Does the type of medical insurance influence outcome after hip or knee total joint replacement?

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Abstract:

Introduction:

The purpose of this study was to determine if Medicaid, Medicare and private patients undergoing primary total knee and hip arthroplasty reported different outcome scores.

Methods:

From 2014-2016, 1076 patients that underwent a total hip arthroplasty and 1936 patients that underwent a total knee arthroplasty and completed a series KOOS/HOOS patient reported outcomes surveys. Available demographic information included gender, age, BMI and payer status.

Baseline (pre-surgery) , 3-month and 1-year post-surgery survey responses were collected utilizing a web-based data collection system and reporting platform. Parametric and non-parametric methods of comparing central tendency measures for the captured responses between the insurance types (Medicare, Medicaid, BCBS, Private) were utilized to determine if significant differences exist. The difference between the baseline (pre-op) of the HOOS and KOOS score was calculated as delta, the difference between baseline and 3 months, baseline and 12 months and 3 months to 12 months.

Results:

The average overall KOOS and HOOS score at base line (pre-op) was 42.8 (KOOS) and 36.9 (HOOS). The average score at 3 months for KOOS and HOOS was 73.8 and 81.7 respectively. At one year the average score for the KOOS and HOOS was 81.2 and 86.5 respectively.

The delta changes for the HOOS score in patients with Medicare at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 45.1, 49.3 and 4.45 respectively. The delta changes for the HOOS score in patients with Medicaid at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 47.7, 42.6 and -0.25 respectively. The delta changes for the HOOS score in patients with BCBS/Manage at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 44.1, 49 and 4.88 respectively. The delta changes for the HOOS score in patients labeled as other/private at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 44.4, 49.7 and 4.81 respectively.

The delta changes for the KOOS score in patients with Medicare at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 30.7, 36.7 and 6.03 respectively. The delta changes for the KOOS score in patients with Medicaid at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 26.4, 32.6 and 9.25 respectively. The delta changes for the KOOS score in patients with BCBS/Manage at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 32, 39.4 and 7.79 respectively. The delta changes for the KOOS score in patients with other/private at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 31.3, 39.3 and 7.19 respectively.

Conclusion:

Overall, the best reported outcome for the HOOS and HOOS was at 1 year, with minimal improvement between the 3 months follow up and 12 month follow up. At one year, there was no significant difference in KOOS/HOOS score for all three payer types. Medicaid and private insurance patients were significantly younger than Medicare patients (p<0.001). There was no significant difference in gender or BMI characteristics.

Medicaid payer status was associated with lower improvement in KOOS and HOOS scores at one year post total knee arthroplasty or hip arthroplasty, compared to patients having Medicare or private health insurance. The difference at 3 month or, 3 to 12 months post-surgery was minimal. The data supports performing total knee replacements or hip arthroplasty in the Medicaid population. Additional investigation may shed light on why Medicaid patients demonstrate a slower recovery on patient reported outcome surveys.

Introduction

The evolution of total joint arthroplasty

Patients that have failed conservative medical therapy for the treatment of chronic refractory joint pain and/or injury are encouraged to undergo a joint arthroplasty. Stability, mobility and freedom from pain are requirements of a normal joint. Some conditions that could lead to total joint arthroplasty (TJA) include inflammatory arthritis, fracture, dysplasia, malignancy and others. TJA is becoming increasingly common and as the US population ages, growth in total joint arthroplasty is expected to increase [1]. Two of the major procedures of total joint replacement are the total knee arthroplasty (TKA) and total hip arthroplasty (THA). Total knee arthroplasty and total hip arthroplasty are two types of surgical procedures in which parts of the joint are replaced with artificial parts [2]. The procedures are becoming more and more common had been proven to reduce pain and improve the quality of life in patients with knee and hip disorders [2].

The first reported successful knee arthroplasty was reported in 1861 and five years following the procedure the patient was said to have been satisfied with the result [3]. In 1890, during various medical conferences, physicians described a system of total replacement of joints by units made of ivory [3]. The use of metallic parts during knee arthroplasty began in the early 1940's, and hinged knee replacements units were first used in the late 1950's [3]. In the 1960's, in Europe, John Charnley and G.K. Mkee came up with the greatest advancement in knee arthroplasty with the development of non-hinged total knee replacement units [3]. The idea was based on the principle that prosthetic components could be firmly fixed in bone with acceptable

materials. Today, over 19 companies in the United States distribute total knee implants of different types [4].

