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Original Research

Active Amphetamine Abuse in Total Hip Arthroplasty Carries Increased Risk for Postoperative Surgical and Medical Complications

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ABSTRACT

Background: The impact of amphetamine abuse on total hip arthroplasty (THA) outcomes has yet to be studied. As the rates of methamphetamine abuse continue to rise, understanding the risk profile of this population is imperative. This study aims to determine the risk of major surgical and medical complications for those with amphetamine abuse undergoing THA, with the hypothesis that amphetamine abuse carries increased risk.

Methods: A retrospective review was performed with all-claims data files of a large national database querying International Classification of Disease, tenth revision, procedure codes identifying 333,038 primary THA, and 1027 with active amphetamine abuse. Medical and surgical complications including infection, dislocation, implant failure, periprosthetic fracture, and revision, as well as length of hospital stay and 90-day readmission rate, were identified. Univariate analysis compared rates of dependent outcomes. To account for independent variables, logistic regression was performed using age, Charlson comorbidity index, sex, obesity, tobacco use, and alcohol use. The results were presented as odds ratios (OR) and *P* values with significance set at <0.05.

Results: Patients with active amphetamine abuse carried an increased risk of dislocation (OR 1.82, $P \leq .001$), infection (OR 2.37, $P \leq .001$), mechanical complications (OR 1.64, $P \leq .001$), periprosthetic fracture (OR 1.53, $P \leq .05$), revision (OR 1.70, $P \leq .001$), 90-day readmission (OR 1.79, $P \leq .001$), as well as medical complications (1.43, $P = .02$) compared to those without documented amphetamine abuse.

Conclusions: Patients with amphetamine abuse are at increased risk of postoperative surgical and medical complications following THA. We recommend consideration of these risks prior to primary THA in this patient population.

Introduction

Methamphetamine is an illicit stimulant, which is on the rise in the United States [1]. From 2015 to 2019, methamphetamine abuse increased by 43% with an estimated annual hospital economic burden of $2.17 billion in 2015 alone [1,2]. As usage rate increases alongside an aging US population, so has the age of users, with one study showing 34% of a level 1 trauma center's methamphetamine-abusing orthopaedic trauma population consisting of patients ≥55 years of age, with the elderly use rate quadrupling over time from 2009 to 2018 [3]. As the rates of amphetamine abuse rise in an aging population, counseling patients regarding risks following arthroplasty while consuming amphetamines with an emphasis on cessation is of utmost importance.

While there is a paucity of research among arthroplasty literature, amphetamine abuse, in particular methamphetamine abuse has been shown to lead to adverse surgical and medical outcomes particularly within orthopaedic trauma literature. One retrospective study from a single level 1 trauma institution found a 3-fold increase in reoperation rates for patients who abuse methamphetamine undergoing open reduction and internal fixation for acetabular fracture [4]. Research has shown that patients with amphetamine abuse disorder have higher resource utilization, with

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increased cardiovascular perioperative complications, longer length of stay, and higher in-hospital mortality and readmission rate [2,3,5,6]. With methamphetamine and illicit amphetamine abuse pervasive and rising among elderly orthopedic populations, understanding the impact among arthroplasty outcomes is of utmost importance however remains unknown [3].

The purpose of this study is 4-fold: (1) to determine the prevalence of amphetamine abuse among the primary total hip arthroplasty (THA) population; (2) to determine the risk of major surgical and medical complications following primary THA for osteoarthritis in patients with amphetamine abuse compared to those without amphetamine abuse; (3) to identify the risks of polysubstance use and its impact on medical and surgical complications; and (4) to evaluate the risk of medical and surgical complications for those with amphetamine abuse in remission compared to those without amphetamine abuse. We hypothesized that patients with amphetamine abuse are more likely to engage in polysubstance use and have higher rates of surgical and medical complications following THA compared to patients without amphetamine abuse, with risks that persist when in remission.

Material and methods

A cross-sectional cohort study was performed by querying International Classification of Disease, tenth revision (ICD-10), procedure codes from the PearlDiver database from 2015 to 2020 for THA indicated for osteoarthritis. Active amphetamine abuse, as well amphetamine abuse in remission was identified. Demographic data including age, sex, obesity, tobacco use, alcohol use, and Charlson comorbidity index were collected. Major surgical and medical complications including infection, dislocation, implant failure, periprosthetic fracture, and revision were then identified by ICD-10 diagnosis codes, as well as length of hospital stay and 90-day readmission rate (Appendix 1).

