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Original Research

Prevalence of Depressive Symptoms in Aseptic Revision Total Knee Arthroplasty Based on the Mode of Failure

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ABSTRACT

Background: Complications following total knee arthroplasty (TKA) that necessitate revision cause considerable psychological distress and symptoms of depression, which are linked to poorer postoperative outcomes, increased complications, and increased healthcare utilization. We aimed to identify the prevalence of mental health disorders and symptoms preoperatively and postoperatively in patients undergoing aseptic revision TKA and to stratify these patients based on their mechanism of failure.

Methods: All patients undergoing aseptic revision TKA from 2008 to 2019 with a minimum 1-year follow-up were retrospectively reviewed at a single institution. Patients (n = 394) were grouped based on 7 failure modes previously described. Patients were considered to have depressive symptoms if their Veterans RAND-12 mental component score was below 42. Preoperative and postoperative Veterans RAND-12 mental component scores at the latest follow-up were evaluated.

Results: Overall comparative prevalence of preoperative to postoperative depressive symptoms was 23.4%-18.8%. By mode of failure are as follows: arthrofibrosis (25.8%-16.7%), aseptic loosening (25.3%-18.9%), extensor mechanism disruption (25%-50%), failed unicompartmental knee arthroplasty (8.6%-14.3%), instability (25.7%-17.1%), osteolysis or polyethylene wear (23.1%-23.1%), and patellar failure (11.8%-23.5%). There was no difference in depressive symptoms among failure modes preoperatively ($P = .376$) or at the latest postoperative follow-up ($P = .175$).

Conclusions: The prevalence of depressive symptoms in revision TKA patients appears to be independent of failure mode. Surgeon awareness and screening for depressive symptoms in this patient population preoperatively with referral for potential treatment may improve early postoperative outcomes.

Introduction

The incidence of revision total knee arthroplasty (rTKA) performed in the United States continues to rise and is projected to increase exponentially over the next several decades, with a 601% increase in rTKA by the year 2030 [1–3]. Common indications for aseptic rTKA include loosening, instability, patellar failure, arthrofibrosis, extensor mechanism deficiency, osteolysis or polyethylene wear, and failed unicompartmental knee arthroplasty (UKA) [4,5]. These procedures place significant economic burden on the U.S. healthcare system with a mean total hospital charges per patient of nearly $75,000 for rTKA [4,5]. While much work has been done to optimize primary total knee arthroplasty (TKA) outcomes in an effort to minimize revision arthroplasty procedures, there is recent interest in identifying modifiable risk factors that could potentially be mitigated perioperatively to reduce complications when these patients do require revision procedures [6,7].

A well-known risk factor for poorer outcomes following both primary and revision arthroplasty procedures is mental health

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disorders, in particular, depression. Patients with psychological disorders and depression undergoing hip and knee arthroplasty procedures have been shown to have increased rates of postoperative complications, increased postoperative pain with higher opioid consumption, increased readmission rates, and larger overall healthcare utilization [8–24]. Several studies have shown that when these patients are treated with medications or psychotherapy perioperatively, they may experience increased improvements in their functional outcomes, lower opioid consumption, and decreased revision rates compared to patients with similar mental health disorders who have not undergone treatment at the time of their arthroplasty procedure [25–28].

Patients with preexisting depressive symptoms specifically undergoing rTKA have also been found to have increased length of stay, greater rates of nonhome discharge, increased readmissions, higher costs of care, and increased risk of adverse outcomes postoperatively [18]. However, there remains a paucity of data examining mental health disorders and their association with functional outcomes specifically in aseptic rTKA. Therefore, the objective of this study is to identify the prevalence of mental health disorders and depressive symptoms both preoperatively and postoperatively in patients undergoing aseptic rTKA. We also stratified these patients based on their mechanism of aseptic failure to evaluate if an association exists between failure mechanism and the prevalence of depressive symptoms, as well as postoperative functional outcomes.