The earliest attempt that is recorded and intended to replace a hip occurred in Germany in 1891, with the use of ivory to replace femoral heads of patients whose hip joints had been destroyed by tuberculosis [5].   In 1925 doctor Marius Smith-Peterson created the first mold arthroplasty out of glass and ultimately refined it to stainless steel thus creating the first total hip replacement that was fitted with bolts and screws [5]. In the early 1960's, doctor Sir John Charnley designed the first low friction arthroplasty, by using a small femoral head which reduces wear due it its smaller surface area   and is considered the father of the current THA [5]. After 50 years of "modern" THA, over 75,000 joint replacements are performed each year within the NHS [6]. Due to the increasingly successful operations, techniques have become standardizes and the average age of those receiving hip replacement has reduced.

Over the past ten to fifteen years the numbers of THAs and TKAs performed in the United States has increased [7]. It is estimated the by 2030 the demand for primary THA is estimated to grow to 572,000, an increase of 174% [7]. The demand for primary total knee arthroplasties is estimated to grow by 683%, or 3.48 million procedures [7]. The rates will vary by differences in socioeconomic status, healthcare delivery system and patient preference. Disparities have been noted based on ethnicity, gender and region and while important advancements have been made in joint arthroplasty outcomes the rise in population and the decrease in trained arthroplasty surgeons will lead to a decreased access to total joint arthroplasty and/or revision by creating a supply-demand imbalance and equity [2].

Hip disability and osteoarthritis outcome score (HOOS) and Knee Injury and Osteoarthritis

Outcome Score (KOOS)

The HOOS is intended to evaluate symptoms and functional limitations related to the hip and it has 40 items that are arranged in five subscales: pain, symptoms, activities of daily living, sport and recreation function and hip related quality of life [8]. With an increased life span and improved health, the standard of outcome after a THA also increases. Some of the main goals for the surgery is getting rid of the pain and improve physical function. Responsiveness to clinical change is an important part of an outcome measure. For example, the HOOS survey is used as a outcome measuring tool, with previous studies showing that younger patients obtain a better postoperative outcome than older patients [8].

The KOOS is a comprehensive measuring tool also made of five separate scored subscales: pain other symptoms, function in daily living, function in sport and recreation, and knee- related quality of life [9]. It is a short, self-administered survey that has been validated for several orthopaedic interventions such anterior cruciate ligament reconstruction, meniscectomy and total knee replacement. The tool was developed precisely with the purpose of covering several types of knee injuries which can later lead to development of osteoarthritis [9].

Both surveys, the HOOS and KOOS are measuring tools that are extensions of the Western Ontario And MacMaster Universities Osteoarthritis Index (WOMAC) [8,9]. Standardized answer options are given (5 Likert boxes) and each question is assigned a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale. The WOMAC assesses pain, stiffness and physical functions in patients with

hip and/or knee osteoarthritis. The use of KOOS and HOOS as outcome measuring tools in patients with TJA is supported by available literature [8,9].

Medical Insurance vs Surgical Outcome

Multiple medical studies, public health initiative and current health care investigations show that socioeconomic and insurance status influence medical outcomes, including major surgical interventions [10]. According to the US Census Bureau from 2007 to 208, number of uninsured Americans increased from 45. 7 to 46.3 million, the numbered covered by private insurance decreased from 202 to 201 million and the numbers of people covered by government insurance increased from 83 to 87.4 million [11] Even with the passage of the Affordable Care Act, studies still show a strong correlation between socioeconomic status and health outcome.

Recent medical studies that focus on the impact of primary payer and insurance status with various surgical subspecialties demonstrate that type of insurance predicts disease severity at time of treatment and post-procedure outcome [12-14]. In a study by Giacovelli et al (2008), insurance status was demonstrated to predict disease severity among a vascular surgery population of over 225,000 patients and most recently a study that represents the largest and most comprehensive review of contemporary outcomes for major surgery indicate that Medicaid and Uninsured payer status discusses worse unadjusted and adjusted outcomes compared with that of private insurance [10].

General surgery literature research articles have shown that racial, sex, and socioeconomic disparities are correlated with worse outcomes, including a higher risk of mortality [15,16]. Total joint arthroplasty studies have shown some similar findings, showing that patients that are minorities have decreased rates of use [17] and higher rates of postoperative

complications [17], and that men have higher complication rates than women [15,16]. However, few studies have investigated disparities amongst insurance payer types in total joint arthroplasty.