Statistical analysis was performed using R (R Core Team, 2021). Descriptive statistics were calculated for demographic variables (Table 1). Complication rates were described as a proportion of the entire cohort. Univariate analysis compared rates of dependent outcomes. Differences in complication rate based on continuous variables (age and Charlson comorbidity index) and categorical variables (sex and obesity diagnosis) were analyzed using t-tests and chi-square tests, respectively. To account for other independent variables, logistic regression analysis was done using age, Charlson comorbidity index, sex, obesity, tobacco use, and alcohol use as additional independent covariates. The results were presented as odds ratios (OR) and *P* values reported, with significance set at <0.05.

Table 2
Comorbidities and complications for stimulant users and those in remission compared to nonstimulant use undergoing primary THA.

Variable	Stimulant [OR (95% CI)]	Remission [OR (95% CI)]
Sex (male)	1.61 (1.58-1.65)	1.92 (1.36-2.70)
Alcohol abuse	10.60 (10.38-10.82)	8.32 (5.86-11.80)
Tobacco use	8.21 (8.04-8.38)	13.21 (9.01-19.36)
AVN	3.53 (3.44-3.63)	4.77 (3.24-7.01)
Surgical complications		
Dislocation	2.96 (2.85-3.07)	2.47 (1.26-4.87)
Infection	3.99 (3.88-4.11)	2.83 (1.53-5.24)
Mechanical	2.54 (2.49-2.59)	0.37 (0.053-2.69)
PPFx	1.90 (1.81-1.99)	1.03 (0.26-4.18)
Revision	3.09 (2.92-3.26)	2.97 (1.22-7.27)
Medical complications	1.52 (1.45-1.60)	1.50 (0.66-3.40)
90-d readmission	2.45 (2.38-2.52)	2.06 (1.20-3.52)

AVN, avascular necrosis; CI, confidence interval; OR, odds ratio; PPFx, periprosthetic femur fracture.

Of the 333,038 primary THA cases for osteoarthritis, 1027 (0.31%) patients were identified with active abuse of amphetamines and 133 (0.04%) patients in remission. Those with active amphetamine abuse were younger and more likely to be male (Table 1). Amphetamine abusers exhibited a higher rate of tobacco and alcohol use and had higher rates of avascular necrosis than nonusers.

Results

We found that all surgical complications studied were higher in amphetamine abusers (Table 2). Those with active amphetamine abuse were significantly more likely to experience dislocation (OR 2.96, 95% confidence interval [CI] 2.85-3.07, $P < .001$) and had higher rates of infection (OR 3.99, 95% CI 3.88-4.11, $P < .001$). They were more likely to experience mechanical complications (OR 2.54,

Table 1
Patient characteristics and complications of nonstimulant users, stimulant users, and those in remission undergoing primary total hip arthroplasty.

Variable	Nonstimulant	Stimulant	Remission	*P*
n	331,878	1027	133	
Age [mean (SD)]	66.77 (10.5)	55.36 (11.2)	53.71 (9.5)	<.001
Sex [n (%)]				
Male	141,194 (42.5)	559 (54.4)	78 (58.6)	<.001
Female	190,684 (57.5)	468 (45.6)	55 (41.4)	
Diabetes, n (%)	104,426 (31.8)	313 (30.5)	46 (34.6)	.52
Alcohol abuse, n (%)	23,084 (7.0)	454 (44.2)	51 (38.4)	<.001
Tobacco use, n (%)	56,235 (16.9)	643 (62.6)	97 (72.9)	<.001
Obesity, n (%)	138,392 (41.7)	421 (42.0)	68 (51.1)	.08
AVN, n (%)	23,138 (7.0)	215 (20.9)	35 (26.3)	<.001
Surgical complications, n (%)				
Dislocation	9456 (2.9)	82 (8.0)	9 (6.8)	<.001
Infection	10,254 (3.1)	116 (11.3)	11 (8.3)	<.001
Mechanical	6556 (2.0)	50 (4.9)	1 (0.8)	<.001
PPFx	4828 (1.5)	28 (2.7)	2 (2.3)	.003
Revision	4303 (1.3)	40 (3.9)	5 (3.8)	<.001
Medical complications, n (%)	10,132 (3.1)	47 (4.6)	6 (4.5)	.01
90-d readmission, n (%)	19,331 (5.8)	135 (13.2)	15 (11.3)	<.001
Length of stay [d (SD)]	2.4 (2.4)	3.7 (4.7)	2.8 (2.7)	<.001

AVN, avascular necrosis; SD, standard deviation.
Significance defined as ≤ 0.05.

