Original Article

Older Age, Female Sex, Anxiety, Substance Use Disorder, Osteoarthritis, Tibial Tubercle Osteotomy, and Opioid Familiarity Are Risk Factors for Prolonged Opioid Use Following Medial Patellofemoral Ligament Reconstruction

Varag Abed, B.S., Camille D. Khalily, M.D., Gregory S. Hawk, Ph.D., Caitlin Conley, Ph.D., David C. Landy, M.D., Ph.D., and Austin V. Stone, M.D., Ph.D.

Purpose: To determine which preoperative factors are associated with prolonged opioid use after medial patellofemoral ligament reconstruction (MPFLR). **Methods:** The M151Ortho PearlDiver database was queried for patients who underwent MPFLR between 2010 and 2020. Inclusion criteria included patients who underwent MPFLR using Current Procedural Terminology codes 27420, 27422, and 27427 and had a patellar instability diagnosis. Prolonged opioid use was defined as opioid use greater than 1 month after surgery. Postoperative opioid use from 1 month to 6 months was assessed. Multivariable logistic regression was used to evaluate the association between patient-related risk factors (age, sex, Charlson Comorbidity Index, anxiety, depression, substance use disorder, osteoarthritis, tibial tubercle osteotomy [TTO], and previous opioid use within 3 months to 1 week of surgery) with prolonged postoperative opioid use. Odds ratios (OR) and their associated 95% confidence intervals (CI) were calculated for each risk factor. **Results:** A total of 23,249 patients were included. There was a higher proportion of female patients compared to male patients (67.8% vs 32.2%) in our cohort, as well as a large proportion of patients who had preoperative opioid use (23.9%). In total, 14.3% of patients had a concomitant TTO. Three months post-MPFLR, male patients were at a decreased risk of opioid usage (OR 0.75; CI 0.67-0.83; $P \leq .001$). Older age (OR 1.01, CI 1.00-1.01; $P \leq .001$), patients with pre-existing anxiety (OR 1.30, CI 1.15-1.47; $P \leq .001$), substance use disorder (OR 2.04, CI 1.80-2.31; $P \leq .001$), knee osteoarthritis (OR 1.70, CI 1.49-1.94; $P \leq .001$), concomitant TTO (OR 1.91, CI 1.67-2.17; $P \leq .001$), and opioid familiarity (OR 7.68, CI 6.93-8.52; $P \leq .001$) were at a significantly increased risk of postoperative opioid usage. **Conclusions:** Older age, female sex, anxiety, substance use disorder, osteoarthritis, tibial tubercle osteotomy, and opioid familiarity are risk factors for prolonged opioid use following MPFLR. **Level of Evidence:** Level III, retrospective cohort study.

In the field of orthopaedic surgery, the use and prescription of opioids has been an important topic of discussion.[1] Although multiple providers in various medical specialties prescribe opioids, orthopaedic surgeons do so at one of the highest rates.[1-3] Orthopaedic patients also have a high prescription refill rate compared with other specialties.[2] Okoli et al.[4] analyzed postoperative opioid use after common outpatient orthopaedic surgeries at a single institution, some of which being rotator cuff repair, anterior cruciate ligament reconstruction (ACLR), and Achilles tendon repair, finding that more than 11% of patients continued using opioids after 6 months.

Previous studies have investigated factors that lead to prolonged opioid use after multiple orthopaedic procedures, such as ACLR and total joint arthroplasty[5,6] to

From the Departments of Orthopaedic Surgery and Sports Medicine (V.A., C.D.K., C.C., D.L., A.V.S.) and Statistics (G.S.H.), University of Kentucky, Lexington, Kentucky, U.S.A.

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Address correspondence to Austin V. Stone, M.D., Ph.D., Department of Orthopaedic Surgery and Sports Medicine, University of Kentucky, 2195 Harrodsburg Rd., Lexington, KY 40504. E-mail: austinvstonemd@gmail.com

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better understand which patients are at an increased risk. Our study uses a large database over multiple years to assess which risk factors influence prolonged opioid use (hydrocodone, oxycodone, morphine, and tramadol) following MPFLR.

The MPFL is a commonly injured ligament in the knee,[7] which has the potential to lead to recurrent patellar instability, especially in children.[8] In the general population, the incidence of lateral patellar dislocations ranges from 5.8 to 7 cases per 100,000 person-years to 29 cases per 100,000 person-years in those aged 10-17 years.[8] Numerous options are available for the treatment of MPFL injuries, ranging from physical therapy to surgery.[9] With MPFLR being a common treatment option for patients with patellar instability, how to best achieve postoperative pain control is an important consideration for surgeons. Aside from the physical pain arising from MPFL injury, psychological factors may also influence pain perception. Corey et al.[10] found that patients who had lower baseline Veterans RAND 12-item Health Survey Mental Component Scores had higher baseline Knee Injury and Osteoarthritis Outcome Score Pain scores.

The purpose of this study was to determine which preoperative factors are associated with prolonged opioid use following MPFLR. We hypothesized that older age, previous opioid use, depression, anxiety, knee osteoarthritis (OA), concomitant tibial tubercle osteotomy (TTO), female sex, and substance use disorder would be associated with prolonged opioid use following MPFLR.

Methods

Database

Data were obtained from the M151Ortho PearlDiver database,[11] which contains records from more than 151 million distinct patients between 2010 and 2020. PearlDiver has both *International Classification of Diseases* (ICD) *Ninth* and *Tenth Revision* diagnosis codes, as well as Current Procedural Terminology (CPT) codes. All information in the database is deidentified. Inclusion criteria included patients who underwent MPFLR using CPT codes 27420, 27422, and 27427 and had a patellar instability diagnosis (Appendix Table 1, available at www.arthroscopyjournal.org). Patients who underwent a concomitant TTO were identified using the CPT codes 27418, 27455, 27457, and 27705.