Rationale

Multiple studies across varying surgical specialties have examined the effect of insurance provider on satisfaction rates and complication rates. However, the disparity between the different types of insurance payer in total joint arthroplasty is poorly understood and very little has been done to examine how patient reported outcomes (PROs) are affected after total joint arthroplasty [1,18]. This study will provide a better understanding of the relationship between the type of patient insurance and total joint arthroplasty. It will also provide valuable information for internal examination of costs and outcomes that can be used to model the effect of various insurance types on bundle payment reimbursement.

Significance

Insurance payer type has been identified as a significant predictor of basic primary care outcome such as glycemic control in diabetes, vaccinations, and overall health care use in various medical studies [18]. Subjects studied are members of the four major payer groups: private insurance, Medicare, Medicaid or the state supplemental insurance plan provided by the state of Arizona called AHCSS. Access to healthcare has been shown to vary with the insurance type and equity in access to health care is a focal point of debate and research [18,19]. The disparities between the various insurance payer types have been shown to be significant contributors to morbidity and mortality [18].

Few studies have investigated differences in payer status and outcome in TJA patients. Some studies suggest that Medicaid patients face great difficulty gaining access to healthcare and

patients that are socially deprived tent to undergo surgery at an earlier age, have more comorbidities, greater severity of symptoms, are not as satisfied as other type payer status [20,21]. Further research should be conducted in order to investigate available resources to the different payer status in order to identify factors that can and should be modified to improve the outcome of TJA in the different group of patients.

Methods

The study was conducted with previous patients that underwent THA or TKA with OrthoArizona a local private practice in Maricopa Country that has over 65 premier musculoskeletal specialists. The orthopedic surgeons and primary care physicians specialize in all areas of orthopedic care including sports medicine, spine, shoulder and elbow, hand and wrist, hip and knee, foot and ankle, podiatry, pediatrics, trauma, industrial injuries and workers' compensation.

There was a total of 3012 patient charts reviewed with 1076 patients that underwent a total hip arthroplasty and 1936 patients that underwent a total knee arthroplasty. Patients eligible for analysis were identified by the administrative office coding staff (CODE team) based on procedure codes to THR and TKR. The only available information available to study was: sex, age, marital status, race, payer status, hospital where procedure was performed, ICD code, type of implant and BMI (Table 1)

The pre-operative, 3 month and 1 year post-operative HOOS Jr and KOOS Jr survey responses were used in concert with responses to experience and complication incident questions from patients having primary THA and TJA procedures respectively during 2014-2016. Data was collected utilizing a novel web-based data collection system and reporting platform that

functions outside the office. The response information was categorized by various forms of public and private health insurance information obtained from EMR records. Parametric and non-parametric methods of comparing central tendency measures for the captured responses between the public and private insurance types were deployed to assess significant differences.

The focus of this study is to identify if the type of insurance that the patients presents with, will influence the outcome of a total joint arthroplasty. The outcome is studied by collecting and interpreting hip and disability osteoarthritis outcome score (HOOS) and knee injury and osteoarthritis outcome score (KOOS). The HOOS and KOOS scores are outcome measurement tools that are considered patient relevant outcomes and are now considered primary outcome measure in clinical trials [8,9,22].

For analysis, insurance status will be grouped into four categories according to the primary coverage: Medicaid (including all stated funded programs), Federal (Medicare, Tri Care, and all other programs funded by the federal government), Commercial (all group and individual plans), and Other (coverage that does not fall into one of the other three categories. To assess score changes from baseline to three months and one year follow up, a delta change in score would be used. The pre operative, 3-month and one year HOOS and KOOS scores will be compared between the categories of primary insurance coverage using appropriate statistical tests with a $p < 0.05$ chosen for statistical significance.

