SLAP Lesions: Trends in Treatment

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Purpose: To determine the trends in SLAP repairs over time, including patient age, and percentage of SLAP repairs versus other common shoulder arthroscopic procedures. **Methods:** The records of 4 sports or shoulder/elbow fellowship trained orthopaedic surgeons were used to identify the total number of common shoulder arthroscopic cases performed between 2004 and 2014 using current procedural terminology codes (CPT): 29822, 29823, 29826, 29827, 29806, 29807, 29825, and 29828. The number of SLAP repairs (CPT code 29807) as a combined or isolated procedure were recorded, and the classification of SLAP type was undertaken using operative reports. Patient age was recorded. Linear regression was used to determine statistical significance. **Results:** There were 9,765 patients who underwent arthroscopic shoulder procedures using the defined CPT codes between 2004 and 2014 by our 4 orthopaedic surgeons. Of these, 619 underwent a SLAP repair (6.3%); average age 31.2 ± 11.9. The age of patients undergoing SLAP repair significantly decreased over time ($P < .001$, $R^2 = 0.794$). Most SLAP repairs were performed on type II SLAP tears ($P = .015$, $R^2 = 0.503$). The percentage of SLAP repairs compared with the total number of shoulder arthroscopic surgeries and total number of patients who underwent SLAP repair significantly decreased over time ($P < .001$, $R^2 = 0.832$ and $P = .002$, $R^2 = 0.674$, respectively). Conversely, the number and percentage of biceps tenodeses are increasing over time ($P = .0024$ and $P = .0099$, respectively). **Conclusions:** Over the past 10 years, the total number of biceps tenodeses has increased, whereas the number and relative percentage of SLAP repairs within our practice have decreased. The average age of patients undergoing SLAP repair is decreasing, and most SLAP repairs are performed for type II SLAP tears. **Level of Evidence:** Level IV, therapeutic case series.

The glenoid labrum, made of fibrocartilaginous tissue, serves to stabilize the humeral head within the glenoid.[1,2] Tears of the anterosuperior labrum were first described by Andrews et al. in 1985.[3-5] This injury was further classified by Snyder et al. in 1990.[6] The injury was labeled a superior labrum anterior posterior (SLAP) tear, and 4 distinct types of SLAP tears were identified. Over time, modifications have been made to the initial classification system such that 10 different types of SLAP tears have now been identified.[5,7,8] Although this tear pattern has been described and studied for quite some time, the ideal treatment of these injuries remains elusive. Indications for operative repair remain unclear with increasing reports of complications and suboptimal outcomes within the literature.[9-11]

With the knowledge that degenerative changes of the superior labrum occur commonly with age and improvements in magnetic resonance imaging quality, SLAP tears are becoming a more frequent diagnosis.[4] Zhang et al.[4] recently reviewed the demographic trends of SLAP repairs in the United States using a publicly available database and found that the number of SLAP repairs significantly increased over time from 2004 to 2009. This increase in the number of diagnosed SLAP tears that are treated with arthroscopic repair is interesting because the ideal treatment for SLAP tears has not been elucidated, and several studies have shown increasing risk of complications and poor

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Table 1. Descriptions of Current Procedural Terminology Codes Used in This Study

Code	Description
29822	Arthroscopy, shoulder, surgical; debridement, limited
29823	Arthroscopy, shoulder, surgical; debridement, extensive
29826	Arthroscopy, shoulder, surgical; decompression of subacromial space with partial acromioplasty, with or without coracoacromial release
29827	Arthroscopy, shoulder, surgical; with rotator cuff repair
29806	Arthroscopy, shoulder, surgical; capsulorrhaphy
29807	Arthroscopy, shoulder, surgical; repair of SLAP lesion
29825	Arthroscopy, shoulder, surgical; with lysis and resection of adhesions, with or without manipulation
29828	Arthroscopy, shoulder, surgical; biceps tenodesis

NOTE. Codes highlighted by the Arthroscopy Association of North America.[12]

outcomes with inability to return to sport particularly in older age patients or overhead throwing athletes.

