Arthroplasty Today 17 (2022) 159–164

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original Research

Same-Day Discharge Following Aseptic Revision and Conversion Total Joint Arthroplasty: A Single-Institution Experience

Christopher F. Deans, MD [a], Leonard T. Buller, MD [a, b], Mary Ziemba-Davis, BA [b], R. Michael Meneghini, MD [a, b, *]

[a] Indiana University School of Medicine, Department of Orthopaedic Surgery, Indianapolis, IN, USA
[b] Indiana University Health Hip & Knee Center, Saxony Hospital, Fishers, IN, USA

ARTICLE INFO

Article history:
Received 12 May 2022
Received in revised form
21 June 2022
Accepted 21 July 2022
Available online xxx

Keywords:
Revision total joint arthroplasty
Revision total hip arthroplasty
Revision total knee arthroplasty
Outpatient arthroplasty
Same-day discharge

ABSTRACT

Background: With hospital inpatient capacity increasingly limited and primary total joint arthroplasty (TJA) rapidly transitioning to outpatient settings, the feasibility of outpatient aseptic revision and conversion TJA (rTJA) has been considered. Before the widespread adoption of outpatient rTJA, guidelines must be established to prevent patient harm. To this end, this study describes our initial experience with same-day-discharge (SDD) aseptic rTJA.

Methods: All aseptic rTJAs performed between May 8, 2015, and December 30, 2021, were retrospectively reviewed. Revision indications, patient selection criteria, and outcomes including SDD success rate, predischarge complications, all-cause emergency department visits, inpatient readmissions, and unplanned clinic encounters within 90 days of surgery were recorded.

Results: Thirty-five SDD aseptic rTJAs were performed. Conversion total hip arthroplasty (55.0%) and instability (27.3%) were the most common indications for hip revision. Instability (50%) and conversion total knee arthroplasty (20.8%) were most common for knee revision. SDD was achieved in 97% (34/35) of cases. One hip patient failed SDD due to persistent hypoxia requiring an overnight hospital stay and also underwent closed reduction for dislocation in the emergency department within 90 days of discharge. Two additional patients had unplanned clinic encounters within 90 days of the index procedure. There were no hospital readmissions or reoperations within 90 days.

Conclusions: Our initial experience suggests SDD aseptic rTJA can be safe and effective when modern perioperative outpatient protocols and surgical techniques are implemented. Future studies should further define patient selection criteria to optimize outcomes and minimize complications in this population.

Introduction

The pandemic caused by the severe acute respiratory syndrome coronavirus 2 virus presented unprecedented challenges to elective total joint arthroplasty (TJA) services. At the height of the pandemic, elective surgeries came to a halt in the United States. It was estimated that 7501-30,002 primary TJAs and 717-2870 revision TJAs were canceled each week in the United States during shutdowns [1] with significant patient access and financial consequences [1–3] The impact of delaying surgery cannot be understated. Consequences include the progression of pain and decrease of function, increased anti-inflammatory and pain medication use, and deteriorating mental health, [3–9] as well as further bone loss and osteolysis or recurrent instability leading to soft-tissue damage. Consequently, increasing safe and effective outpatient TJA has been recommended to minimize inpatient hospital burden while appropriately caring for patients in a timely manner [10].

Outpatient primary TJA has been adopted at a growing number of ambulatory surgical centers (ASCs) and hospital systems in the United States. Studies have demonstrated that with appropriate risk stratification and patient selection, and modern arthroplasty care pathways and perioperative protocols, outpatient primary TJA

* Corresponding author. Indiana University Health, Department of Orthopaedic Surgery, 13100 East 136th Street, Suite 2000, Fishers, IN 46037, USA. Tel.: +1 317 688 5980.
E-mail address: rm_meneghini@yahoo.com

https://doi.org/10.1016/j.artd.2022.07.022

has outcomes equivalent or superior to inpatient primary TJA [11–20] More recently, early discharge following aseptic revision TJA has been investigated; however, only a few studies have been published to date, [21–24] with only 2 studies focused specifically on same-day discharge (SDD) [21,22]. As the trend toward outpatient primary and aseptic revision TJA accelerates, futher investigation is required to identify patient selection criteria and best perioperative practices to ensure patient safety. This study reports our experience with aseptic conversions and revisions (rTJAs) performed as SDD surgeries including indications, patient selection criteria, and outcomes.

