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Incidence and Trends of Anterior Cruciate Ligament Reconstruction in the United States

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Background: Anterior cruciate ligament (ACL) injury is among the most commonly studied injuries in orthopaedics. The previously reported incidence of ACL injury in the United States has varied considerably and is often based on expert opinion or single insurance databases.

Purpose: To determine the incidence of ACL reconstruction (ACLR) in the United States; to identify changes in this incidence between 1994 and 2006; to identify changes in the demographics of ACLR over the same time period with respect to location (inpatient vs outpatient), sex, and age; and to determine the most frequent concomitant procedures performed at the time of ACLR.

Study Design: Descriptive epidemiological study.

Methods: *International Classification of Diseases, 9th Revision* (ICD-9) codes 844.2 and 717.83 were used to search the National Hospital Discharge Survey (NHDS) and the National Survey of Ambulatory Surgery (NSAS) for the diagnosis of ACL tear, and the procedure code 81.45 was used to search for ACLR. The incidence of ACLR in 1994 and 2006 was determined by use of US Census Data, and the results were then stratified based on patient age, sex, facility, concomitant diagnoses, and concomitant procedures.

Results: The incidence of ACLR in the United States rose from 86,687 (95% CI, 51,844-121,530; 32.9 per 100,000 person-years) in 1994 to 129,836 (95% CI, 94,993-164,679; 43.5 per 100,000 person-years) in 2006 ($P = .015$). The number of ACLRs increased in patients younger than 20 years and those who were 40 years or older over this 12-year period. The incidence of ACLR in females significantly increased from 10.36 to 18.06 per 100,000 person-years between 1994 and 2006 ($P = .0003$), while that in males rose at a slower rate, with an incidence of 22.58 per 100,000 person-years in 1994 and 25.42 per 100,000 person-years in 2006. In 2006, 95% of ACLRs were performed in an outpatient setting, while in 1994 only 43% of ACLRs were performed in an outpatient setting. The most common concomitant procedures were partial meniscectomy and chondroplasty.

Conclusion: The incidence of ACLR increased between 1994 and 2006, particularly in females as well as those younger than 20 years and those 40 years or older. Research efforts as well as cost-saving measures may be best served by targeting prevention and outcomes measures in these groups. Surgeons should be aware that concomitant injury is common.

Keywords: ACL reconstruction; incidence; sex; age

Anterior cruciate ligament (ACL) injury is one of the most extensively studied orthopaedic conditions, with more than 1100 manuscripts published in the year 2013. Authors commonly report that approximately 200,000 ACL injuries occur per year in the United States,[8,13,17] with 100,000 to 150,000 of these undergoing reconstruction.[41] However, these estimates are based on studies dating back more than 20 years, many of which were based on predictions that have continued to populate the ACL literature.[9,13] The true incidence of ACL reconstruction in the United States is currently unknown.[28] With an increasing number of children engaging in high-level athletics and older individuals remaining active longer, the incidence of ACL injury and ACL reconstruction may be higher than previously reported.

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A better understanding of the epidemiological patterns of ACL injury is vital to the development of prevention and treatment strategies. The ultimate goal of epidemiological studies is to influence prevention of the disease or injury based on a better understanding of the "at-risk" patient. Given that a recent systematic review demonstrated the effectiveness of ACL prevention programs,[22] investigators need to determine the populations on whom to focus these efforts. Evaluation of national databases can provide insight into the epidemiological patterns of a disease. National databases of ACL injuries have been created in other countries[15,34,37]; however, the only large database of ACL injuries in the United States comes from an insurance provider.[26] While larger national surveys have been conducted by the National Center for Health Statistics, no previous authors have analyzed these data specifically for demographic data regarding ACL reconstruction.[23]

The aims of this study were multifold: (1) to determine the incidence of ACL reconstructions in the United States; (2) to identify any changes in this incidence between 1994 and 2006; (3) to determine the demographics of ACL reconstruction with respect to location (inpatient vs outpatient), age of patients, and patient sex; (4) to identify any changes in these demographics over the study period; and (5) to determine the most frequent concomitant procedures that were performed at the time of ACL reconstruction.

