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Association Between Comorbid Depression and Rates of Postoperative Complications, Readmissions, and Revision Arthroscopic Procedures After Elective Hip Arthroscopy

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Investigation performed at University of California–San Francisco, San Francisco, California, USA

Background: Depression and related psychiatric diagnoses are common in patients undergoing hip arthroscopy for femoroacetabular impingement syndrome (FAIS). The effects of depression on postoperative complications, readmissions, and additional ipsilateral hip surgery are not well studied.

Hypothesis: Patients with preoperative depression who undergo hip arthroscopy for FAIS would experience higher rates of 90-day postoperative complications and readmissions, with an increased risk of additional ipsilateral hip procedures, as compared with patients without depression.

Study Design: Cohort study; Level of evidence, 3.

Methods: A retrospective cohort study between 2010 and 2019 was performed using the Mariner/PearlDiver database. Current Procedural Terminology and International Classification of Diseases codes were used to compare patients with and without preexisting depression who underwent hip arthroscopy for FAIS. Patients were matched at a 1:1 ratio based on age, sex, Charlson Comorbidity Index, body mass index, and tobacco use. Patients undergoing shoulder or knee arthroscopy were also identified to compare lifetime preoperative depression prevalence amongst groups.

Results: The lifetime preoperative depression prevalence was significantly higher in patients undergoing hip arthroscopy as compared with patients undergoing shoulder or knee arthroscopy (25.4% vs 22.2% vs 19.8%; $P < .001$). When compared with the patients without depression, patients with preoperative depression had higher rates of 90-day readmissions (2.4% vs 1.5%) and complications, including urinary tract infection (36.2% vs 28.9%), pneumonia (12.9% vs 9.1%), hematoma formation (3.1% vs 1.9%), acute kidney injury (4.0% vs 2.6%), deep venous thrombosis/pulmonary embolism (2.6% vs 1.7%), and superficial infection (4.9% vs 2.8%; $P < .01$ for all comparisons). Preoperative depression was associated with significantly higher odds of undergoing revision hip arthroscopy within 2 years (6.3% vs 2.4%; $P < .001$).

Conclusion: Patients with preexisting depression experienced higher rates of 90-day postoperative complications and hospital readmissions after elective hip arthroscopy for FAIS and were more likely to undergo revision hip arthroscopy within 2 years of the index procedure.

Keywords: depression; hip; arthroscopy; femoroacetabular impingement; postoperative complications

Hip arthroscopy is a minimally invasive procedure most commonly utilized to treat femoroacetabular impingement syndrome (FAIS), which has become increasingly recognized as a source of hip pain and disability.^{3,28} While FAIS reduces patients' ability to perform activities of daily living or participate in sports,²⁸ arthroscopic management results in improved functional patient-reported outcomes (PROs) and return to sports at midterm follow-up.^{4,5,22,26,35} Recent studies have reported superior

outcomes after hip arthroscopy as compared with nonoperative management, with patients who undergo arthroscopy being more likely to achieve the minimal clinically important difference for several validated PRO scores.^{10,11}

A significant proportion of patients with FAIS have psychiatric disorders, with up to 35% of patients reported to have a diagnosis of depression or anxiety before elective hip arthroscopy.¹⁶ These conditions are associated with inferior PROs after hip arthroscopy,^{8,21,23,24} as well as an increased risk of chronic opioid use and higher health care costs.¹⁵ Although several studies have demonstrated that patients with depression and anxiety experience less improvement in PROs after arthroscopic management of FAIS,^{23,34} data

are lacking on the effect of mental health conditions on postoperative complication rates, revision hip arthroscopy rates, and conversion to total hip arthroplasty (THA).

The purpose of this study was to determine the prevalence of depression and related psychiatric disorders among patients undergoing hip arthroscopy for FAIS and to assess the association between preoperative depression and postoperative complications, readmissions, and revision hip arthroscopy. We hypothesized that patients with these psychiatric disorders undergoing hip arthroscopy would experience increased rates of 90-day postoperative complications and readmissions as well as increased risk of undergoing early revision hip arthroscopy (within 2 years of the index procedure) as compared with patients without these psychiatric comorbidities.

METHODS

Using PearlDiver (PearlDiver Technologies), we searched for deidentified data from the Mariner database, which comprises 122 million patient lives from multiple insurance payer types, including private insurance, Medicare, Medicaid, government, and cash. A retrospective cohort study was performed using patient data between 2010 and 2019. Complete patient cohort allocation is outlined in Figure 1.

Identification of Arthroscopic Hip, Knee, and Shoulder Procedures

Arthroscopic hip procedures for FAIS were identified using Current Procedural Terminology (CPT) codes 29914, 29915, 29916, 29860, 29861, 29862, and 29863. Patients who underwent hip arthroscopy with an associated encounter code for septic arthritis or hip trauma, including acetabular fracture, femoral head fracture, intra-articular foreign/loose bodies, and hip dislocation, were excluded (Appendix Table A1). Patients with a preexisting ipsilateral artificial hip joint before hip arthroscopy were also excluded. Arthroscopic knee and shoulder procedures were also identified using CPT codes in order to compare lifetime prevalence of preoperative depression (Appendix Table A2).

Identification of Depression and Related Psychiatric Disorders

A diagnosis of depression or related psychiatric disorders was identified using International Classification of Diseases, Ninth Revision (ICD-9) and Tenth Revision (ICD-10), codes (Appendix Table A3). Patients with a reported diagnosis code within the year preceding hip arthroscopy were included in

the “depression” group (experimental group), while patients with no such diagnosis preceding hip arthroscopy were included in the “no depression” group (control group). Patients without at least 1 year of records before an arthroscopic hip procedure were excluded to reduce selection bias.