The overall purpose of this study was to determine the trends in SLAP repairs over time, including patient age and percentage of SLAP repairs versus other common shoulder arthroscopic procedures. The authors hypothesized that the rate of SLAP repairs relative to total arthroscopic shoulder procedures would decrease over time, as will the age of patients undergoing SLAP repairs, in the 4 surgeons whose data will be analyzed.

Methods

The surgical database of 4 fellowship trained shoulder and/or elbow (A.A.R. and G.P.N.) or sports (B.J.C. and N.N.V.) orthopaedic surgeons at our institution was queried from January 1, 2004, to December 31, 2014. Patient age at the time of surgery was recorded. Operative reports were reviewed by the lead author (B.J.E.) to determine the type of SLAP tear. An exemption was granted by the institutional review board for this study as, "this research involves the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are either publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects." The Current Procedural Terminology (CPT) code used to determine the number of SLAP repairs was 29807. To obtain the denominator for the number of arthroscopic shoulder surgeries performed by these 4 surgeons during the study period so the rate of SLAP repairs could be determined, the following common CPT codes were used: 29822, 29823, 29826, 29827, 29806, 29807, 29825, and 29828.

The descriptions of these CPT codes in Table 1 are from the Arthroscopy Association of North America.[12] The data were divided into total number of shoulder arthroscopies performed each year by each surgeon, as well as the number of SLAP repairs performed each year by each surgeon. No patient was excluded. To avoid counting the same patient who may have had multiple procedures on the same day more than once, the date of surgery was isolated for each patient, and if they had more than 1 CPT code listed for that surgical day, only the primary code was recorded. There were patients who had multiple surgeries over the course of the 10-year study period, and if the surgeries were performed on different days, each surgery was recorded and used in the analysis as an individual procedure. If a SLAP repair was one of the codes listed on an operative day when multiple CPT codes were listed, the SLAP repair code was the code that was recorded. The type of SLAP tear was also recorded based on the findings in the previously dictated operative reports, along with concomitant procedures performed. Descriptions of the definitions used to classify each SLAP tear are provided in Table 2.[5,7]

Labral repairs were generally performed with the patient in the lateral decubitus position using a beanbag and general endotracheal anesthesia. After a standard diagnostic arthroscopy using standard anterior and posterosuperior portals, the superior labrum is carefully evaluated. If a disruption of the labrum is present and a labral repair is anticipated, 8.25-mm cannulas are established anteriorly and posteriorly, and accessory portals, such as the portal of Wilmington, are made as necessary to address the specific tear. The labral tissues are gently debrided and a good bleeding bony surface of the glenoid is obtained with a rasp and elevator. The labral tear is then fixed with one of a variety of techniques. The patient is held in a brace to protect the repair postoperatively followed by initiation of early range of motion.

Table 2. Descriptions of How the SLAP Tears in This Study Were Classified Into Types

Type of SLAP Tear	Description
Type I	Fraying and degeneration of the superior labrum with and intact biceps anchor
Type II	Labral fraying with a biceps that is detached from the glenoid tubercle
Type III	Intact biceps root with a bucket handle tear of the superior labrum
Type IV	Bucket handle tear of the labrum with extension into the biceps attachment
Type V	Similar to a type II SLAP tear with anteroinferior labral extension
Type VI	Similar to a type II SLAP tear with an unstable labral flap (often a parrot beak tear of the labrum) with separation of the biceps tendon
Unspecified	The type of SLAP tear could not be determined by the previously dictated operative report

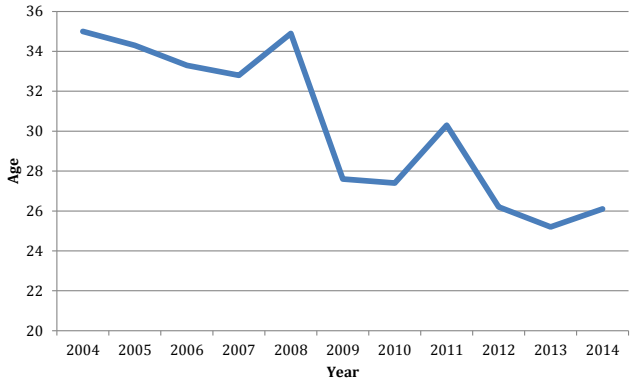

Fig 1. Average age of patients undergoing SLAP repair at our institution between 2004 and 2014. The age of patients undergoing SLAP repair significantly decreased over time ($P < .001$, $R^2 = 0.794$).