MATERIALS AND METHODS

Using a similar method as a recent study evaluating a different orthopaedic condition,[10] we evaluated the number and location of ACL reconstruction procedures performed in the United States during the years 1994, 1995, 1996, and 2006. Data for 1997 to 2005 are not available in the databases used in this study. The National Center for Health Statistics (NCHS) conducts several health care surveys annually, including the National Hospital Discharge Survey (NHDS) and the National Survey of Ambulatory Surgery (NSAS). These surveys are designed to collect data from a national sample and use a weighting procedure to generate unbiased national estimates. Estimations are performed using inflation by reciprocals of the probabilities of sample selection, adjustment for no response, and population weighting ratio adjustments. Disproportionate sampling is used in an effort to provide a national sample that will allow subgroup analysis.

The NHDS is an inpatient database and was included in this study to identify any change in treatment location from 1994 to 2006. This database provides information on inpatient discharges from nonfederal short-stay hospitals by conducting a survey of approximately 500 of these facilities across the United States. Criteria required to participate in this survey include an average length of stay fewer than 30 days and more than 6 inpatient beds. Federal, military, Department of Veterans Affairs, and governmental institutionalized hospital units did not participate in this survey.

The NSAS survey uses similar exclusion criteria but is designed to capture data related to outpatient procedures performed at either hospital-based or freestanding outpatient surgery centers. This database again collects data from a sample of these nonfederal centers across the United States and the District of Columbia. These surveys are distributed to 112 geographical areas across the United States and the District of Columbia, with data being collected from more than 500 hospitals with 400 emergency departments and 250 outpatient departments.

The data are collected from a sample of visits, and persons with multiple visits during a given year may be sampled more than once. However, the databases were designed to detect the number of visits or procedures and not the number of people undergoing a procedure. Both the NHDS and NSAS databases use a quality control program to ensure accurate coding and have an overall error rate of 0.3%. Further information regarding the surveys and data can be found in *National Health Statistics Reports*.[11]

International Classification of Diseases, 9th Revision (ICD-9) codes were used to extract relevant patient encounters from these databases. Cases with the ICD-9 procedure code for ACL reconstruction of 81.45 (other repair of the cruciate ligaments) were extracted, and then those with a diagnostic code of 717.83 (disruption of posterior cruciate ligament) were removed so as to remove surgeries involving only the posterior cruciate ligament. The databases were used to extract the following data: location of procedure, patient age, patient sex, and concomitant diagnoses and procedure codes.

Data were gathered from the NHDS and the NSAS databases for the years 1994, 1995, 1996, and 2006. These databases use a multistage probability design whereby the largest facilities are selected by default and others are sampled with a 3-stage stratified cluster design, with the exception of the 2006 NSAS data. In that year, facilities were sampled by use of a multistage probability design whereby facilities had varying selection probabilities, and the stratified cluster design used by the earlier years was not used. Unfortunately, this difference in sampling strategies introduces additional uncertainty in comparisons that include 2006.

To allow comparison among the different years within each database as well as between NSAS and NHDS databases, relative standard errors (RSEs) were extracted or computed for each measure tested. The RSE is an index of the sampling variability (sampling error) of the extracted values (eg, frequency/incidence estimate) and can be thought of as a measure of reliability, or how "unsure" the authors are of each estimate.

To protect confidentiality of individual patients, both NHDS and NSAS data were aggregated and presented with appropriate "weights" for each aggregate observation. The weights were used in the computation of incidence estimates, and the variabilities of these aggregate results were then modeled to provide a best fit to the actual data variability, which is obscured by the data aggregation, producing model parameters that were then provided for specific outcomes and combinations of outcomes. These parameters are provided in the documentation with the NHDS and NSAS databases (www.cdc.gov/nchs/nhds.htm,

TABLE 1
ACL Reconstruction Incidence by Location

	1994			1995			1996			2006		
Location	Total (95% CI)	Per 100,000 Person-Years	% Total	Total	Per 100,000 Person-Years	% Total	Total	Per 100,000 Person-Years	% Total	Total (95% CI)	Per 100,000 Person-Years	% Total
Inpatient	49,484[a] (39,523-59,445)	18.81	57	41,944	15.75	41	32,951	12.23	32	6698 (3858-9538)	2.24	5
Outpatient	37,203 (24,328-50,078)	14.14	43	61,454	23.08	59	71,216	26.43	68	123,138[b] (92,463-153,813)	41.24	95
Total	86,687[c] (51,844-121,530)	32.94	100	103,398	38.83	100	104,167	38.67	100	129,836[c] (94,993-164,679)	43.48	100

[a]The incidence of ACL reconstruction performed in an inpatient setting was significantly higher than in an outpatient setting in 1994 ($P < .0001$).
[b]The incidence of ACL reconstruction performed in an inpatient setting was significantly lower than in an outpatient setting in 2006 ($P < .0001$).
[c]The incidence of ACL reconstructions was significantly higher in 2006 than in 1994 ($P = .015$).