95% CI 2.49-2.59, $P < .001$) and periprosthetic fracture (OR 1.90, 95% CI 1.81-1.99, $P < .001$). Risk of revision was significantly higher for amphetamine abusers (OR 3.09, 95% CI 2.92-3.26, $P < .001$). Medical complications were also higher for those with active amphetamine abuse (OR 1.52, 95% CI 1.45-1.60, $P < .001$). Risk of 90-day readmission postoperatively was also significantly higher for active amphetamine abusers (OR 2.45, 95% CI 2.38-2.52, $P < .001$). Those with active amphetamine abuse had longer length of stay than those without amphetamine abuse (3.70 days ± 4.65 days vs 2.41 days ± 2.38 days, $P < .001$). Logistic regression analysis controlling for confounding variables is shown in Table 3. Patients with active amphetamine abuse carried a higher risk of dislocation (OR 1.82, $P \leq .001$), infection (OR 2.37, $P \leq .001$), mechanical complications (OR 1.64, $P \leq .001$), periprosthetic fracture (OR 1.53, $P \leq .05$), revision (OR 1.70, $P \leq .001$), readmission (OR 1.79, $P \leq .001$), as well as medical complications (OR 1.43, $P = .02$).

Amphetamine abusers were more likely to use tobacco (OR 8.21, 95% CI 8.04-8.38, $P < 001$) and alcohol (OR 10.60, 95% CI 10.38-10.82, $P < .001$) compared to nonusers (Table 2). Alcohol use independently carried a significantly elevated risk of all measured complications when analyzed via logistic regression, including dislocation (OR 1.99, $P < .001$), infection (OR 1.55, $P < .001$), mechanical complications (OR 1.44, $P < .001$), periprosthetic fracture (OR 2.57, $P < .001$), revision (OR 1.70, $P < .001$), readmission (OR 1.79, $P < .001$), and medical complications (OR 1.35, $P < .001$) (Table 3). Similarly, tobacco use independently carried a significant elevated risk for all measured complications of dislocation (OR 1.48, $P < .001$), infection (OR 1.30, $P < .001$), mechanical complications (OR 1.34, $P < .001$), periprosthetic fracture (OR 1.39, $P < .001$), revision (OR 1.37, $P < .001$), readmission (OR 1.33, $P < .001$), and medical complications (OR 1.28, $P < .001$) (Table 3).

For those in remission from amphetamine abuse, increased risk of dislocation and infection persisted compared to patients with no history of amphetamine abuse (OR 2.47, 95% CI 1.26-4.87, $P < .001$ and OR 2.83, 95% CI 1.53-5.24, $P < .001$, respectively). Revision rate was also higher (OR 2.97, 95% CI 1.22-7.27, $P < .001$). There was no difference in risk of medical complications (OR 1.50, 95% CI 0.66-3.40). 90-day readmission rate was also increased for those in remission (OR 2.06, 95% CI 1.20-3.52, $P < .001$). Logistic regression found that patients in remission from amphetamine abuse were not at increased risk of dislocation, infection, revision, readmission, or medical complications (Table 3).

Discussion

There is a paucity of literature addressing the risk profile of amphetamine abusers who undergo primary THA. We found that primary THA is being performed in patients with active amphetamine abuse and that these patients carried an elevated risk of surgical and medical complications. Amphetamine abusers were more likely to experience infection, and dislocations and were more likely to be readmitted postoperatively or undergo revision. We found that amphetamine abuse carried increased risk of polysubstance abuse with alcohol and/or tobacco, which were both independently associated with increased risk of complications. Patients in remission from amphetamine abuse were also at higher risk of dislocation, infection, revision, and 90-day readmission than nonusers.

