Arthroplasty Today 27 (2024) 101359

Contents lists available at ScienceDirect

Arthroplasty Today

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

Original Research

# Comparison of Postoperative Outcomes of Patients Undergoing Total Hip and Total Knee Arthroplasty Following a Diagnosis of Dementia: A TriNetX Database Study

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ARTICLE INFO

*Article history:*
Received 10 November 2023
Received in revised form
13 February 2024
Accepted 21 February 2024
Available online xxx

*Keywords:*
Total hip arthroplasty
Total knee arthroplasty
Dementia
Postoperative complications

ABSTRACT

*Background:* As life expectancy improves for patients with dementia, the demand for mobility-improving surgeries such as total joint arthroplasty (TJA) will increase. There is little research on patients with dementia undergoing TJA, although dementia has been shown to be a risk factor for complications. The purpose of this study is to compare postoperative outcomes of patients with dementia undergoing TJA at 90 days, 2 years, and 5 years.

*Methods:* The TriNetX database was retrospectively queried for all patients undergoing total hip arthroplasty (THA) and total knee arthroplasty (TKA). Patients were divided into cohorts by preoperative diagnosis of dementia and propensity score matched. The following outcomes were evaluated between groups at 90 days, 2 years, and 5 years postoperatively: revision, resection arthroplasty, closed reduction (THA only), femur fracture plating, and prosthetic joint infection. Readmission and manipulation under anesthesia (TKA only) were evaluated at 90 days postoperatively. Univariate and multivariate analyses were performed.

*Results:* After matching, there were no differences in demographics or comorbidities between groups. TKA (odds ratio [OR] = 1.75, 95% confidence interval [CI] 1.42-2.15, $P < .001$) and THA (OR = 2.17, 95% CI 1.92-2.45, $P < .001$) patients with dementia were more likely to be readmitted than patients without dementia. At 2 years (OR = 2.07, 95% CI 1.14-3.77, $P = .015$) and 5 years (OR = 2.14, 95% CI 1.32-3.48, $P = .002$) postoperatively, THA patients with dementia were more likely to have proximal femur fracture plating than patients without dementia.

*Conclusions:* Patients undergoing THA with dementia had worse outcomes than patients undergoing THA without dementia and TKA with dementia. The overall rate of complications was low, and a diagnosis of dementia should not be an absolute contraindication to proceeding with TJA.



## Introduction

Primary total hip arthroplasty (THA) and total knee arthroplasty (TKA) typically are very successful and, as such, are 2 of the most commonly performed orthopaedic surgeries in the United States, with numbers of procedures performed annually continuing to increase [1-3]. Life expectancy, and the number of people living well into later decades of life, has increased along with the demand for procedures such as THA and TKA that enable patients to continue to live active lives [4,5]. Although these patients may be at somewhat higher risk for postoperative complications, multiple studies have demonstrated that arthroplasty procedures can be safely performed into the 9th decade of life [4-7]. In studies of older patients undergoing total joint arthroplasty (TJA), dementia has consistently shown to be a risk factor for postoperative complications and mortality following surgery, although studies specifically examining patients with dementia undergoing TJA have been much more limited [8-14].

Dementia is a constellation of cognitive changes due to a number of different disorders including Alzheimer's disease and

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https://doi.org/10.1016/j.artd.2024.101359

vascular disease [15]. The prevalence of dementia doubles every 5 years in people from age 65 to 85; 13.8 million people in the United States are projected to have a dementia diagnosis by 2050 [15]. Patients affected by dementia typically have shorter life expectancies, and as the condition progresses, they typically will have increasing difficulty participating in normal activities and performing self-care [11,15]. One significant concern with performing THA and TKA on patients with dementia is the decline in cognitive function may limit the patient's ability to participate in postoperative rehabilitation and maintain activity restrictions that may be necessary [13,16]. The purpose of this study is to compare postoperative outcomes of patients with dementia undergoing THA and TKA at 90 days, 2 years, and 5 years. We hypothesize that patients with dementia will have worse outcomes when undergoing THA and TKA than patients without dementia.