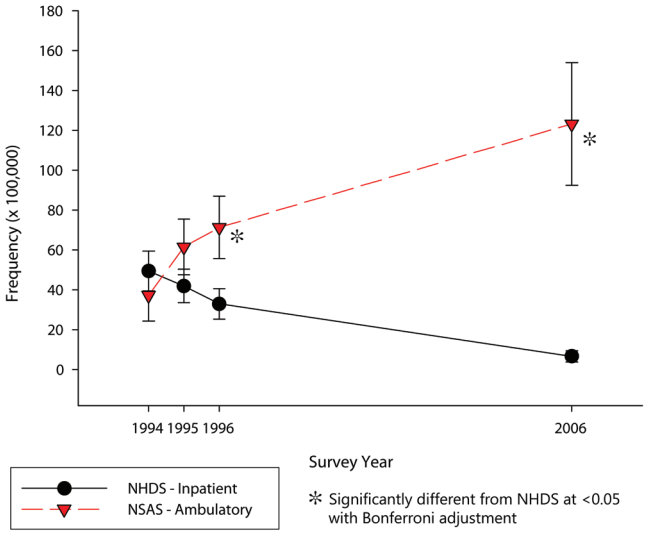

Figure 1. Incidence of outpatient compared with inpatient ACL reconstruction. NHDS, National Hospital Discharge Survey; NSAS, National Survey of Ambulatory Surgery.

www.cdc.gov/nchs/nsas.htm). The parameters were used to generate an approximate estimate of the variability and thus the RSE of the estimate based on the relationship between the RSE and the magnitude of the particular estimate and estimate type. The RSE was multiplied by the estimate itself to obtain the standard error (SE), and the RSE and SE were then used for statistical tests of differences between estimates. The SE was used to calculate 95% confidence intervals, presented here.

These methods for calculating RSE and SE apply to all datasets except for the NSAS 2006 results. The NSES 2006 dataset explicitly lists the RSE for each procedure code category. Thus, in our case, the category "replacement or other repair of the knee" has an associated RSE that was used as an estimate for the RSE for ACL reconstruction, as this provided the best estimate available given the documentation provided with the dataset.

Statistical significance was tested with Student *t* test by use of the weighted data and appropriately transformed RSEs. When multiple comparisons were made within a set of tests, the family-wise error rate was controlled using step-down Bonferroni adjustment to the *P* value. All analysis were performed in SAS version 9.2 Software (SAS Institute Inc).

RESULTS

The total number of ACL reconstruction procedures increased significantly during the study period from 86,687 (95% CI, 51,844-121,530) in 1994 to 129,836 (95% CI, 94,993-164,679) in 2006 ($P = .015$). When corrected for population changes, the number of procedures rose from 32.94 per 100,000 person-years in 1994 to 43.48 per 100,000 person-years in 2006 ($P = .015$) (Table 1). The percentage of ACL reconstructions performed in an outpatient setting increased from 43% to 95% of the total ACL reconstructions between 1994 and 2006. The numbers of procedures in the inpatient and outpatient setting for the studied years are shown in Table 1 along with the total number of ACL reconstructions (Figure 1).

The average age of patients undergoing ACL reconstruction was 28 ± 10 years in 1994 compared with 29 ± 13 years in 2006 ($P = .473$). The number of ACL reconstructions performed in the United States in patients younger than 20 years increased from 12.22 per 100,000 person-years in 1994 to 17.97 per 100,000 person-years in 2006. Similarly, the number of ACL reconstructions performed in those 40 years or older increased over the time period studied, from 1.65 per 100,000 persons in 1994 to 7.57 per 100,000 persons in 2006 (Figure 2). Data concerning age distribution of ACL reconstructions performed by year are reported in Table 2.

The number of ACL reconstructions performed in females increased significantly from 1994 to 2006, increasing from 32% to 42% of the total number of ACL reconstructions performed in the United States (Figure 3). The incidence of ACL reconstruction in females significantly increased from 10.36 per 100,000 person-years in 1994 to 18.06 per 100,000 person-years in 2006 ($P = .0003$). ACL reconstruction in males decreased from 68% of the total number of ACL reconstructions being performed in 1994 to 58% of total in 2006. The incidence per 100,000 person-years still increased from 22.58 in 1994 to 25.42 in 1996, however. The sex-based differences are detailed in Table 3.