Risk Factors

Prolonged opioid use was defined as using opioids for greater than 1-month postoperatively. Age, sex, Charlson Comorbidity Index, history of anxiety, depression, substance use disorder (alcohol, opioid, cannabis, sedatives, hypnotics, anxiolytics, cocaine, stimulants, hallucinogens, inhalants, psychoactive substances), knee OA, concomitant TTO, and previous opioid use within 3 months to 1 week of MPFLR was assessed. Patients with a previous diagnosis of depression, anxiety, substance use disorder, and knee OA were identified using the ICD codes in Appendix Tables 2-5, available at www.arthroscopyjournal.org, respectively.

Postoperative Opioid Prescriptions

Multiple formulations of hydrocodone, oxycodone, morphine, and tramadol were included in the queries. Patients who received a prescription of these medications within 6 months postoperatively were identified. Patients were stratified based on the timing of their prescriptions. The same opioid formulations were included in our query of preoperative opioid use. Patients with an opioid prescription within 3 months to 1 week before their surgery were identified and placed into the opioid-familiar group. All other patients in the population were placed into the opioid-naïve group.

Data Analysis

Demographic variables and comorbidities were tabulated and reported. Multivariable logistic regression was performed to independently analyze patient demographics and comorbid conditions. Odds ratios (ORs) and their associated 95% confidence intervals (CIs) were calculated for each risk factor, with $P < .05$ being considered statistically significant. R software (R Foundation for Statistical Computing, Vienna, Austria) that was embedded within PearlDiver was used for all statistical analysis.

Results

In total, 23,249 patients met inclusion criteria for analysis. There was a much higher proportion of female patients compared with male patients (67.8% vs. 32.2%), as well as a large proportion of patients who had preoperative opioid use (23.9%, of whom 68.8% were female and 31.2% were male). The majority of patients had a Charlson Comorbidity Index score of mild (93.2%), and 14.3% of patients had a concomitant TTO. Complete patient demographics are included in Table 1.

When stratifying patients by opioid familiarity, the percentage of patients who had opioid prescriptions within 3 months to 1 week of surgery substantially required more opioids compared with those who did not at all timepoints measured (Fig 1).

On multivariable analysis, older age, female sex, anxiety, substance use disorder, knee OA, concomitant TTO, and preoperative opioid use were found to have statistically significant associations with prolonged opioid use following MPFLR (Table 2).

On stratified analysis, breaking down opioid-familiar and -naïve patients by sex, female patients were

Table 1. Cohort Demographics (N = 23,249)

	N	%
Demographics		
Female	15,773	67.8%
Male	7,475	32.2%
Age ≤13 y	1,417	6.1%
Age 14-17 y	6,992	30.1%
Age 18-25 y	5,938	25.5%
Age 26-35 y	3,527	15.2%
Age 36-49 y	2,719	11.7%
Age 50-64 y	1,484	6.4%
Age ≥65 y	1,171	5.0%
Charlson Comorbidity Index		
Mild (0-2)	21,678	93.2%
Moderate (3-4)	1,086	4.7%
Severe (5+)	485	2.1%
Comorbidities		
Anxiety	5,326	22.9%
Depression	4,700	20.2%
Substance use disorder	2,591	11.1%
Knee osteoarthritis	4,126	17.7%
Concomitant TTO	3,327	14.3%
Opioid *familiar*	5,550	23.9%
Female	3,816	68.8%
Male	1,734	31.2%

TTO, tibial tubercle osteotomy.

found to be at greater risk of prolonged postoperative opioid use regardless of opioid familiarity. For both opioid-familiar and opioid-naïve patients, ORs were greatest 2 months postoperatively (1.46 and 1.56, respectively) (Table 3). Similarly, opioid familiar patients were at higher risk of prolonged postoperative opioid use regardless of sex. For both male and female patients, ORs were highest 3 months postoperatively (10.84 and 9.25, respectively) (Table 4).

Discussion

Our study found that multiple preoperative factors were associated with prolonged opioid use following MPFLR. Specifically, older age, patients who are female, have anxiety, substance use disorder, knee osteoarthritis, concomitant TTO, and opioid familiar appear to be at an increased risk according to our data. Interestingly, a preoperative diagnosis of depression was not associated with prolonged opioid use. Age was identified by our study as a significant quantitative predictor, with an estimated 1% to 2% increase in the odds of prolonged opioid use per additional year of age.

Previous studies have determined risk factors for prolonged opioid use after orthopaedic conditions. Castle et al[2] performed a retrospective review of 102 patients undergoing MPFLR at a single institution, finding that age >30 years and body mass index (BMI) >30, cartilage damage, preoperative opioid use, smoking history, and history of psychiatric disorders were associated with prolonged opioid use postoperatively. Baron et al[12] analyzed the Humana administrative claims database between 2007-2017 for patients undergoing patellofemoral stabilization surgery. From a sample of 1,316 patients, preoperative opioid use, obesity, and preexisting anxiety or depression were significant risk factors for prolonged opioid use postoperatively. Our study builds upon the literature by using the PearlDiver database from 2010 to 2020,