## Material and methods

### *Study population*

This study was deemed institutional review board exempt as a review of de-identified aggregated data by the institutional clinical research committee. The TriNetX Research Network (TriNetX) database was queried as of June 21, 2023. Patient cohorts and outcome measures were defined using international classification for disease 10th edition (ICD-10) diagnosis codes and Current Procedural Terminology (CPT) codes. All patients who underwent a primary TKA and primary THA, defined by CPT codes 27447 and 27130 , respectively, were included and divided into 4 cohorts by procedure and whether they had been diagnosed with dementia (ICD-10: F00.0-F03, G30.0-G30.9, G31.1) at any time prior to their procedure. Patients in the THA cohorts that had a diagnosis of hip fracture (ICD-10: S72.0, S72.1, M84.45) within 7 days prior to surgery were excluded from the analysis.

### *Study outcomes*

The primary outcomes examined for the TKA cohorts were any of the following occurring from 1 day to 5 years postoperatively: revision (CPT: 27486 and 27487), resection (CPT: 27488), distal femur fracture plating (CPT: 27511, 27513, and 27514), and prosthetic joint infection (ICD-10: T84.53-T84.54). Additionally, manipulation under anesthesia (CPT: 27570) was examined up to 90 days postoperatively and readmission (CPT:1013659) was examined from 5 to 90 days postoperatively.

The primary outcomes examined for the THA cohorts were any of the following occurring from 1 day to 5 years postoperatively: revision (CPT:27134, 27137 and 27138), resection (CPT: 27090, 27091), closed reduction (CPT: 27265), proximal femur fracture plating (CPT: 27507, 27244, 27236), and prosthetic joint infection (ICD-10 T84.51-T84.52). Additionally, readmission (CPT:1013659) was examined from 5 to 90 days postoperatively.

### *Statistical analysis*

Cohorts were propensity score matched on age, sex, ethnicity, race and the following comorbidities: diabetes mellitus (ICD-10: E08-E13), overweight or obesity (ICD-10: E65-E68), atrial fibrillation (AFIB) (ICD-10: I48), congestive heart failure (CHF) (ICD-10: I50), chronic ischemic heart disease (ICD-10: I25), hypertension (ICD-10: I10), chronic kidney disease (ICD-10: N18), and chronic obstructive pulmonary disease (ICD-10: J44). Differences in cohort demographics and comorbidities were assessed with 2-sided independent sample t-tests and chi-squared tests. Differences in outcomes of the matched cohorts were assessed using odds ratios (ORs) and 95% confidence intervals (CIs). Statistical significance was assessed at $P = .05$. All statistical analysis was performed within the TriNetX platform.

### *TriNetX*

TriNetX is a global research network that includes data from more than 170 healthcare organizations across 30 countries and over 400 million patients [17]. Of the participating organizations, 76 share data for aggregated outcomes research and are included in this study. Variables captured include demographics, medications, laboratory test values, diagnoses mapped to ICD-10 coding and procedures mapped to CPT coding. Health Insurance Portability and Accountability Act compliant electronic health record data are collected from participating healthcare organizations who submit structured and unstructured data elements. TriNetX is a federated network and received a waiver from Western Institutional Review Board as the only data received includes aggregated counts and statistical summaries of de-identified information. No protected health information is exchanged in retrospective analyses.

## Results

There were 184,650 patients that underwent TKA; 1630 (0.9%) patients were diagnosed with dementia prior to their TKA. Prior to matching, there were significant differences in age, sex, and multiple comorbidities between TKA patients with and without dementia. After matching, both cohorts had 1558 patients and there were no demographic or comorbidity differences between them (Table 1).

