Is Socioeconomic Status a Risk Factor for Stiffness After Total Knee Arthroplasty? A Multicenter Case-control Study

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KEYWORDS

• Total knee arthroplasty • Arthrofibrosis • Manipulation • Socioeconomic status

KEY POINTS

- Socioeconomic factors appear to play a role in functional outcomes following total knee arthroplasty.
- Black and young patients are at increased odds for manipulation following total knee arthroplasty.
- Patients should be identified and counseled regarding risk of arthrofibrosis and need for manipulation.

INTRODUCTION

Total knee arthroplasty (TKA) remains a successful surgical intervention for patients suffering from debilitating pain from degenerative joint disease. Multiple studies have not only documented the long-term survivorship of TKA, but also the dramatic functional improvement that occurs following surgery.[1–3] In general, the perioperative morbidity and mortality following TKA is low, and complications, such as infection, aseptic loosening, and polyethylene wear, are relatively uncommon.[4–7]

Arthrofibrosis (stiffness) is a common complication following TKA, occurring in 8% to 60% of patients.[8–13] Defined as limited range of motion (ROM), arthrofibrosis or stiffness can dramatically affect a patient's quality of life, leading to poor functional outcomes, pain, and limitation of activities of daily living. It has been shown that patients

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require approximately 90° of flexion to ambulate and walk on inclines and up to 110° to climb stairs, sit, and get up from a chair comfortably.[14,15]

When physical therapy fails to improve motion, physicians most often recommend a manipulation under anesthesia. Manipulation is the most common, noninvasive procedure to treat stiffness following TKA. This procedure allow for passive improvement in ROM by the surgeon on the operative knee to break adhesions and improve motion. Most of the literature reports only modest improvement (approx 30° improvement in flexion) with manipulation as treatment.[16–23] Because of the significant functional limitations that can develop with arthrofibrosis following TKA, and oftentimes suboptimal improvements with manipulation of the stiff knee, it is important to identify factors that predispose patients to the development of arthrofibrosis to determine strategies to prevent its occurrence.

A patient's preoperative ROM has long thought to be the most important sole determinant of postoperative ROM following TKA, and thus the most important predictor of the need for manipulation.[12,24,25] Recent data, however, suggest a significant disparity in functional outcomes following TKA based on race, ethnicity, and socioeconomic status.[26,27] The purpose of our study was to determine if race, gender, body mass index (BMI), and insurance type were risk factors for manipulation following TKA.

METHODS

We performed a multicenter retrospective case-control study. Each of the 3 centers obtained institutional review board approval. The cases and controls were identified by queries of institutional practice management systems and institutional prospective patient registries. All referral cases were excluded. Cases were defined as manipulations for postoperative TKA stiffness. Controls were defined as patients with total knee replacement who did not require a manipulation. The control group was randomly selected using a 2:1 ratio and controls were stratified by center and physician.

Medical records were reviewed to document the following: dates of primary knee replacement, dates of manipulation, age at the date of the primary total knee replacement surgery, gender, race/ethnicity, insurance type, BMI, and femoral component design. Age was defined as a categorical variable with age groups stratified as follows: 0 to 44 years, 45 to 64 years, 65 to 74 years, and older than 75 years. Race/ethnicity was categorized as white, Black, Hispanic, other, and unknown. BMI was categorized using the World Health Organization's definition (**Table 1**). Insurance type was identified as private, Medicare, Medicaid, other, and unknown. Femoral component design was defined as a single radius or multi-radius curvature.

Between May 2004 and December 2010, 1557 patients met the eligibility criteria. Of these 1557 patients, 521 required a manipulation following primary total knee replacement surgery (cases) and 1036 patients did not require a manipulation following primary total knee replacement surgery (controls). Of the 1557 patients, 951 (61.1%) were female, 606 (38.9%) were male, and the average age was 63.7 years (30.2–90.3 years).

Standard univariate descriptive statistics were calculated, including mean, frequency, and proportions. A bivariate analysis was performed using a chi-square test to determine statistical differences in proportions between dichotomous or categorical variables. Additionally, an independent *t* test was used to assess differences in means for continuous variables. Multiple logistic regression analysis was used to determine the associations between race, gender, BMI, age, femoral component design, and insurance type and the need for manipulation to treat postoperative stiffness.

RESULTS

Bivariate Analyses

With the numbers available, there were no significant differences with respect to gender ($P = .16$), BMI ($P = .58$), or femoral component design ($P = .52$), between the 2 groups. See **Table 1** for complete bivariate results. There was a significant ($P<.0001$) difference in age. The control group was significantly older with a mean age of 65.4 years compared with the mean age of the manipulation group of 60.2 years (30.2–86.7 years). There was a significant ($P<.0001$) effect of race/ethnicity. Overall, most patients were white; however, there was a higher proportion (13%) of Black patients who required a manipulation compared with those who did not (6%). There was also a significant ($P<.0001$) association with insurance type. Of the 521 cases, 330 (63.3%) had private insurance coverage compared with 43.5% of the control group. Conversely, 52% (539 of 1036) of the control group had Medicare coverage compared with 29.6% (154 of 521) of the cases.

Multivariate Analyses

As compared with whites, Black patients had a twofold increase in the odds of undergoing a manipulation (odds ratio [OR] 2.13, 95% confidence interval [CI] 1.46–3.11). Patients younger than 45 years had twice the odds of undergoing