TABLE 2
ACL Reconstruction Incidence by Age

	1994		1995		1996		2006	
Age, y	Total	Per 100,000 Person-Years	Total	Per 100,000	Total	Per 100,000 Person-Years	Total	Per 100,000 Person-Years
<20	32,155	12.22	40,005	15.02	41,500	15.41	53,653	17.97
20-29	30,740	11.683	34,856	13.09	29,030	10.78	26,815	8.98
30-39	17,724	6.74	18,063	6.78	21,160	7.86	20,846	6.98
≥40	4343	1.65	7954	2.98	10,828	4.02	22,588	7.57
Total	86,687	32.94	10,3398	38.83	104,167	38.67	129,836	43.48

TABLE 3
ACL Reconstruction Incidence by Sex

	1994			1995			1996			2006		
Sex	Total (95% CI)	Per 100,000 Person-Years	% Total	Total	Per 100,000 Person-Years	% Total	Total	Per 100,000 Person-Years	% Total	Total (95% CI)	Per 100,000 Person-Years	% Total
Male	59,416 (34,612-84,220)	22.58	68	68,106	25.58	66	65,427	24.42	63	75,910 (51,106-100,714)	25.42	58
Female	27,271[a] (12,714-41,828)	10.36	32	35,292	13.25	34	38,740	14.38	37	53,926[a] (39,369-68,483)	18.06	42

[a]The incidence of ACL reconstruction was significantly higher in females in 2006 than in 1994 ($P = .0003$)

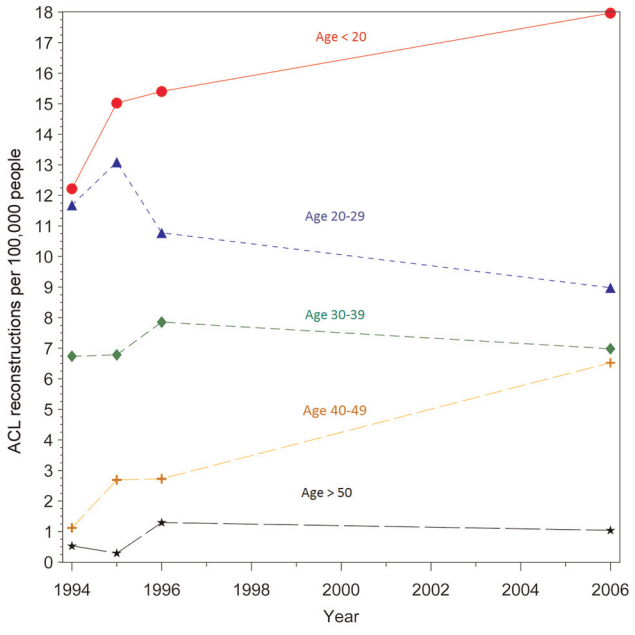

Figure 2. Number of ACL reconstructions performed in the United States based on age.

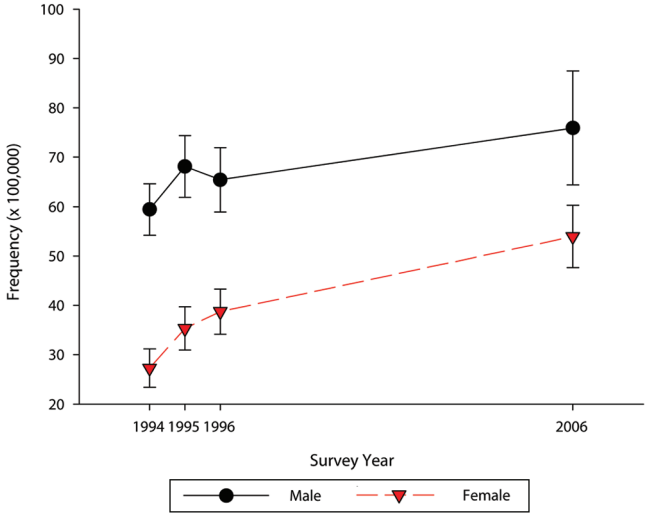

Figure 3. Incidence of ACL reconstruction by patient sex.