Material and methods

Study sample

All unilateral aseptic rTJAs performed by a single surgeon as procedures with same calendar day discharge between May 8, 2015, (when our first SDD rTJA was performed) and December 30, 2021, in an academic tertiary care hospital were retrospectively reviewed using the total joint registry approved by our institutional review board. No cases were excluded.

SDD eligibility

Patients were eligible for SDD rTJA if the following criteria were met: revision for aseptic diagnosis, no history of urinary retention, medical comorbidities under appropriate control, confirmed care support at home with a designated caregiver attending preoperative education classes with the patient, medical clearance by an internal medicine (IM) specialist utilizing a validated outpatient risk stratification tool, [17,25] and patient willingness for SDD surgery after extensive clinic discussion. Final decisions regarding offered SDD were made by the patient. Surgery location (either the ASC or hospital) was a joint decision by the care team and patient based upon safety and insurance coverage.

Patient care protocols

All patients underwent risk assessment and medical clearance within 4 weeks of surgery by an IM specialist whose practice focuses exclusively on total hip (THA) and knee (TKA) arthroplasty. Upcoming surgeries were discussed during a routine coordinated care conference attended by the multidisciplinary care team to share information and proactively develop patient care plans. Preoperatively, patients and family members received comprehensive clinic-based education and attended a hospital-based joint replacement class. The same modern perioperative pain control, clinical, and rehabilitation protocols were used for all patients. SDD postoperative criteria included spontaneous voiding of at least 200 ml of urine with less than 400 ml of residual urine on bladder scan, tolerating a meal without nausea or vomiting, adequate pain control on oral medications, ability to ambulate at least 100 feet with an assistive device and, if applicable, appropriate stair use, verbalizing and demonstrating hip precautions, independently accomplishing necessary activities of daily living such as dressing, surgeon and IM clearance, and receiving a dose of postoperative prophylactic intravenous antibiotics.

Perioperative and postoperative pain control and anesthesia protocols

A multimodal pain protocol was used for all cases. Unless contraindicated, patients received acetaminophen (1000 mg per os [PO]) 24 hours before surgery and oxycodone (10-20 mg PO), celecoxib (200 mg PO), and pregabalin (75 mg PO) immediately before surgery. Intraoperatively, surgeries were performed with standardized light general anesthesia and a single-shot intrathecal injection of low-dose bupivacaine or mepivacaine with low-dose fentanyl. Beginning on June 1, 2016, patients were allowed to drink clear liquids up to 2 hours before surgery. Postoperatively, patients were permitted to drink freely. Patient-specific, goal-directed fluid therapy called for perioperative administration of approximately 2000 mL of crystalloid sodium lactate or normal saline in the presence of significant renal disease. In knees, a periarticular injection of 0.2% (200 mg) ropivacaine, 0.5 mg of epinephrine, 80 mcg clonidine, and 30 mcg ketorolac (removed for patients with renal insufficiency) forming a total volume of 101.3 mL was administered immediately following the final implant fixation. Postoperatively, unless contraindicated, patients received acetaminophen (1000 mg PO 3 times a day), OxyContin (Purdue Pharma, Stamford, CT; 10-20 mg PO q12 hours), celecoxib (200 mg PO twice a day), and/or oxycodone (5-10 mg every 4 hours pro re nata) for mild pain and 10-20 mg every 4 hours pro re nata for moderate pain. Intravenous tranexamic acid (1 g prior to incision followed by 1 g 2 hours later) was standardly used. Thromboprophylaxis was with 81 mg of enteric-coated aspirin twice daily for 6 weeks along with sequential compression devices during postoperative recovery [26]. Patients at higher risk of thromboembolism were treated with additional chemoprophylaxis per IM recommendation.