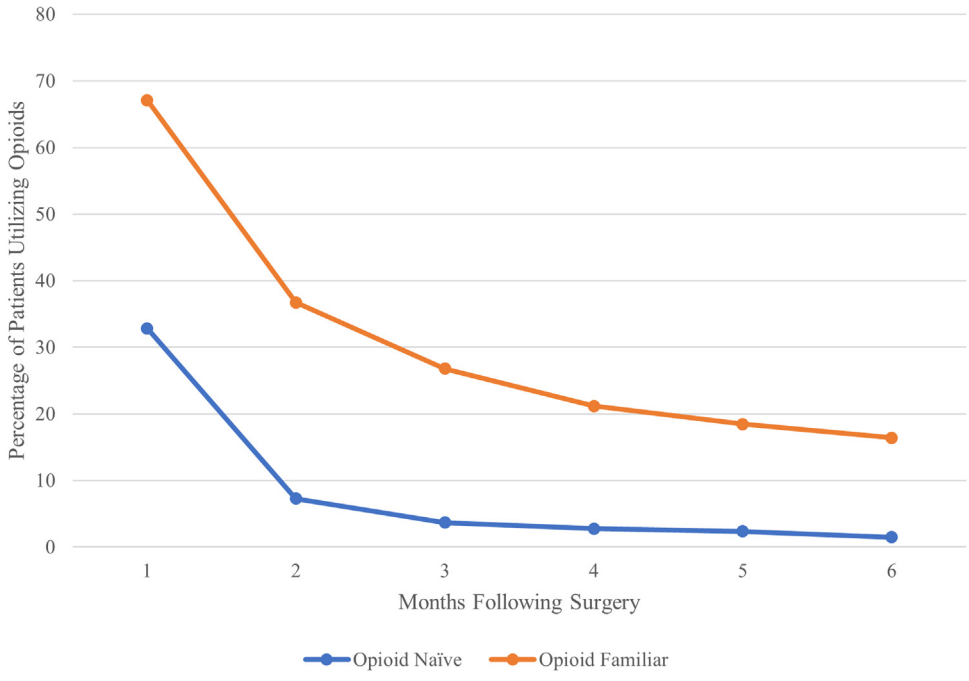

Fig 1. Percentage of patients using opioids. Orange line represents the percentage of opioid familiar patients who continued using opioids up to 6 months postoperatively. Blue line represents the percentage of opioid naïve patients who continued using opioids up to 6 months postoperatively

Table 2. Risk Factors for Prolonged Opioid Use

Opioid Use Duration After Surgery	Variable	Odds Ratio (95% Confidence Interval)	*P* Value
Up to 1 month	Age	1.01 (1.01-1.01)	<.001
	Charlson Comorbidity Index	0.99 (0.97-1.02)	.46
	Male sex	0.85 (0.80-0.90)	<.001
	Anxiety	1.11 (1.03-1.20)	.009
	Depression	1.10 (1.01-1.19)	.027
	Substance use disorder	1.71 (1.56-1.88)	<.001
	Knee osteoarthritis	1.17 (1.07-1.28)	<.001
	Concomitant tibial tubercle osteotomy	2.00 (1.86-2.17)	<.001
	Opioid familiar	3.68 (3.44-3.93)	<.001
Up to 2 months	Age	1.01 (1.01-1.02)	<.001
	Charlson Comorbidity Index	0.98 (0.95-1.01)	.24
	Male sex	0.68 (0.62-0.74)	<.001
	Anxiety	1.26 (1.13-1.40)	<.001
	Depression	0.95 (0.85-1.06)	.41
	Substance use disorder	2.10 (1.88-2.34)	<.001
	Knee osteoarthritis	1.52 (1.36-1.71)	<.001
	Concomitant tibial tubercle osteotomy	1.73 (1.55-1.93)	<.001
	Opioid familiar	5.89 (5.42-6.40)	<.001
Up to 3 months	Age	1.01 (1.00-1.01)	<.001
	Charlson Comorbidity Index	1.01 (0.97-1.04)	.77
	Male sex	0.75 (0.67-0.83)	<.001
	Anxiety	1.30 (1.15-1.47)	<.001
	Depression	0.97 (0.85-1.10)	.63
	Substance use disorder	2.04 (1.80-2.31)	<.001
	Knee osteoarthritis	1.70 (1.49-1.94)	<.001
	Concomitant tibial tubercle osteotomy	1.91 (1.67-2.17)	<.001
	Opioid familiar	7.68 (6.93-8.52)	<.001
Up to 4 months	Age	1.00 (1.00-1.01)	.11
	Charlson Comorbidity Index	1.01 (0.97-1.05)	.65
	Male sex	0.79 (0.70-0.89)	<.001
	Anxiety	1.24 (1.09-1.42)	.001
	Depression	1.04 (0.90-1.20)	.58
	Substance use disorder	1.97 (1.72-2.25)	<.001
	Knee osteoarthritis	1.92 (1.66-2.22)	<.001
	Concomitant tibial tubercle osteotomy	1.99 (1.73-2.29)	<.001
	Opioid familiar	7.65 (6.82-8.60)	<.001
Up to 5 months	Age	1.00 (0.99-1.00)	.61
	Charlson Comorbidity Index	1.02 (0.98-1.05)	.44
	Male sex	0.78 (0.69-0.89)	<.001
	Anxiety	1.21 (1.05-1.40)	.009
	Depression	1.07 (0.92-1.24)	.38
	Substance use disorder	2.01 (1.74-2.31)	<.001
	Knee osteoarthritis	2.14 (1.84-2.50)	<.001
	Concomitant tibial tubercle osteotomy	2.08 (1.79-2.41)	<.001
	Opioid familiar	7.62 (6.73-8.64)	<.001
Up to 6 months	Age	1.00 (0.99-1.00)	.16
	Charlson Comorbidity Index	1.01 (0.97-1.05)	.59
	Male sex	0.78 (0.68-0.89)	<.001
	Anxiety	1.22 (1.05-1.42)	.008
	Depression	1.07 (0.91-1.24)	.42
	Substance use disorder	1.92 (1.65-2.22)	<.001
	Knee osteoarthritis	2.42 (2.06-2.84)	<.001
	Concomitant tibial tubercle osteotomy	2.12 (1.82-2.47)	<.001
	Opioid familiar	7.40 (6.49-8.44)	<.001