Material and methods

Patient population

This is a retrospective review of consecutive patients undergoing aseptic rTKA at a single institution by fellowship-trained arthroplasty surgeons between September 2008 and May 2019 approved by our institutional review board. All patients were required to have a minimum of 1-year follow-up. Indication for aseptic rTKA included arthrofibrosis, aseptic loosening, extensor mechanism disruption, failed UKA, instability, osteolysis or polyethylene wear, and patella fracture. Patients undergoing revision of femoral, tibial, patella, or all components were included; however, those undergoing isolated polyethylene liner exchange were excluded from the study. Patient demographic data, including age, sex, body mass index (BMI), surgery type, indication for revision surgery, follow-up, and number of psychiatric medications at the time of revision surgery, were obtained. There were no patient exclusions based on age, comorbidities, or number of joint surgeries. Patients with missing data were excluded. Patients who underwent subsequent revision surgery within 1 year of the initial revision surgery were also excluded.

Outcome measures

We assessed 2 validated patient-reported outcome measures: the Veterans RAND (VR)-12 Item Health Score, including both the mental and physical component scores, and Knee Society Score (KSS). Each of these was evaluated preoperatively and at the latest follow-up visit for each patient. A VR-12 mental component score (MCS) of less than 42 was considered at risk for depressive symptoms, as has been previously described [29–31]. Additionally, each patient was evaluated for an existing diagnosis of multiple mental health disorders at the time of revision surgery, including depression, anxiety, post-traumatic stress disorder, anger disorder, bipolar disorder with or without mania, and panic attacks. (Table 1) These diagnoses were established and verified by the internal medicine

Table 1
Patient demographics.

n = 394	Arthrofibrosis (n = 66)	Aseptic loosening (n = 111)	Extensor mechanism deficiency (n = 12)	Failed UKA (n = 35)	Instability (n = 140)	Osteolysis or PE wear (n = 13)	Patella fracture (n = 17)	*P* value
Age	63.3 ± 8.5	66.6 ± 8.6	62.8 ± 7.5	60.5 ± 12.6	63.6 ± 9.6	61.9 ± 9.8	61.8 ± 7.6	.015[a]
BMI	27.9 ± 4.9	31.8 ± 7.2	32.4 ± 7.1	29.2 ± 4.8	28.5 ± 5.3	30.2 ± 7.9	29.3 ± 5.9	<.001[a]
Follow-up (y)	3.3 ± 2.3	2.9 ± 2.2	3.9 ± 1.9	2.7 ± 2.0	3.0 ± 2.4	2.9 ± 2.2	2.8 ± 1.8	.689
Sex								
Male	42.4%	49.6%	50.0%	34.3%	31.4%	69.2%	47.1%	.027[a]
Female	57.6%	50.4%	50.0%	65.7%	68.6%	30.8%	52.9%	
Number of psychiatric meds prescribed	0.32 ± 0.64	0.41 ± 0.69	1.00 ± 0.95	0.40 ± 0.74	0.67 ± 0.97	0.39 ± 0.77	0.77 ± 1.30	.011[a]
Preoperative diagnosis of depression								
Yes	18.2%	23.4%	41.7%	25.7%	23.6%	23.1%	29.4%	.723
No	81.8%	76.6%	58.3%	74.3%	76.4%	76.9%	70.6%	
Preoperative diagnosis of mental health disorder								
Yes	24.2%	26.1%	58.3%	31.4%	35.7%	23.1%	47.1%	.102
No	75.8%	73.9%	41.7%	68.6%	64.3%	76.9%	52.9%	

BMI, body mass index; UKA, unicompartmental knee arthroplasty.
[a] Indicates statistical significance ($P < .05$).

providers who routinely evaluate these patients as part of their preoperative clearance visit.

Statistical analysis

Patient demographics and outcomes data were categorized based on mode of failure and indication for the rTKA procedure. Comparative analysis was performed for each mode of failure indicating revision surgery. One-way analysis of variance was used to compare age, BMI, length of follow-up, VR-12 mental scores at each time point, VR-12 physical scores at each time point, and the change in VR-12 scores over time. Chi-squared analysis was used to compare sex, presence of preoperative mental health disorders diagnoses, and the proportion of patients with a MCS less than 42 at each time point. Fisher's exact test was used to compare the proportion of patients with a mental score less than 42 at their preoperative visit and latest follow-up for each failure mechanism. A value of $P < .05$ was considered statistically significant for each analysis. All analyses were performed using the Minitab, version 18, software (State College, PA).