Baseline characteristics were collected for the experimental and control groups. To control for baseline differences, the groups were matched by age, sex, body mass index, tobacco use, and Charlson Comorbidity Index (CCI). The CCI is a widely used and validated adjustment index that accounts for multiple comorbidities to provide an overall assessment of a patient's health.⁶

Identification of 90-Day Readmissions, Postoperative Complications, and Revision Hip Procedures

Patient outcomes, including readmission and medical complications, were tracked for 90 days after hip arthroscopy. Appendix Table A4 provides a comprehensive list of tracked complications with their corresponding ICD-9 and ICD-10 codes.

Revision hip arthroscopy was defined as any hip arthroscopy performed on the ipsilateral hip after the index procedure; laterality of the index and revision procedures was defined via ICD-10 codes for hip pain and dysfunction (Appendix Table A5). Conversion to THA was defined as an ipsilateral THA after the index procedure; laterality was defined as in revision hip arthroscopy. Given that these laterality codes were implemented in 2015 with the advent of ICD-10, analysis of revision hip arthroscopy and conversion THA was limited to the period between 2015 and 2018.

Patients with a diagnosis of depression or related psychiatric disorder who underwent revision hip arthroscopy or conversion to THA within 2 years were included in the “depression” group (experimental group), while patients without such diagnoses who underwent these procedures within the defined times were included in the “no depression” group (control group). Patients without at least 2 years of records after an arthroscopic hip procedure were excluded to reduce selection bias.

Statistical Analysis

Rates of postoperative readmission, complications, and revision hip arthroscopy were compared using chi-square analysis; odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Statistical significance was set at $P < .5$ for all tests. Statistical tests were performed with the R Statistical Package.

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Ethical approval for this study was waived by the University of California–San Francisco (21-33336).

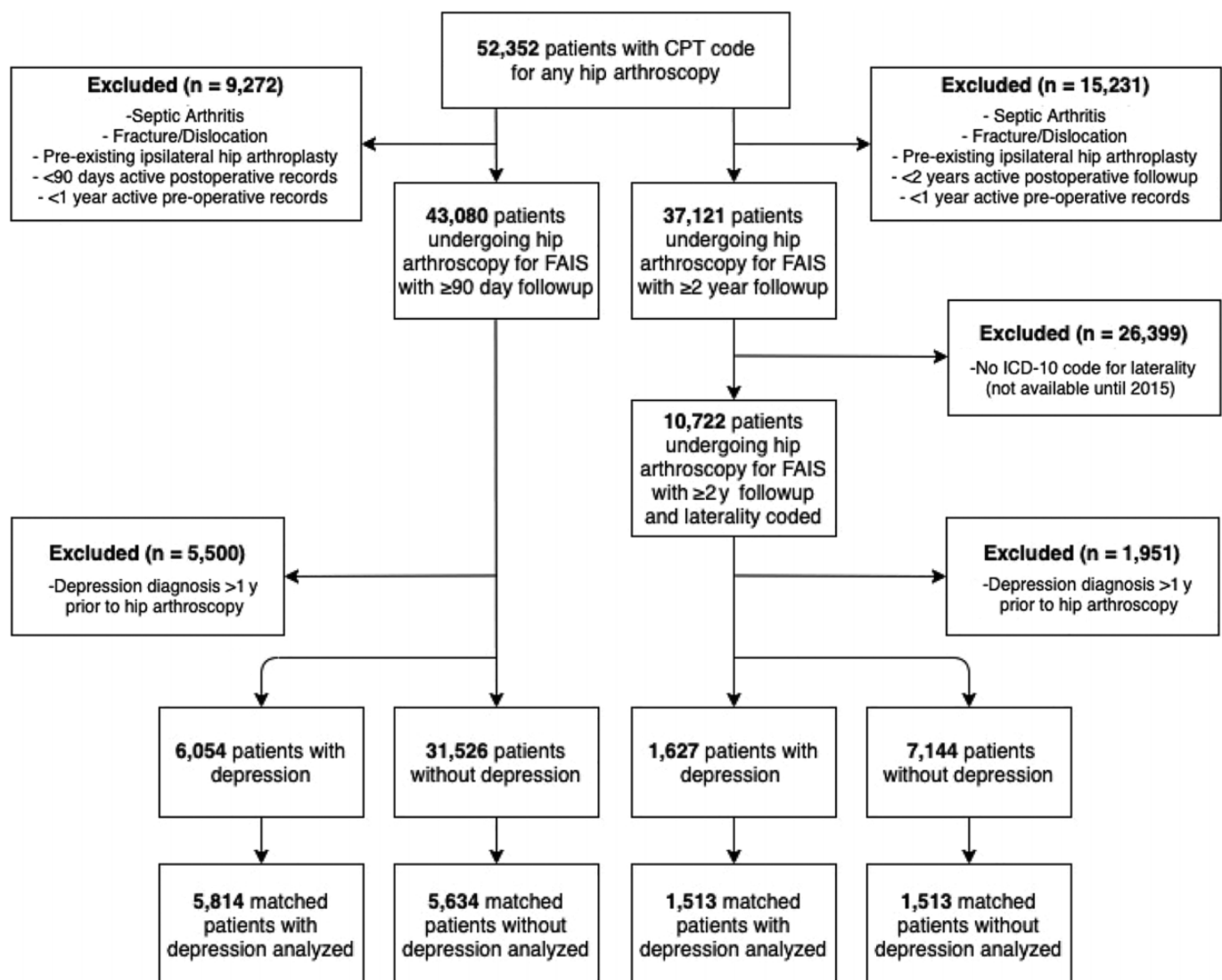


Figure 1. CONSORT diagram outlining study cohort allocations. CPT, Current Procedural Terminology; FAIS, femoroacetabular impingement syndrome; ICD-10, International Classification of Diseases, Tenth Revision.

