, while our retrospective design is less effective at controlling bias com-

pared to a randomized controlled trial, we attempted to minimize this issue by employing a standardized postoperative treatment protocol. As a result, the main distinction between the groups was whether or not they received dexamethasone. Second, although our sample size was adequate to identify significant differences in pain and opioid consumption, it may not have been sufficient to detect less common complications. Third, our focus was primarily on short-term in-hospital outcomes, and we did not evaluate long-term pain or functional status, which could offer a more comprehensive view of the intervention's effects. Future well-controlled studies that address these limitations could yield more robust data to further support our findings and enhance our understanding of postoperative pain management strategies.

CONCLUSION

In conclusion, our study demonstrates that administering weight-based low-dose dexamethasone (0.1 mg/kg) effectively reduces postoperative pain and opioid consumption following TKA, without increasing the risk of deep infections or other significant complications. These results support the safe integration of low-dose dexamethasone into postoperative pain management protocols to enhance patient recovery and satisfaction. However, further research is warranted to refine dosing strategies and to assess the long-term benefits and safety of dexamethasone use in this population.

LIST OF ABBREVIATIONS

total knee replacement (TKA); nonsteroidal anti-inflammatory drugs (NSAIDs); body mass index (BMI); American Society of Anesthesiologists (ASA)

.....

ACKNOWLEDGEMENTS

The authors wish to thank Division of Digital Innovation and Data Analytics (DIDA) Faculty of Medicine, Prince of Songkla University for the assistance in collecting the data of this report.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee and Institutional Review Board of the Faculty of Medicine, Prince of Songkla University. Consent to participate: Not applicable

CONSENT FOR PUBLICATION

Not Applicable

AVAILABILITY OF DATA AND MATERIALS

The datasets generated during this current study are available from the corresponding author upon reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

Funding for this research was provided by the Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand. The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

Submitted: April 28, 2025 EST. Accepted: June 27, 2025 EST.

Published: August 20, 2025 EST.