sampling more than 23,000 patients. Three of the main findings in our study that differentiate it from the aforementioned 2 studies are treating age as a quantitative value, showing the increase in odds per year of increased age instead of grouping patients into categories of <30 years old and >30 years old. Also, we found that although preexisting anxiety was a significant risk factor for prolonged opioid use after MPFLR, depression was not. Finally, we found that patients who undergo a concomitant TTO are at an increased risk for prolonged opioid use following MPFLR. In a sample of 21,202 patients who underwent ACLR, 17.7% used ≥2

Table 3. Sex Controlled for Opioid Familiarity

Cohort	Opioid Use Duration After Surgery, mo	Female Patients (No. With Prescription/Total)	Male Patients (No. With Prescription/Total)	Odds Ratio (95% Confidence Interval)	*P* Value
Opioid familiar	1	2,609/3,816	1,116/1,734	1.20 (1.06-1.35)	.003
	2	1,503/3,816	535/1,734	1.46 (1.29-1.64)	<.001
	3	1,086/3,816	401/1,734	1.32 (1.16-1.51)	<.001
	4	855/3,816	320/1,734	1.28 (1.11-1.47)	<.001
	5	750/3,816	275/1,734	1.28 (1.11-1.48)	<.001
	6	670/3,816	240/1,734	1.30 (1.12-1.51)	<.001
Opioid naïve	1	4,110/11,957	1,702/5,741	1.24 (1.16-1.33)	<.001
	2	979/11,957	311/5,741	1.56 (1.37-1.78)	<.001
	3	493/11,957	155/5,741	1.55 (1.29-1.86)	<.001
	4	368/11,957	118/5,741	1.51 (1.23-1.87)	<.001
	5	317/11,957	101/5,741	1.52 (1.21-1.91)	<.001
	6	284/11,957	90/5,741	1.53 (1.20-1.94)	<.001

opioid prescriptions 0 to 90 days postoperatively, dropping to 2.7% between 91 and 360 days postoperatively. Risk factors for prolonged opioid use were preoperative opioid use, age ≥20 years, substance use, other activity at time of injury, chondroplasty, chronic pulmonary disease, and American Society of Anesthesiologists classification ≥3.[6] Our study showed similar results, where at 3 months, 26.8% of opioid familiar patients and 3.7% of opioid-naïve patients were using opioids.

Male patients had a decreased risk of prolonged opioid use following MPFLR compared with female patients. This has been seen in previous orthopaedic literature, as following both ACLR and total hip arthroplasty (THA), female patients were at an increased risk for prolonged opioid use.[6,13] There can be a multitude of factors as to why this is the case. Although there have not been many studies assessing sex differences in opioid use, Serdarevic et al[14] assessed 8,525 participants from a community outreach program based out of the University of Florida Clinical and Translational Science Institute, finding that women were more likely to report a lifetime use of use prescription opioids than men. Similarly, Back et al[15] interviewed 24 participants from their community (12 male and 12 female) who had prescription opioid dependence, finding that while men were significantly more likely to crush and snort prescription opioids (75% vs 17%), women were significantly more likely to use opioids to cope with interpersonal stress, and use them in the morning.

Although the physical stress of surgery is demanding, the psychological stresses than surround it can be as well. Harris et al[16] found that a preoperative diagnosis of depression or anxiety resulted in greater odds of multiday hospitalization, 90-day readmission, revision surgery, and chronic postoperative opioid use following anterior cervical discectomy and fusion. Likewise, a randomized control trial performed by Kurkis et al[17] found that in patients undergoing THA, depression was correlated with increased opioid use and preoperative education on opioid use did not affect opioid use or disposal frequency 6 weeks postoperatively. In the sports medicine literature, patients with a history of depression report lower self-reported functional scores at baseline and 1-year postoperatively following

Table 4. Opioid Familiarity Controlled for Sex

Cohort	Opioid Use Duration After Surgery, mo	Opioid Familiar (No. with Prescription/Total)	Opioid Naïve (No. with Prescription/Total)	Odds Ratio (95% Confidence Interval)	*P* Value
Male patients	1	1,116/1,734	1,702/5,741	4.29 (3.83-4.80)	<.001
	2	535/1,734	311/5,741	7.79 (6.68-9.08)	<.001
	3	401/1,734	155/5,741	10.84 (8.92-13.17)	<.001
	4	320/1,734	118/5,741	10.78 (8.66-13.42)	<.001
	5	275/1,734	101/5,741	10.53 (8.32-13.32)	<.001
	6	240/1,734	90/5,741	10.09 (7.86-12.94)	<.001
Female patients	1	2,609/3,816	4,110/11,957	4.13 (3.82-4.46)	<.001
	2	1,503/3,816	979/11,957	7.29 (6.65-7.99)	<.001
	3	1,086/3,816	493/11,957	9.25 (8.25-10.37)	<.001
	4	855/3,816	368/11,957	9.09 (8.00-10.34)	<.001
	5	750/3,816	317/11,957	8.98 (7.83-10.30)	<.001
	6	670/3,816	284/11,957	8.75 (7.58-10.11)	<.001

ACLR.[18] In our study, anxiety was seen to be a risk factors for prolonged opioid use following MPFLR; however, depression was not.