RESULTS

Among the entire Mariner population, 52,352 patients underwent elective hip arthroscopy for FAIS between 2010 and 2019. The lifetime and 1-year preprocedure prevalence of depression in patients undergoing hip arthroscopy was 25.4% and 14.5%, respectively, as compared with 19.8% and 11.6% in patients undergoing elective knee arthroscopy and 22.2% and 12.9% in patients undergoing elective shoulder arthroscopy ($P < .001$ for all intergroup comparisons). Between 2011 and 2018, the prevalence of depression in patients undergoing elective hip arthroscopy increased from 11.6% to 18.9% (Figure 2).

Characteristics of the study groups are listed in Table 1. Before matching, patients with depression were more likely to be older, female, and obese and more likely to use tobacco and have a higher CCI.

90-Day Readmissions and Complications

The matched analysis for 90-day readmissions and complications consisted of 5814 patients with a diagnosis of depression or related psychiatric disorder within 1 year of hip arthroscopy and 5634 patients without such diagnoses (Table 2).

When comparing these matched groups, we found a significantly increased odds of 90-day readmission in the depression group (OR, 1.59 [95% CI, 1.21-2.10]; $P < .001$). The depression group also had increased odds of multiple 90-day postoperative medical complications, such as urinary tract infection (OR, 1.39 [95% CI, 1.29-1.51]; $P < .001$), pneumonia (OR, 1.49 [95% CI, 1.32-1.67]; $P < .001$), hematoma formation (OR, 1.64 [95% CI, 1.29-2.08]; $P < .001$), acute kidney injury (OR, 1.58 [95% CI, 1.28-1.95]; $P < .001$), deep venous thrombosis/pulmonary

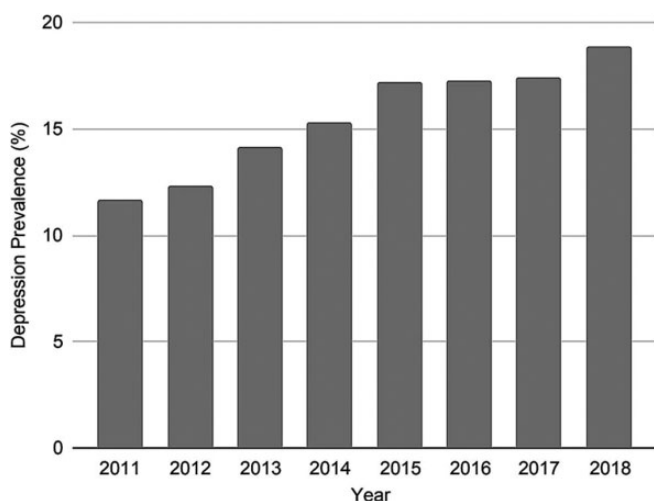


Figure 2. Year-by-year percentage of patients undergoing elective hip arthroscopy with a recorded diagnosis of depression within 1 year before surgery.

TABLE 1
Descriptive Data of Unmatched Study Cohorts Undergoing Hip Arthroscopy for FAIS^a

	Depression (n = 6054)	No Depression (n = 31,526)
Age, y	41.1 ± 13.5	39.8 ± 15.2
Female sex	4838 (79.9)	21,389 (67.8)
Obese	2165 (35.8)	6407 (20.3)
Tobacco use	2053 (33.9)	5087 (16.1)
CCI	0.64 ± 1.27	0.38 ± 0.92

^aData are reported as mean ± SD or n (%). Difference between cohorts for each variable: $P < .001$. CCI, Charlson Comorbidity Index; FAIS, femoroacetabular impingement syndrome.

embolism (OR, 1.51 [95% CI, 1.16-1.95]; $P = .002$), and superficial wound infection (OR, 1.76 [95% CI, 1.44-2.14]; $P < .001$) (Table 3).

Revision Hip Arthroscopy and Conversion to THA

The matched analysis for early revision hip arthroscopy and conversion to THA (as defined by ipsilateral hip arthroscopy or THA within 2 years of the index procedure) consisted of 1513 patients with a diagnosis of depression or related psychiatric disorder within 1 year of hip arthroscopy and 1513 patients without such diagnoses. The overall rates of early revision hip arthroscopy and conversion to THA were 4.4% and 3.1%, respectively. The depression group had increased odds of early revision hip arthroscopy (OR, 2.78 [95% CI, 1.88-4.11; $P < .001$]) but not early conversion to THA ($P = .40$) (Table 4).

DISCUSSION

This study demonstrated that a diagnosis of depression or related psychiatric disorders is correlated with increased

TABLE 2
Descriptive Data of Matched Study Cohorts Undergoing Hip Arthroscopy for FAIS^a

	Depression (n = 5814)	No Depression (n = 5634)	P Value
Age, y	41.0 ± 13.4	41.0 ± 13.4	.83
Female sex	4728 (80.1)	4728 (80.1)	≥.99
Obese	2055 (34.8)	2055 (34.8)	≥.99
Tobacco use	1954 (33.1)	1954 (33.1)	≥.99
CCI	0.53 ± 0.97	0.53 ± 0.97	≥.99

^aData are reported as mean ± SD or n (%). CCI, Charlson Comorbidity Index; FAIS, femoroacetabular impingement syndrome.

risk for multiple short-term postoperative complications after hip arthroscopy for FAIS. In addition, depression was associated with increased risk of undergoing ipsilateral revision hip arthroscopy within 2 years of primary arthroscopy.

In our study, the lifetime prevalence of preoperative depression in patients undergoing elective hip arthroscopy was 25.4%. It has been reported that up to 35% of patients undergoing hip arthroscopy carry a diagnosis of anxiety or depression,¹⁰ as compared with 20% of patients undergoing total knee arthroplasty⁹ and 12% of patients undergoing shoulder arthroplasty.²⁷ In a large database study, Iglinski-Benjamin et al¹⁴ found that depression was the most common comorbid psychiatric diagnosis in patients undergoing hip arthroscopy and that patients in this cohort had a higher incidence of psychiatric conditions than did patients undergoing anterior cruciate ligament reconstruction or shoulder stabilization surgery.