REFERENCES

1. Minaei R, Salehpour M, Kouhestani E, et al. A Randomized Double-Blind Prospective Study Comparing the Efficacy of Subperiosteal and Periarticular Injections of a Local Anesthetic for Postoperative Pain Management after Total Knee Arthroplasty. *Arch Bone Jt Surg*. 2023;11:704-710.
2. Zhou Y, Chen X, Chen C, et al. The efficacy and safety of duloxetine for the treatment of patients after TKA or THA: A systematic review and meta-analysis. *Medicine (Baltimore)*. 2023;102:e34895. doi:[10.1097/MD.00000000000034895](https://doi.org/10.1097/MD.00000000000034895). PMID:37653762
3. YaDeau JT, Cushner FD, Westrich G, et al. What Is the Role of a Periarticular Injection for Knee Arthroplasty Patients Receiving a Multimodal Analgesia Regimen Incorporating Adductor Canal and Infiltration Between the Popliteal Artery and Capsule of the Knee Blocks? A Randomized Blinded Placebo-Controlled Noninferiority Trial. *Anesth Analg*. Published online January 8, 2024. doi:[10.1213/ANE.0000000000006805](https://doi.org/10.1213/ANE.0000000000006805)
4. Iamthanaporn K, Rojjanasirisawat N, Yuenyongviwat V. Superior analgesic efficacy of preemptive low-dose ketorolac compared with parecoxib after total knee arthroplasty: A retrospective propensity score matching study. *J Orthop Surg Hong Kong*. 2024;32:10225536231225758. doi:[10.1177/10225536231225758](https://doi.org/10.1177/10225536231225758)
5. Ebihara T, Hamada T, Nakamura K, et al. Efficacy of Corticosteroid Addition to a Periarticular Cocktail Injection to Counteract Nausea and Vomiting After Total Knee Arthroplasty. *Cureus*. 2023;15:e33874. doi:[10.7759/cureus.33874](https://doi.org/10.7759/cureus.33874). PMID:36819319
6. Wu L, Si H, Li M, et al. The optimal dosage, route and timing of glucocorticoids administration for improving knee function, pain and inflammation in primary total knee arthroplasty: A systematic review and network meta-analysis of 34 randomized trials. *Int J Surg Lond Engl*. 2020;82:182-191. doi:[10.1016/j.ijsu.2020.07.065](https://doi.org/10.1016/j.ijsu.2020.07.065)
7. Hatayama K, Terauchi M, Oshima A, et al. Comparison of Intravenous and Periarticular Administration of Corticosteroids in Total Knee Arthroplasty: A Prospective, Randomized Controlled Study. *J Bone Joint Surg Am*. 2021;103:319-325. doi:[10.2106/JBJS.20.01153](https://doi.org/10.2106/JBJS.20.01153)
8. Tammachote N, Kanitnate S. Intravenous Dexamethasone Injection Reduces Pain From 12 to 21 Hours After Total Knee Arthroplasty: A Double-Blind, Randomized, Placebo-Controlled Trial. *J Arthroplasty*. 2020;35:394-400. doi:[10.1016/j.arth.2019.09.002](https://doi.org/10.1016/j.arth.2019.09.002)
9. Derby CB, Gasbjerg KS, Hägi-Pedersen D, et al. Prolonged effects of dexamethasone following total knee arthroplasty: A pre-planned sub-study of the DEX-2-TKA trial. *Acta Anaesthesiol Scand*. 2024;68:35-42. doi:[10.1111/aas.14319](https://doi.org/10.1111/aas.14319)
10. Li Q, Fang G, Liao W, et al. Intraoperative intravenous versus periarticular injection of glucocorticoids in improving clinical outcomes after total knee arthroplasty: A prospective, randomized and controlled study. *J Orthop Surg Hong Kong*. 2024;32:10225536241256554. doi:[10.1177/10225536241256554](https://doi.org/10.1177/10225536241256554)
11. Liu XY, Mou P, Cao J, et al. Effects of Dexamethasone on Postoperative Glycemic Control in Patients After Primary Total Joint Arthroplasty: A Randomized Double-Blind Controlled Trial. *J Arthroplasty*. 2024;39:2213-2220. doi:[10.1016/j.arth.2024.04.030](https://doi.org/10.1016/j.arth.2024.04.030)
12. Gasbjerg KS, Lunn TH, Hägi-Pedersen D, et al. Associations of dexamethasone's effect on morphine consumption after total knee arthroplasty-Subgroup analyses. *Acta Anaesthesiol Scand*. 2024;68:546-555. doi:[10.1111/aas.14377](https://doi.org/10.1111/aas.14377)
13. Pinsornsak P, Sukkarnkosol S, Boontanapibul K. Does Nefopam Provide Analgesic Effect and Reduce Morphine Consumption After Primary Total Knee Arthroplasty? A Prospective, Double-Blind, Randomized Controlled Trial. *J Arthroplasty*. 2022;37:845-850. doi:[10.1016/j.arth.2022.01.079](https://doi.org/10.1016/j.arth.2022.01.079)
14. Liang S, Xing M, Jiang S, et al. Effect of Intravenous Dexamethasone on Postoperative Pain in Patients Undergoing Total Knee Arthroplasty: A Systematic Review and Meta-Analysis. *Pain Physician*. 2022;25:E169-E183.
15. Nielsen NI, Kehlet H, Gromov K, et al. High-dose steroids in high pain responders undergoing total knee arthroplasty: a randomised double-blind trial. *Br J Anaesth*. 2022;128:150-158. doi:[10.1016/j.bja.2021.10.001](https://doi.org/10.1016/j.bja.2021.10.001). PMID:34749994
16. Saini MK, Reddy NR, Reddy PJ, et al. The application of low-dose dexamethasone in total knee arthroplasty: finding out the best route and dosage schedule. *Arch Orthop Trauma Surg*. 2023;143:1005-1012. doi:[10.1007/s00402-022-04356-x](https://doi.org/10.1007/s00402-022-04356-x)

17. Koh IJ, Chang CB, Lee JH, et al. Preemptive low-dose dexamethasone reduces postoperative emesis and pain after TKA: a randomized controlled study. *Clin Orthop*. 2013;471:3010-3020. doi:[10.1007/s11999-013-3032-5](https://doi.org/10.1007/s11999-013-3032-5). PMID:23645340
18. Godshaw BM, Mehl AE, Shaffer JG, et al. The Effects of Peri-Operative Dexamethasone on Patients Undergoing Total Hip or Knee Arthroplasty: Is It Safe for Diabetics? *J Arthroplasty*. 2019;34:645-649.
19. Vuorinen MA, Palanne RA, Mäkinen TJ, et al. Infection safety of dexamethasone in total hip and total knee arthroplasty: a study of eighteen thousand, eight hundred and seventy two operations. *Int Orthop*. 2019;43:1787-1792. doi:[10.1007/s00264-018-4156-8](https://doi.org/10.1007/s00264-018-4156-8)
20. Xu H, Zhang S, Xie J, et al. Multiple Doses of Perioperative Dexamethasone Further Improve Clinical Outcomes After Total Knee Arthroplasty: A Prospective, Randomized, Controlled Study. *J Arthroplasty*. 2018;33:3448-3454. doi:[10.1016/j.arth.2018.06.031](https://doi.org/10.1016/j.arth.2018.06.031)