Our study found a prevalence of 0.31% recorded active amphetamine abuse in primary THA within our cohort, a number that we suspect may be underreported and expected to increase given trends in amphetamine abuse. As amphetamine abuse continues to rise, understanding surgical risk factors associated with its abuse is paramount in primary THA. From 2016 to 2019, methamphetamine abuse was found to rise by 43%, and the number of adults diagnosed with methamphetamine abuse disorder rose 62% in the same timeframe [1]. Furthermore, in a large retrospective study of trauma patients from 2009 to 2018, the rate of methamphetamine abuse quadrupled in this timeframe in patients older than 55 years of age [3]. As methamphetamine abuse rises in popularity, particularly among geriatric patients, consideration of amphetamine abuse and its effects on THA outcomes is becoming increasingly relevant. Understanding outcomes following THA in this population will be helpful in counseling patients seeking joint replacement while actively using amphetamines, with emphasis on cessation prior to undergoing THA.

The effect of amphetamine abuse within the arthroplasty realm is limited, with most research being within orthopaedic trauma where in some regions, amphetamine abuse is pervasive. In a retrospective database review from 2008-2018 at a level 1 academic trauma center, of 371 patients who underwent traumatic acetabular open reduction internal fixation, nearly 10% abused methamphetamines [4]. This study found that methamphetamine abusers had more than 2 times the reoperation rate at 90 days postoperatively (17% vs 7%), and 1 year postoperatively (25% vs 11%) compared to abstainers, with an adjusted odds ratio of 1 year reoperation of 3.2 (95% CI 1.2-8.5, $P = .03$). Similarly, our study found an elevated risk of revision for amphetamine abusers following primary THA (OR 1.70, $P \leq .001$). Additionally, the study by Zusman, et al. found an adjusted 1-year survival of native hip following acetabular fractures treated with open reduction internal fixation in methamphetamine abusers of only 55%. As indications for THA expand, with THA often pursued following failed open reduction internal fixation for acetabular fracture as well as acutely for acetabular fracture [7], addressing amphetamine abuse and its impact on THA outcomes in the trauma setting is warranted.

This study demonstrates the high-risk profile of amphetamine abuse for THA outcomes, which is similar to risks seen in alcohol misuse and tobacco use. In one study of nationwide claims data assessing outcomes following THA, patients with alcohol misuse had longer LOS (4 days vs 3 days, $P < .0001$) and higher risk of 90-day medical complications (45.94% vs 12.25%; OR, 2.89, $P < .0001$) and 2-year implant-related complications (17.71% vs 8.46%; OR, 1.97, $P < .0001$) [8]. Tobacco use, on the other hand, has been shown to carry a higher risk for infection requiring revision surgery (OR 1.54, 95% CI 1.25-1.91) via meta-analysis [9], as well as have higher risk for postoperative medical complications and increased mortality [10]. This study shows that like alcohol and tobacco use, amphetamine abuse carries profound, independent risk of surgical complications; however, those with amphetamine abuse are also at high risk of concomitant alcohol and tobacco use as well as other high-risk behaviors. Further study analyzing the impact of polysubstance use is needed.

Our study demonstrated no difference in risk of dislocation, infection, revision, and 90-day readmission for patients in remission from amphetamine abuse. This result should be interpreted with caution, as we suspect that these risks do persist independently with amphetamine abuse in remission, but our study possibly underpowered in this regard. Studying the true impact of remission is challenging given the high risk of methamphetamine relapse rate, which has been estimated to be as high as 85% [11]. Additional research with a more robust cohort of patients in remission from amphetamine abuse is needed to analyze the change in risk profile between those with active amphetamine abuse and those in remission to better understand whether these risk factors are modifiable with methamphetamine cessation.

There are limitations of this study, particularly in its retrospective database nature, which may lead to potential selection bias as not all arthroplasty cases are encompassed within this database. Furthermore, the PearlDiver database, while broad and

Table 3
Results from multivariate analysis using logistic regression. Odds ratios reported when adjusting for all comorbidities.