While the prevalence of depression in patients with FAIS has been well documented, the relationship between FAIS and depression is not well understood but could stem from a variety of patient-related factors, such as the high costs and significant wait time between onset of symptoms and diagnosis of a labral tear.¹⁷ It is also possible that patients with depression have increased sensitivity to somatic injuries,⁷ which can lead to amplified FAI symptoms necessitating surgical intervention. Despite these gaps in the literature, prior studies have shown that depression and anxiety are associated with higher rates of opioid use and increased costs of care for patients undergoing hip arthroscopy.^{2,15} Given our findings that patients with preoperative depression experience higher rates of postoperative complications, the prevalence of depression in patients undergoing hip arthroscopy has the possibility to represent a significant burden to our health care system.

While a connection between mental health and PROs after hip arthroscopy for FAIS has been demonstrated,^{8,21,23,24} our study is the first to our knowledge to show how mental health may affect postoperative complication and readmission rates in a large population of patients undergoing hip arthroscopy. Although this concept is novel to the field of hip arthroscopy, it has been

TABLE 3
Comparison of 90-Day Postoperative Complications After Hip Arthroscopy

	Complications, No. (%)		Odds Ratio (95% CI)	P Value ^a
	Depression (n = 5814)	No Depression (n = 5634)		
Readmission within 90 d	137 (2.4)	84 (1.5)	1.59 (1.21-2.10)	<.001
Urinary tract infection	2103 (36.2)	1630 (28.9)	1.39 (1.29-1.51)	<.001
Pneumonia	751 (12.9)	511 (9.1)	1.49 (1.32-1.67)	<.001
Hematoma formation	182 (3.1)	109 (1.9)	1.64 (1.29-2.08)	<.001
Superficial wound infection	284 (4.9)	160 (2.8)	1.76 (1.44-2.14)	<.001
Acute kidney injury	235 (4.0)	146 (2.6)	1.58 (1.28-1.95)	<.001
Deep venous thrombosis/pulmonary embolism	151 (2.6)	98 (1.7)	1.51 (1.16-1.95)	.002
Cardiac arrest	29 (0.5)	25 (0.4)	1.12 (0.66-1.92)	.77
Lower extremity nerve injury	31 (0.5)	36 (0.6)	0.83 (0.51-1.35)	.54
Heterotopic ossification	34 (0.6)	23 (0.4)	1.44 (0.84-2.44)	.23
Septic arthritis	19 (0.3)	17 (0.3)	1.08 (0.56-2.09)	.94
Need for transfusion	111 (1.9)	88 (1.6)	1.23 (0.93-1.63)	.18

^aBold P values indicate statistically significant difference between cohorts ($P < .05$).

TABLE 4
Comparison of Additional Ipsilateral Hip Procedures Within 2 Years

	Additional Procedures, No. (%)		Odds Ratio (95% CI)	P Value ^a
	Depression (n = 1513)	No Depression (n = 1513)		
Revision hip arthroscopy	96 (6.3)	36 (2.4)	2.78 (1.88-4.11)	<.001
Conversion to total hip arthroplasty	43 (2.8)	52 (3.4)	0.82 (0.55-1.24)	.40

^aBold P value indicates statistically significant difference between cohorts ($P < .05$).

demonstrated in patients with depression undergoing hip, knee, and shoulder arthroplasty,^{27,31} who have been shown to be at increased risk of postoperative anemia, renal failure, and prosthetic joint infection. The mechanisms underlying this interaction are likely multifactorial but may include the upregulation of inflammatory cytokines (eg, tumor necrosis factor α , interleukin 1 β , and the cyclo-oxygenase 2 pathway), which has been observed in depression and other psychiatric diagnoses.^{25,29,30} High levels of these cytokines may lead to an inflammatory condition in the perioperative period and thus negatively affect patient outcomes. A diagnosis of depression itself may also indicate worse patient health and higher rates of chronic medical illness, which in turn could contribute to an increased risk of postoperative complications in patients with depression.¹⁸

Despite our knowledge of the relationship between depression and patient outcomes, it is unknown how exactly preoperative treatment for depression affects postoperative outcomes after hip arthroscopy. While there is mixed evidence surrounding this concept within the arthroplasty literature,^{13,20} no studies to date have examined this topic in a population of patients undergoing hip arthroscopy; thus, further investigation is warranted to optimize patient outcomes and reduce postoperative complications.

In our study, patients with depression were nearly 3 times more likely to undergo revision hip arthroscopy within 2 years of the index procedure. These patients underwent

similar rates of conversion to THA as compared with controls likely because we included age (a good surrogate for Tönnis grade) in our matching criteria. The overall rate of early revision hip arthroscopy in our study (4.4%) is consistent with rates reported in the literature.^{19,36} While radiographic and intraoperative findings such as residual FAI are cited as common reasons for revision hip arthroscopy, few studies have examined patient characteristic factors associated with revision hip arthroscopy. Kester et al¹⁹ and West et al³⁶ identified patient age, female sex, and index procedure performed by a low-volume surgeon as risk factors for undergoing revision hip arthroscopy within 2 years. Although studies have associated these and other numerous risk factors with early conversion from hip arthroscopy to THA,^{1,32} previous studies to our knowledge have not reported an association between depression and revision hip arthroscopy.

One potential explanation for our findings is lower pre- and postoperative PROs disclosed by patients with depression and other mental health diagnoses. Although these patients can achieve the minimal clinically important difference for the Hip Outcome Score and modified Harris Hip Score,²³ Shapira et al³³ demonstrated a threshold effect for the modified Harris Hip Score at 1 year after hip arthroscopy that predicted need for a secondary hip procedure. Depression also has a synergistic relationship with pain,¹² and unimproved or worsening postoperative pain may influence a surgeon's decision to perform revision hip arthroscopy. Future investigation into the risk factors and decision-

making processes surrounding revision hip arthroscopy in the setting of depression is necessary to help surgeons counsel patients considering revision hip arthroscopy and to prevent unnecessary revision procedures in patients with continued symptoms despite unclear surgical indications.

