



# Fibromyalgia increases 90-day complications and cost following primary total hip arthroplasty

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**Background:** Fibromyalgia (FM) is known to cause chronic pain and impact multiple organ systems in addition to the musculoskeletal system. With the increasing prevalence of patients with FM undergoing primary total hip arthroplasty (THA), there is paucity in the literature regarding the impact of FM following primary THA. The purpose of the study was to compare complications in patients with and without FM undergoing primary THA, with the use of an administrative database.

**Methods:** A retrospective review was performed using the Medicare Standard Analytical Files from the PearlDiver database. Patients undergoing primary THA were queried using the International Classification of Disease, ninth revision (ICD-9) procedure code 81.51. Inclusion criteria for the study group consisted of patients undergoing primary THA with a diagnosis of FM 90 days prior to the procedure. Patients without FM undergoing THA served as controls. Patients in the study group were matched to controls according to age, gender, and Charlson-Comorbidity Index (CCI). Two mutually exclusive cohorts were formed and outcomes analyzed and compared included medical and implant complications, 90-day readmission rates, and cost. Statistical analysis was performed using to calculate odds-ratios (OR), 95% confidence intervals (95% CI), and their respective P values.

**Results:** After the matching process 152,206 patients were identified with (n=76,103) and without FM (n=76,103) undergoing primary THA. FM patients had greater odds of developing medical complications (2.88% vs. 1.43%; OR: 2.05; P<0.001), implant related complications (5.94% vs. 3.79%; OR: 1.60; P<0.001), 90-day readmission rates (12.5% vs. 11.6%; OR: 1.71; P<0.001) and total global 90-day episode of care cost (\$71,081.10 vs. \$70,969.65, P<0.001).

**Conclusions:** The study illustrates an increased risk of postoperative complications and higher costs in patients with FM following primary THA. Appropriate counseling and preoperative optimization could potentially mitigate and reduce these complications and costs.

**Keywords:** Fibromyalgia (FM); Medicare; database; complications; cost

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## Introduction

Total hip arthroplasty (THA) has been shown to be a cost effective and safe procedure with minimal outcomes (1). Recent studies have shown that there has been an increase in the number of THA procedures performed in the United States and is expected to grow exponentially (1). Kurtz *et al.* predict the number of primary THA procedures being performed will increase 174% to 572,000 annually (2). With the increasing number of THAs being performed, Orthopedic Surgeons continue to stay cognizant on patient reported outcome measurements (PROMs) as a method to track patient recovery and improvement (3). Identifying risk factors associated with adverse events and worse clinical outcomes prior to surgery, may mitigate postoperative complications and improve PROMs (3).

Currently, 2.1% of females and 1.8% of males are affected with fibromyalgia (FM), with the incidence of the disease continuing to increase (4). FM is characterized by chronic pain, fatigue, sleep disruption, and joint stiffness. Low *et al.* have identified painful experiences during infant development, physical and psychological trauma during childhood, maternal deprivation, and premature birth as being potential risk factors for developing FM; in addition to rheumatoid arthritis, female gender, family history and obesity (5-7). With the increasing prevalence of FM and number of primary THA procedures being performed, the impact of FM on postoperative outcomes and economic burden on THA has not been well established (2,7).

The purpose of this study was to determine whether patients undergoing primary THA with FM had poor postoperative outcomes compared to patients without FM, with the use of an administrative database. The researchers of this study hypothesize that patients with FM undergoing THA will have greater postoperative and implant related complications, 90-day readmissions, day of surgery costs and total global 90-day episode of care cost following the index procedure.

## Methods

A retrospective, Level III, analysis was performed from 2005–2014 using the Medicare Standard Analytical Files from the PearlDiver supercomputer (PearlDiver Technologies, Fort Wayne, IN). PearlDiver is a commercially available database used extensively for orthopedic-related research and is compliant with the Health Information Portability and Affordability Act (HIPAA) (8). The database contains

records of over 100 million patients providing information such as diagnosis, complications, procedures, length of stay (LOS), cost, and reimbursements; in addition to other information. Since PearlDiver contains de-identified information the study was exempt from International Review Board (IRB) approval. Patients in the study were queried using the International Classification of Disease, ninth revision (ICD-9) codes.

The inclusion criteria of the study included all patients in the database who underwent primary THA and were queried using ICD-9 procedure code 81.51. All patients with a diagnosis of FM were queried using ICD-9 diagnosis code 729.1. Using Boolean command operations, the study group consisted of all patients in the database with a diagnosis of FM 90 days prior to their index procedure and a diagnosis on the day of their procedure. Patients undergoing primary THA without FM served as the control group. Study group patients were matched to controls according to age, gender, and Charlson-Comorbidity Index (CCI). CCI is a measurement of morbidity and mortality and predicts worse outcomes with a higher score, and was used as a marker to ensure that the two groups were matched appropriately and no statistical significance existed (9). After the matching process, two mutually exclusive cohorts were formed. Medial and implant related complications were analyzed and compared through ICD-9 coding, using previously described techniques (9) (Table S1).