Measures and data analysis

All study data were prospectively documented in the electronic medical record, extracted by medical chart review, and verified for accuracy. Study data included patient sex, age in years, body mass index (BMI) in kg/m^2, American Society of Anesthesiologist's Physical Status classification (ASA-PS), comorbidities (yes vs no for diabetes mellitus, chronic kidney disease, obstructive sleep apnea, coronary artery disease, psychological/psychiatric diagnosis, history of coronavirus infection), procedure type (revision THA [rTHA], revision TKA [rTKA]), clinical indication(s) for revision surgery, surgery location (ASC, hospital), procedure start to procedure stop (incision to close) for calculation of procedure duration in minutes, components revised, complications before discharge, and discharge time for calculation of hours of stay (defined as time in hours between surgery stop and discharge). All entries in the medical record were reviewed for unplanned clinic visits, emergency department (ED) visits, inpatient readmissions, and reoperations within 90 days of the index surgery. Minitab 19.1.1 (Minitab Inc., State College, PA) was used for descriptive data analysis.

Results

Thirty-five SDD unilateral aseptic rTJAs were analyzed. During the same time, 474 unilateral aseptic rTJAs were performed as inpatient procedures, with 69.6% discharged the day after surgery, 17.8% discharged on postoperative day (POD) 2, and 12.6% discharged on or after POD 3.

Eleven aseptic rTHAs (31.4%) and 24 aseptic rTKAs (68.6%) were performed. Most patients were female (63.6% of rTHAs and 66.7% of rTKAs). The average age was 45.5 ± 15.2 (range: 18-66) years and 63.31 ± 8.6 (range: 43-78) years for rTHA and rTKA patients, respectively. The average BMI was 27.8 ± 6.2 (range: 21-42) kg/m^2 and 32.4 ± 7.2 (range: 24-57) kg/m^2, respectively. None of the patients were classified as ASA-PS 4; 54.5% of rTHA patients and 54.2% of rTKA patients were classified as ASA-PS 1 or 2. The prevalence of specific patient comorbidities is presented in Table 1. The most prevalent comorbidities in rTHA patients were coronary artery

Table 1
Patient comorbidities by joint.

Comorbidity	rTHA	rTKA
Diabetes, % (n)	18.2 (2)	25.0 (6)
Chronic kidney disease, % (n)	0.0 (0)	12.5 (3)
Obstructive sleep apnea, % (n)	0.0 (0)	25.0 (6)
Coronary artery disease, % (n)	27.3 (3)	8.3 (2)
Psychological/psychiatric diagnosis, % (n)[a]	27.3 (3)	20.8 (5)
History of coronavirus infection, % (n)	0.0 (0)	8.3 (2)

[a] All anxiety and/or depression with good control of symptoms.

disease (27.3%) and anxiety/depression (27.3%). For rTKA patients, these were diabetes (25%) and obstructive sleep apnea (25%).

Indications for revisions are shown Figure 1. Fifty-five percent (n = 6) of rTHA procedures were conversions to TJAs (1 failed resurfacing arthroplasty and 5 diseased hips with existing hardware), 27.3% (n = 3) were for instability, and 9.1% each were performed for failure of a constrained liner (n = 1) and adverse local tissue reaction (n = 1). Fifty percent (n = 12) of rTKA procedures were performed for instability, 20.8% (n = 5) were conversions to TJA (3 failed unicompartmental knee arthroplasties, 1 failed patella resurfacing, and 1 diseased knee with existing hardware), 16.7% (n = 4) were performed for component loosening, and 12.5% (n = 3) were performed for bearing wear. The components revised are summarized in Table 2. The index revision was the first revision for 72.7% (8/11) of rTHA patients and 91.7% (22/24) of rTKA patients. Two rTHA and 2 rTKA patients had undergone 1 previous aseptic revision of the index joint, with 1 additional rTHA patient having undergone 3 previous aseptic revisions on the index joint.

Twenty-six percent (n = 9) of procedures were performed in the ASC, and 74% (n = 26) were performed in the hospital. The average procedure duration was 74.2 ± 19.8 (range: 47-111) minutes for rTHA cases and 83.0 ± 28.6 (range: 44 to 143) minutes for rTKA cases.

SDD was achieved in 97% (34/35) of cases. An 18-year-old female rTHA patient with a BMI of 42 kg/m^2 and ASA-PS classification of 3 experienced persistent hypoxia postoperatively requiring 1-2 liters of oxygen via nasal cannula and incentive spirometry until resolution. The patient was discharged 19.5 hours after the conclusion of her procedure resulting in a failure to achieve SDD.

Excluding the 1 patient discharged the day after surgery, on average, SDD rTHA patients were discharged home 5.5 ± 1.7 (range: 3.2-8.1) hours after procedure completion, and SDD rTKA patients were discharged home 4.4 ± 1.1 (range: 2.3-6.8) hours after procedure completion.