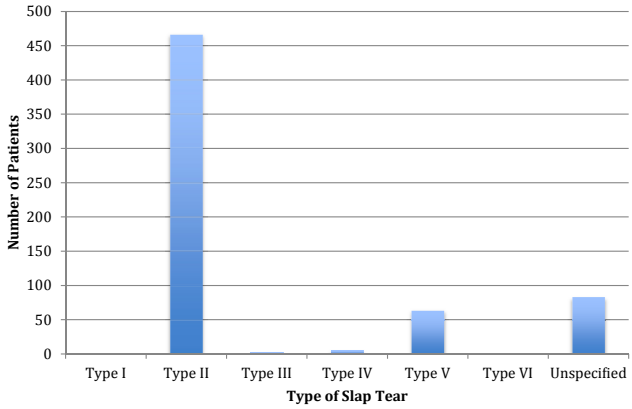

Fig 2. The breakdown of the type of SLAP tears that underwent surgical repair between 2004 and 2014 at our institution. Significantly more SLAP tears that underwent repair were type II than any other type of SLAP tear ($P = .015$, $R^2 = 0.503$).

Statistical Analysis

Continuous variable data were reported as weighted means ± weighted standard deviations. Categorical variable data were reported as frequencies with percentages. For all statistical analysis either measured and calculated from study data extraction or directly reported from the individual studies, $P < .05$ was considered statistically significant. The rate of change of the percentage of SLAP tears, the overall number of SLAP tears, the age of patients undergoing SLAP tears, and the type of SLAP tears that underwent repair were reported using a linear regression model.

Results

There were a total of 9,765 patients who underwent arthroscopic shoulder procedures between 2004 and 2014 by 4 of the authors who were fellowship trained in shoulder and/or elbow (A.A.R. and G.P.N.) and sports (B.J.C. and N.N.V.) using the following CPT codes: 29822, 29823, 29826, 29827, 29806, 29807, 29825, and 29828. Each surgeon averaged over 100 arthroscopic shoulder procedures each year using these 8 CPT codes (average number of procedures performed by each surgeon each year: 240.37 ± 68.4).

Of the 9,765 patients identified, 619 underwent a SLAP repair (6.3% of all shoulder procedures). The average age of patients who underwent SLAP repair was 31.2 ± 11.9 compared with 49 ± 14.7 for all arthroscopic procedures. The age of patients undergoing SLAP repair significantly decreased over time ($P < .001$, $R^2 = 0.794$) (Fig 1). Of all SLAP tears that underwent repair, 466 (75.3%) were classified as type II SLAP tears, significantly more than any other type of SLAP tear ($P = .015$, $R^2 = 0.503$) (Fig 2). The percentage of SLAP repairs compared with the total number of shoulder arthroscopic surgeries using the previously mentioned CPT codes significantly decreased over time ($P < .001$, $R^2 = 0.832$) (Fig 3). The total number of patients who underwent SLAP repair significantly decreased over time ($P = .002$, $R^2 = 0.674$) (Fig 4). Overall, 38.25% ± 19.07% of patients who underwent a SLAP repair had a concomitant procedure at the time of their SLAP repair. The concomitant procedures are listed in Table 3. In patients who had at least 1 concomitant procedure performed at the time of their SLAP repair, the average number of concomitant procedures performed was 1.26 ± 0.20.