Results

Patient population

A total of 671 revision TKA procedures were performed at our institution from September 2008 to May of 2019. Of these, 394 patients were identified as undergoing aseptic rTKA at our institution who met inclusion criteria. Of these patients, the mode of failure was arthrofibrosis for 66 patients (16.8%), aseptic loosening for 111 (28.2%), extensor mechanism deficiency for 12 (3.0%), failed UKA for 35 (8.9%), instability for 140 (35.5%), osteolysis or polyethylene wear for 13 (3.3%), and patella fracture for 17 patients (4.3%). There were statistically significant differences in age (range 28-89 years, mean 64 ± 9.5 years), sex, and BMI (range 15.8-55.6, mean 29.6 ± 6.2) between groups, though the average age was between 60 and 66 years for all groups and the average BMI ranged from 27 to 32 for all groups. There were no statistically significant differences in length of follow-up (range 1-10 years, mean 3 ± 2.3 years). There were statistically significant differences in the average number of psychiatric medications prescribed (range 0-5 medications, mean 0.5 ± 0.9 medications) to patients, with those being revised for extensor mechanism having the highest average amount. There was no statistically significant difference in the presence of a preoperative diagnosis of depression ($P = .723$) or other mental health disorders ($P = .102$). Table 1 demonstrates the demographic data for each mode of failure.

Knee Society Scores and functional outcomes

The range of motion (ROM) was significantly different across all modes of failure both at the preoperative visit (range 13-145 degrees, mean 108.7 ± 21.1 degrees; $P < .001$) and at the latest postoperative follow-up visit (range 43-145 degrees, mean 118.7 ± 14.6 degrees; $P < .001$). Patients revised for arthrofibrosis demonstrated the lowest ROM at both time points. For all modes of failure, there was an increase in average ROM from the preoperative visit compared to the latest postoperative follow-up visit. Preoperative function, as determined by KSS, was significantly different between all mechanisms of failure (range -20 to 100, mean 57.04 ± 24.2; $P < .001$); however, the function at latest follow-up did not show statistically significant differences between failure modes (range −20 to 100, mean 69.9 ± 26.5; $P = .118$). All failure modes demonstrated an increase in function between the 2 time points. Statistically significant differences in the preoperative KSS were also found between all modes of failure (range −2 to 200, mean 102.3 ± 36.3; $P = .008$), but no statistically significant differences in KSS was present at the latest follow-up visit (range 2-200, mean 144.1 ± 40.4; $P = .214$). Similar to other functional outcomes, all failure mechanisms demonstrated increases in Knee Society scores from preoperative visit to latest follow-up. Table 2 demonstrates all of the functional outcome data for each mode of failure.

VR-12 mental and physical scores

There were no significant differences found in VR-12 mental scores between modes of failure at the preoperative visit (range 18.6-75.5, mean 51.5 ± 12.1; $P = .186$) or the latest follow-up (range 16.6-74.4, mean 53.4 ± 11.4; $P = .793$). Patients undergoing revision for failed UKA, osteolysis or polyethylene wear, and patellar failure did not have an average increase from preoperative visit to latest follow-up. For all other modes of failure, the average VR-12 mental score improved over time; however, this improvement was below the previously established minimally clinically important difference (MCID) for the VR-12 mental score of 11.16 [32]. No significant differences were found in the VR-12 physical scores between failure mechanisms at preoperative visit (range 10.5-58.1, mean 31.5 ± 9.2; $P = .087$) or latest follow-up (range 8.2-57.4, mean 37.0 ± 11.8; $P = .358$). For all aseptic revision indications, the VR-12 physical scores improved over time from preoperative visit to latest follow-up and many of these improvements were above the MCID of 4.96 previously established for the VR-12 physical score [32]. When specifically evaluating the change in the VR-12 scores over time, no statistically significant difference was found between modes of failure for the mental score ($P = .128$) nor the physical score ($P = .059$). Table 3 and 4 demonstrate all VR-12 mental and physical score data.

Prior studies have established a VR-12 MCS below 42 as a positive screen for depression symptoms [29–31]. Looking specifically at patients with an MCS less than 42, there were no statistically significant differences between modes of failure at the preoperative visit ($P = .376$) or latest follow-up visit ($P = .175$). Table 5 demonstrates the analysis of MCS less than 42 between failure mechanisms. Evaluating the percentage of patients with MCS less than 42 within each mode of failure, none of the cohorts had significant changes between their preoperative and postoperative visits, as shown in Table 6.