Substance use disorder was found to be a risk factor for prolonged opioid use following MPFLR. Cunningham et al[19] assessed patients undergoing lower-extremity fracture fixation, finding that those with alcohol abuse had increased perioperative opioid demand. Cannabis use has variable results, where a study found no increase in opioid use following hip arthroscopy[20] or elective hand surgeries[21] postoperatively, whereas another found an increased risk following posterior lumbar spinal fusion.[22] Our study builds upon these, as we combined multiple substance use disorders into one category, with findings indicating that there may be an increased risk for opioid use among these patients.

The biggest risk factor found in our study was opioid familiarity. It was found that 23.9% of patients were opioid familiar prior to their surgery. Patients with previous opioid use had a staggering 668% increase in the odds of prolonged use at 3 months. This leveled out and decreased slightly from 4 to 6 months. Similar results have been seen following other orthopaedic procedures. Kunkel et al[23] found a 5-fold and 4-fold increase in the percentage of patients with chronic opioid use following THA and total knee arthroplasty (TKA), respectively. Rogers et al[24] analyzed hip arthroscopy patients, finding that those who used opioids before the procedure needed more refills following the procedure. Also, patients with a formal opioid use disorder diagnosis had significantly greater risk for revision hip arthroscopy. Khazi et al[25] had similar findings, where preoperative opioid use was associated with prolonged opioid use following anatomic and reverse total shoulder arthroplasty. Our study is in line with this as preoperative opioid use was seen to be a large risk factor for prolonged opioid use following MPFL, adding to the established literature.

Overall, our study found multiple risk factors that have the potential to cause prolonged opioid use following MPFLR. Future prospective studies can be performed to determine the effect of these risk factors, allowing for the control of confounding variables. Specifically, a more detailed breakdown could be performed to determine which substance use disorders are associated with increased opioid use following MPFLR.

Limitations

This study was not without limitations. Since we used PearlDiver, the extracted data have the potential for coding errors. Also, preoperative opioid use may be due to other health issues, which can affect outcomes. We attempted to account for this by assessing the Charlson Comorbidity Index, and it was not associated with prolonged opioid use. In addition, we were not able to control for postoperative physical therapy. This may influence outcomes due to improved function leading to better pain control. We were unable to account for BMI due to the large number of pediatric patients in our sample. Pediatric BMI is measured in percentiles while adult BMI is not, which could lead to heterogeneity and inaccurate reporting. Patients were not able to be separated based on receiving/filling one prescription versus multiple pre- and postoperatively. Finally, we assumed that opioid prescriptions were indicative of opioid use, but we cannot determine if patients ingested the medications based on data available in PearlDiver.

Conclusions

Older age, female sex, anxiety, substance use disorder, osteoarthritis, tibial tubercle osteotomy, and opioid familiarity are risk factors for prolonged opioid use following MPFLR.

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Appendix Table 1. Patellar Instability Diagnosis Codes

ICD-9-D-8363	ICD-9-D-8364	
ICD-10-D-M2200	ICD-10-D-M2201	ICD-10-D-M2202
ICD-10-D-M2210	ICD-10-D-M2211	ICD-10-D-M2212
ICD-10-D-M222X1	ICD-10-D-M222X2	ICD-10-D-M222X9
ICD-10-D-M223X1	ICD-10-D-M223X2	ICD-10-D-M223X9
ICD-10-D-M228X1	ICD-10-D-M228X2	ICD-10-D-M228X9
ICD-10-D-M2290	ICD-10-D-M2291	ICD-10-D-M2292
ICD-10-D-S83001A	ICD-10-D-S83001D	ICD-10-D-S83001S
ICD-10-D-S83002A	ICD-10-D-S83002D	ICD-10-D-S83002S
ICD-10-D-S83003A	ICD-10-D-S83003D	ICD-10-D-S83003S
ICD-10-D-S83004A	ICD-10-D-S83004D	ICD-10-D-S83004S
ICD-10-D-S83005A	ICD-10-D-S83005D	ICD-10-D-S83005S
ICD-10-D-S83006A	ICD-10-D-S83006D	ICD-10-D-S83006S
ICD-10-D-S83011A	ICD-10-D-S83011D	ICD-10-D-S83011S
ICD-10-D-S83012A	ICD-10-D-S83012D	ICD-10-D-S83012S
ICD-10-D-S83013A	ICD-10-D-S83013D	ICD-10-D-S83013S
ICD-10-D-S83014A	ICD-10-D-S83014D	ICD-10-D-S83014S
ICD-10-D-S83015A	ICD-10-D-S83015D	ICD-10-D-S83015S
ICD-10-D-S83016A	ICD-10-D-S83016D	ICD-10-D-S83016S
ICD-10-D-S83091A	ICD-10-D-S83091D	ICD-10-D-S83091S
ICD-10-D-S83092A	ICD-10-D-S83092D	ICD-10-D-S83092S
ICD-10-D-S83093A	ICD-10-D-S83093D	ICD-10-D-S83093S
ICD-10-D-S83094A	ICD-10-D-S83094D	ICD-10-D-S83094S
ICD-10-D-S83095A	ICD-10-D-S83095D	ICD-10-D-S83095S
ICD-10-D-S83096A	ICD-10-D-S83096D	ICD-10-D-S83096S

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

Appendix Table 2. Depression Diagnosis Codes

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-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-311
ICD-10-D-F0631	ICD-10-D-F0632	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-9, International Classification of Diseases, Ninth Revision; ICD-10, International Classification of Diseases, Tenth Revision.