The most common concurrent ICD-9 diagnosis codes used at the time of ACL reconstruction were 836.0, 717.2, or 717.0, indicating a medial meniscus tear. This was reported in 26.7% of ACL reconstructions in 1994 and increased to 44.3% of ACL reconstructions in 2006. Lateral meniscus tears, denoted with diagnosis codes 836.1, 717.4, or 717.43, remained relatively constant and were reported in 1994 at 20.1% and in 2006 at 17.4% of ACL reconstructions performed. Table 4 provides data on the most common diagnoses reported per year studied.

The total number of concomitant procedures reported in 1994 was 106,638, or 123% of the total number of ACL reconstructions performed. In 2006 this number rose to 200,325, or 154% of the total number of ACL

TABLE 4
Most Common Diagnosis Codes With ACL Reconstruction[a]

		1994			1995			1996			2006		
Diagnosis Code No.	Description	No.	%	Rank	No.	%	Rank	No.	%	Rank	No.	%	Rank
836.0, 717.2, 717.0	Medial meniscus tear	14,136	26.7	1	30,278	29.3	1	28,637	27.5	1	57,462	44.3	1
836.1, 717.4, 717.43	Lateral meniscus tear	9214	20.1	2	22,403	21.7	2	25,941	24.9	2	22,591	17.4	2
717.7	Chondromalacia patella	3230	6.9	3	8593	8.3	3	7092	6.8	3	11,722	9.0	4
844.1	MCL sprain	1528	1.8	11	2582	2.5	7						
823.0	Fracture of tibia	1092	1.3	12									
799.9	Other/unknown	1931	2.2	9							7191	5.5	5
715.1, 715.2, 715.3, 715.36	Localized arthritis	1733	2.0	10				739	0.7	9			
E928.9	Unspecified accident	2387	2.8	8				906	0.9	8			
E927	Unspecified overexertion	5161	6.0	4	1775	1.7	9	5093	4.9	4	3938	3.0	7
836.2, 733.92,717.5	Other tear of cartilage or meniscus	2458	2.8	6	4601	4.4	5	691	0.6	10	17,553	13.5	3
E849.4	Accident occurring in recreation or sport	2663	3.1	5	2941	2.8	6						
844.9	Sprain/strain unspecified				2056	2.0	8	3264	3.1	6			
718.86, 717.9, 727.89, 719.46	Other/unspecified joint derangement, synovium, pain	2444	2.8	7	5146	5.0	4	4173	4.0	5	4704	3.6	6
719.96	Unspecified disorder of lower leg							1984	1.9	7			
Total concomitant diagnoses		67,974			45,566			56,370			161,675		

[a]MCL, medial collateral ligament.

TABLE 5
Concomitant Procedure Codes at the Time of ACL Reconstruction

		1994			1995			1996			2006		
Procedure Code No.	Description	No.	%	Rank	No.	%	Rank	No.	%	Rank	No.	%	Rank
80.26	Arthroscopic excision joint structure	53,178	61.3	1	58,845	56.9	1	56,421	54.2	1	100,618	77.5	1
80.6	Excision of meniscus	31,896	36.8	2	40,552	39.2	2	33,172	31.8	2	52,166	40.2	2
81.47	Other repair of knee	12,754	14.7	3	13,272	12.8	3	11,510	11.1	3	27,440	21.1	3
80.86	Local excision lesion of joint-knee	5675	6.5	4	6575	6.4	4	4139	4.0	4	19,221	14.8	4
80.76	Complete/partial resection of synovial membrane–knee	3135	3.6	5	1681	1.6	5	2358	2.3	6			
81.46	Other repair of collateral ligaments				1170	1.1	6	3344	3.2	5	880	0.7	5
Total concurrent procedures		106,638	123		128,514	124		113,089	108		200,325	154	

reconstructions being performed. The most common procedures associated with ACL reconstruction are listed in Table 5.

DISCUSSION

The aims of this study were to determine the incidence of ACL reconstructions in the United States; identify any changes in this incidence between 1994 and 2006; evaluate changes in the demographics of ACL reconstruction with respect to location (inpatient vs outpatient), patient age, and sex; and determine the most frequent concomitant procedures. Between 1994 and 2006, both the number of ACL reconstructions and the incidence of ACL reconstruction increased in the United States. This increase was driven by increases in the number of ACL reconstructions performed in females and patients younger than 20 and those 40 years or older.