Predictors	Complications																			
	Dislocation			Infection			Mechanical			PPFx			Revision			Readmission			Medical		
	β	aOR (95% CI)	P	β	aOR (95% CI)	P	β	aOR (95% CI)	P	β	aOR (95% CI)	P	β	aOR (95% CI)	P	β	aOR (95% CI)	P	β	aOR (95% CI)	P
Age	0.002	1.00 (1.00-1.00)	.06	−0.01	0.99 (0.98-0.99)	<.001	−0.01	0.99 (0.99-0.99)	<.001	0.03	1.03 (1.03-1.04)	<.001	−0.02	0.98 (0.98-0.99)	<.001	0.01	1.01 (1.01-1.01)	<.001	0.15	1.03 (1.03-1.03)	<.001
CCI	0.09	1.09 (1.08-1.10)	<.001	0.09	1.09 (1.08-1.10)	<.001	0.06	1.06 (1.05-1.07)	<.001	0.06	1.06 (1.05-1.07)	<.001	0.06	1.06 (1.04-1.07)	<.001	0.12	1.12 (1.12-1.13)	<.001	0.12	1.16 (1.16-1.17)	<.001
Sex (male)	−0.36	0.70 (0.66-0.73)	<.001	0.05	1.05 (1.01-1.10)	.01	−0.09	0.91 (0.67-0.96)	<.001	−0.40	0.68 (0.64-0.72)	<.001	−0.05	0.95 (0.89-1.01)	.10	−0.09	0.92 (0.89-0.95)	<.001	0.27	1.12 (1.08-1.17)	<.001
Diabetes	0.05	1.05 (0.10-1.09)	.06	.22	1.25 (1.20-1.30)	<.001	0.06	1.06 (1.01-1.12)	.03	−0.03	0.97 (0.91-1.03)	.29	0.04	1.04 (0.97-1.11)	.27	0.16	1.17 (1.13-1.21)	<.001	0.29	1.33 (1.27-1.39)	<.001
Alcohol abuse	**0.69**	**1.99 (1.87-2.12)**	**<.001**	0.44	1.55 (1.46-1.65)	<.001	**0.36**	**1.44 (1.32-1.56)**	**<.001**	**0.94**	**2.57 (2.35-2.80)**	**<.001**	**0.53**	**1.70 (1.55-1.87)**	**<.001**	**0.58**	**1.79 (1.71-1.88)**	**<.001**	**0.30**	**1.35 (1.26-1.45)**	**<.001**
Tobacco use	0.39	1.48 (1.40-1.55)	<.001	0.26	1.30 (1.24-1.36)	<.001	0.29	1.34 (1.26-1.43)	<.001	0.33	1.39 (1.29-1.50)	<.001	0.32	1.37 (1.28-1.48)	<.001	0.28	1.33 (1.28-1.38)	<.001	0.25	1.28 (1.22-1.35)	<.001
Obesity	0.05	1.06 (1.01-1.10)	.01	**0.54**	**1.71 (1.64-1.78)**	**<.001**	0.26	1.30 (1.23-1.36)	<.001	0.10	1.11 (1.04-1.17)	<.001	0.31	1.36 (1.28-1.45)	<.001	0.22	1.25 (1.21-1.29)	<.001	0.17	1.19 (1.14-1.24)	<.001
Stimulant use	**0.60**	**1.82 (1.43-2.27)**	**<.001**	**0.86**	**2.37 (1.93-2.88)**	**<.001**	**0.49**	**1.64 (1.21-2.16)**	**<.001**	**0.43**	**1.53 (1.02-2.20)**	**.028**	**0.53**	**1.70 (1.21-2.31)**	**.001**	**0.58**	**1.79 (1.47-2.14)**	**<.001**	**0.36**	**1.43 (1.04-1.91)**	**.02**
Remission	0.34	1.41 (0.66-2.65)	.32	0.35	1.42 (0.72-2.55)	.27	−1.52	0.22 (0.01-0.98)	.13	−0.17	0.85 (0.14-2.68)	.82	0.40	1.49 (0.52-3.29)	.39	0.31	1.36 (0.75-2.28)	.27	0.27	1.31 (0.51-2.75)	.52

aOR, adjusted odds ratio; CCI, Charlson comorbidity index; CI, confidence interval.
Bold denotes two highest risks of complication per predictor.