Demographics	Medicare N=1,606	Medicaid / Other Gov't N=90	BCBS/Manage N=829	Other Private N=487	P-value
Overall Population					
Age (mean, SD)	73.6 (5.61)	60.2 (10.6)	62.2 (7.96)	64.9 (8.76)	<0.001
Gender (male, %)	651 (40.5)	48 (53.3)	389 (46.9)	208 (42.7)	0.004
Ethnicity (white, %)	331 (20.6)	20 (22.2)	179 (21.6)	83 (17.0)	0.001
BMI, kg/m^2 (mean, SD)	29.2 (4.93)	32.7 (4.63)	30.2 (5.67)	30.6 (5.71)	0.21
Marital Status (n, %)					0.33
Never Married	28 (1.74)	6 (6.67)	22 (2.65)	6 (1.23)	
Married	275 (17.1)	17 (18.9)	166 (20.0)	72 (14.8)	
Divorced/Widowed	33 (2.05)	2 (2.22)	23 (2.77)	8 (1.64)	
HOOS Population	Medicare N=550	Medicaid / Other Gov't N=31	BCBS/Manage N=327	Other Private N=168	
Age (mean, SD)	73.6 (5.65)	54.7 (10.7)	61.1 (8.24)	64.1 (9.19)	<0.001
Gender (male, %)	217 (39.5)	17 (54.8)	158 (48.3)	74 (44.1)	0.03
Ethnicity (white, %)	124 (22.6)	9 (29.0)	85 (25.9)	23 (13.7)	0.13
BMI, kg/m^2 (mean, SD)	27.1 (4.74)	N/A	30.3 (5.48)	27.4 (5.08)	0.04
Marital Status (n, %)					0.65
Never Married	12 (2.18)	14 (4.28)	14 (4.28)	1 (0.60)	
Married	100 (18.2)	71 (21.7)	71 (21.7)	20 (11.9)	
Divorced/Widowed	9 (1.64)	9 (2.75)	9 (2.75)	3 (1.79)	
KOOS Population	Medicare N=1,056	Medicaid / Other Gov't N=59	BCBS/Manage N=502	Other Private N=319	
Age (mean, SD)	73.6 (5.59)	63.0 (9.51)	62.9 (7.68)	65.3 (8.52)	<0.001
Gender (male, %)	434 (41.1)	31 (52.5)	231 (46.0)	134 (42.0)	0.14
Ethnicity (white, %)	207 (19.6)	11 (18.6)	94 (18.7)	60 (18.8)	0.002
BMI, kg/m^2 (mean, SD)	29.9 (4.82)	32.7 (4.63)	30.1 (5.81)	31.6 (5.59)	0.18
Marital Status (n, %)					0.21
Never Married	16 (1.52)	5 (8.47)	8 (1.59)	5 (1.57)	
Married	175 (16.6)	11 (18.6)	95 (18.9)	52 (16.3)	
Divorced/Widowed	24 (2.27)	2 (3.39)	14 (2.79)	5 (1.57)	

Table 1 – Study Patient Demographics

Power and Sample Size analysis

The primary outcome for this power and sample size calculation is the change in HOOS and KOOS Score from baseline to 3 month to 1 year between insurance statuses. The total number of subjects in our data is approximately 3000 participants. If the mean difference in the change in HOOS and KOOS Scores between insurance statuses is equal to the standard deviation, 3000 patients will achieve a statistical power of > 99%. Further, 3000 patients will achieve a statistical power of > 99% if the standard deviation is 3x the mean difference.

Statistical analysis

Demographic and clinical characteristics will be assessed between insurance statuses using means, standard deviations for continuous variables and frequencies, proportions for categorical variables. The one-way ANOVA will be used to compare continuous variables and chi-squared for categorical variables.

Means and standard deviations will be estimated at 3 time points (pre, 3 months and 1 year). The repeated measures ANOVA will assess differences in HOOS and KOOS scores between time points. Finally, the Linear Mixed Model Equation will be used to ascertain the mean differences in the change in HOOS and KOOS scores between Pre and 3 months, Pre and 1 year, and 3months to 1 year between the insurance statuses using no insurance as the reference group.

Results

As expected, Medicaid and Private Insurance/Managed care were younger than Medicare patients ($p<0.001$) but there was no significant difference in gender or BMI characteristics. The average overall KOOS and HOOS score at base line (pre-op) was 42.8 (KOOS) and 36.9 (HOOS). The average KOOS and HOOS score at 3 months was 73.8 and 81.7 respectively. At one year the average KOOS and HOOS score was 81.2 and 86.5 respectively. To assess further the changes in KOOS and HOOS score the delta changes were calculated between the initial pre-op (baseline) score and the follow up visit at 3 months, 1 year and the changes between 1 year and 3 months follow up. The delta changes in the HOOS score in patients with Medicare at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 45.1, 49.3 and 4.45 respectively. The delta changes in the HOOS score in patients with Medicaid at baseline to 3