The overall number and percentage of biceps tenodeses significantly increased over time ($P = .0024$ and $P = .0099$, respectively). The average age of patients undergoing biceps tenodesis (49.33 ± 13.2 years) did not significantly change over time ($P = .934$). Figure 5 show the overall number (1,840 total biceps tenodeses) (A) and percentage (B) of biceps tenodeses performed each year compared with the number of SLAP repairs

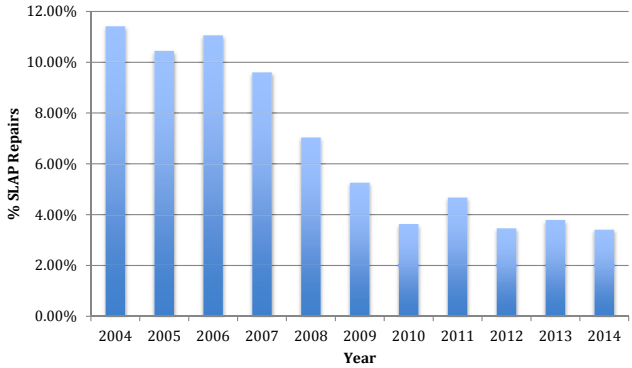

Fig 3. The percentage of shoulder arthroscopic procedures by 4 surgeons at our institution that were SLAP repairs between 2004 and 2014. The percentage of SLAP repairs compared with the total number shoulder arthroscopic surgeries using the previously mentioned CPT codes significantly decreased over time ($P < .001$, $R^2 = 0.843$).

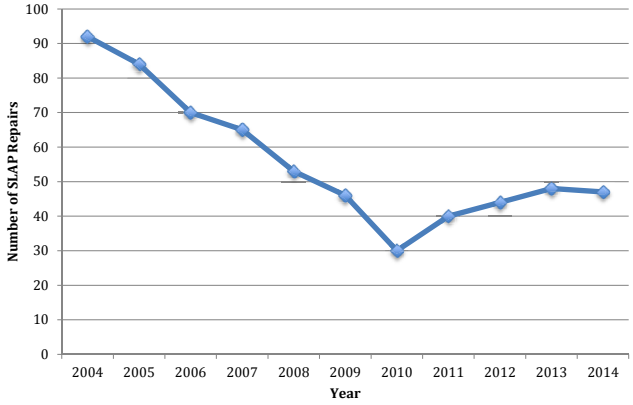

Fig 4. Total number of SLAP repairs performed each year from 2004 to 2014 by 4 surgeons at our institution. The number of SLAP repairs significantly decreased over time ($P = .002$, $R^2 = 0.667$).

performed per year between 2004 and 2014. The indications for biceps tenodesis included biceps tendinopathy, SLAP tears, biceps instability, and others.

Discussion

There have been reports of increasing numbers of SLAP repair procedures performed, along with increasing reports of complications and poor outcomes.[10,11] The purpose of this study was to determine the trends in SLAP repairs over time, including patient age and percentage of SLAP repairs versus other common shoulder arthroscopic procedures, using surgical data from fellowship trained, subspecialty-based orthopaedic surgeons in an academic practice. The authors' hypotheses were confirmed in that the age of patients undergoing SLAP repair, the total number of SLAP repairs, and the relative rate of SLAP repairs to other shoulder arthroscopic procedures are significantly decreasing over time.

Table 3. Concomitant Procedures Performed at the Same Time as the SLAP Repair by Year

	No. of Concomitant Procedures by Current Procedural Terminology Code				
Year	29806	29822	29823	29825	29826
2004	22	2	48	0	34
2005	11	4	23	3	15
2006	5	1	2	1	4
2007	3	1	1	0	5
2008	5	1	2	0	5
2009	13	1	11	0	8
2010	11	1	5	0	4
2011	10	3	10	0	4
2012	13	6	20	1	5
2013	17	6	6	0	4
2014	16	9	7	2	5

29806, arthroscopy, shoulder, surgical; capsulorrhaphy; 29822, arthroscopy, shoulder, surgical; debridement, limited; 29823, arthroscopy, shoulder, surgical; debridement, extensive; 29825, arthroscopy, shoulder, surgical; with lysis and resection of adhesions, with or without manipulation; 29826, arthroscopy, shoulder, surgical; decompression of subacromial space with partial acromioplasty, with or without coracoacromial release.