comprehensive, relies on accurate manual coding by practitioners, which may introduce a component of coding bias. We chose to include ICD-10 codes to eliminate mismatches in coding found in the previous ICD-9 system. As such, cases prior to 2015 were not included and follow-up was limited at 6 years. Amphetamine abuse-type stimulant codes were utilized for this study, excluding codes for other stimulants such as cocaine and caffeine and amphetamine-type stimulants taken in a prescribed manner, with the aim to select solely for illicit amphetamine abuse or misuse. This cohort may also include those who abuse prescription amphetamines illicitly or in a disordered manner rather than solely address methamphetamine abuse independently. Additionally, as discussed, it is suspected that amphetamine abuse may be underreported and as such underestimate postoperative risks. Furthermore, with the high rate of relapse with methamphetamine abuse, those carrying relapse diagnoses may in fact not truly be in remission. With the PearlDiver database encompassing all insurance claims data with the exception of Kaiser and TRICARE, it is an optimal database to generalize data. Even so, this remains the first and largest cohort to address amphetamine abuse within primary THA outcomes and illuminates the high-risk profile of amphetamine abuse.

Conclusions

Patients actively using amphetamine are at high risk of postoperative surgical and medical complications following THA. The risks from amphetamine abuse are similar to those seen with alcohol misuse and tobacco use. We recommend consideration of these risks prior to undergoing primary THA in this patient population.

Conflicts of interest

The authors declare there are no conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101372.

CRediT authorship contribution statement

Mackenzie Kelly: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Thomas Huff:** Writing – review & editing, Writing – original draft, Supervision, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Kathryn Schabel:** Writing – review & editing, Writing – original draft, Supervision, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Jung Yoo:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Elizabeth Lieberman:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ryland Kagan:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Appendix 1
ICD-10 Procedure and diagnosis codes used for inclusion.