**Table 1**
TKA baseline demographics and comorbidities.

| Demographics and comorbidities | Before matching | | | After matching | | |
|---|---|---|---|---|---|---|
| | Dementia N = 1630 | No dementia N = 183,020 | *P* value | Dementia N = 1558 | No dementia N = 1558 | *P* value |
| Age | 73.7 ± 9.2 | 65.9 ± 9.9 | **<.001** | 73.7 ± 9.2 | 73.8 ± 9.0 | .810 |
| Female | 1015 (65.1) | 107,273 (60.8) | **.001** | 1015 (65.1) | 995 (63.9) | .454 |
| White race | 1235 (79.3) | 138,374 (78.5) | .442 | 1235 (79.3) | 1259 (80.8) | .282 |
| Not Hispanic or Latino | 1236 (79.3) | 136,627 (77.5) | .080 | 1236 (79.3) | 1263 (81.1) | .225 |
| Diabetes mellitus | 488 (31.3) | 31,558 (17.9) | **<.001** | 488 (31.3) | 490 (31.5) | .938 |
| Overweight or obese | 469 (30.1) | 48,027 (27.2) | **.011** | 469 (30.1) | 470 (30.2) | .969 |
| Atrial fibrillation | 257 (16.5) | 11,812 (6.7) | **<.001** | 257 (16.5) | 252 (16.2) | .809 |
| CHF | 249 (16.0) | 8053 (4.6) | **<.001** | 249 (16.0) | 236 (15.1) | .521 |
| CAD | 426 (27.3) | 20,506 (11.6) | **<.001** | 426 (27.3) | 442 (28.4) | .523 |
| Hypertension | 1205 (77.3) | 91,656 (52.0) | **<.001** | 1205 (77.3) | 1216 (78.0) | .636 |
| Chronic kidney disease | 323 (20.7) | 11,716 (6.6) | **<.001** | 323 (20.7) | 325 (20.9) | .930 |
| COPD | 209 (13.4) | 8528 (4.8) | **<.001** | 209 (13.4) | 187 (12.0) | .237 |

CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease.
$P < .05$ in bold; all data presented as n (%) or mean ± SD.

**Table 2**
TKA outcomes.

| Outcome | Dementia N = 1558 | No dementia N = 1558 | Odds ratio (dementia vs no dementia) | *P* value |
|---|---|---|---|---|
| 90-d outcomes | | | | |
| Readmission | 270 (17.3) | 167 (10.7) | 1.75 (1.42, 2.15) | **<.001** |
| Revision arthroplasty | 18 (1.2) | 10 (0.6) | 1.81 (0.83, 3.93) | .129 |
| Resection arthroplasty | 10 (0.6) | 10 (0.6) | 1.00 (0.42, 2.41) | 1 |
| Distal femur fracture plating | 0 (0) | 0 (0) | N/A | N/A |
| Manipulation under anesthesia | 20 (1.3) | 21 (1.3) | 0.95 (0.51, 1.76) | .875 |
| Periprosthetic joint infection | 27 (1.7) | 15 (1.0) | 1.81 (0.96, 3.42) | .062 |
| 2-y outcomes | | | | |
| Revision arthroplasty | 41 (2.6) | 29 (1.9) | 1.43 (0.88, 2.31) | .147 |
| Resection arthroplasty | 10 (0.6) | 10 (0.6) | 1.00 (0.42, 2.41) | 1 |
| Distal femur fracture plating | 10 (0.6) | 10 (0.6) | 1.00 (0.42, 2.41) | 1 |
| Periprosthetic joint infection | 37 (2.4) | 30 (1.9) | 1.24 (0.76, 2.02) | .387 |
| 5-y outcomes | | | | |
| Revision arthroplasty | 52 (3.3) | 42 (2.7) | 1.25 (0.83, 1.88) | .295 |
| Resection arthroplasty | 12 (0.8) | 12 (0.8) | 1.00 (0.45, 2.23) | 1 |
| Distal femur fracture plating | 10 (0.6) | 10 (0.6) | 1.00 (0.42, 2.41) | 1 |
| Periprosthetic joint infection | 40 (2.6) | 41 (2.6) | 0.98 (0.63, 1.52) | .910 |

$P < .05$ in bold; all data presented as n (%).

