National trends in the diagnosis and repair of SLAP lesions in the United States

Mark C Dougherty, J Erik Kulenkamp, Haroutioun Boyajian, Jason L Koh, Michael J Lee and Lewis L Shi

Abstract

Background: Since superior labrum anterior-to-posterior (SLAP) tear was introduced as an International Classification of Diseases-Ninth Revision, Clinical Modification diagnosis in 1994, awareness, diagnosis, and surgical treatment of this disorder has increased. Here, we aim to clarify trends in the frequency of SLAP tear diagnosis and arthroscopic SLAP repair surgery in the United States. Methods: Using private insurance claims from 2003 to 2013 in MarketScan (approximately 55 million Americans), we identified patients with SLAP tear diagnosis or arthroscopic SLAP repair surgery. Population-based rates of SLAP diagnosis and related shoulder procedures were calculated. Results: A total of 329,643 patients in the MarketScan database received a SLAP tear diagnosis. In all, 62.8% underwent some form of shoulder surgery after diagnosis. SLAP diagnosis increased from 28.0 per 100,000 in 2003 to 142.4 per 100,000 in 2013 (p < 0.0001); the rate of shoulder surgery in these patients increased from 20.1 per 100,000 in 2003 to 74.1 per 100,000 in 2013 (p < 0.0001). However, the percentage of patients with SLAP tears who got shoulder surgery decreased (p < 0.0001). In 2003, almost no patient got biceps tenodesis for SLAP tears; by 2013, 18.1% of surgeries for SLAP tear were biceps tenodesis. Isolated arthroscopic SLAP repairs peaked in 2009 at 28.4 per 100,000 and stabilized thereafter. Conclusion: We confirmed prior reports that SLAP diagnosis increased from 2003 to 2013, although the percentage of these patients who underwent surgery decreased over this period. Arthroscopic SLAP repair doubled but then plateaued after 2009. Biceps tenodesis now accounts for a substantial portion of surgeries for SLAP tear. This may reflect an improved understanding of superior labrum anatomy and biomechanics.

Keywords

arthroscopic SLAP repair, biceps tenodesis, SLAP, superior labrum

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Introduction

Superior labrum anterior-to-posterior (SLAP) tears are a well-known cause of shoulder pain—often associated with instability—in both young athletes and elderly patients. However, despite our knowledge of SLAP lesions, diagnosis remains difficult because the clinical presentation of a SLAP lesion is often identical to that of other shoulder injuries. Furthermore, SLAP tears often occur in conjunction with other conditions such as rotator cuff tears and shoulder impingements. Typically, a diagnosis can be made with a combination of physical examination, magnetic resonance arthrography, and careful history taking, but confirmation of a SLAP tear may require arthroscopic examination.

1 Department of Neurosurgery, University of Iowa Hospitals and Clinics, Iowa City, IA, USA
2 Department of Ophthalmology and Visual Neurosciences, University of Minnesota, Minneapolis, MN, USA
3 Department of Surgery, Henry Ford Health System, Detroit, MI, USA
4 Department of Orthopaedic Surgery, NorthShore University Health System, NorthShore Orthopaedic Institute, Evanston, IL, USA
5 Division of Shoulder and Elbow Surgery, Department of Orthopaedic Surgery and Rehabilitation Medicine, University of Chicago Medicine, Chicago, IL, USA

Corresponding author:
Lewis L Shi, Division of Shoulder and Elbow Surgery, Department of Orthopaedic Surgery and Rehabilitation Medicine, University of Chicago Medicine and Biological Sciences, 5841 S Maryland Ave, Chicago, IL 60637, USA.
Email: lshi@bsd.uchicago.edu
There are currently two main surgical approaches to treating SLAP lesions: arthroscopic repair of the labrum (SLAP repair) and biceps tenodesis. Clinical evidence suggests that SLAP repair allows for a greater return to pre-injury functionality than biceps tenodesis, particularly in overhead athletes, but may require more rehabilitation and recovery. Increased age has also been shown to correlate with higher rates of postoperative stiffness, reoperation, persistent pain, and decreased patient satisfaction after SLAP repair. Some groups have suggested limiting SLAP repair to patients below the age of 40 years, but there is as yet no widely accepted guideline for the treatment of SLAP tears based on patient age.

Recent studies have found a dramatic, unexplained increase in the rate of SLAP repair surgeries during the early 2000s. Zhang et al. identified an increase in SLAP repair incidence from 17.0 per 10,000 orthopedic patients in 2004 to 28.1 per 10,000 orthopedic patients in 2009 using insurance claims from the PearlDiver Patient Records Database. A New York State-based study found a 464% increase in SLAP repair surgeries from 2002 to 2010, far outpacing the 135% increase in orthopedic ambulatory surgeries of all types over the same period. Finally, a Wisconsin Hospital Association Database study found an increase from 103.8 SLAP surgeries per 100,000 in 2002 to 190.1 per 100,000 in 2010. Nevertheless, these findings are not without debate: one study evaluating orthopedic surgery board applications between 2002 and 2011 found decreased rates of SLAP repair reported. We hope to clarify this apparent discrepancy with our study.