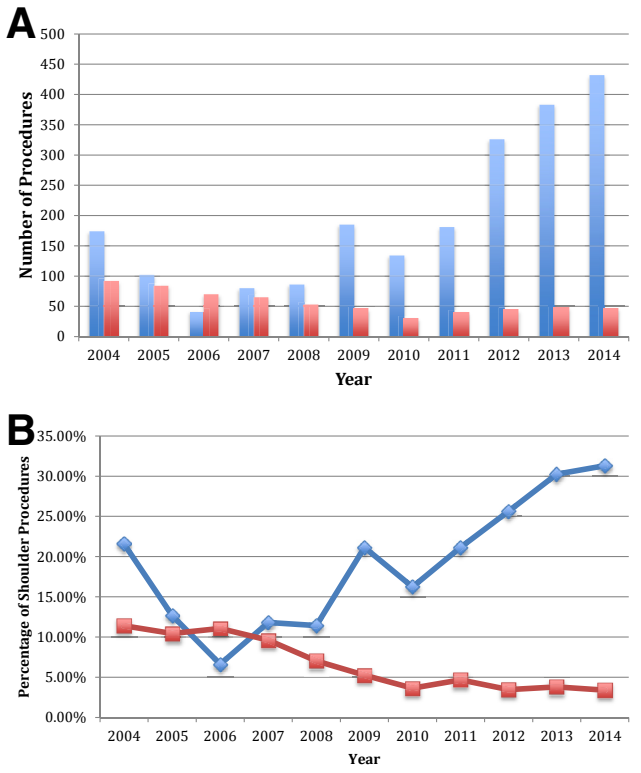

Fig 5. (A) Overall number of biceps tenodeses versus SLAP repairs per year from 2004 to 2014. The blue bars represent biceps tenodeses, whereas the red bars represent the number SLAP repairs. (B) Percentage of all shoulder arthroscopic surgeries that were biceps tenodeses versus SLAP repairs per year from 2004 to 2014. The blue line represents biceps tenodeses, whereas the red line represents the number SLAP repairs.

Although the exact cause of SLAP tears has not been identified, several theories, including those from Andrews, Burkhart, and Morgan, exist.[3,13-15] Current physical exam maneuvers are inaccurate and cannot reliably diagnose a SLAP tear.[16] Furthermore, studies have shown that magnetic resonance imaging has a tendency to overcall SLAP tears, with a positive predictive value of 24%.[17] The lack of physical exam maneuvers and diagnostic tests to reliably diagnose SLAP tears has led to a significant increase in the number of SLAP repairs performed in the United States.[4] Weber et al.[9] recently reviewed data from the American Board of Orthopaedic Surgery Part II database from 2003 to 2007 to determine the incidence rates, complications, and outcomes for SLAP repairs using the CPT code 29807. The study found 4,975 SLAP repairs that were performed between 2003 and 2008. The percentage of SLAP repairs compared with all shoulder arthroscopic procedures increased during their study period, and

when sports medicine trained orthopaedic surgeons were isolated, SLAP repairs made up 12.4% of all shoulder arthroscopic procedures. When compared with the results of this study, our surgeons performed a lower percentage of SLAP repairs (6.3% *v* 12.4%) and when a SLAP repair was performed, it was performed in younger patients (31.2 *v* 37.4). Furthermore, the actual difference in percentages would likely be greater if all shoulder arthroscopic procedures were used for the denominator in this study and not the 8 most common CPT codes. The most concerning conclusion from the Weber et al.[9] study was that only 26.3% of patients stated that they were pain free, whereas only 13.1% rated their function as normal.