Procedure	Procedure codes
Primary THA	ICD-10-P-0SR9019, ICD-10-P-0SR901A, ICD-10-P-0SR901Z, ICD-10-P-0SR9029, ICD-10-P-0SR902A, ICD-10-P-0SR902Z, ICD-10-P-0SR9039, ICD-10-P-0SR903A, ICD-10-P-0SR903Z, ICD-10-P-0SR9049, ICD-10-P-0SR904A, ICD-10-P-0SR904Z, ICD-10-P-0SR9069, ICD-10-P-0SR906A, ICD-10-P-0SR906Z, ICD-10-P-0SRB019, ICD-10-P-0SRB01A, ICD-10-P-0SRB01Z, ICD-10-P-0SRB029, ICD-10-P-0SRB02A, ICD-10-P-0SRB02Z, ICD-10-P-0SRB039, ICD-10-P-0SRB03A, ICD-10-P-0SRB03Z, ICD-10-P-0SRB049, ICD-10-P-0SRB04A, ICD-10-P-0SRB04Z, ICD-10-P-0SRB069, ICD-10-P-0SRB06A, ICD-10-P-0SRB06Z
Revision	ICD-10-P-0SP908Z, ICD-10-P-0SP909Z, ICD-10-P-0SP90BZ, ICD-10-P-0SP90EZ, ICD-10-P-0SP90JZ, ICD-10-P-0SP90KZ, ICD-10-P-0SPA0JZ, ICD-10-P-0SPB08Z, ICD-10-P-0SPB09Z, ICD-10-P-0SPB0BZ, ICD-10-P-0SPB0EZ, ICD-10-P-0SPB0JZ, ICD-10-P-0SPB0KZ, ICD-10-P-0SPE0JZ, ICD-10-P-0SPR0JZ, ICD-10-P-0SPS0JZ
Diagnosis	**Diagnosis Codes**
Obesity	ICD-10-D-E6601, ICD-10-D-E6609, ICD-10-D-E661, ICD-10-D-E662, ICD-10-D-E668, ICD-10-D-E669
Tobacco use	ICD-10-D-Z720, ICD-10-D-Z716, ICD-10-D-F17290
Alcohol use	ICD-9-D-30390, ICD-9-D-30392, ICD-9-D-30391, ICD-9-D-30502, ICD-9-D-30500, ICD-9-D-30501, ICD-10-D-F1020, ICD-10-D-F1010
Avascular necrosis	ICD-9-D-73342, ICD-10-D-M87051, ICD-10-D-M87052, ICD-10-D-M87059, ICD-10-D-M87151, ICD-10-D-M87152, ICD-10-D-M87159, ICD-10-D-M87251, ICD-10-D-M87252, ICD-10-D-M87256, ICD-10-D-M87351, ICD-10-D-M87352, ICD-10-D-M87353, ICD-10-D-M87851, ICD-10-D-M87852, ICD-10-D-M87859
Prosthetic dislocation	ICD-10-D-T84020A, ICD-10-D-T84020D, ICD-10-D-T84021A, ICD-10-D-T84021D
Periprosthetic joint infection	ICD-10-D-T8451XA, ICD-10-D-T8451XD, ICD-10-D-T8452XA, ICD-10-D-T8452XD
Mechanical complications	ICD-10-D-T84030A, ICD-10-D-T84030D, ICD-10-D-T84030S, ICD-10-D-T84031A, ICD-10-D-T84031D, ICD-10-D-T84031S, ICD-10-D-T84050A, ICD-10-D-T84050D, ICD-10-D-T84050S, ICD-10-D-T84051A, ICD-10-D-T84051D, ICD-10-D-T84051S, ICD-10-D-T84060A, ICD-10-D-T84060D, ICD-10-D-T84060S, ICD-10-D-T84061A, ICD-10-D-T84061D, ICD-10-D-T84061S, ICD-10-D-T84090A, ICD-10-D-T84090D, ICD-10-D-T84091A, ICD-10-D-T84091D, ICD-10-D-T84091S
Periprosthetic fracture	ICD-10-D-M9701XA, ICD-10-D-M9702XA
Medical complications	ICD-10-D-I9788, ICD-10-D-D65, ICD-9-D-48239, ICD-10-D-I9789, ICD-10-D-I21A1, ICD-10-D-J9600, ICD-9-D-481, ICD-10-D-I21A9, ICD-9-D-483, ICD-9-D-4828, ICD-10-D-I2129, ICD-9-D-4829, ICD-10-D-J95859, ICD-10-D-A419, ICD-10-D-J160, ICD-9-D-5849, ICD-9-D-41072, ICD-10-D-I236, ICD-10-D-J13, ICD-10-D-I237, ICD-9-D-4821, ICD-10-D-I2121, ICD-9-D-48231, ICD-10-D-I238, ICD-10-D-I97790, ICD-10-D-J95851, ICD-9-D-41070, ICD-9-D-48232, ICD-9-D-41071, ICD-9-D-5845, ICD-9-D-4824, ICD-10-D-J17, ICD-9-D-48230, ICD-10-D-J168, ICD-9-D-4822, ICD-9-D-4823, ICD-10-D-I231, ICD-10-D-I230, ICD-9-D-51884, ICD-10-D-I235, ICD-10-D-I234, ICD-10-D-I233, ICD-9-D-48249, ICD-10-D-I232, ICD-9-D-45384, ICD-9-D-45385, ICD-9-D-45382, ICD-10