Additionally, 90-day readmission rates and cost were also analyzed and compared. 90-day was chosen as the time period for medical complications, readmission rates, and reimbursements as that is the time frame in accordance with the bundled payment care initiative (BPCI) set forth by the Center of Medicare and Medicaid Services (CMS) for joint arthroplasty (9). Reimbursements were used as a marker for cost, since it provides accurate information as to what providers were paid through insurance companies (9).

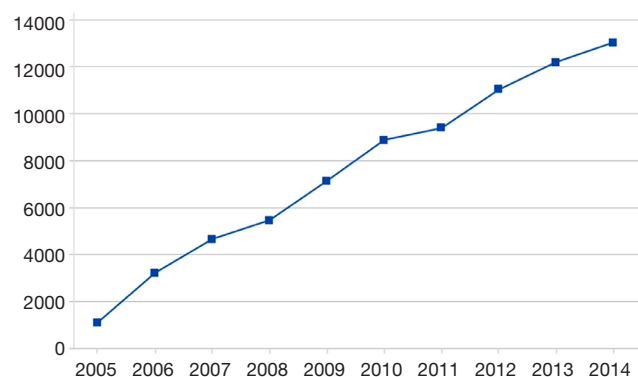
Statistical analysis was performed using the programming language R (University of Auckland, New Zealand) to calculate odds-ratios (OR) along with their respective 95% confidence interval (95% CI) and P value. A P value of <0.05 was considered statistically significant.

## Results

After the matching process, a total of 152,206 patients (female =113,152; male =37,238; unknown =1,816) with (n=76,103) and without (n=76,103) FM underwent primary

**Table 1** Demographics of patients with and without fibromyalgia undergoing primary total hip arthroplasty within the Medicare population

Demographics	Size (%)
Age (years)	
<64	32,474 (21.33)
65–69	41,360 (27.17)
70–74	32,104 (21.09)
75–79	25,058 (16.46)
80–84	14,086 (9.25)
>85	5,308 (3.48)
Unknown	1,816 (1.19)
Gender	
Female	113,152 (74.34)
Male	37,238 (24.46)
Unknown	1,816 (1.19)



**Figure 1** Annual trends of patients with fibromyalgia undergoing primary total hip arthroplasty within the Medicare population from 2005–2014.

THA between 2005–2014 (*Table 1*). Comparison of CCI scores of both cohorts was  $5.68 \pm 2.31$ , with a P value of 1.00 indicating the study and control group were matched (*Table 1*). The calculated annual growth rate (CAGR) of patients with FM undergoing primary THA in the Medicare population was 31.54% (*Figure 1*).

### 90-day medical complications

Patients with FM undergoing primary THA were at

greater odds and incidence of developing 90-day medical complications (2.88% *vs.* 1.43%; OR: 2.05, 95% CI: 1.91–2.21,  $P < 0.001$ ) such as shortness of breath (OR: 3.38, 95% CI: 2.64–4.32,  $P < 0.001$ ), cerebrovascular accidents (OR: 3.27, 95% CI: 1.66–6.43,  $P < 0.001$ ), pneumonia (OR: 2.67, 95% CI: 1.86–3.85,  $P < 0.001$ ), non-healing surgical wound (OR: 2.27, 95% CI: 1.11–4.62,  $P < 0.001$ ), urinary tract infections (OR: 2.10, 95% CI: 1.82–2.43,  $P < 0.001$ ), acute post-hemorrhagic anemia (OR: 1.95, 95% CI: 1.70–2.25,  $P < 0.001$ ), thrombocytopenia (OR: 1.84, 95% CI: 1.05–3.22,  $P = 0.032$ ), requiring transfusions (OR: 1.69, 95% CI: 1.36–2.10,  $P < 0.001$ ), and acute kidney failure (OR: 1.58, 95% CI: 1.14–2.20,  $P = 0.005$ ) compared to patients without FM undergoing primary THA.

FM patients were found to be at greater odds of delirium (OR: 1.90, 95% CI: 0.92–3.96,  $P = 0.082$ ), acute pancreatitis (OR: 1.76, 95% CI: 0.89–3.49,  $P = 0.100$ ), deep vein thrombosis (OR: 1.22, 95% CI: 0.91–1.63,  $P = 0.183$ ), postoperative wound infections (OR: 1.12, 95% CI: 0.78–1.58,  $P = 0.531$ ), paralytic ileus (OR: 1.11, 95% CI: 0.78–2.15,  $P = 0.739$ ), and pulmonary embolism (OR: 1.04, 95% CI: 0.59–1.82,  $P = 0.886$ ) compared to controls however no statistical difference was found (*Table 2*).