Postoperatively, based on the matched cohorts, TKA patients with dementia were 1.75 times more likely to be readmitted within 90 days (OR: 1.75, 95% CI: 1.42-2.15; $P < .001$). There were no significant differences in revision, resection, distal femur fracture plating, or periprosthetic joint infection at 90 days, 2 years, or 5 years postoperatively. Additionally, there was no difference in manipulation under anesthesia at 90 days postoperatively between those who had dementia and those who did not prior to TKA (Table 2).

There were 125,025 patients that underwent THA; 4277 (3.4%) of patients were diagnosed with dementia prior to their THA. Prior to matching, there were significant differences in age, sex, race, ethnicity, and multiple comorbidities. After matching, both cohorts had 3892 patients and there were no demographic or comorbidity differences between them (Table 3).

Postoperatively, based on the matched cohorts, THA patients with dementia patients were 2.17 times more likely to be readmitted (OR: 2.17, 95% CI: 1.92-2.45; $P < .001$). At 2 years postoperatively, THA patients with dementia were 2.07 times more likely to have proximal femur fracture plating (OR: 2.07, 95% CI:1.14-3.77; $P = .015$). Additionally, at 5 years, THA patients with dementia were 2.14 times more likely to have proximal femur fracture plating (OR: 2.14, 95% CI: 1.32-3.48; $P = .002$) (Table 4).

## Discussion

In this study patients with dementia undergoing primary TJA fared worse overall than patients without dementia, although this varied when looking at TKA alone and THA alone. When looking just at TKA, patients with dementia had a higher rate of readmission within 90 days postoperatively than patients without dementia, but otherwise had no increased risk of postoperative complications within 90 days, 2 years or 5 years following surgery. Patients undergoing THA with dementia also had a higher rate of readmission within 90 days postoperatively and a higher rate of proximal femur fracture plating within 2 years and 5 years postoperatively.

While there are relatively few studies examining postoperative outcomes of patients with dementia undergoing TKA, higher resource utilization was a common finding and there was limited evidence for increased risk of revision or other postoperative complications [12-14]. A recent study by Hernandez et al. [12] found higher resource utilization, specifically emergency department visits and discharge to skilled nursing facility, in patients with dementia undergoing TKA when compared to patients without dementia, but no increased risk of other postoperative complications including revision. In a systematic review by Luan Erfe et al. [14] they found moderate evidence for increased length of stay and discharge to a health-care facility in patients with mild cognitive impairment or dementia, but no evidence of increased risk of revision or other surgical complications. A study by Jämsen et al. [13] examined a nationwide registry of patients undergoing TJA and found that patients with dementia undergoing TKA and THA had a higher rate of prolonged hospitalization following surgery. Buller et al. [18] found that a diagnosis of dementia was an independent predictor of nonhome discharge following TKA or THA when

**Table 3**
THA baseline demographics and comorbidities.

| Demographics and comorbidities | Before matching | | | After matching | | |
|---|---|---|---|---|---|---|
| | Dementia N = 4277 | No dementia N = 120,748 | *P* value | Dementia N = 3892 | No dementia N = 3892 | *P* value |
| Age | 78.9 ± 9.0 | 63.2 ± 12.2 | **<.001** | 78.4 ± 9.0 | 78.4 ± 8.9 | .861 |
| Female | 2458 (60.5) | 62,842 (53.5) | **<.001** | 2351 (60.4) | 2332 (59.9) | .660 |
| White race | 3394 (83.6) | 96, 327 (82.) | **.011** | 3249 (83.5) | 3274 (84.1) | .442 |
| Not Hispanic or Latino | 3423 (84.3) | 95,297 (81.1) | **<.001** | 3272 (84.1) | 3298 (84.7) | .417 |
| Diabetes mellitus | 1192 (29.3) | 15,240 (13.0) | **<.001** | 1111 (28.5) | 1098 (28.2) | .744 |
| Overweight or obese | 1063 (26.2) | 24,542 (20.9) | **<.001** | 992 (25.5) | 968 (24.9) | .531 |
| Atrial fibrillation | 1059 (26.1) | 7202 (6.1) | **<.001** | 937 (24.1) | 946 (24.3) | .812 |
| CHF | 937 (23.1) | 4846 (4.1) | **<.001** | 783 (20.1) | 760 (19.5) | .513 |
| CAD | 1422 (35.0) | 12,504 (10.6) | **<.001** | 1293 (33.2) | 1337 (34.4) | .292 |
| Hypertension | 3229 (79.5) | 54,229 (46.2) | **<.001** | 3060 (78.6) | 3101 (79.7) | .253 |
| Chronic kidney disease | 1055 (26.0) | 6915 (5.9) | **<.001** | 923 (23.7) | 935 (24.0) | .750 |
| COPD | 699 (26.0) | 6030 (5.1) | **<.001** | 608 (15.6) | 604 (15.5) | .900 |

CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease.
$P < .05$ in bold; all data presented as n (%) and mean ± SD.

**Table 4**
THA outcomes.

| Outcome | Dementia N = 3892 | No dementia N = 3892 | Odds ratio (dementia vs no dementia) | *P* value |
|---|---|---|---|---|
| 90-d outcomes | | | | |
| Readmission | 902 (23.2) | 475 (12.2) | 2.17 (1.92, 2.45) | **<.001** |
| Revision arthroplasty | 56 (1.4) | 53 (1.4) | 1.06 (0.72, 1.54) | .772 |
| Resection arthroplasty | 10 (0.3) | 10 (0.3) | 1.00 (0.42, 2.41) | 1 |
| Closed reduction | 10 (0.3) | 13 (0.3) | 0.77 (0.34, 1.76) | .531 |
| Proximal femur fracture plating | 15 (0.4) | 10 (0.3) | 1.50 (0.67, 3.35) | .317 |
| Periprosthetic joint infection | 31 (0.8) | 21 (0.5) | 1.48 (0.85, 2.51) | .164 |
| 2-y outcomes | | | | |
| Revision arthroplasty | 90 (2.3) | 79 (2.0) | 1.14 (0.84, 1.55) | .392 |
| Resection arthroplasty | 15 (0.4) | 10 (0.3) | 1.50 (0.67, 3.35) | .317 |
| Closed reduction | 17 (0.4) | 19 (0.5) | 0.89 (0.46, 1.72) | .738 |
| Proximal femur fracture plating | 33 (0.8) | 16 (0.4) | 2.07 (1.14, 3.77) | **.015** |
| Periprosthetic joint infection | 53 (1.4) | 37 (1.0) | 1.44 (0.94, 2.19) | .090 |
| 5-y outcomes | | | | |
| Revision arthroplasty | 99 (2.5) | 94 (2.4) | 1.06 (0.79, 1.40) | .716 |
| Resection arthroplasty | 18 (0.5) | 10 (0.3) | 1.80 (0.83, 3.91) | .130 |
| Closed reduction | 19 (0.5) | 25 (0.6) | 0.76 (0.42, 1.38) | .364 |
| Proximal femur fracture plating | 51 (1.3) | 24 (0.6) | 2.14 (1.32, 3.48) | **.002** |
| Periprosthetic joint infection | 59 (1.5) | 40 (1.0) | 1.48 (0.99, 2.22) | .055 |

$P < .05$ in bold; all data presented as n (%).

examining perioperative outcomes of patients undergoing TJA with psychiatric comorbidities. While the current study was not able to examine all of these outcomes specifically, we also found higher resource utilization, specifically increased readmissions, in patients with dementia undergoing TKA, without an increased rate of other postoperative complications. The improvement in quality of life for patients undergoing elective TJA may outweigh the possible increased resource utilization and possible increased complications in this population.