Appendix Table 3. Anxiety Diagnosis Codes

ICD-9-D-29384	ICD-9-D-30000	ICD-9-D-30001
ICD-9-D-30002	ICD-9-D-30009	ICD-9-D-30020
ICD-9-D-30021	ICD-9-D-30022	ICD-9-D-30023
ICD-9-D-30029	ICD-10-D-F064	ICD-10-D-F4000
ICD-10-D-F4001	ICD-10-D-F4002	ICD-10-D-F4010
ICD-10-D-F4011	ICD-10-D-F40210	ICD-10-D-F40218
ICD-10-D-F40220	ICD-10-D-F40228	ICD-10-D-F40230
ICD-10-D-F40231	ICD-10-D-F40232	ICD-10-D-F40233
ICD-10-D-F40240	ICD-10-D-F40241	ICD-10-D-F40242
ICD-10-D-F40243	ICD-10-D-F40248	ICD-10-D-F40290
ICD-10-D-F40291	ICD-10-D-F40298	ICD-10-D-F408
ICD-10-D-F409	ICD-10-D-F410	ICD-10-D-F411
ICD-10-D-F413	ICD-10-D-F418	ICD-10-D-F419

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

Appendix Table 4. Substance Use Diagnosis Codes

ICD-10-D-F1010	ICD-10-D-F1011	ICD-10-D-F10120	ICD-10-D-F10121
ICD-10-D-F10129	ICD-10-D-F10130	ICD-10-D-F10131	ICD-10-D-F10132
ICD-10-D-F10139	ICD-10-D-F1014	ICD-10-D-F10150	ICD-10-D-F10151
ICD-10-D-F10159	ICD-10-D-F10180	ICD-10-D-F10181	ICD-10-D-F10182
ICD-10-D-F10188	ICD-10-D-F1423	ICD-10-D-F1019	ICD-10-D-F1020
ICD-10-D-F1021	ICD-10-D-F10220	ICD-10-D-F10221	ICD-10-D-F10229
ICD-10-D-F10230	ICD-10-D-F10231	ICD-10-D-F10232	ICD-10-D-F10239
ICD-10-D-F1024	ICD-10-D-F10250	ICD-10-D-F10251	ICD-10-D-F10259
ICD-10-D-F1026	ICD-10-D-F1027	ICD-10-D-F10280	ICD-10-D-F10281
ICD-10-D-F10282	ICD-10-D-F10288	ICD-10-D-F1029	ICD-10-D-F10920
ICD-10-D-F10921	ICD-10-D-F10929	ICD-10-D-F10930	ICD-10-D-F10931
ICD-10-D-F10932	ICD-10-D-F10939	ICD-10-D-F1094	ICD-10-D-F10950
ICD-10-D-F10951	ICD-10-D-F10959	ICD-10-D-F1096	ICD-10-D-F1097
ICD-10-D-F10980	ICD-10-D-F10981	ICD-10-D-F10982	ICD-10-D-F10988
ICD-10-D-F1099	ICD-10-D-F1110	ICD-10-D-F1111	ICD-10-D-F11120
ICD-10-D-F11121	ICD-10-D-F11122	ICD-10-D-F11129	ICD-10-D-F1113
ICD-10-D-F1114	ICD-10-D-F11150	ICD-10-D-F11151	ICD-10-D-F11159
ICD-10-D-F11181	ICD-10-D-F11182	ICD-10-D-F11188	ICD-10-D-F1119
ICD-10-D-F1120	ICD-10-D-F1121	ICD-10-D-F11220	ICD-10-D-F11221
ICD-10-D-F11222	ICD-10-D-F11229	ICD-10-D-F1123	ICD-10-D-F1124
ICD-10-D-F11250	ICD-10-D-F11251	ICD-10-D-F11259	ICD-10-D-F11281
ICD-10-D-F11282	ICD-10-D-F11288	ICD-10-D-F1129	ICD-10-D-F1190
ICD-10-D-F11920	ICD-10-D-F11921	ICD-10-D-F11922	ICD-10-D-F11929
ICD-10-D-F1193	ICD-10-D-F1194	ICD-10-D-F11950	ICD-10-D-F11951
ICD-10-D-F11959	ICD-10-D-F11981	ICD-10-D-F11982	ICD-10-D-F11988