Other countries have used national databases to better understand the overall effect of ACL injury and reconstruction. In Finland, a cohort study of 46,000 adolescents found an incidence of ACL injury of 60.9 per 100,000 person-years.[37] A Swedish database demonstrated an incidence of ACL injury of 78 per 100,000 person-years but showed that only 36% of these cases undergo ACL reconstruction.[34] A study from New Zealand demonstrated an incidence of ACL reconstruction of 36.9 per 100,000 person-years.[15] The present study demonstrated an incidence of 129,836 ACL reconstructions performed in 2006, which corresponds to a rate of 43.48 per 100,000 person-years. A wide range of incidence rates of both ACL injury and ACL reconstruction have been published.[8,9,13,17,25] Most of these numbers are based on estimations by authors, which have then been perpetuated throughout the orthopaedic literature and the Internet.

Incidence rates of ACL injury and reconstruction depend on the population being studied and are likely higher in athletic populations compared with population as a whole. Several studies have evaluated incidence rates in athletes, from which relative risks have been determined based on sex, sports, and use of an ACL prevention regimen.[38] A study at the US Military Academy at West Point determined an ACL injury incidence proportion of 3.24 per 100 athlete-years in males and 3.51 per 100 athlete-years in females over a 4-year collegiate career.[29]

Gwinn et al[18] found ACL injury incidence rates of 0.51 and 0.13 per 1000 athlete-exposures in female and male intercollegiate athletes, 0.25 and 0.18 per 1000 athlete-exposures in female and male intramural athletes, and 3.07 and 0.32 per 1000 athlete-exposures in male and female midshipmen during military training at the US Naval Academy; there was a relative risk of 2.44 for ACL injury in women compared with men. The injury rate was significantly greater in NCAA women's soccer and basketball (0.31 and 0.29, respectively) than in males playing the same sports (0.13 and 0.07, respectively).[1] Another study of soccer injuries found that incidence rates were higher in females at 0.10 per 1000 game hours, compared with 0.057 per 1000 game hours in males. This study also demonstrated that those in more competitive leagues had a higher risk of injury, indicating that the risk of ACL injury increased with a more intense level of play.[6]

The number of female athletes has steadily risen since the Title IX legislation was passed in 1972. Before this date, female participation in sport was estimated at 3.7%, but by 1998 it had risen to 33%.[16] Estimations of high school female athletes had reached nearly 3 million by 2006, which represented a more than 1000% increase.[24] Additional studies have demonstrated that female athletes have a higher rate of injury than male athletes,[24] with females having a 4- to 6-fold increased risk of ACL tear compared with males in the same sport.[30] A variety of suggested risk factors have been proposed, including being in the preovulatory phase of the menstrual cycle, having decreased intercondylar notch width, and having a greater knee abduction moment during impact on landing described as a "valgus intersegmental torque."[39,42] The present study demonstrated an increase in the number of ACL reconstructions in females: Females accounted for 32% of the ACL reconstructions performed in 1994 and 42% of those performed in 2006, with a near doubling in incidence from 10.36 to 18.06 per 100,000 person-years ($P = .0003$).

The number of ACL reconstructions performed in those 40 years or older increased from 1.65 per 100,000 person-years in 1994 to 7.57 per 100,000 person-years in 2006. Several studies have demonstrated increased incidence of ACL injury with greater sport participation,[20,37] and recent studies have shown that patients are performing high-level athletic activities longer in life.[2,43] A recent systematic review of ACL reconstructions in patients older than 40 years (mean age, 47.8 years) demonstrated similar patient-based and functional outcome scores when compared with patients with an average age of 26.7 with a minimum follow-up of 2 years (unpublished data, N.A.M. et al, 2014). Patients may be electing to proceed with ACL reconstructions rather than nonoperative treatment due to a desire to remain active and continue to perform activities that require cutting and pivoting with the knee. While there is no direct evidence that ACL reconstruction prevents the progression of arthritis, the combination of good results and low complication rates makes ACL reconstruction in this population a good option.

The number of ACL reconstructions performed in the United States in patients younger than 20 years increased from 12.22 per 100,000 person-years in 1994 to 17.97 per 100,000 person-years in 2006. The root cause of this increase is unknown, and unfortunately our data do not explain this trend. Further study will be necessary to determine whether increased overall sports participation, increased year-round athletic participation, or possibly changing surgical indications may be contributing to this change. ACL reconstruction in the pediatric and adolescent population is fraught with controversy, including graft selection, transphyseal versus physeal-sparing techniques, and potential increased risk of revision surgery.