### Two-year implant related complications

FM patients were found to have greater odds and incidence of 2-year short-term implant related complications (5.94% *vs.* 3.74%; OR: 1.60, 95% CI: 1.52–1.68,  $P < 0.001$ ) such as articular bearing surface wear of prosthetic joint (OR: 3.20, 95% CI: 1.93–5.29,  $P < 0.001$ ), broken prosthetic joint implant (OR: 2.00, 95% CI: 1.56–2.56,  $P < 0.001$ ), THA revisions (OR: 1.85, 95% CI: 1.45–2.36,  $P < 0.001$ ), mechanical loosening of prosthetic joint (OR: 1.71, 95% CI: 1.50–1.94,  $P < 0.001$ ), dislocation of prosthetic joint (OR: 1.63, 95% CI: 1.51–1.75,  $P < 0.001$ ), periprosthetic fracture around prosthetic joint (OR: 1.44, 95% CI: 1.26–1.64,  $P < 0.001$ ), and prosthetic joint infection (PJI) (OR: 1.38, 95% CI: 1.26–1.52,  $P < 0.001$ ) compared to match controls (*Table 3*).

### 90-day readmission rate and episode-of-care

Patients with FM undergoing THA were found to have a greater incidence and risk of (12.5% *vs.* 11.6%; OR: 1.71, 95% CI: 1.50–1.94,  $P < 0.001$ ) of 90-day readmission rates compared to patients without FM. Total global 90-day episode of care mean reimbursements were higher

**Table 2** 90-day medical complications amongst patients with and without fibromyalgia undergoing primary total hip arthroplasty within the Medicare population

Complications	FM (%)	Control (%)	OR	95% CI	P value
SOB	0.37	0.10	3.38	2.64–4.32	<0.001
CVA	0.05	0.01	3.27	1.66–6.43	<0.001
Pneumonia	0.14	0.05	2.67	1.86–3.85	<0.001
NHSW	0.03	0.01	2.27	1.11–4.62	<0.001
UTI	0.75	0.35	2.10	1.82–2.43	<0.001
APA	0.75	0.38	1.95	1.70–2.25	<0.001
Delirium	0.03	0.01	1.90	0.92–3.96	0.082
Thrombocytopenia	0.05	0.02	1.84	1.05–3.22	0.032
Acute pancreatitis	0.03	0.03	1.76	0.89–3.49	0.100
Transfusions	0.29	0.17	1.69	1.36–2.10	<0.001
AKF	0.12	0.07	1.58	1.14–2.20	0.005
DVT	0.13	0.11	1.22	0.91–1.63	0.183
PWI	0.08	0.07	1.12	0.78–1.58	0.531
Paralytic ileus	0.03	0.02	1.11	0.78–2.15	0.739
PE	0.03	0.03	1.04	0.59–1.82	0.886
Total	2.88	1.43	2.05	1.91–2.21	<0.001

FM, fibromyalgia; OR, odds-ratio; 95% CI, 95% confidence interval; SOB, shortness of breath; CVA, cerebrovascular accident; NHSW, non-healing surgical wound; UTI, urinary tract infection; APA, acute post-hemorrhagic anemia; AKF, acute kidney failure; DVT, deep vein thrombosis; PWI, postoperative wound infections.

in FM patients undergoing THA (\$71,081.10 *vs.* \$70,969.65,  $P < 0.001$ ) compared to matched controls.

## Discussion

As the prevalence of FM continues to increase; the number of primary THA procedures is also increasing (2,7). The study illustrates FM to be a risk factor for postoperative complications following primary THA. Patients with FM were found to have greater odds of developing medical complications, implant related complications, readmission rates, which overall was associated with increased episode of care costs following primary THA. Predominantly known to effect the musculoskeletal system, the study illustrates FM being associated with pulmonary, neurovascular, and immune-related complications.