The findings of our study should be interpreted in the context of its limitations. The validity of our results is reliant on accurate ICD-10 and CPT coding, although specific inclusion and exclusion criteria were applied to minimize potential misclassification. Given the limitations of the Mariner database, we were not able to directly control for multiple variables, such as the severity of depression symptoms, pharmacologic treatment of depression, radiographic measurements of FAI, labral tear morphology, degree of preexisting osteoarthritis, and completeness of impingement correction. The Mariner database does not provide granular data on preoperative function, intraoperative findings, or surgical technique, which limited us to perform a matched-cohort analysis instead of a multivariate logistic regression analysis. Additionally, we were unable to evaluate pre- and postoperative PROs to investigate possible correlation between outcome scores and revision hip arthroscopy. Finally, given the retrospective nature of this database study, it is important to note that we were able to report only on correlations between depression and incidence of postoperative complications; determination of causation lies outside the scope of this study.

CONCLUSION

Patients with a diagnosis of depression or similarly related psychiatric disorders experience higher rates of 90-day complications and hospital readmissions after elective hip arthroscopy for FAIS and are more likely to undergo revision hip arthroscopy within 2 years of the index procedure. Given the prevalence of depression in this population, mental health screening should be considered part of a standard preoperative patient assessment.

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APPENDIX

TABLE A1
ICD-9 and ICD-10 Codes for Exclusion Criteria^a

Hip trauma

ICD-10-D-M24051, ICD-10-D-M24351, ICD-10-D-M24352, ICD-10-D-M24451, ICD-10-D-M24452, ICD-10-D-M247, ICD-10-D-S32401A, ICD-10-D-S32401B, ICD-10-D-S32401D, ICD-10-D-S32401G, ICD-10-D-S32401 K, ICD-10-D-S32401 S, ICD-10-D-S32402A, ICD-10-D-S32402B, ICD-10-D-S32402D, ICD-10-D-S32402G, ICD-10-D-S32402 K, ICD-10-D-S32402 S, ICD-10-D-S32409A, ICD-10-D-S32409B, ICD-10-D-S32409D, ICD-10-D-S32409G, ICD-10-D-S32409 K, ICD-10-D-S32409 S, ICD-10-D-S32411A, ICD-10-D-S32411B, ICD-10-D-S32411D, ICD-10-D-S32411 K, ICD-10-D-S32411 S, ICD-10-D-S32412A, ICD-10-D-S32412D, ICD-10-D-S32412 S, ICD-10-D-S32413A, ICD-10-D-S32413D, ICD-10-D-S32413 S, ICD-10-D-S32414A, ICD-10-D-S32414D, ICD-10-D-S32414 S, ICD-10-D-S32415A, ICD-10-D-S32415D, ICD-10-D-S32415 S, ICD-10-D-S32416A, ICD-10-D-S32416D, ICD-10-D-S32421A, ICD-10-D-S32421B, ICD-10-D-S32421D, ICD-10-D-S32421 K, ICD-10-D-S32421 S, ICD-10-D-S32422A, ICD-10-D-S32422B, ICD-10-D-S32422D, ICD-10-D-S32422G, ICD-10-D-S32422 K, ICD-10-D-S32422 S, ICD-10-D-S32423A, ICD-10-D-S32423D, ICD-10-D-S32424A, ICD-10-D-S32424D, ICD-10-D-S32424G, ICD-10-D-S32424 S, ICD-10-D-S32425A, ICD-10-D-S32425D, ICD-10-D-S32425 S, ICD-10-D-S32426A, ICD-10-D-S32431A, ICD-10-D-S32431B, ICD-10-D-S32431D, ICD-10-D-S32431G, ICD-10-D-S32431 K, ICD-10-D-S32432A, ICD-10-D-S32432B, ICD-10-D-S32432D, ICD-10-D-S32432G, ICD-10-D-S32432 K, ICD-10-D-S32432 S, ICD-10-D-S32433A, ICD-10-D-S32433D, ICD-10-D-S32433 S, ICD-10-D-S32434A, ICD-10-D-S32434D, ICD-10-D-S32434G, ICD-10-D-S32434 S, ICD-10-D-S32435A, ICD-10-D-S32435B, ICD-10-D-S32435D, ICD-10-D-S32435 K, ICD-10-D-S32435 S, ICD-10-D-S32436A, ICD-10-D-S32492A, ICD-10-D-S32492B, ICD-10-D-S32492D, ICD-10-D-S32492G, ICD-10-D-S32492 K, ICD-10-D-S32492 S, ICD-10-D-S32499A, ICD-10-D-S32499D, ICD-10-D-S32499 S, ICD-10-D-S72051A, ICD-10-D-S72051B, ICD-10-D-S72051D, ICD-10-D-S72051G, ICD-10-D-S72051 K, ICD-10-D-S72051 S, ICD-10-D-S72052A, ICD-10-D-S72052D, ICD-10-D-S72052G, ICD-10-D-S72052 H, ICD-10-D-S72052 J, ICD-10-D-S72052 K, ICD-10-D-S72052P, ICD-10-D-S72052 S, ICD-10-D-S72059A, ICD-10-D-S72059C, ICD-10-D-S72059D, ICD-10-D-S72059 S, ICD-10-D-S72061A, ICD-10-D-S72061B, ICD-10-D-S72061D, ICD-10-D-S72061E, ICD-10-D-S72061 H, ICD-10-D-S72061P, ICD-10-D-S72061 S, ICD-10-D-S72062A, ICD-10-D-S72062D, ICD-10-D-S72062E, ICD-10-D-S72062G, ICD-10-D-S72062 S, ICD-10-D-S72063A, ICD-10-D-S72064A, ICD-10-D-S72064C, ICD-10-D-S72064D, ICD-10-D-S72064F, ICD-10-D-S72064 S, ICD-10-D-S72065A, ICD-10-D-S72065D, ICD-10-D-S72065 S, ICD-10-D-S72091A, ICD-10-D-S72091B, ICD-10-D-S72091C, ICD-10-D-S72091D, ICD-10-D-S72091G, ICD-10-D-S72091 K, ICD-10-D-S72091 M, ICD-10-D-S72091P, ICD-10-D-S72091 S, ICD-10-D-S72092A, ICD-10-D-S72092B, ICD-10-D-S72092C, ICD-10-D-S72092D, ICD-10-D-S72092E, ICD-10-D-S72092G, ICD-10-D-S72092 H, ICD-10-D-S72092 K, ICD-10-D-S72092 M, ICD-10-D-S72092 N, ICD-10-D-S72092P, ICD-10-D-S72092 S, ICD-10-D-S72099A, ICD-10-D-S72099B, ICD-10-D-S72099D, ICD-10-D-S72099F, ICD-10-D-S72099 K, ICD-10-D-S72099 S, ICD-10-D-S73004A, ICD-10-D-S73004D, ICD-10-D-S73004 S, ICD-10-D-S73005A, ICD-10-D-S73005D, ICD-10-D-S73005 S, ICD-10-D-S73014A, ICD-10-D-S73014D, ICD-10-D-S73014 S, ICD-10-D-S73015A, ICD-10-D-S73015D, ICD-10-D-S73024D, ICD-10-D-S73025A, ICD-10-D-S73034A, ICD-10-D-S73034D, ICD-10-D-S73034 S, ICD-10-D-S73035A, ICD-10-D-S73035D, ICD-10-D-S73035 S, ICD-10-D-S73044A, ICD-10-D-S73044D, ICD-10-D-S73044 S, ICD-10-D-S73045A, ICD-10-D-S73045D, ICD-9-D-71865, ICD-9-D-8080, ICD-9-D-8081, ICD-9-D-83500, ICD-9-D-83501, ICD-9-D-83502, ICD-9-D-83503