Discussion

The present study demonstrates that nearly one quarter of all aseptic rTKA patients met criteria for depressive symptoms based on an VR-12 MCS less than 42 at the time of revision surgery. Overall, the comparative prevalence of depressive symptoms from preoperative visit to latest follow-up in this cohort of aseptic rTKA patients, decreased from 23.4% to 18.8% over time. Despite this relative decrease in depressive symptoms when all aseptic rTKA patients were considered, when individual failure modes were considered, none of the changes over time reached statistical significance. To the author's knowledge, no studies exist that characterize the prevalence of depressive symptoms and postoperative outcomes based on etiology of failure for rTKA. No association was found between the prevalence of depressive symptoms and outcomes based on mode of failure, making screening for these symptoms' imperative for all modes of failure in rTKA.

The prevalence of depressive symptoms in aseptic rTKA patients in the present study is similar to what has been reported as the national average in the United States in 2019 (18.5%) [33], but higher than that reported by prior studies evaluating depression in aseptic rTKA cohorts [18]. The prevalence of depression continues

Table 2
Analysis of preoperative and postoperative range of motion, function and knee society scores.

n = 394	Arthrofibrosis (n = 66)	Aseptic loosening (n = 111)	Extensor mechanism deficiency (n = 12)	Failed UKA (n = 35)	Instability (n = 140)	Osteolysis or PE wear (n = 13)	Patella fracture (n = 17)	*P* value
Preoperative ROM	80.3 ± 25.0	110.0 ± 17.8	107.4 ± 34.6	119.8 ± 11.4	116.0 ± 13.0	109.9 ± 16.2	118.1 ± 13.3	<.001[a]
Postoperative ROM	105.3 ± 17.8	119.5 ± 12.4	114.5 ± 20.1	124.7 ± 12.4	123.4 ± 10.3	119.2 ± 11.1	118.5 ± 16.3	<.001[a]
Preoperative function	59.8 ± 22.1	53.0 ± 25.1	38.3 ± 31.4	59.2 ± 19.1	57.4 ± 22.7	63.1 ± 35.2	75.6 ± 18.3	.001[a]
Postoperative function	70.8 ± 28.8	71.0 ± 25.4	53.8 ± 32.0	74.9 ± 27.4	66.6 ± 24.1	71.9 ± 37.4	79.1 ± 23.2	.118
Preoperative Knee score	45.2 ± 17.7	43.9 ± 19.8	35.3 ± 19.4	48.8 ± 18.5	44.2 ± 16.1	50.9 ± 21.0	59.9 ± 20.0	.008[a]
Postoperative Knee score	70.4 ± 22.0	77.8 ± 19.6	70.4 ± 21.4	76.1 ± 19.4	73.4 ± 19.0	78.0 ± 18.7	80.0 ± 21.3	.214

ROM, range of motion; UKA, unicompartmental knee arthroplasty.
[a] Indicates statistical significance ($P < .05$).

to increase in the general, U.S. population and a high proportion of those patients are female and 45 years and older, which is a similar patient population to those undergoing rTKA in the present study [33,34].

It has been well established that a preexisting diagnosis of depression can lead to adverse outcomes following arthroplasty procedures. Not only have several studies found that patients with a depression diagnosis are at increased risk of having significantly more medical comorbidities [12,18,21], the diagnosis has also been linked to increased postoperative surgical and medical complications [14,19,21,24], increased pain postoperatively [13,18–20], increased readmission and emergency departments visits postoperatively, revision surgery, and overall inpatient cost of care following rTKA [18]. All of these increased risks put these particular patients at greater probability of larger overall costs of care, placing further strain on the U.S. healthcare system, indicating the importance of screening and identifying these patients prior to revision TKA.