In a retrospective study performed by Çetin *et al.*, 57.1% of patients with FM ( $n=35$ ) complained of having dyspnea (10). According to the World Health Organization's dyspnea classification, nine patients were classified as

grade 1, six had grade 2, four patients had grade 3, and one had grade 4 dyspnea; whereas none of the matched cohorts suffered from dyspnea (10). Forti *et al.*, found that patients with FM had reduced respiratory muscle endurance, inspiratory muscle strength, and thoracic mobility compared to healthy patients (11). Reduction in these parameters have been shown to lead to shortness of breath, atelectasis, pneumonia, and other respiratory complications; whereas respiratory muscle training has shown to reduce the relative risk of respiratory related complications (12,13). These pulmonary changes would help to explain why patients with FM were at greater odds of developing respiratory complications such as dyspnea and pneumonia. Additionally, the findings in the study are consistent with the literature on FM increasing the odds of developing cerebrovascular accidents (CVA) (14,15). In a population based study by Tseng *et al.*, multivariate analysis illustrated that patients with FM were found to be at greater risk of developing an ischemic stroke compared to patients without FM (14). The pathophysiology behind this

**Table 3** Two-year implant related complications amongst patients with and without fibromyalgia undergoing primary total hip arthroplasty within the Medicare population

Complications	FM (%)	Control (%)	OR	95% CI	P value
Articular bearing surface wear of prosthetic joint	0.08	0.03	3.20	1.93–5.29	<0.001
Broken prosthetic joint implant	0.25	0.12	2.00	1.56–2.56	<0.001
THA revisions	0.24	0.13	1.85	1.45–2.36	<0.001
Mechanical loosening	0.84	0.49	1.71	1.50–1.94	<0.001
Dislocation of prosthetic joint	2.44	1.51	1.63	1.51–1.75	<0.001
Periprosthetic fracture	0.72	0.51	1.44	1.26–1.64	<0.001
PJI	1.37	1.00	1.38	1.26–1.52	<0.001
Total	5.94	3.79	1.60	1.52–1.68	<0.001

FM, fibromyalgia; OR, odds-ratio; 95%CI, 95% confidence interval; THA, total hip arthroplasty; PJI, prosthetic joint infection.

mechanism is endothelial dysfunction caused by chronic pain. Arterial flow mediated dilatation and vascular response to sublingual nitroglycerine were found to be diminished in patients with FM (15). These vascular imbalances could help explain the increased risk of CVA in patients with FM.

Furthermore, patients with FM incurred greater total episode of care costs compared to controls. While FM is not considered to be an independent risk factor for increasing cost following THA, the complications from FM are associated with increased costs. Phillips *et al.* found that the cost for treating periprosthetic fractures increased in patients with an in-hospital LOS more than 30 days, operating time, type of implants used and in those patients with concomitant deep infections (16). Similarly, pneumonia and CVA which were complications seen in this study, have been shown to increase the cost of care by an average of \$7,154 and \$3,890–\$28,451, respectively (17,18). The economic burden of this condition is the reason why providers continually seek to optimize patients prior to surgery. Presurgical optimization may not only minimize postoperative complications, but may potentially decrease cost of care in patients (9).

The study is not present without limitations. The use of a database analysis study, the validity of the study and results are reliant on accurate procedural and diagnostic coding within the database (19). This translates to the fact that miscoding and noncoding by providers is a potential source of error. It is estimated that 1.3% of coding errors are currently present in the Medicare population (20). Additionally, this study only analyzed a single insurer's data and may not be a true cross-sectional depiction of FM in the United States (20). Lastly, patients with FM are prone

to having other comorbid conditions and adverse events which may be underreported (19).

## Conclusions

The study illustrates that patients with FM undergoing primary THA are at a greater risk for medical complications and early implant failure along with greater odds of 90-day readmission rates, and incurring a higher episode of care costs. The results of this study may improve a providers' ability to counsel patients regarding specific adverse events associated with FM and THA. The study necessitates further research on comparing preoperative optimization methods which can help to minimize postoperative complications.

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## Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/aoj.2018.08.04>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Since PearlDiver contains de-identified information the study was exempt



from International Review Board (IRB) approval.

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## Supplementary

**Table S1** International Classification of Disease (ICD-9) ninth revision codes

Procedure and/or complication	ICD-9 code
Total hip arthroplasty	81.51
Fibromyalgia	729.1
Acute kidney failure	584.9
Acute post hemorrhagic anemia	285.1
Acute pancreatitis	577.0
Articular bearing surface wear	996.46
Broken prosthetic joint implant	996.44
Cardiac complications	997.1
Cerebrovascular accidents	434.90–434.91
Deep vein thrombosis	453.4
Delirium	293.0
Digestive system complications	997.4
Dislocation of prosthetic joint	996.42
Hematoma	998.12
Hemorrhage	998.11
Mechanical loosening of prosthetic joint	996.41
Myocardial infarction	410
Other complications due to internal joint prosthesis	996.77
Paralytic ileus	560.1
Periprosthetic fractures	996.44
Periprosthetic osteolysis	996.45
Pneumonia	480–486
Postoperative infection	998.59
Prosthetic joint infection	996.66
Pulmonary embolism	415.1
Respiratory complications	997.39
Seroma	998.13
Shortness of breath	786.05
Total hip arthroplasty revision	81.53; 00.74–00.77
Transfusions	99.X
Urinary tract infections	599.0