-D-I82629, ICD-9-D-45383, ICD-10-D-J15211, ICD-10-D-J15212, ICD-9-D-45381, ICD-9-D-51881, ICD-9-D-4838, ICD-9-D-45389, ICD-9-D-45387, ICD-9-D-45386, ICD-9-D-99802, ICD-9-D-48242, ICD-10-D-I228, ICD-9-D-41060, ICD-9-D-4830, ICD-9-D-41061, ICD-9-D-99800, ICD-9-D-4831, ICD-9-D-41062, ICD-9-D-99801, ICD-9-D-48240, ICD-10-D-I229, ICD-9-D-48241, ICD-10-D-I222, ICD-10-D-I221, ICD-9-D-41052, ICD-9-D-99731, ICD-10-D-I220, ICD-9-D-99732, ICD-10-D-T8110XA, ICD-10-D-I82619, ICD-9-D-99739, ICD-10-P-0BH18EZ, ICD-10-D-I2109, ICD-10-D-N170, ICD-10-D-I2102, ICD-10-P-0BH17EZ, ICD-10-D-I219, ICD-10-D-I2101, ICD-9-D-41050, ICD-10-D-I214, ICD-10-D-N178, ICD-9-D-41051, ICD-10-D-N179, ICD-9-D-41042, ICD-10-D-I213, ICD-10-D-T8119XA, ICD-9-D-41041, ICD-9-D-45340, ICD-9-D-45341, ICD-10-D-I82609, ICD-10-D-J150, ICD-10-D-I2119, ICD-10-D-J151, ICD-10-D-T8112XA, ICD-9-D-41519, ICD-10-D-I97710, ICD-10-D-J95822, ICD-10-D-I2111, ICD-10-D-J1520, ICD-10-D-J158, ICD-10-D-J159, ICD-10-D-J156, ICD-10-D-J157, ICD-10-D-J95821, ICD-10-D-J154, ICD-10-D-J155, ICD-10-D-J153, ICD-9-D-41040, ICD-9-D-41512, ICD-9-D-41513, ICD-10-D-I8291, ICD-10-D-J1529, ICD-10-D-J9690, ICD-9-D-51853, ICD-10-D-I82409, ICD-9-D-51851, ICD-9-D-51852, ICD-9-D-41030, ICD-9-D-41031, ICD-9-D-41032, ICD-10-D-J951, ICD-10-D-I82290, ICD-10-D-I469, ICD-10-D-T883XXA, ICD-9-D-48289, ICD-9-D-48283, ICD-9-D-48282, ICD-9-D-48284, ICD-9-D-4109, ICD-10-D-I82419, ICD-10-D-J9620, ICD-9-D-4108, ICD-9-D-48281, ICD-9-D-4107, ICD-9-D-4106, ICD-9-D-41021, ICD-9-D-4105, ICD-9-D-41022, ICD-9-D-4104, ICD-9-D-4103, ICD-9-D-41020, ICD-10-D-I2699, ICD-9-D-5770, ICD-9-D-4101, ICD-9-D-4102, ICD-10-D-I82A19, ICD-10-D-I2692, ICD-9-D-9971, ICD-10-D-I824Y9, ICD-10-D-I82B19, ICD-10-D-I2690, ICD-9-D-41091, ICD-9-D-41090, ICD-10-D-I82890, ICD-10-D-I82C19, ICD-9-D-41010, ICD-9-D-41011, ICD-10-D-J952, ICD-9-D-99591, ICD-9-D-41012, ICD-10-D-J953, ICD-9-D-4539, ICD-10-D-I82429, ICD-9-P-9604, ICD-10-D-J9588, ICD-9-D-99586, ICD-10-D-J9589, ICD-10-D-K859, ICD-10-D-J181, ICD-9-D-41080, ICD-9-D-4275, ICD-9-D-41082, ICD-9-D-41081, ICD-10-D-T8111XA, ICD-9-D-41000, ICD-10-D-I82439, ICD-9-D-2866, ICD-9-D-41001, ICD-9-D-41002
Stimulant use	ICD-10-D-F15120, ICD-10-D-F15121, ICD-10-D-F15122, ICD-10-D-F15129, ICD-10-D-F1513, ICD-10-D-F1514, ICD-10-D-F15150, ICD-10-D-F15151, ICD-10-D-F15159, ICD-10-D-F15180, ICD-10-D-F15181, ICD-10-D-F15182, ICD-10-D-F15188, ICD-10-D-F1519, ICD-10-D-F15220, ICD-10-D-F15221, ICD-10-D-F15222, ICD-10-D-F15229, ICD-10-D-F1523, ICD-10-D-F1524, ICD-10-D-F15250, ICD-10-D-F15251, ICD-10-D-F15259, ICD-10-D-F15280, ICD-10-D-F15281, ICD-10-D-F15282, ICD-10-D-F15288, ICD-10-D-F1529, ICD-10-D-F15920, ICD-10-D-F15921, ICD-10-D-F15922, ICD-10-D-F15929, ICD-10-D-F1593, ICD-10-D-F1594, ICD-10-D-F15950, ICD-10-D-F15951, ICD-10-D-F15959, ICD-10-D-F15980, ICD-10-D-F15981, ICD-10-D-F15982, ICD-10-D-F15988, ICD-10-D-F1599
Remission	ICD-10-D-F1511, ICD-10-D-F1521