An increasing number of ACL reconstructions are performed in outpatient ambulatory surgery centers; we found that there was an increase from only 43% of ACL reconstructions performed in this setting in 1994 to 95% in 2006. This trend is likely due to in part to advances in anesthesia techniques, regional anesthesia, and recognition of the advantages of multimodal analgesic regimens.[5] Within orthopaedics, changes in rehabilitation protocols and patient expectations have likely contributed to the increase in outpatient surgery.[3] In a study evaluating rotator cuff repairs, a significant increase was noted in the number of outpatient surgeries performed compared with the number of inpatient surgeries performed over a 10-year span from 1996 to 2006. While arthroscopic techniques have likely contributed to this trend, open surgeries such as hip and knee arthroplasty are also being performed on an outpatient basis because of improvements in intraoperative and postoperative analgesia.[3-5] Colvin et al,[10] evaluating national trends in rotator cuff surgery, found a larger percentage of regional anesthesia being performed in 2006 compared with 1996. Yet current research has not shown a significant benefit with femoral nerve block alone in the setting of ACL reconstruction.[27] Significant cost savings can be seen with shorter hospital stays or outpatient surgery.[21,31,33,35]

Injuries of the ACL are frequently accompanied by concomitant injuries, the most common being cartilage, meniscus, and medial collateral ligament injuries. A study of 81 patients with ACL tears noted injuries to the lateral meniscus in 54%, medial meniscus in 51%, and medial collateral ligament in 22%, with greater prevalence in patients with more severe bone bruises on magnetic resonance imaging.[44] Examining more than 700 ACL reconstructions, Ghodadra et al[14] found meniscal tears in 67% and chondral injuries in approximately 50% of patients at the time of reconstruction, with increased number of meniscal tears and chondral injuries in chronic ACL-deficient knees. Using the Multicenter Orthopaedic Outcomes Network (MOON) database, other investigators found acute medial and lateral meniscus tears in 40.4% and 45.9% of patients undergoing ACL reconstruction, respectively.[7] A recent systematic review of more than 11,000 meniscal tears treated at the time of ACL reconstruction found that for 65%, the meniscus was partially or completely removed, while 26% were treated with repair and 9% were left in situ.[36] Our study demonstrated a much higher percentage of medial meniscus tears compared with lateral meniscus tears, especially in 2006. This could possibly be related to the greater number of older patients being treated with ACL reconstruction. Regardless, a large

number of concomitant diagnoses and procedures were associated with ACL reconstruction in this study. This has significant implications for future injury to the knee joint, and several authors have reported acceleration of degenerative joint changes after meniscectomy.[12,19,32,40]

Limitations of this study include the nature of database studies, including the inherent errors in data entry that can exist in any national database. When one is using a database, it is difficult to control for the quality and completeness of the data gathered. Changes in reimbursements and bundling of procedures may theoretically affect reporting codes by providers. Also, these databases do not include US military personnel who may have experienced ACL injury and been treated operatively in a military or VA hospital. This could account for a substantial number of patients, as these are young, active individuals at risk for ACL injury. While both databases reported yearly data from 1994 to 1996, thereafter data were reported only once a decade. Thus, we do not have data from 1997 to 2005, and therefore we cannot report that the increase in the number of ACL procedures occurred as a trend over time; we can only report that the number of these procedures increased between 1994 and 2006 as single years in comparison. As an additional weakness, due to the method used by these databases in reporting variance, no estimates for variance within age subgroups can be created and thus our age group data cannot be compared statistically. This study used US Census data to determine the incidence of ACL reconstruction; however, it is likely that this incidence is much higher in the athletic population. Finally, the number of ACL reconstructions cannot be used as a surrogate for the number of ACL injuries, as not all ACL injuries are treated operatively. Future studies are needed to identify the prevalence of actual injuries, which would highlight the changes in number of injuries or detect changing indications in ACL injuries.

Anterior cruciate ligament reconstruction is one of the most common orthopaedic procedures. Using NCHS data, we report an increase in the incidence ACL reconstructions from 32.9/100,000 in 1994 to 43.5/100,000 in 2006, with increased numbers in patients younger than 20 years, in those 40 years or older, and in females. ACL reconstructions were more frequently performed in outpatient facilities as well. Concomitant procedures are common with ACL reconstruction and typically consist of partial meniscectomy or chondroplasty.

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