Risk Factors for Infection After Knee Arthroscopy: Analysis of 595,083 Cases From 3 United States Databases

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Purpose: To identify and quantify patient- and procedure-related risk factors for post-arthroscopic knee infections using a large dataset. **Methods:** An administrative health care database including 8 years of records from 2 large commercial insurers and Medicare (a 5% random sample) was queried to identify all knee arthroscopies performed on patients aged at least 15 years using Current Procedural Terminology (CPT) codes. Each CPT code was designated as a high- or low-complexity procedure, with the former typically requiring accessory incisions or increased operative time. Deep infections were identified by a CPT code for incision and drainage within 90 days of surgery. Superficial infections were identified by *International Classification of Diseases, Ninth Revision* infection codes without any record of incision and drainage. Patients were compared based on age, sex, body mass index, tobacco use, presence of diabetes, and Charlson Comorbidity Index. **Results:** A total of 526,537 patients underwent 595,083 arthroscopic knee procedures. Deep postoperative infections occurred at a rate of 0.22%. Superficial infections occurred at a rate of 0.29%. Tobacco use and morbid obesity were the largest risk factors for deep and superficial infections, respectively ($P < .001$; relative risk of 1.90 and 2.19, respectively). There were also higher infection rates among patients undergoing relatively high-complexity arthroscopies, men, obese patients, diabetic patients, and younger patients (in order of decreasing relative risk). Increased Charlson Comorbidity Index was associated with superficial and total infections ($P < .001$). **Conclusions:** Post-arthroscopic knee infections were more frequent among morbidly obese patients, tobacco users, patients undergoing relatively complex procedures, men, obese patients, diabetic patients, relatively young patients, and patients with increased comorbidity burdens in this study population. This knowledge may allow more informed preoperative counseling, aid surgeons in patient selection, and facilitate infection prevention by targeting individuals with higher inherent risk. **Level of Evidence:** Level IV, cross-sectional study.

Knee arthroscopy, which is one of the most common outpatient surgical procedures both in orthopaedics[1] and beyond,[2] is generally regarded as safe.[3] However, infection is a known and potentially devastating postoperative complication, with possible sequelae including accelerated joint degeneration, early arthroplasty, fusion, and amputation.

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The rate of infection after knee arthroscopy is generally considered small and has been cited to be as low as 0.04% in a 1982 instrument sterilization study of 12,505 arthroscopies.[4] However, studying post-arthroscopic infections, like other rare outcomes, is inherently difficult because traditional studies are underpowered. The use of large databases with pooled data can overcome this limitation, allowing broad analyses that would not be possible with single-center or even multicenter studies.[2,3,5,6] Previous investigations in this field have used such datasets,[3,5,7] with one identifying correlations between deep post-arthroscopic infections and young age, as well as between such infections and male sex.[5] However, that work did not consider traditional risk factors for infection such as diabetes and obesity, stratify between deep and superficial infections, or make an effort to control for the possibility that younger patients and men may undergo more complex

procedures. Other authors more thoroughly examined general complication rates and risk factors using large databases but did not specifically consider infections.[3,7]

In numerous other areas of orthopaedics, specific risk factors for postoperative infection have been identified including diabetes, obesity, and tobacco use.[8,9] This knowledge enhances preoperative patient counseling, assists surgeons with patient selection, and facilitates infection prevention by allowing quality-improvement efforts to target high-risk patients. The goal of this study was to identify and quantify patient- and procedure-related risk factors for post-arthroscopic knee infections using a large dataset. We hypothesized that such predictors would include demographic factors as suggested by prior arthroscopy research as well as risk factors for infection previously identified in other realms of orthopaedics.

Methods

A large administrative health care database (www.pearldiver.com, PearlDiver, Fort Wayne, IN) containing all patient data from 2 major private insurers (United Healthcare and Humana) and a 5% random sample of Medicare data was queried (this 5% sample is the standard format of longitudinal Medicare data made available by the Centers for Medicare & Medicaid Services). PearlDiver operates a proprietary database on a commercial basis, and access was leased by us. Each dataset spans 8 years (United Healthcare and Medicare, 2005-2012; Humana, 2007-2014), includes inpatient and outpatient records, and facilitates longitudinal tracking.

All patients undergoing knee arthroscopy were identified by use of Current Procedural Terminology (CPT) codes. Patients younger than 15 years or of unknown age were excluded. CPT codes were designated as either high or low complexity based on whether the procedure typically requires accessory incisions in addition to standard arthroscopic portals and/or a relatively long operative time, according to the senior author's (G.V.K.) experience (Table 1). Patients in whom a postoperative infection developed were identified using *International Classification of Diseases, Ninth Revision* (ICD-9) and CPT codes. Those with deep infections were identified by the presence of a CPT code for incision and drainage (I&D) within 90 days of the surgical procedure. Those in whom superficial postoperative infections developed were identified by the assignment of an ICD-9 diagnosis code for postoperative infection within 90 days of the arthroscopic procedure without an associated CPT code for I&D (Table 2).

Patients were stratified by diabetes status, body mass index (BMI), and tobacco use with ICD-9 codes (Table 3). The Charlson Comorbidity Index (CCI) was determined for each patient as a proxy for overall comorbid status. This broadly used index is calculated based on a heavily validated formula that incorporates the presence or absence of 22 comorbid conditions, each weighted based on its ability to predict 1- and 10-year postoperative survival.[10]

Incidences of deep, superficial, and total infections were calculated and stratified by age, sex, diabetes

Table 1. Current Procedural Terminology Codes for Arthroscopic Knee Index Surgical Procedures

Code	Description	No. of Procedures Including Code (at Least Once)	Rate (of Arthroscopies), %	Complexity of Procedure
29866	Mosaicplasty with autograft	1,148	0.19	High
29867	Mosaicplasty with allograft	1,091	0.18	High
29868	Meniscal transplantation	355	0.06	High
29870	Synovial biopsy	10,041	1.69	Low
29873	Lateral release	24,470	4.11	Low
29874	Removal of loose body	24,222	4.07	Low
29875	Limited synovectomy	66,574	11.19	Low
29876	Major synovectomy	56,179	9.44	Low
29877	Chondroplasty	168,587	28.33	Low
29879	Abrasion arthroplasty (chondroplasty with or without microfracture)	62,370	10.48	Low
29880	Meniscectomy, med and lat	141,033	23.70	Low
29881	Meniscectomy, med or lat	336,860	56.61	Low
29882	Meniscal repair, med or lat	20,497	3.44	High
29883	Meniscal repair, med and lat	2,420	0.41	High
29884	Lysis of adhesions	6,538	1.10	Low
29885	Drilling and grafting for OCD	537	0.09	Low
29886	Drilling for OCD	1,241	0.21	Low
29887	Drilling for OCD with internal fixation	1,529	0.26	Low
29888	ACL reconstruction	77,899	13.09	High
29889	PCL reconstruction	1,386	0.23	High

ACL, anterior cruciate ligament; lat, lateral; med, medial; OCD, osteochondritis dissecans; PCL, posterior cruciate ligament.