The rTHA patient who failed SDD also was the only patient who presented to the ED within 90 days of the index surgery. The patient had undergone conversion rTHA from prior osteochondroplasty and trochanteric advancement following failed pinning for slipped capital femoral epiphysis. At 52 and 66 days following the index rTHA, the patient underwent closed reductions for anterior dislocations at an outside ED. At 97 days, the index surgeon re-revised the patient for recurrent instability with uneventful recovery and no further instability events at the latest follow-up of 43.5 months.

There were 2 unplanned clinic encounters within 90 days of the index procedure. A 63-year-old male who underwent rTKA of the tibial component and polyethylene liner for aseptic loosening was seen 10 days after SDD discharge for drainage from his distal incision secondary to hematoma formation. In the absence of signs or symptoms of deep infection, conservative treatment resulted in full recovery in a few weeks. In the second instance, a 59-year-old male underwent rTKA for instability with uneventful recovery until sustaining a ground-level fall after tripping over his dog. Radiographs and the clinical examination at the unplanned visit 26 days after SDD were unremarkable. A short course of narcotics for pain was reinitiated for 2 weeks with full recovery.

There were no direct hospital readmissions or reoperations, and no additional complications prior to discharge, unplanned clinic encounters, or ED visits within 90 days of surgery.

Discussion

Over the past decade, optimization of perioperative pathways has made it possible for outpatient primary TJA to become a reality for appropriately selected patients [11–20] In the future, multiple factors will present limitations on utilization of inpatient beds for

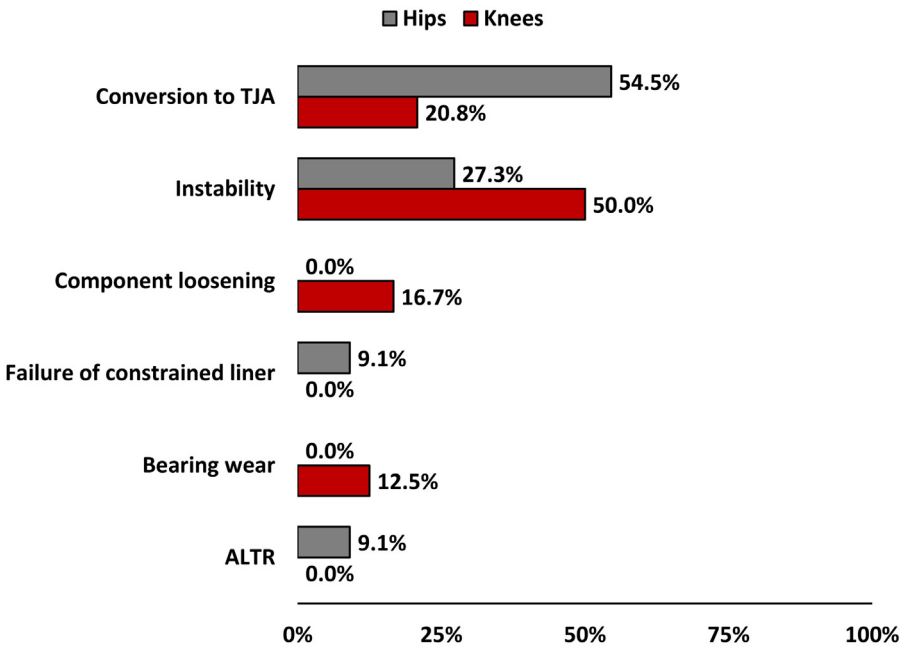

Figure 1. Indications for aseptic revision surgery. ALTR, adverse local tissue reaction.

orthopedic procedures including possible continuation of the COVID-19 pandemic, initiatives led by the Centers for Medicare and Medicaid Services to reduce lengths of stay and remove procedures from the inpatient-only list, and projected increases in the need for rTJA [27,28]. Consequently, it is prudent to develop perioperative pathways that allow for safe accelerated recovery and discharge following aseptic rTJA.