months, baseline to 12 months and 3 months to 12 months were 47.7, 42.6 and -0.25 respectively. The delta change in the HOOS score in patients with BCBS/Manage at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 44.1, 49 and 4.88 respectively. The delta change in the HOOS score in patients labeled as other/private at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 44.4, 49.7 and 4.81 respectively. The delta change in the KOOS score in patients with Medicare at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 30.7, 36.7 and 6.03 respectively. The delta changes for the KOOS score in patients with Medicaid at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 26.4, 32.6 and 9.25 respectively. The delta changes for the KOOS score in patients with BCBS/Manage at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 32, 39.4 and 7.79 respectively. The delta changes for the KOOS score in patients with other/private at baseline to 3 months, baseline to 12 months and 3 months to 12 months were 31.3, 39.3 and 7.19 respectively.
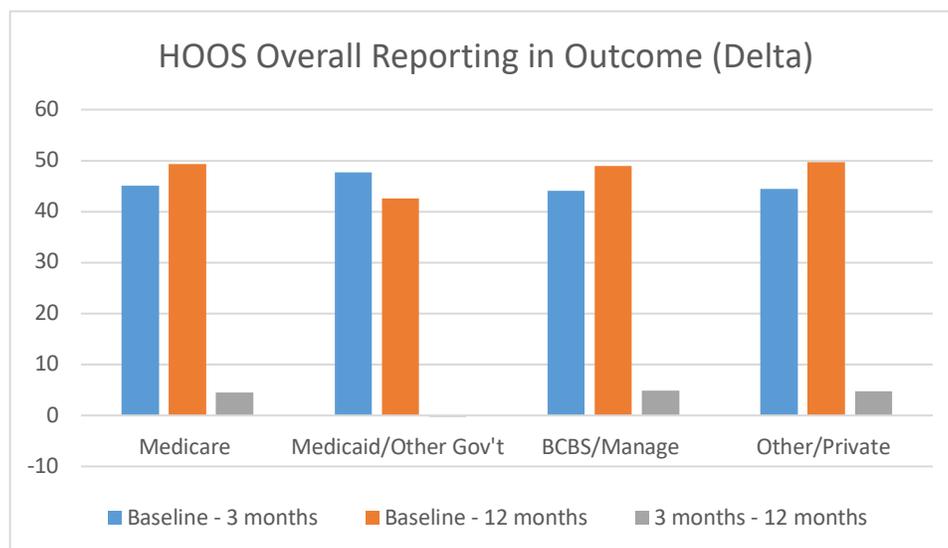
Graph 1 - HOOS Delta changes among different insurance status

KOOS Overall Reporting in Outcome (Delta)
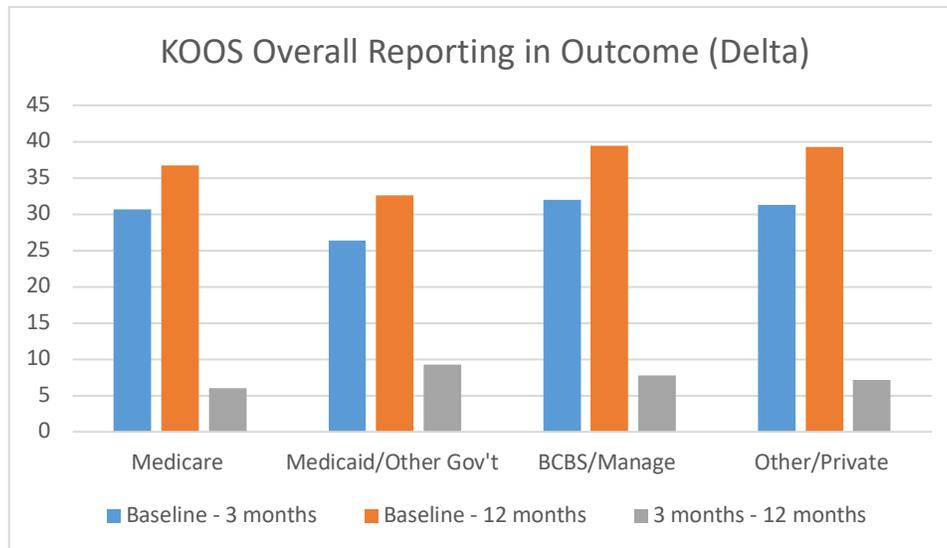
Graph 2- HOOS Delta changes among different insurance status

Conclusion

Medicaid payer status was associated with a lower KOOS overall and sub-category scores at 3 months post TKA compared to patients having Medicare or private health insurance. Further research should be conducted to investigate the causes for these differences.

The relative effect of surgeon on outcome is minimal and in our sample was similar in magnitude to the effect of patient gender. Surgical approach is not controlled and may represent physician comfort, training, or deliberate selection for patient factors. Future work will explore nested or combined models looking at longitudinal patient effects to see if similar trends hold. This analysis provides a robust model to quantitatively compare surgeons across procedures and patient variables.

The KOOS and HOOS pain, quality of life and symptoms scores were all predictive of patient satisfaction at 3 months post-operatively from primary total knee and hip arthroplasty, the overall KOOS/HOOS score was the strongest predictor. This study demonstrates the value of collecting and monitoring patient reported outcomes.

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