



# Obesity, Morbid Obesity and their Related Medical Comorbidities are Associated with Increased Complications and Revision Rates after Unicompartmental Knee Arthroplasty



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## ABSTRACT

Recent studies have demonstrated clinical success in expanding the indications for unicompartmental knee arthroplasty (UKA) to patients with increased body mass index (BMI). This study utilized national databases to identify 15,770 unique patients who underwent UKA between 2005 and 2011. 18.7% of patients undergoing a UKA were obese or morbidly obese. Univariate analysis demonstrated that obesity and morbid obesity were associated with significantly higher complication rates within 90 days postoperatively compared to non-obese patients. The overall short-term revision rate in obese and morbidly obese patients undergoing UKA was almost twice as high as the revision rate in non-obese patients. Obese and morbidly obese patients being considered for UKA should be counseled preoperatively regarding their increased risk of postoperative complications and revision surgery.

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Unicompartmental knee arthroplasty (UKA) is a valuable surgical option in patients with arthritis limited to a single compartment of the knee. UKA has several proposed advantages over total knee arthroplasty (TKA), including preservation of bone stock, shorter recovery, lower perioperative complications, improved function, and lower cost [1,2]. While knee arthroplasty utilization has increased over the past couple of decades, so too has obesity [3]. Not surprisingly, many patients undergoing total joint arthroplasty are obese and the effect of obesity on surgical outcomes is of interest to providers and patients.

Body weight is a potentially modifiable risk factor for knee osteoarthritis (OA) and obesity increases the risk for the initiation and progression of knee OA [4–6]. In the studies of patients who have undergone total knee and hip arthroplasty, adverse events have been demonstrated to occur more commonly in obese patients, including dislocation, aseptic loosening, superficial infection, and revision surgery [7–10]. Less is known about the influence of obesity on UKA outcomes.

Historically, the indications for UKA were older (>60 years), lower-weight (less than 82 kg), lower-demand patients [11]. Multiple studies have corroborated these strict indications and have shown that increased weight leads to worse functional outcome scores, implant failure, and higher revision rates in patients undergoing UKA [12–14]. However, the indications for UKA are changing and many historical contraindications, such as weight less than 82 kg, are being challenged. Recent studies have demonstrated success in expanding the use of UKA to

heavier patients [15–17]. A recent study retrospectively reviewed 1000 mobile bearing UKAs and found no significant outcome difference, failure rate or survival between UKAs performed in ideal weight patients compared to non-ideal [16]. Another retrospective series of nearly 500 patients found that BMI greater than 30 did not affect clinical outcome or implant survivorship [18]. A retrospective review of 212 mobile bearing UKAs found that 10-year survival rates were similar between subgroups, whether stratified by BMI or weight [17]. While informative, all of these studies have been small and retrospective in nature and results have often been contradictory.

To our knowledge, there is no large national database study looking at the effect of obesity or morbid obesity on postoperative complications in patients undergoing UKA. The goal of this study is to assess the association of obesity, morbid obesity and their related medical comorbidities with the risk of postoperative complications and need for revision surgery in patients undergoing UKA.

## Materials and Methods

Data in this study were collected from the PearlDiver Patient Record Database (PearlDiver Inc, Fort Wayne, IN). The PearlDiver database is a publicly available, Health Insurance Portability and Accountability Act (HIPAA)-compliant national database. The database specifically has more than 2 billion individual patient records and contains Current Procedural Terminology (CPT) and *International Classification of Diseases, 9th Revision* (ICD-9) codes related to orthopedic procedures.

There are two sub-databases within PearlDiver: a private-payer database and a Medicare-based database. The private-payer database has over 30 million individual patient records from 2007 to 2011. The

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Medicare database has over 100 million individual patient records from 2005 to 2011. To prevent overlap of patients between the two databases or counting patients who used both private and Medicare insurances for a single procedure, all patients from the private-payer database were restricted to age less than 65 years and all patients from the Medicare database were restricted to age greater than 65.

The database was queried for UKA using CPT code 27446 (arthroplasty, knee, condyle and plateau; medial OR lateral compartment). The dataset included both private payer (age < 65) and Medicare (age > 65) data. This search yielded procedural volumes, gender distribution, and age distribution for the CPT code. UKA patients were then divided into morbidly obese, obese and non-obese cohorts using ICD-9 codes for morbid obesity (BMI 40 and over): 278.01, V85.4, V85.41–V85.45, and obesity (BMI between 30 and 39): 278.00, V85.3, V85.30–V85.39.