Our single institution experience demonstrates that, in appropriately selected patients, SDD aseptic rTJA is safe with a low risk of predischarge and 90-day postdischarge complications and feasible with a 97% success rate. Thirty-four of 35 aseptic rTJA patients in our sample safely achieved SDD. Study findings demonstrated a 2.9% (1 of 35 patients) ED visit rate, a 0% direct readmission rate, and a 5.7% (2 of 35 patients) unplanned clinic visit rate within 90 days of aseptic rTJA, with only 1 patient requiring repeat operative intervention for recurrent hip instability. For 3 (8.6%) study patients, BMI exceeded the 40-kg/m^2 cutoff recommended for delaying primary TJA especially in the presence of other comorbidities [29]. The study patient who failed SDD due to hypoxia and was the only 90-day ED readmission (for dislocation) had a BMI of 42 kg/m^2, with no other medical comorbidities including smoking and alcohol use. The other 2 patients with BMIs equal to 44 and 57 kg/m^2 had additional comorbidities collectively including hypertension, hyperlipidemia, obstructive sleep apnea, chronic lower extremity edema, peripheral neuropathy, and asymptomatic chronic abnormal electrocardiogram results, but neither patient experienced complications before or within 90 days of SDD rTJA discharge. While limited in number, such cases are consistent with recent evidence indicating the inadequacy of surgical decision-making based on a single BMI cutoff [30,31] and support standardized application of patient selection criteria, preoperative medical optimization, and perioperative risk management for patients undergoing both primary and revision TJA in an ambulatory setting. Evidence-based enhanced recovery, fast-track, and short-stay protocols for the preoperative, intraoperative, and postoperative management of TJA patients have a proven track record of success in reducing perioperative medical complications in both the inpatient and outpatient settings [32-35] Key features of these protocols include medical evaluation, patient optimization, and education before surgery, as well as perioperative strategies to control glycemia, adverse anesthesia effects, pain, nausea and vomiting, infection, venous thromboembolism, blood loss requiring transfusion, and urinary retention [36,37].

Our study is the third investigation directly addressing the feasibility of SDD aseptic rTJA. Law et al. [21] and Crawford et al. [22] reported results of SDD aseptic rTKA and rTHA using identical patient-selection algorithms whereby patients with medical conditions that could not be optimized before surgery, organ-transplant patients, revisions requiring complex implants and long surgical durations, and cases where high blood loss was likely were ineligible for outpatient surgery. In their knee study, [21] 43% of 106 cases were conversions of unicompartmental knee arthroplasties to TKAs, 38% were revisions with polyethylene exchange only, and the remainder were single or full component revisions or, in 1 case, open fracture reduction. In their hip study, [22] 21% of 47 cases were conversions, and 79% were revisions with procedures ranging from head exchange only to full component exchange. Sixty-two percent (66/106) of knee patients [21] and 32% (15/47) of hip patients [22] had 1 or more major comorbidity. Adjusting for 4 rTKA and 2 rTHA patients who delayed discharge for convenience, successful SDD rates were, respectively, 91.2% (93/102) and 97.8% (44/45), similar to the 97% success rate in our SDD case series. Overnight stays for medical reasons involved sleep apnea, low oxygen levels, nausea/vomiting, antibiotic administration, pain monitoring, and urinary retention, [21,22] perhaps indicating a need for more clearly defined patient-selection protocols and/or adjustments to outpatient perioperative protocols. With high SDD success rates, the current study and those by Law et al. [21] and Crawford et al. [22] help to inform best practices for safely transitioning rTJA from the inpatient to the outpatient setting, more specifically SDD.

Table 2
Components revised by joint.

Components revised	rTHA	rTKA
Acetabular and femoral components, head, liner	54.6 (6)	
Head and liner	45.5 (5)	
Femoral, tibial, and patellar components, polyethylene liner		8.3 (2)
Femoral and tibial components, polyethylene liner		45.8 (11)
Femoral component, polyethylene liner		12.5 (3)
Tibial component, polyethylene liner		4.2 (1)
Patella component, polyethylene liner		8.3 (2)
Polyethylene liner		20.8 (5)

Current study findings also are consistent with studies on rapid discharge after aseptic rTJA. In a matched cohort of 183 same- or next-day discharge and 183 later-discharge patients, Buller et al. [23] found no differences in 90-day ED visits (3.4% vs 6.7%, respectively) or hospital readmission rates (3.9% vs 2.4%, respectively). More recently, Pontasch et al. [24] investigated a single surgeon cohort of 33 aseptic rTKAs with full component exchange performed in an academic center with modern rapid recovery protocols and a goal of discharge by 11 AM on POD 1. Sixty-four percent of patients achieved this goal with an average stay of 22 hours. Nineteen percent (4 patients) had an unplanned ED visit, and 9.5% (2 patients) were readmitted within 90 days of discharge, which did not statistically differ compared to patients undergoing nonrapid recovery aseptic rTJA. Although it is important to note that the Buller et al. [23] and Pontasch et al. [24] studies do not provide direct evidence for SDD, they support feasible transition of appropriate aseptic rTJA surgeries to the outpatient setting.