ICD-10-D-F1199	ICD-10-D-F1210	ICD-10-D-F1211	ICD-10-D-F12120
ICD-10-D-F12121	ICD-10-D-F12122	ICD-10-D-F12129	ICD-10-D-F1213
ICD-10-D-F12150	ICD-10-D-F12151	ICD-10-D-F12159	ICD-10-D-F12180
ICD-10-D-F12188	ICD-10-D-F1219	ICD-10-D-F1220	ICD-10-D-F1221
ICD-10-D-F12220	ICD-10-D-F12221	ICD-10-D-F12222	ICD-10-D-F12229
ICD-10-D-F1223	ICD-10-D-F12250	ICD-10-D-F12251	ICD-10-D-F12259
ICD-10-D-F12280	ICD-10-D-F12288	ICD-10-D-F1229	ICD-10-D-F1290
ICD-10-D-F12920	ICD-10-D-F12921	ICD-10-D-F12922	ICD-10-D-F12929
ICD-10-D-F1293	ICD-10-D-F12950	ICD-10-D-F12951	ICD-10-D-F12959
ICD-10-D-F12980	ICD-10-D-F12988	ICD-10-D-F1299	ICD-10-D-F1310
ICD-10-D-F1311	ICD-10-D-F13120	ICD-10-D-F13121	ICD-10-D-F13129
ICD-10-D-F13130	ICD-10-D-F13131	ICD-10-D-F13132	ICD-10-D-F13139
ICD-10-D-F1314	ICD-10-D-F13150	ICD-10-D-F13151	ICD-10-D-F13159
ICD-10-D-F13180	ICD-10-D-F13181	ICD-10-D-F13182	ICD-10-D-F13188
ICD-10-D-F1319	ICD-10-D-F1320	ICD-10-D-F1321	ICD-10-D-F13220
ICD-10-D-F13221	ICD-10-D-F13229	ICD-10-D-F13230	ICD-10-D-F13231
ICD-10-D-F13232	ICD-10-D-F13239	ICD-10-D-F1324	ICD-10-D-F13250
ICD-10-D-F13251	ICD-10-D-F13259	ICD-10-D-F1326	ICD-10-D-F1327
ICD-10-D-F13280	ICD-10-D-F13281	ICD-10-D-F13282	ICD-10-D-F13288
ICD-10-D-F1329	ICD-10-D-F1390	ICD-10-D-F13920	ICD-10-D-F13921
ICD-10-D-F13929	ICD-10-D-F13930	ICD-10-D-F13931	ICD-10-D-F13932
ICD-10-D-F13939	ICD-10-D-F1394	ICD-10-D-F13950	ICD-10-D-F13951
ICD-10-D-F13959	ICD-10-D-F1396	ICD-10-D-F1397	ICD-10-D-F13980
ICD-10-D-F13981	ICD-10-D-F13982	ICD-10-D-F13988	ICD-10-D-F1399
ICD-10-D-F1410	ICD-10-D-F1411	ICD-10-D-F14120	ICD-10-D-F14121
ICD-10-D-F14122	ICD-10-D-F14129	ICD-10-D-F1413	ICD-10-D-F1414
ICD-10-D-F14150	ICD-10-D-F14151	ICD-10-D-F14159	ICD-10-D-F14180
ICD-10-D-F14181	ICD-10-D-F14182	ICD-10-D-F14188	ICD-10-D-F1419
ICD-10-D-F1420	ICD-10-D-F1421	ICD-10-D-F14220	ICD-10-D-F14221
ICD-10-D-F14222	ICD-10-D-F14229	ICD-10-D-F1424	ICD-10-D-F14250
ICD-10-D-F14251	ICD-10-D-F14259	ICD-10-D-F14280	ICD-10-D-F14281
ICD-10-D-F14282	ICD-10-D-F14288	ICD-10-D-F1429	ICD-10-D-F1490
ICD-10-D-F14920	ICD-10-D-F14921	ICD-10-D-F14922	ICD-10-D-F14929
ICD-10-D-F1493	ICD-10-D-F1494	ICD-10-D-F14950	ICD-10-D-F14951
ICD-10-D-F14959	ICD-10-D-F14980	ICD-10-D-F14981	ICD-10-D-F14982
ICD-10-D-F14988	ICD-10-D-F1499	ICD-10-D-F1510	ICD-10-D-F1511
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