Given the findings of prior studies, we hypothesized that we would observe an increased frequency of SLAP diagnosis and related shoulder surgeries (such as SLAP repair and biceps tenodesis) from 2003 to 2013.

Methods

Our study used the Truven Health MarketScan Commercial Database with Medicare Supplemental (marketscan.truvenhealth.com; Ann Arbor, Michigan, USA), a private insurance database with claims data for approximately 55 million US residents from 2003 to 2013. Cohort identification was based on the International Classification of Diseases–Ninth Revision, Clinical Modification (ICD-9) codes and Current Procedure Terminology-Four (CPT) codes. In the United States, ICD diagnosis codes are used to identify the diagnosis for which a clinical encounter occurred, while CPT codes are used to identify specific procedures or services that are rendered. For example, a physical therapy appointment could have an ICD diagnosis code of SLAP tear and a CPT code for physical therapy services. Likewise, an office visit with an orthopedic surgeon could use the same ICD-9 code but would, instead, use the CPT code for office evaluation, and a surgery would use the CPT code for the relevant surgical procedure performed. Our cohort included all patients in MarketScan who received at least one SLAP diagnosis (ICD-9 diagnosis code 840.7) during the covered time period. Within this group, we identified patients who had particular shoulder procedures during the study period, such as arthroscopic SLAP repair (CPT 29,807) and biceps tenodesis (CPT 23,430, open biceps tenodesis or CPT 29,828, arthroscopic biceps tenodesis). Of note, the ICD-9 system also includes procedure codes; however, these were not used because MarketScan codifies outpatient procedures—including SLAP repair and biceps tenodesis—with CPT rather than ICD-9 procedure codes. The full list of shoulder procedure codes used in this study is listed in Appendix 1. This study was determined to be exempt from informed consent and review by the local Institutional Review Board due to the anonymous nature of the MarketScan database.

The total number of patients in the MarketScan database in a given year was estimated by averaging the number of patients enrolled on the first day of each quarter. Such an estimate is necessary as the number of patients changes constantly as insurance coverage is picked up or dropped. The estimated total population was used to calculate annual rates of SLAP diagnosis and surgical procedures of the shoulder. In calculating these rates, only one diagnosis code and surgery was counted per patient each year to avoid the influence of duplicate coding. For example, if a patient has multiple follow-up appointments that each lists SLAP tear as the visit diagnosis, we count that as one SLAP diagnosis and, therefore, avoid artificially inflating the rate of SLAP diagnosis by counting a single patient’s SLAP tear multiple times. Linear regression was used to determine the significance of year-to-year differences in SLAP diagnosis and shoulder surgery rates. A p value of <0.0001 was used as the cutoff for statistical significance. Data analysis was performed using Stata 14.0 (College Station, TX, USA).

Results

Over the 11-year time period studied, 329,643 distinct patients received a total of 5,014,227 SLAP tear diagnoses. That is, there were 5,014,227 clinical encounters (including office visits, procedures, imaging studies, physical therapy, etc.) for these patients for which SLAP tear was coded as the main problem addressed. Of those patients, 206,864 (62.8%) underwent some form of shoulder surgery after receiving their SLAP diagnosis. The rate of SLAP tear diagnosis increased in every year of the period studied, from 28.0 per 100,000 in 2003 to 142.4 per 100,000 in 2013—a more than fivefold increase (p < 0.0001, Figure 1). In contrast, the percentage of patients with known SLAP tears who would ultimately undergo shoulder surgery decreased with time (p < 0.0001).

The overall rate of shoulder surgery increased significantly over the study period, from an initial rate of 20.1 surgeries per 100,000 in 2003 to 74.1 per 100,000 in 2013 (p < 0.0001, Figure 2). The distribution of surgeries for SLAP patients changed over time, however. In 2003, over
half of the surgically treated SLAP tear patients got arthroscopic SLAP repair and most of those who did not had either debridement or another operation that did not address the SLAP tear. With time, however, biceps tenodesis emerged as a treatment modality for a substantial number of patients with SLAP tears. By 2013, 18.1% of all surgical patients with SLAP tears were receiving biceps tenodesis surgery, with or without simultaneous SLAP repair. Meanwhile, the total number of isolated arthroscopic SLAP repairs peaked in 2009 at 28.4 per 100,000 and declined thereafter. The largest single group of surgical patients in the cohort by 2013 was the group with debridement without either SLAP repair or biceps tenodesis, although still 49.8% of surgical patients received one or more procedures that directly addressed their SLAP tear (Figure 2).