COVID-19-related cancellations resulted in large backlogs for TJA surgeons with attendant long wait times for patients [1,38,39]. Brown et al. [4] observed that 54% of patients on their waiting list reported that their arthritis symptoms had worsened since the pandemic. Clement et al. [40] surveyed 843 patients on a waitlist for primary TJA in the United Kingdom and observed that 80% felt their quality of life had deteriorated while waiting for surgery. Thirty-five percent of patients awaiting THA and 22% of patients awaiting TKA rated their health state “worse than death,” and 86% would have preferred undergoing surgery despite potential increased risks associated with COVID-19. In the only study evaluating the impact of surgery wait times on patients requiring rTJA, Davis et al. [41] prospectively evaluated 127 Canadian patients waiting an average of 124 days to undergo rTHA and found statistically significant increases in pain and physical disability for each additional 6 months of wait time which negatively impacted pain and function scores once surgery was performed. Appropriate utilization of SDD primary and revision TJA may mitigate this and other undesirable patient-related and musculoskeletal consequences of delaying surgery. The need to resume surgery for patients in a timely manner by using SDD protocols must be accompanied by a strong commitment to safe and excellent surgical outcomes [20]. The current and previous studies on outpatient aseptic rTJA [21,22] provide a perioperative framework for others to build on in their efforts toward this end.

Our study is not without limitations. While specific guidelines were applied to select patients for SDD, no formal selection criteria have been developed. Guidelines used for SDD patient selection

were based upon the primary TJA literature, as well as over 10 years of rapid discharge arthroplasty experience. It is possible that the generalizability of our experience is limited, and each institution should critically evaluate patient selection criteria and all stages of the perioperative pathway to ensure patient safety. In addition, surgeries in the current study were performed by a fellowship-trained arthroplasty surgeon with over 15 years of complex revision experience which may limit the generalizability of study findings to other arthroplasty practices. Consistent with prior reports, [21,22] we elected to include conversion TJAs. While not recognized by payors as rTJAs, the principles of reconstruction are identical, and as such, we felt this population should be included. A final limitation of this study is its small sample size, and future studies should seek to evaluate a larger cohort of rTJA patients. On the other hand, the detailed granularity of our data and 100% follow-up are a particular strength as unrecognized predischarge and postdischarge complications are unlikely.

To safely establish aseptic rTJA as a routinely acceptable outpatient procedure, the development of formal patient selection criteria is necessary. Similarly, studies should assess whether patients who stay overnight in the hospital following aseptic rTJA receive meaningful benefit relative to the potential risk of nosocomial complications and added costs. Previous studies have demonstrated that 84% of patients staying in the hospital after primary TJA required no interventions overnight [42].

Conclusions

In conclusion, this report describes a single institution's experience performing SDD aseptic rTJA, including indications, patient selection criteria, perioperative protocols and pathways, and outcomes. The results of this case series may help provide meaningful information to surgeons seeking to perform rapid-discharge rTJA in their own practice setting. Study findings suggest that with thoughtful patient selection and modern perioperative protocols and surgical techniques, SDD for aseptic rTJA is safe and effective.

Conflicts of interest

L. T. Buller is an AAHKS program committee member. R. M. Meneghini receives royalties from Enovis, OsteoRemedies, and Kinamed; is a paid consultant for Enovis, OsteoRemedies, 3M, and Kinamed; has stock or stock options in Emovi and PeekMed; is in the editorial or governing board of Journal of Arthroplasty and Orthopedics Today; and is a board member American Association of Hip and Knee Surgeons, Hip Society, Knee Society, International Congress for Joint Reconstruction, and Mid-America Orthopaedic Association. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2022.07.022.

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