Preexisting hip arthroplasty

ICD-10-D-Z96641, ICD-10-D-Z96642, ICD-10-D-Z96643, ICD-10-D-Z96649, ICD-9-D-V4364

Septic arthritis

ICD-10-D-M00051, ICD-10-D-M00052, ICD-10-D-M00251, ICD-10-D-M00252, ICD-10-D-M00851, ICD-10-D-M00852, ICD-10-D-M00859, ICD-10-D-M0089, ICD-10-D-M009, ICD-10-D-M01X51, ICD-10-D-M01X52, ICD-10-D-M01X59, ICD-9-D-71100, ICD-9-D-71105, ICD-9-D-71108, ICD-9-D-71109

^aICD-9, International Classification of Diseases, Ninth Revision; ICD-10, International Classification of Diseases, Tenth Revision.

TABLE A2
Codes for arthroscopic shoulder and knee procedures

Arthroscopic Shoulder procedures

CPT-29805, CPT-29806, CPT-29807, CPT-29819, CPT-29820, CPT-29821, CPT-29822, CPT-29823, CPT-29824, CPT-29825, CPT-29826, CPT-29827, CPT-29828, CPT-S2300

Arthroscopic Knee Procedures

CPT-29850, CPT-29851, CPT-29866, CPT-29867, CPT-29868, CPT-29870, CPT-29871, CPT-29873, CPT-29874, CPT-29875, CPT-29876, CPT-29877, CPT-29879, CPT-29880, CPT-29881, CPT-29882, CPT-29883, CPT-29884, CPT-29885, CPT-29886, CPT-29887, CPT-G0289, CPT-S2112

TABLE A3
ICD-9 and ICD-10 Codes for Depression and Related Psychiatric Diagnoses^a

Depression and related diagnoses

ICD-10-D-F3130, ICD-10-D-F3131, ICD-10-D-F3132, ICD-10-D-F314, ICD-10-D-F315, ICD-10-D-F320, ICD-10-D-F321, ICD-10-D-F322, ICD-10-D-F323, ICD-10-D-F324, ICD-10-D-F325, ICD-10-D-F328, ICD-10-D-F3281, ICD-10-D-F3289, ICD-10-D-F329, ICD-10-D-F330, ICD-10-D-F331, ICD-10-D-F332, ICD-10-D-F333, ICD-10-D-F3340, ICD-10-D-F3341, ICD-10-D-F3342, ICD-10-D-F338, ICD-10-D-F339, ICD-10-D-F341, ICD-10-D-F4320, ICD-10-D-F4321, ICD-10-D-F4322, ICD-10-D-F4323, ICD-10-D-F4324, ICD-10-D-F4325, ICD-10-D-F4329, ICD-9-D-2962, ICD-9-D-29620, ICD-9-D-29621, ICD-9-D-29622, ICD-9-D-29623, ICD-9-D-29624, ICD-9-D-29625, ICD-9-D-29626, ICD-9-D-2963, ICD-9-D-29630, ICD-9-D-29631, ICD-9-D-29632, ICD-9-D-29633, ICD-9-D-29634, ICD-9-D-29635, ICD-9-D-29636, ICD-9-D-29651, ICD-9-D-29652, ICD-9-D-29653, ICD-9-D-29654, ICD-9-D-29655, ICD-9-D-29656, ICD-9-D-3004, ICD-9-D-3090, ICD-9-D-3091, ICD-9-D-30921, ICD-9-D-30922, ICD-9-D-30923, ICD-9-D-30924, ICD-9-D-30928, ICD-9-D-30929, ICD-9-D-3093, ICD-9-D-3094, ICD-9-D-3098, ICD-9-D-30981, ICD-9-D-30982, ICD-9-D-30983, ICD-9-D-30989, ICD-9-D-3099, ICD-9-D-311

^aICD-9, International Classification of Diseases, Ninth Revision; ICD-10, International Classification of Diseases, Tenth Revision.