Recently, multiple authors have reported outcomes of SLAP repairs as unpredictable, especially in older patients.[9,11,18] Provencher et al.[18] reviewed 179 patients who underwent repair for a type II SLAP tear. At a mean follow-up of 40.4 months, 37% were classified as a failure, and 28% underwent a revision. This study also found that the only risk factor that significantly increased a patient's risk of failure was age more than 36. Similarly, Boileau et al.[19] found that 60% of patients who underwent repair for a type II SLAP tear were disappointed because of persistent pain and only 20% were able to return to sports at their preinjury level. This was in comparison to a group of patients who underwent arthroscopic biceps tenodesis for a type II SLAP tear and showed a 93% satisfaction rate and an 87% return to the previous level of sport. Our study showed that the number of biceps tenodeses significantly increased over time, whereas that of SLAP repairs significantly decreased over time. Furthermore, the average age of patients undergoing SLAP repair significantly decreased over time to 26.1 ± 9.8 in 2014, whereas the average age of biceps tenodesis patients remained constant at almost 50 years. Although the indications for biceps tenodesis were multiple, 1 of these was a SLAP tear, specifically in older patients. Although patient outcomes were not assessed in this study, the authors have decreased the number of SLAP repairs and increased the number of biceps tenodeses because we feel patients more than 35 years of age who have SLAP repairs become more stiff and have more pain than those who undergo biceps tenodesis. In the majority of patients, there does not appear to be a clear indication to perform a SLAP repair over a biceps tenodesis, hence the trends seen in this study.

Although some argue that SLAP repairs restore arm function better than biceps tenodesis, Chalmers et al. proved this to be inaccurate. The authors evaluated 18 pitchers (7 uninjured controls, 6 after a SLAP repair, and 5 after a subpectoral biceps tenodesis) and found that pitchers who underwent a SLAP repair had altered patterns of thoracic rotation compared with the controls and pitchers who had undergone a biceps tenodesis.[20] Laughlin et al.[21] similarly found altered mechanics in 13 collegiate and professional pitchers who underwent SLAP repairs compared with a group of control pitchers. Furthermore, the results of SLAP repairs in nonoverhead throwing athletes have also been poor, especially in patients older than 40 years of age.[10,11] Hence, even in high-level athletes, biceps tenodesis is a reliable option compared with SLAP repair.

In a busy subspecialty-based, referral shoulder practice, SLAP repairs currently represent a little more than 6% of the authors' surgical practice compared with slightly less than 30% for biceps tenodeses. Because overtreatment of SLAP tears may result in increased complications such as stiffness, persistent pain, and need for revision surgery, these data may be helpful for comparative purposes regarding current indications for SLAP repair. Every patient should be treated on an individual basis, but the future treatment of SLAP tears will likely see an increase in biceps tenodesis and a decrease in SLAP repairs based on the outcomes reported in the literature and the high risk of failure and complications seen with SLAP repairs.

Limitations

The strengths of this study include the use of a database of more than 9,000 patients by 4 busy fellowship trained orthopaedic surgeons. The limitations of this study include the lack of outcome variables to determine if patients who underwent SLAP repairs performed better than those who underwent a debridement, although this was not the focus of this article. Unfortunately, the exact number of patients who underwent biceps tenodesis for a SLAP tear could not be reliably reported because of lack of description regarding the status of the biceps labral complex in some patients undergoing a biceps tenodesis. Although the dates of surgery were scrutinized to ensure multiple codes used for a single patient used on the same day were not counted as multiple surgeries, there is a possibility that some were counted twice. The most common shoulder CPT codes were chosen to create the denominator in determining the rate of SLAP repair versus other shoulder arthroscopic procedures. Because not all arthroscopic shoulder CPT codes were included, the actual rate of SLAP repair compared with all shoulder arthroscopies is likely lower.

Conclusions

Over the past 10 years, the total number of biceps tenodesis has increased, whereas the number and relative percentage of SLAP repairs within our practice have decreased. The average age of patients undergoing SLAP repair is decreasing, and most SLAP repairs are performed for type II SLAP tears.

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