The majority of the available literature on postoperative outcomes of patients with dementia undergoing THA looks at THA for hip fracture rather than primary THA. Patients with dementia undergoing THA for hip fracture are at higher risk for increased resource utilization in the form of longer length of stay and increased non-home discharge, increased risk of medical complications including postoperative delirium, increased frequency of prosthesis related complications, and increased mortality [9,19-21]. In a study by Jamsen et al. [13] they found that patients with dementia undergoing primary THA had an increased risk for revision and that dislocation was the leading cause for revision, although there was no increased risk of dislocation. This study demonstrated similar findings, with no increased risk of dislocation at any time point, although we did not demonstrate an increased risk of revision. Hernandez et al. [11] also demonstrated similar findings to the current study with increased resource utilization at 90 days and increased revision at 90 days, although in contrast to the current study they did not find increased revision at 2 years. Unlike Hernandez et al. [11] who noted no increased risk for proximal femoral fracture plating, we did find an increased risk in patients with dementia at 2 years and 5 years postoperatively. Despite the increased risk of postoperative complications in patients with dementia in this study, the overall revision rate and proximal femoral fracture plating rate are low at all time points, only rising to 2.5% and 1.0%, respectively, at 5 years.

Patients undergoing THA are commonly perceived to perform better than patients undergoing TKA, and studies on functional outcomes and pain do bear that out [22,23]. However, there have been some studies that show increased short-term complications in patients undergoing THA compared with TKA [24,25]. This is consistent with our findings in patients with dementia; patients undergoing THA have increased complications, notably revision, when compared with patients undergoing TKA. One possible explanation for the decreased rate of revision in patients with dementia undergoing TKA is a reluctance for surgeons, patients, and families to undertake a revision unless it is absolutely necessary. One national registry study on patients with dementia undergoing TJA found that the leading cause for revision TJA was periprosthetic dislocation, which most commonly occurs after THA rather than TKA [13]. Another possible cause for the increased rate of revision that we found in this study is the method of implant fixation. In the United States greater than 90% of THA are performed with cementless fixation [26], and cemented TKA is considered the gold standard fixation [27]. While uncemented prostheses confer some advantages with both THA and TKA, such as greater longevity of the prosthesis, they have also been associated with an increased risk of early revision and aseptic loosening [28-31]. In THA, uncemented stems have also been associated with an increased risk of periprosthetic fracture [30-32].

This study does have a number of limitations. The use of a conglomerate research database that relies solely on coded data limits our ability to obtain additional information that may provide clarity to this subject, such as the severity of the dementia at the time of surgery and more granular surgical details such as method of fixation or surgical approach. The TriNetX database is an opt-in database and therefore may bias the sample to larger, research-oriented facilities. There are also the inherent biases of a retrospective observational study that may limit the generalizability to a wider population. There are various definitions of a successful TJA outcome that could not be accounted for in this study including amount of pain relief, functional return, and quality of life. We were also unable to account for other postoperative complications such as medical issues, ED returns, prolonged hospitalization, and nonhome discharge that significantly affect patient outcomes. A strength of this study is the ability to analyze a large, matched cohort that takes into account important demographic factors and comorbidities. Additionally, this study has a longer follow up period when compared to similar published studies which can provide valuable information to surgeons and other medical providers [11,12,14,21]. As such we feel this this study is a valuable contribution to literature and provides clarity to an issue that has had limited study.

## Conclusions

Patients undergoing TKA and THA with dementia have worse outcomes when compared with patients without dementia,

although this varies by procedure type. Patients undergoing TKA with dementia had an increased risk of readmission within 90 days postoperatively, but no increased risk of surgical complications within 90 days, 2 years, or 5 years. Patients undergoing THA with dementia had an increased risk of complications within 90 days, 2 years, and 5 years postoperatively. The overall rate of complications was low, and a diagnosis of dementia should not be an absolute contraindication to proceeding with total joint arthroplasty. Further studies are needed to validate these findings and to evaluate the influence of other factors, such as the severity of dementia, on postoperative complications.

## Conflicts of Interest

Paul King reports being a paid consultant for Smith and Nephew; has received research support from a company as a principal investigator from DePuy and Firstkind LTD; and is a part of the Journal of Arthroplasty editorial board. James MacDonald is a part of Speakers bureau of and has received research support from a company as a principal investigator from Smith and Nephew. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101359.

## CRediT authorship contribution statement

**Andrea H. Johnson:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Jane C. Brennan:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation. **Paul J. King:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Justin J. Turcotte:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **James H. MacDonald:** Writing – review & editing, Supervision, Resources, Conceptualization.

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