**Discussion**

Our results confirm the reports of others that the diagnosis of SLAPs increased substantially from 2003 to 2013—we observed a fivefold increase in that time. Similarly, the rate of SLAP surgery more than doubled from 2003 to 2009. Increases of this magnitude are not likely to be the result of a true increase in incidence over the same time period, as there have not been any notable increases in activities that increase the risk of SLAP tears, such as overhead sports. The relative plateau in SLAP surgery rates after 2009 is previously unreported and may reflect a change in practice following reports concerned with the potential for overutilization of SLAP repair surgery as a treatment method for a SLAP tear. At present, there is no indication that the rate of arthroscopic SLAP repair will return to its 2009 peak. Instead, it would appear that many SLAP repair procedures were replaced by biceps tenodesis procedures from 2009 to 2013, given that the total combined rate of biceps tenodesis and SLAP repair remained fairly steady over that period. The overall rate of shoulder surgery continued to rise throughout the study period, but after 2009, this rise was almost entirely due to procedures that do not address the SLAP tear.

These changes seem to reflect the evolution of knowledge regarding management of SLAP lesions. In 2003, biceps tenodesis was not well recognized as a possible treatment for SLAP tears, but with time it began to even supplant SLAP repair in some cases as the modality for SLAP treatment. This corresponds to increasing reports and studies over time showing biceps tenodesis as an alternative to SLAP repair and is now believed to be the preferred surgical management in many circumstances, such as in older patients. Nevertheless, as of 2013, there were still more than twice as many SLAP repairs as biceps tenodesis procedures for patients with SLAP tears. It remains unclear
what the ideal distribution between these two different treatment modalities is, and further characterization of the patients who got one versus the other is beyond the scope of this study.

There are several advantages in using an insurance database such as MarketScan for analysis of diagnoses and procedures. It is a large national database, which allows us to identify small differences that other databases cannot and reduces the impact of physician-to-physician coding and practice variations. Thus, it provides a more accurate picture of what is actually happening with orthopedic practice across much of the United States.

Limitations

There are also several limitations inherent to the analysis of insurance claims data. This study relies on consistent, accurate billing codification by physicians who likely practice in widely disparate locations and settings. We also cannot accurately account for patients who have multiple shoulder surgeries, as ICD-9 codes do not denote laterality, so we cannot know whether a second day of surgery means reoperation or operation on the contralateral shoulder. However, these coding ambiguities are unlikely to vary by year or surgery type, so the differences we have identified are still noteworthy.

Conclusions

We were able to confirm previous reports that the diagnosis of SLAP tears increased substantially from 2003 to 2013, although the percentage of these patients who underwent surgery decreased consistently over the same period. The rate of SLAP repair more than doubled from 2003 to 2009, then reached a relative plateau through 2013, whereas biceps tenodesis for SLAP tear increased from nearly zero to a substantial percentage of surgical patients. These findings may reflect rising awareness of SLAP tears and an improved understanding of the anatomy and biomechanics of the superior labrum.

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**ORCID iD**
Mark C Dougherty https://orcid.org/0000-0003-3247-0261

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**Appendix 1**

**CPT codes**
1. Arthroscopic SLAP repair
   a. 29,807 SLAP lesion repair
2. Biceps tenodesis
   a. 23,430 Tenodesis long tendon, biceps (open)
   b. 29,828 Biceps tenodesis (arthroscopy)
3. Debridement
   a. 29,822 Debridement, limited (arthroscopy)
   b. 29,823 Debridement, extensive (arthroscopy)
4. Other shoulder procedures
   a. 23,120 Claviculectomy, partial
   b. 23,130 Acromioplasty/-ectomy, partial
   c. 23,000 Removal subdeltoid calcareous deposits
   d. 23,333 Removal foreign body deep
   e. 23,405 Tenotomy, shoulder; single
   f. 23,406 Tenotomy, shoulder; multiple
   g. 23,410 Repair ruptured cuff; acute (open)
   h. 23,412 Repair ruptured cuff; chronic (open)
   i. 23,420 Reconstruction rotator cuff tear (RCT), chronic (acromioplasty)
   j. 23,462 Capsulorraphy, LatarJet
   k. 23,455 Capsulorraphy, anterior; Bankart
   l. 23,460 Capsulorraphy, anterior; bone block
   m. 23,465 Capsulorraphy, posterior, GHJ
   n. 23,466 Capsulorraphy, multidirectional
   o. 29,805 Diagnostic; with or without synovial biopsy (arthroscopy)
   p. 29,819 Removal of loose bodies (arthroscopy)
   q. 29,824 Distal claviculectomy (including Mumford) (arthroscopy)
   r. 29,825 Lysis of adhesions (arthroscopy)
   s. 29,826 Subacromial decompression (arthroscopy)
   t. 29,806 Capsulorraphy (arthroscopy)
   u. 29,827 Rotator cuff repair (arthroscopy)
   v. 29,999 Endoscopy/Arthroscopy Procedures on the Musculoskeletal System, otherwise unlisted (arthroscopy)