TABLE A4
ICD-9 and ICD-10 Codes for Tracked Complications^a

Acute kidney injury

ICD-10-D-N170, ICD-10-D-N171, ICD-10-D-N172, ICD-10-D-N178, ICD-10-D-N179, ICD-9-D-5845, ICD-9-D-5846, ICD-9-D-5847, ICD-9-D-5848, ICD-9-D-5849

Cardiac arrest

ICD-10-D-I462, ICD-10-D-I468, ICD-10-D-I469, ICD-9-D-42741, ICD-9-D-4275

Deep venous thrombosis/pulmonary embolism

ICD-10-D-I2601, ICD-10-D-I2602, ICD-10-D-I2609, ICD-9-D-4151, ICD-9-D-41511, ICD-9-D-41512, ICD-9-D-41513, ICD-9-D-41519, ICD-10-D-I2690, ICD-10-D-I2692, ICD-10-D-I2694, ICD-10-D-I2699, ICD-9-D-4532, ICD-9-D-4533, ICD-9-D-4534, ICD-9-D-45382, ICD-9-D-45384, ICD-9-D-45385, ICD-9-D-45386

Hematoma

ICD-10-D-E89811, ICD-10-D-G9751, ICD-10-D-G9752, ICD-10-D-I97418, ICD-10-D-I97610, ICD-10-D-I97618, ICD-10-D-I97620, ICD-10-D-J9561, ICD-10-D-J95830, ICD-10-D-J95831, ICD-10-D-K9161, ICD-10-D-K91840, ICD-10-D-K91841, ICD-10-D-L7602, ICD-10-D-L7621, ICD-10-D-L7622, ICD-10-D-M96810, ICD-10-D-M96830, ICD-10-D-M96831, ICD-10-D-N99820, ICD-10-D-N99821, ICD-10-D-T888XXA, ICD-9-D-99811, ICD-9-D-99812, ICD-9-D-99813

(continued)

TABLE A4 (continued)

Nerve injury

ICD-10-D-S7400XA, ICD-10-D-S7400XD, ICD-10-D-S7400XS, ICD-10-D-S7401XA, ICD-10-D-S7401XD, ICD-10-D-S7401XS, ICD-10-D-S7402XA, ICD-10-D-S7402XD, ICD-10-D-S7402XS, ICD-10-D-S7410XA, ICD-10-D-S7410XD, ICD-10-D-S7410XS, ICD-10-D-S7411XA, ICD-10-D-S7411XD, ICD-10-D-S7411XS, ICD-10-D-S7412XA, ICD-10-D-S7412XD, ICD-10-D-S7412XS, ICD-10-D-S7420XA, ICD-10-D-S7420XS, ICD-10-D-S7421XA, ICD-10-D-S7421XD, ICD-10-D-S7421XS, ICD-10-D-S7422XA, ICD-10-D-S7422XD, ICD-10-D-S7422XS, ICD-10-D-S748X1A, ICD-10-D-S748X1D, ICD-10-D-S748X2A, ICD-10-D-S748X2D, ICD-10-D-S748X9A, ICD-10-D-S748X9D, ICD-10-D-S7490XA, ICD-10-D-S7490XD, ICD-10-D-S7491XA, ICD-10-D-S7491XD, ICD-10-D-S7491XS, ICD-10-D-S7492XA, ICD-10-D-S7492XD, ICD-10-D-S7492XS, ICD-10-D-S8400XA, ICD-10-D-S8400XD, ICD-10-D-S8400XS, ICD-10-D-S8401XA, ICD-10-D-S8401XD, ICD-10-D-S8401XS, ICD-10-D-S8402XA, ICD-10-D-S8402XD, ICD-10-D-S8402XS, ICD-10-D-S8410XA, ICD-10-D-S8410XD, ICD-10-D-S8410XS, ICD-10-D-S8411XA, ICD-10-D-S8411XD, ICD-10-D-S8411XS, ICD-10-D-S8412XA, ICD-10-D-S8412XD, ICD-10-D-S8412XS, ICD-10-D-S8420XA, ICD-10-D-S8420XD, ICD-10-D-S8421XA, ICD-10-D-S8421XD, ICD-10-D-S8421XS, ICD-10-D-S8422XA, ICD-10-D-S8422XD, ICD-10-D-S8422XS, ICD-10-D-S84801A, ICD-10-D-S84801D, ICD-10-D-S84801 S, ICD-10-D-S84802A, ICD-10-D-S84802D, ICD-10-D-S84802 S, ICD-10-D-S84809A, ICD-10-D-S8490XA, ICD-10-D-S8490XD, ICD-10-D-S8490XS, ICD-10-D-S8491XA, ICD-10-D-S8491XD, ICD-10-D-S8491XS, ICD-10-D-S8492XA, ICD-10-D-S8492XD, ICD-10-D-S8492XS, ICD-10-D-S9400XA, ICD-10-D-S9400XD, ICD-10-D-S9400XS, ICD-10-D-S9401XA, ICD-10-D-S9401XD, ICD-10-D-S9401XS, ICD-10-D-S9402XA, ICD-10-D-S9402XD, ICD-10-D-S9402XS, ICD-10-D-S9410XA, ICD-10-D-S9410XD, ICD-10-D-S9410XS, ICD-10-D-S9411XA, ICD-10-D-S9411XD, ICD-10-D-S9411XS, ICD-10-D-S9412XA, ICD-10-D-S9412XD, ICD-10-D-S9412XS, ICD-10-D-S9420XA, ICD-10-D-S9420XD, ICD-10-D-S9420XS, ICD-10-D-S9421XA, ICD-10-D-S9421XD, ICD-10-D-S9421XS, ICD-10-D-S9422XA, ICD-10-D-S9422XD, ICD-10-D-S9422XS, ICD-10-D-S9430XA, ICD-10-D-S9430XD, ICD-10-D-S9431XA, ICD-10-D-S9431XD, ICD-10-D-S9431XS, ICD-10-D-S9432XA, ICD-10-D-S9432XD, ICD-10-D-S9432XS, ICD-10-D-S948X1A, ICD-10-D-S948X1D, ICD-10-D-S948X1 S, ICD-10-D-S948X2A, ICD-10-D-S948X2D, ICD-10-D-S948X2 S, ICD-10-D-S948X9A, ICD-10-D-S948X9D, ICD-10-D-S948X9 S, ICD-10-D-S9490XA, ICD-10-D-S9490XD, ICD-10-D-S9490XS, ICD-10-D-S9491XA, ICD-10-D-S9491XD, ICD-10-D-S9491XS, ICD-10-D-S9492XA, ICD-10-D-S9492XD, ICD-10-D-S9492XS, ICD-9-D-9560, ICD-9-D-9561, ICD-9-D-9562, ICD-9-D-9563, ICD-9-D-9564, ICD-9-D-9565, ICD-9-D-9566, ICD-9-D-9567, ICD-9-D-9568, ICD-9-D-9569