In the present study, all modes of failure had improvement in the average ROM, function, and KSS from preoperative visit to the latest follow-up, though some failure modes demonstrated larger advances over time compared to others. Additionally, all failure modes showed improvements in average VR-12 physical scores, many of which were above the MCID; however, not all mechanisms of failure had increased VR-12 mental scores at latest follow-up compared to preoperatively. Additionally, all improvements in the VR-12 mental score were below the previously established MCID. Patients undergoing revision for failed UKA, osteolysis or polyethylene wear or for patella fracture each had decreases in their VR-12 mental scores over time. Prior studies have demonstrated that patients with untreated depression have smaller gains in their physical function scores with joint arthroplasty [27]. Others have demonstrated that patients undergoing rTKA with history of depression or anxiety have lesser changes in Oxford Knee Score following their revision procedure [35], as well as both lower preoperative and postoperative patient reported outcome scores [22] compared to their counterparts without depression. Extensor mechanism deficiency, failed UKA, osteolysis or polyethylene wear, and patellar fracture had equal or increasing prevalence of depressive symptoms in the present study, as indicated by a larger percentage of patients with MCS less than 42 at latest follow-up compared to their preoperative visit. Figoni et al. [36] found that patients who experience mechanical complications within 90 days following primary TKA are at 1.57 times higher risk of developing a new psychiatric diagnosis, which increases to 2.24 times more likely for those who underwent subsequent revision surgery within 30 days of their diagnosis of mechanical complication. This corresponds to a prevalence of 16.4% for new mental health disorders following rTKA for mechanical complications, which is consistent with the present study [36]. Despite improvement in physical function following rTKA that meet the MCID, the mean improvement in mental health scores did not reach the MCID for any etiology of failure in the present study. This further supports the need for surgeons to assist in providing patients with access to mental health care throughout their episode of care, as solely treating the physical problem does not necessarily improve the mental health status of the patient.

Treatment of the underlying depression or mental health disorder, either with psychotherapy or medications, has been shown to improve outcomes following arthroplasty. Blackburn et al. [17] demonstrated that although increased severity of depression or anxiety preoperatively led to worse postoperative outcomes, treatment of the underlying disorder with improvement in psychological symptoms, led to improved disability scores. Schwartz et al. [26] found that perioperative psychotherapy decreased the

Table 3
Analysis of VR-12 mental and physical scores from preoperative visit to latest follow-up visit.

n = 394	Arthrofibrosis (n = 66)	Aseptic loosening (n = 111)	Extensor mechanism deficiency (n = 12)	Failed UKA (n = 35)	Instability (n = 140)	Osteolysis or PE wear (n = 13)	Patella fracture (n = 17)	*P* value
VR-12 MS Preoperative	51.3 ± 11.8	50.1 ± 11.9	47.2 ± 15.5	55.7 ± 9.3	51.6 ± 12.5	51.8 ± 12.5	55.1 ± 12.5	.186
VR-12 MS Follow-up	53.5 ± 11.8	53.8 ± 10.6	48.8 ± 16.4	54.3 ± 10.6	53.5 ± 11.5	51.2 ± 11.9	52.0 ± 12.3	.793
VR-12 PS Preoperative	30.9 ± 8.1	30.2 ± 8.8	29.9 ± 5.2	31.4 ± 8.7	31.8 ± 9.6	37.4 ± 11.4	35.3 ± 12.4	.087
VR-12 PS Follow-up	38.4 ± 11.2	37.4 ± 12.2	34.6 ± 8.5	39.4 ± 12.3	35.3 ± 11.7	37.7 ± 10.9	39.2 ± 13.0	.358

MS, mental score; PS, physical score; UKA, unicompartmental knee arthroplasty; VR-12, Veterans RAND-12.

Table 4
Analysis of the change in VR-12 Mental and Physical Scores from preoperative visit to latest follow-up visit.

n = 394	Arthrofibrosis (n = 66)	Aseptic loosening (n = 111)	Extensor mechanism deficiency (n = 12)	Failed UKA (n = 35)	Instability (n = 140)	Osteolysis or PE wear (n = 13)	Patella fracture (n = 17)	*P* value
Change in VR-12 mental score	2.2 ± 11.7	3.7 ± 11.8	1.6 ± 10.5	−1.4 ± 11.5	1.9 ± 10.8	−0.7 ± 12.6	−3.2 ± 9.1	.128
Change in VR-12 physical score	7.5 ± 10.7	7.1 ± 12.1	4.8 ± 9.8	8.0 ± 12.4	3.5 ± 12.1	0.4 ± 14.1	3.9 ± 13.0	.059

UKA, unicompartmental knee arthroplasty; VR-12, Veterans RAND-12.

