

# Rates of Periprosthetic Fracture following Primary Total Hip Arthroplasty have Increased Dramatically from 2010 to 2019

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## INTRODUCTION:

Periprosthetic fractures (PPFs) are a potential complication of primary total hip arthroplasty (THA) that often lead to increased morbidity and high economic burden. With an aging population, and simultaneous expansion of THA to younger and more active patients, there is growing concern for higher rates of PPF. The purpose of this study was to investigate the recent trends in 2-year PPF incidence after primary THA, and to identify the differences in these trends among different patient populations.

## METHODS:

A retrospective observational study was conducted using a national administrative claims database. Patients who underwent primary THA during the years 2010-2019 were identified via current procedural terminology (CPT) codes. PPF diagnoses within 2 years of surgery were identified via international classification of diseases (ICD) codes. Incidence rates of PPF were reported as percentages, and a compounded annual growth rate (CAGR) was calculated. Linear regression analysis was conducted to assess overall trends. A subanalysis was conducted to stratify baseline characteristics including age, biological sex, and high-risk comorbidities. Multivariable logistic regression was performed to compare rates in subsequent years to the initial (2010) value and adjust for the effects of age, biological sex, and comorbidities. A threshold of significance of  $p < 0.05$  was used.

## RESULTS:

A total of 500,078 primary THA patients were identified. Of these patients, 4,342 had a PPF within 2 years of surgery. The total rate of 2-year PPF increased from 0.65% in 2010 to 1.2% in 2019. The CAGR of all PPFs was +7.05% relative growth annually. Multivariable logistic regression showed that the odds ratio of PPF increased throughout the 2010 to 2019 time window when compared to the initial rate observed in 2010. The increase in odds reached statistical significance starting on 2014 (OR: 1.20,  $p = 0.014$ ) and continued to be significant as it increased through 2019 (OR: 1.57,  $p < 0.001$ ). Linear regression of subpopulations demonstrated that the most pronounced increases occurred in patients less than 50 years old (CAGR = +9.24%,  $p = 0.005$ ), less than 60 years old (CAGR = +8.41%  $p < 0.001$ ), greater than 70 years old (CAGR = +7.36%,  $p < 0.001$ ), and who had comorbid osteoporosis (CAGR = +13.7%,  $p = 0.001$ ), vitamin D deficiency (CAGR = +12.2%,  $p = 0.002$ ), chronic kidney disease (CKD) (CAGR = +9.59%,  $p = 0.001$ ), and Medicaid insurance (CAGR = +7.19%,  $p < 0.001$ ).

## DISCUSSION AND CONCLUSION:

We observed that the 2-year rates of PPF after primary THA have been steadily increasing since 2010. From 2010 to 2019, the overall rates of PPF nearly doubled. The groups with the greatest increase in risk are patients less than 60 years old, patients greater than 70 years old, patients with Medicaid insurance, and patients with comorbid osteoporosis, vitamin D deficiency, and CKD. These findings provide an overview of high-risk groups, some of whom have modifiable risk factors and may benefit from treatments aimed to mitigate the rise in PPF after THA in the United States.

Figure 1. National trends in 2-year postoperative periprosthetic fracture (PPF) rates after total hip arthroplasty (THA).

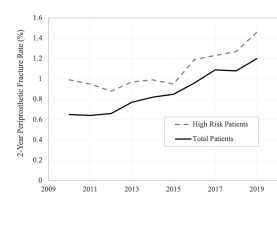


Figure 2. Odds ratios of 2-year postoperative periprosthetic fracture (PPF) rates after total hip arthroplasty (THA) based on multivariable logistic regression adjusting for age, biological sex, and Charlson Comorbidity Index.

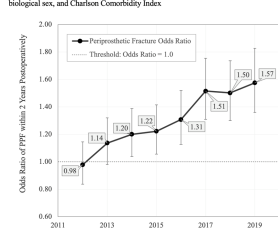


Table 1. Multivariable logistic regression evaluating the odds of 2-year postoperative periprosthetic fracture after total hip arthroplasty (THA) by year of index procedure compared to the year 2010

Year	Odds Ratio (OR)	OR 95% CI	p-value <sup>a</sup>
2011	0.96	(0.80-1.11)	0.481
2012	0.98	(0.84-1.14)	0.780
2013	1.14	(0.98-1.32)	0.092
2014	1.20	(1.04-1.39)	<b>0.014</b>
2015	1.22	(1.06-1.41)	<b>0.007</b>
2016	1.31	(1.13-1.52)	<b>&lt;0.001</b>
2017	1.51	(1.23-1.75)	<b>&lt;0.001</b>
2018	1.50	(1.3-1.74)	<b>&lt;0.001</b>
2019	1.57	(1.36-1.83)	<b>&lt;0.001</b>

<sup>a</sup> Bolded values represent significance below a threshold of  $p < 0.05$

CI = confidence interval

<sup>b</sup> Multivariable logistic regression controlling for age, biological sex, and Charlson Comorbidity Index

Table 2. Population characteristics of patients who had a periprosthetic fracture around a total hip arthroplasty (THA) postoperatively

	PPF	OR	95% CI	p-value <sup>a</sup>
<b>Rate of Periprosthetic Fracture (PPF) Around a Total Hip Arthroplasty (THA) Postoperatively Within 2 Years of Surgery (%)</b>				
Periprosthetic Fractures, N(Total) = 4,342				
Total	4,342	1.00		
High-Risk <sup>b</sup>	1,153	1.89	(1.68-2.14)	<b>&lt;0.001</b>
<b>Age (Years)</b>				
<50	837	2.37	(2.02-2.78)	<b>&lt;0.001</b>
50-59	640	1.44	(1.24-1.66)	<b>&lt;0.001</b>
60-69	970	1.57	(1.39-1.78)	<b>&lt;0.001</b>
70+	1,235	1.95	(1.73-2.19)	<b>&lt;0.001</b>
<b>Biological Sex</b>				
Female	1,561	1.48	(1.31-1.67)	<b>&lt;0.001</b>
Male	844	0.93	(0.81-1.07)	<b>&lt;0.001</b>
<b>Comorbidity</b>				
Osteoporosis	1,461	2.40	(2.10-2.74)	<b>&lt;0.001</b>
Medicaid	1,461	1.89	(1.68-2.14)	<b>&lt;0.001</b>
Rheumatoid Arthritis	1,153	1.89	(1.68-2.14)	<b>&lt;0.001</b>
CKD	1,235	1.95	(1.73-2.19)	<b>&lt;0.001</b>
Diabetes	2,260	1.54	(1.37-1.73)	<b>&lt;0.001</b>
Vitamin D Deficiency	1,461	2.40	(2.10-2.74)	<b>&lt;0.001</b>
Tobacco Use	1,153	1.89	(1.68-2.14)	<b>&lt;0.001</b>
Medicaid	1,461	1.89	(1.68-2.14)	<b>&lt;0.001</b>
Insurance	1,153	1.89	(1.68-2.14)	<b>&lt;0.001</b>
Age-High Risk Comorbidity	1,153	1.89	(1.68-2.14)	<b>&lt;0.001</b>

<sup>a</sup> Bolded values represent significance below a threshold of  $p < 0.05$

PPF, periprosthetic fracture; CAGR, compounded annual growth rate; CKD, chronic kidney disease

<sup>b</sup> Patients with osteoporosis, rheumatoid arthritis, chronic kidney disease, diabetes, vitamin D deficiency, tobacco use

<sup>c</sup> Ordinal least squares linear regression