The morbidly obese, obese, and non-obese cohorts were queried for basic demographics including gender, age (<65, 65–80, >80) and smoking status. Comorbidities for each cohort were assessed, including diabetes mellitus (DM), obstructive sleep apnea (OSA), hyperlipidemia (HLD), hypertension (HTN), peripheral vascular disease (PVD), congestive heart failure (CHF), coronary artery disease (CAD), chronic kidney disease (CKD), chronic lung disease, and chronic liver disease (CLD) using ICD-9 codes for each disease.

Each cohort was then assessed for major complications within 90 days postoperatively, including pulmonary embolism (PE), deep vein thrombosis (DVT), postoperative infection, postoperative irrigation and debridement (I&D), myocardial infarction (MI), and respiratory failure. Each cohort was also assessed for minor complications, including postoperative stiffness, manipulation under anesthesia, (MUA), urinary tract infection (UTI), pneumonia, acute renal failure (ARF), cerebrovascular accident (CVA), acute cholecystitis, and need for blood transfusion. In addition, each cohort was assessed for local complications (postoperative infection, postoperative I&D, stiffness, MUA), medical complications (MI, respiratory failure, CVA, UTI, pneumonia, ARF), and separately for VTE (PE and/or DVT), infection (diagnosis and/or I&D), and stiffness (diagnosis and/or MUA).

Due to potential HIPAA concerns, the PearlDiver database will not output patient numbers less than 11. Complications were grouped into “major”, “minor”, “local”, and “medical” categories to assure sufficient numbers were achieved to obtain output from the database. Additionally, overall revision rates, as defined by CPT codes, were compared between the morbidly obese, obese, and non-obese cohorts. Please refer to Table 1 for a list of all CPT and ICD-9 codes used in the study.

Statistical comparisons were made with chi-square linear-by-linear association analysis with  $P < 0.05$  considered significant. Chi-square tests, 95% confidence intervals, and odds ratios were calculated using SPSS, version 21.

## Results

15,770 unique patients underwent a UKA in the PearlDiver database over the 7-year period between 2005 and 2011. 2942 of these patients (18.7%) were coded as obese or morbidly obese. Obese and morbidly obese patients were more likely to be female and smokers ( $P < 0.0001$ ).

Obese and morbidly obese patients had higher rates of all assessed medical comorbidities, including DM, OSA, HLD, HTN, PVD, CHF, CAD, CKD, COPD, and CLD compared to non-obese patients ( $P < 0.0001$ ). The highest associations were found between patients with or without obesity for the following comorbidities: DM [42.6 vs. 21.9%, respectively ( $P < 0.0001$ )] and OSA [20.5 vs. 4.5%, respectively ( $P < 0.0001$ )]. When compared to obese patients, morbidly obese patients had a higher rate of OSA ( $P < 0.0001$ ). Interestingly, morbidly obese patients had a lower rate of HLD than obese patients ( $P < 0.0001$ ). Aside from OSA and HLD, there are no significant differences in the remaining comorbidities between obese and morbidly obese. Table 2 provides a comparison of patient characteristics between the morbidly obese, obese, and non-obese cohorts.