Pneumonia

ICD-10-D-J120, ICD-10-D-J121, ICD-10-D-J122, ICD-10-D-J123, ICD-10-D-J1281, ICD-10-D-J1289, ICD-10-D-J129, ICD-10-D-J13, ICD-10-D-J14, ICD-10-D-J150, ICD-10-D-J151, ICD-10-D-J1520, ICD-10-D-J15211, ICD-10-D-J15212, ICD-10-D-J1529, ICD-10-D-J153, ICD-10-D-J154, ICD-10-D-J155, ICD-10-D-J156, ICD-10-D-J157, ICD-10-D-J158, ICD-10-D-J159, ICD-10-D-J160, ICD-10-D-J168, ICD-10-D-J17, ICD-10-D-J180, ICD-10-D-J181, ICD-10-D-J182, ICD-10-D-J188, ICD-10-D-J189, ICD-9-D-4800, ICD-9-D-4801, ICD-9-D-4802, ICD-9-D-4808, ICD-9-D-4809, ICD-9-D-481, ICD-9-D-4820, ICD-9-D-4821, ICD-9-D-48230, ICD-9-D-48232, ICD-9-D-48239, ICD-9-D-48240, ICD-9-D-48241, ICD-9-D-48242, ICD-9-D-48249, ICD-9-D-48281, ICD-9-D-48282, ICD-9-D-48283, ICD-9-D-48284, ICD-9-D-48289, ICD-9-D-4829, ICD-9-D-4830, ICD-9-D-4831, ICD-9-D-4838, ICD-9-D-4843, ICD-9-D-4846, ICD-9-D-4848, ICD-9-D-485, ICD-9-D-486

Septic arthritis

ICD-10-D-M00051, ICD-10-D-M00052, ICD-10-D-M00251, ICD-10-D-M00252, ICD-10-D-M00851, ICD-10-D-M00852, ICD-10-D-M00859, ICD-10-D-M0089, ICD-10-D-M009, ICD-10-D-M01X51, ICD-10-D-M01X52, ICD-10-D-M01X59, ICD-9-D-71100, ICD-9-D-71105, ICD-9-D-71108, ICD-9-D-71109

Superficial wound infection

ICD-10-D-T8131XA, ICD-10-D-T8131XD, ICD-10-D-T8131XS, ICD-10-D-T8141XA, ICD-10-D-T8141XD, ICD-10-D-T8141XS, ICD-9-D-99832, ICD-9-D-99851, ICD-9-D-99859, ICD-9-D-99883

Transfusion

ICD-10-P-30230N0, ICD-10-P-30233H0, ICD-10-P-30233H1, ICD-10-P-30233J1, ICD-10-P-30233K1, ICD-10-P-30233L1, ICD-10-P-30233N0, ICD-10-P-30233N1, ICD-10-P-30233P1, ICD-10-P-30233R1, ICD-10-P-30233S1, ICD-10-P-30233V1, ICD-10-P-30243H0, ICD-10-P-30243K1, ICD-10-P-30243N1, ICD-10-P-30243R1, ICD-10-P-30243S1, ICD-10-P-30243Y0, ICD-10-P-30253N0, ICD-10-P-30253N1, ICD-10-P-30263G1, ICD-10-P-30263N1, ICD-10-P-30273N1, ICD-10-P-30283B1, ICD-9-P-9904

Urinary tract infection

ICD-10-D-N390, ICD-9-D-5990

^aICD-9, International Classification of Diseases, Ninth Revision; ICD-10, International Classification of Diseases, Tenth Revision.

TABLE A5

ICD-10 Codes for Revision Procedures: Laterality Modifiers and Total Hip Arthroplasty Procedures^a

Laterality modifiers

ICD-10-D-M24152, ICD-10-D-M24852, ICD-10-D-M25852, ICD-10-D-S73192A, ICD-10-D-S73192D, ICD-10-D-S73192 S, ICD-10-D-M24151, ICD-10-D-M24851, ICD-10-D-M25851, ICD-10-D-S73191A, ICD-10-D-S73191D, ICD-10-D-S73191S

Total hip arthroplasty procedures

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, ICD-10-P-0SRB07Z, ICD-10-P-0SRB0J9, ICD-10-P-0SRB0JA, ICD-10-P-0SRB0JZ, ICD-10-P-0SRB0KZ, 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-0SR90J9, ICD-10-P-0SR90JA, ICD-10-P-0SR90JZ

^aICD-10, International Classification of Diseases, Tenth Revision.