Table 5
Analysis of the percentage of patients with MCS <42 between revision failure mechanisms.

n = 394	Arthrofibrosis (n = 66)	Aseptic loosening (n = 111)	Extensor mechanism deficiency (n = 12)	Failed UKA (n = 35)	Instability (n = 140)	Osteolysis or PE wear (n = 13)	Patella fracture (n = 17)	*P* value
Mental score <42 Preoperative	25.8% [17]	25.3% [28]	25.0% [3]	8.6% [3]	25.7% [36]	23.1% [3]	11.8% [2]	.376
Mental score <42 Follow-up	16.7% [11]	18.9% [21]	50.0% [6]	14.3% [5]	17.1% [24]	23.1% [3]	23.5% [4]	.175

UKA, unicompartmental knee arthroplasty.

risk of discharge to a facility and decreased opioid consumption, such that patients who did not undergo psychotherapy were more likely to have chronic opioid use, as well as increased risk of revision arthroplasty. Similarly, Geng et al. [28] showed that patients undergoing therapy with a psychiatrist perioperatively, either cognitive behavioral therapy or prescription medication, had improved patient reported outcome scores, satisfaction with their procedure, and greater ROM at 2 years postoperatively. Selective serotonin reuptake inhibitor use perioperatively has also been linked to decreasing rates of all cause revision and aseptic revision following arthroplasty procedures [25]. Therefore, identifying patients with a diagnosis of depression or those at risk of developing depressive symptoms perioperatively is of paramount importance given that appropriate treatment may substantially improve functional outcomes and lower the risk of adverse postoperative events.

The limitations of this study are inherent in any retrospective review study, though the data analyzed is collected in a prospective manner to avoid potential selection or recall biases. Additionally, the authors recognize that there are different classifications and varying degrees of depression and mental health disorders within the *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition* that are unable to be accounted for in the present study. While medical records were used to determine the number of psychiatric medications each patient was prescribed at the time of revision surgery, the associated diagnoses for each patient and prescribed medication were variable. For this reason, an MCS less than 42 was used as the standardized and previously described [29–31] method of determining the prevalence of depressive symptoms in our patient cohort. Using this method, we are unable to account for additional, associated mental health disorders that may have also affected the outcomes measured. Additionally, we are unable to identify which patients may have been receiving psychotherapy treatment or other means of treatment for their mental health disorder, which could influence the patient-reported outcomes evaluated in this study. Finally, the number of patients within each cohort may be underpowered to detect statistically significant differences for specific outcomes evaluated in this study. However, to the authors' knowledge, no studies exist that characterize the prevalence of depressive symptoms and outcomes based on the etiology of failure for rTKA. Despite these limitations, the authors believe this study provides important clinical data regarding the prevalence of depressive symptoms and mental health disorders in the rTKA population and valuable information regarding a potentially modifiable risk factor to optimize perioperatively.

Conclusions

Nearly a quarter of all aseptic rTKA patients met criteria for depressive symptoms based on a MCS less than 42 at the time of revision surgery, which decreased to 18.8% at the latest follow-up

Table 6
Analysis of the change in percentage of patients with MCS <42 over time.

Mechanism of failure	Preoperative MCS <42	Latest follow-up MCS <42	*P* value
Arthrofibrosis (n = 66)	25.8% [17]	16.7% [11]	.287
Aseptic loosening (n = 111)	25.3% [28]	18.9% [21]	.332
Extensor mechanism deficiency (n = 12)	25.0% [3]	50.0% [6]	.400
Failed UKA (n = 35)	8.6% [3]	14.3% [5]	.710
Instability (n = 140)	25.7% [36]	17.1% [24]	.109
Osteolysis or PE wear (n = 13)	23.1% [3]	23.1% [3]	1.000
Patellar Failure (n = 17)	11.8% [2]	23.5% [4]	.656

MCS, mental component score; UKA, unicompartmental knee arthroplasty.

visit postoperatively. There is no difference in depressive symptoms among different aseptic failure modes preoperatively or at the latest follow-up postoperatively. Surgeon awareness and preoperative screening for depressive symptoms in this patient population may be warranted with referral for potential treatment to optimize early postoperative outcomes. Arthroplasty surgeons have realized the importance of optimizing medical and somatic conditions to improve perioperative outcomes following revision knee arthroplasty procedures; however, a greater focus on optimization of psychological conditions to improve postoperative outcomes may be warranted moving forward.

Conflicts of interest

The authors declare there are no conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2023.101298.

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