(continued)

Appendix Table 4. Continued

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-F1520	ICD-10-D-F1521
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-F1590	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	ICD-10-D-F1610	ICD-10-D-F1611	ICD-10-D-F16120
ICD-10-D-F16121	ICD-10-D-F16122	ICD-10-D-F16129	ICD-10-D-F1614
ICD-10-D-F16150	ICD-10-D-F16151	ICD-10-D-F16159	ICD-10-D-F16180
ICD-10-D-F16183	ICD-10-D-F16188	ICD-10-D-F1619	ICD-10-D-F1620
ICD-10-D-F1621	ICD-10-D-F16220	ICD-10-D-F16221	ICD-10-D-F16229
ICD-10-D-F1624	ICD-10-D-F16250	ICD-10-D-F16251	ICD-10-D-F16259
ICD-10-D-F16280	ICD-10-D-F16283	ICD-10-D-F16288	ICD-10-D-F1629
ICD-10-D-F1690	ICD-10-D-F16920	ICD-10-D-F16921	ICD-10-D-F16929
ICD-10-D-F1694	ICD-10-D-F16950	ICD-10-D-F16951	ICD-10-D-F16959
ICD-10-D-F16980	ICD-10-D-F16983	ICD-10-D-F16988	ICD-10-D-F1699
ICD-10-D-F1810	ICD-10-D-F1811	ICD-10-D-F18120	ICD-10-D-F18121
ICD-10-D-F18129	ICD-10-D-F1814	ICD-10-D-F18150	ICD-10-D-F18151
ICD-10-D-F18159	ICD-10-D-F1817	ICD-10-D-F18180	ICD-10-D-F18188
ICD-10-D-F1819	ICD-10-D-F1820	ICD-10-D-F1821	ICD-10-D-F18220
ICD-10-D-F18221	ICD-10-D-F18229	ICD-10-D-F1824	ICD-10-D-F18250
ICD-10-D-F18251	ICD-10-D-F18259	ICD-10-D-F1827	ICD-10-D-F18280
ICD-10-D-F18288	ICD-10-D-F1829	ICD-10-D-F1890	ICD-10-D-F18920
ICD-10-D-F18921	ICD-10-D-F18929	ICD-10-D-F1894	ICD-10-D-F18950
ICD-10-D-F18951	ICD-10-D-F18959	ICD-10-D-F1897	ICD-10-D-F18980
ICD-10-D-F18988	ICD-10-D-F1899	ICD-10-D-F1910	ICD-10-D-F1911
ICD-10-D-F19120	ICD-10-D-F19121	ICD-10-D-F19122	ICD-10-D-F19129
ICD-10-D-F19130	ICD-10-D-F19131	ICD-10-D-F19132	ICD-10-D-F19139
ICD-10-D-F1914	ICD-10-D-F19150	ICD-10-D-F19151	ICD-10-D-F19159
ICD-10-D-F1916	ICD-10-D-F1917	ICD-10-D-F19180	ICD-10-D-F19181
ICD-10-D-F19182	ICD-10-D-F19188	ICD-10-D-F1919	ICD-10-D-F1920
ICD-10-D-F1921	ICD-10-D-F19220	ICD-10-D-F19221	ICD-10-D-F19222
ICD-10-D-F19229	ICD-10-D-F19230	ICD-10-D-F19231	ICD-10-D-F19232
ICD-10-D-F19239	ICD-10-D-F1924	ICD-10-D-F19250	ICD-10-D-F19251
ICD-10-D-F19259	ICD-10-D-F1926	ICD-10-D-F1927	ICD-10-D-F19280
ICD-10-D-F19281	ICD-10-D-F19282	ICD-10-D-F19288	ICD-10-D-F1929
ICD-10-D-F1990	ICD-10-D-F19920	ICD-10-D-F19921	ICD-10-D-F19922
ICD-10-D-F19929	ICD-10-D-F19930	ICD-10-D-F19931	ICD-10-D-F19932
ICD-10-D-F19939	ICD-10-D-F1994	ICD-10-D-F19950	ICD-10-D-F19951
ICD-10-D-F19959	ICD-10-D-F1996	ICD-10-D-F1997	ICD-10-D-F19980
ICD-10-D-F19981	ICD-10-D-F19982	ICD-10-D-F19988	ICD-10-D-F1999
ICD-9-D-3030	ICD-9-D-30300	ICD-9-D-30301	ICD-9-D-30302
ICD-9-D-30303	ICD-9-D-3039	ICD-9-D-30390	ICD-9-D-30391
ICD-9-D-30392	ICD-9-D-30393	ICD-9-D-304	ICD-9-D-3040
ICD-9-D-30400	ICD-9-D-30401	ICD-9-D-30402	ICD-9-D-30403
ICD-9-D-3041	ICD-9-D-30410	ICD-9-D-30411	ICD-9-D-30412
ICD-9-D-30413	ICD-9-D-3042	ICD-9-D-30420	ICD-9-D-30421
ICD-9-D-30422	ICD-9-D-30423	ICD-9-D-3043	ICD-9-D-30430
ICD-9-D-30431	ICD-9-D-30432	ICD-9-D-30433	ICD-9-D-3044
ICD-9-D-30440	ICD-9-D-30441	ICD-9-D-30442	ICD-9-D-30443
ICD-9-D-3045	ICD-9-D-30450	ICD-9-D-30451	ICD-9-D-30452
ICD-9-D-30453	ICD-9-D-3046	ICD-9-D-30460	ICD-9-D-30461
ICD-9-D-30462	ICD-9-D-30463	ICD-9-D-3047	ICD-9-D-30470
ICD-9-D-30471	ICD-9-D-30472	ICD-9-D-30473	ICD-9-D-3048
ICD-9-D-30480	ICD-9-D-30481	ICD-9-D-30482	ICD-9-D-30483
ICD-9-D-3049	ICD-9-D-30490	ICD-9-D-30491	ICD-9-D-30492
ICD-9-D-30493	ICD-9-D-305	ICD-9-D-3050	ICD-9-D-30500
ICD-9-D-30501	ICD-9-D-30502	ICD-9-D-30503	ICD-9-D-3051
ICD-9-D-30510	ICD-9-D-30511	ICD-9-D-30512	ICD-9-D-30513
ICD-9-D-3052	ICD-9-D-30520	ICD-9-D-30521	ICD-9-D-30522

(continued)

Appendix Table 4. Continued

ICD-9-D-30523	ICD-9-D-3053	ICD-9-D-30530	ICD-9-D-30531
ICD-9-D-30532	ICD-9-D-30533	ICD-9-D-3054	ICD-9-D-30540
ICD-9-D-30541	ICD-9-D-30542	ICD-9-D-30543	ICD-9-D-3055
ICD-9-D-30550	ICD-9-D-30551	ICD-9-D-30552	ICD-9-D-30553
ICD-9-D-3056	ICD-9-D-30560	ICD-9-D-30561	ICD-9-D-30562
ICD-9-D-30563	ICD-9-D-3057	ICD-9-D-30570	ICD-9-D-30571
ICD-9-D-30572	ICD-9-D-30573	ICD-9-D-3058	ICD-9-D-30580
ICD-9-D-30581	ICD-9-D-30582	ICD-9-D-30583	ICD-9-D-3059
ICD-9-D-30590	ICD-9-D-30591	ICD-9-D-30592	ICD-9-D-30593

ICD-10, International Classification of Diseases, Tenth Revision.

Appendix Table 5. Osteoarthritis Diagnosis Codes

ICD-9-D-71516	ICD-9-D-71526	ICD-9-D-71536
ICD-9-D-71596	ICD-10-D-M170	ICD-10-D-M1710
ICD-10-D-M1711	ICD-10-D-M1712	ICD-10-D-M172
ICD-10-D-M1730	ICD-10-D-M1731	ICD-10-D-M1732
ICD-10-D-M174	ICD-10-D-M175	ICD-10-D-M179

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