**Table 1**  
CPT and ICD-9 Codes Used in Study.

| Description                                                                                         | CPT/ICD-9 Code                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Obesity and morbid obesity                                                                          |                                                                                                                                                                                                                                                              |
| Morbid obesity (BMI 40 and over)                                                                    | ICD-9 278.01, V85.4, V85.41–V85.45                                                                                                                                                                                                                           |
| Obesity (BMI between 30 and 39)                                                                     | ICD-9 278.00, V85.3, V85.30–V85.39                                                                                                                                                                                                                           |
| Postoperative complications                                                                         |                                                                                                                                                                                                                                                              |
| Pulmonary embolism (PE)                                                                             | ICD-9 415.1, 415.11, 415.19                                                                                                                                                                                                                                  |
| Deep vein thrombosis (DVT)                                                                          | ICD-9 453.4, 453.40, 453.41, 453.42                                                                                                                                                                                                                          |
| Diagnosis of postoperative infection                                                                | ICD-9 998.5, 998.51, 998.59, 711.9, 996.66, 996.69                                                                                                                                                                                                           |
| Postoperative irrigation and debridement                                                            | CPT 23030, 23031, 23040, 29820, 29821, 29822, 29823                                                                                                                                                                                                          |
| Acute myocardial infarction                                                                         | ICD-9 410.00–410.02, 410.10–410.12, 410.20–410.22, 410.30–410.32, 410.40–410.42, 410.50–410.52, 410.60–410.62, 410.70–410.72, 410.80–410.82, 410.90–410.92                                                                                                   |
| Respiratory failure                                                                                 | ICD-9 518.0, 518.51, 518.52, 518.81, 518.82                                                                                                                                                                                                                  |
| Stiffness requiring manipulation under anesthesia                                                   | CPT 27570                                                                                                                                                                                                                                                    |
| Urinary tract infection                                                                             | ICD-9 098.0, 098.1, 098.10, 098.19, 599.0                                                                                                                                                                                                                    |
| Pneumonia                                                                                           | ICD-9 480.0–480.9, 481, 482.0–482.9                                                                                                                                                                                                                          |
| Acute renal failure                                                                                 | ICD-9 584.5–584.9, 580.0–580.9, 586                                                                                                                                                                                                                          |
| Cerebrovascular accident                                                                            | ICD-9 430, 431, 432.0, 432.1, 432.9, 433, 433.0, 433.00, 433.01, 433.1, 433.10, 433.11, 433.2, 433.20, 433.21, 433.3, 433.30, 433.31, 433.8, 433.80, 433.81, 433.9, 433.90, 433.91, 434, 434.0, 434.00, 434.01, 434.1, 434.10, 434.11, 434.9, 434.90, 434.91 |
| Acute cholecystitis                                                                                 | ICD-9 574.0, 574.3, 574.1, 575.0, 575.12, 574.4, 574.6, 574.8, 575.10                                                                                                                                                                                        |
| Postoperative blood transfusion                                                                     | CPT 36430, ICD-9 V58.2, 990.0, 990.2, 990.3, 990.4                                                                                                                                                                                                           |
| Revision knee surgery                                                                               |                                                                                                                                                                                                                                                              |
| Revision of total knee arthroplasty, with or without allograft; femoral and entire tibial component | 27487                                                                                                                                                                                                                                                        |
| Revision of total knee arthroplasty, with or without allograft; 1 component                         | 27486                                                                                                                                                                                                                                                        |

Obese and morbidly obese patients undergoing UKA had significantly higher major complication rates within 90 days postoperatively compared to non-obese patients ( $P < 0.0001$ ). Obesity was associated with a two-fold greater risk of major complications (5.3 vs. 2.3%, respectively) (OR 2.3, 95% CI [1.9–3.0],  $P < 0.0001$ ). Morbid obesity was associated with a three-fold greater risk of major complications (7.2 vs. 2.3%, respectively) (OR 3.2, 95% CI [2.5–4.2],  $P < 0.0001$ ). Morbidly obese patients had a higher major complication rate than obese patients but this difference approached statistical significance (OR 1.4, 95% CI [1.0–1.9],  $P = 0.057$ ) [Tables 3 and 4].

Minor complication rates within 90 days postoperatively were significantly higher in obese and morbidly obese patients undergoing UKA compared to non-obese patients ( $P < 0.0001$ ). Obesity was associated with more than a two-fold greater risk of minor complications (9.8 vs. 4.1%, respectively) (OR 2.5, 95% CI [2.1–3.0],  $P < 0.0001$ ). Morbid obesity was associated with more than a three-fold greater risk of minor complications (13.0 vs. 4.1%, respectively) (OR 3.5, 95% CI [2.8–4.2],  $P < 0.0001$ ). The difference in minor complication rates between morbidly obese and obese patients was statistically significant (OR 1.4, 95% CI [1.1–1.7],  $P = 0.012$ ) [Tables 3 and 4].

While there was no difference in local complication rates between obese and non-obese patients, morbidly obese patients had significantly higher rates of local complications than obese or non-obese patients (6.7% vs. 3.7% or 3.4%, respectively) ( $P < 0.0001$ ). Medical complication rates were higher in obese and morbidly obese patients compared to non-obese patients (10.4% and 7.8% vs. 2.0%, respectively) ( $P < 0.0001$ ). In addition, morbidly obese patients had a significantly

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