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National Trends in the Repair of Isolated Superior Labral Tear from Anterior to Posterior in Korea

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Disclosure

The authors have no potential conflicts of
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Author Contributions

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ABSTRACT

Background: The optimal treatment for superior labral tear from anterior to posterior (SLAP) lesions is controversial. Thus, we aimed to investigate the national surgical trends in isolated SLAP repair in Korea.

Methods: We analyzed a nationwide database from the Korean Health Insurance Review and Assessment Service from 2008 to 2017. We investigated the trends in SLAP repair by time, sex, age, and the type of health care institution.

Results: From 2008 to 2017, 27,850 isolated SLAP repairs were identified. Age-adjusted incidence rate of isolated SLAP repair increased by 692% from 1.07/100,000 in 2008 to 8.48/100,000 in 2012 ($P = 0.005$). However, the incidence rate declined significantly after 2012 ($P = 0.032$) and was 5.28/100,000 in 2017. Sex-specific incidence rate of isolated SLAP repair was 2.3 times higher in men than in women. The decline since 2012 was most evident in patients aged ≥ 40 years ($P = 0.01$); however, the incidence rates of isolated SLAP repair during the study period were similar between patients aged ≥ 40 years and those aged < 40 years. Moreover, hospitals with 30–100 beds had the greatest change in the number of isolated SLAP repair cases.

Conclusion: In Korea, the incidence of isolated SLAP repair increased dramatically until 2012; since then, it has declined. Although the decrease in isolated SLAP repair later in the study was evident in those aged ≥ 40 years, the incidence rate was still relatively high in patients aged ≥ 40 years.

Keywords: Superior Labral Tear from Anterior to Posterior; Surgery; Trends; Epidemiology

INTRODUCTION

Superior labral tear from anterior to posterior (SLAP) lesions have been recognized as a cause of shoulder pain since the mid-1980s.¹ These lesions were classified into four types by Snyder et al.² Among the four types of SLAP lesions, type II SLAP could be treated by arthroscopic SLAP repair.³ Arthroscopic isolated SLAP repair could result in improved clinical outcomes in young patients with a history of a traumatic event.^{4,5} However, several studies have shown suboptimal outcomes after SLAP repair and an increasing risk of complications such as stiffness, chondral injuries, and need for revision surgery.^{6,7} Although patient age and prior

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level of function play important roles in guiding surgical management, the indication for isolated SLAP repair remains unclear.

Because of the lack of consensus regarding the optimal treatment of SLAP lesions, the trends in SLAP repair showed a changing pattern over time. In the United States, while the incidence of SLAP repair showed an increasing trend before 2010,^{8,9} a decreasing trend has been reported in more recent studies.^{10,11} In addition, although suboptimal outcomes and complications were reported for SLAP repair in older patients,^{12,13} the incidence of SLAP repair in patients aged ≥ 40 years was shown to be similar to that in younger, more active patients.⁹ Surprisingly, SLAP repair was performed in several patients aged > 80 years.⁸ Understanding the epidemiology is important for clarifying the indications of SLAP repair and educating orthopedic surgeons about the optimal treatment of SLAP lesions. Nevertheless, with the exception of the United States, few epidemiologic studies on SLAP repair exist worldwide.⁸⁻¹¹

Thus, this study aimed to investigate the national surgical trends in isolated SLAP repair in Korea by analyzing nationwide data acquired from the Korean Health Insurance Review and Assessment Service (HIRA) database. We examined the trends in SLAP repair by time, sex, age, and the type of healthcare institution. Our hypotheses were as follows. First, the incidence of SLAP repair would show a decreasing trend more recently in Korea. Second, the decreasing trend would be more evident in older patients.

METHODS

Data source

In this cross-sectional epidemiology study, the authors analyzed nationwide data obtained from the HIRA database. In Korea, the National Health Insurance covers 100% of the population, including 97% of health insurance and 3% of medical aid.¹⁴ All healthcare providers submit claims data for inpatient and outpatient management, including diagnostic codes (classified according to the International Classification of Diseases, 10th revision [ICD-10]), procedure codes, and demographic information, to the HIRA to request reimbursement for medical costs from the National Health Insurance service. Hence, medical data of almost all outpatients or hospitalized patients in Korea are prospectively recorded in the HIRA database.

Data collection

We studied patients who underwent isolated SLAP repair from 2008 to 2017. Although ICD-10 codes S434, M411, and S4610 could be used as diagnostic codes for SLAP lesion,¹⁴ there was no clear diagnostic ICD-10 code for isolated SLAP lesion during the study period. Therefore, identifying isolated SLAP repair using a diagnostic code was insufficient because other diagnostic codes were possibly entered in numerous isolated SLAP repair cases. Consequently, we identified patients who had isolated SLAP repair using procedure codes. In Korea, the operation code for isolated SLAP repair is N0935. However, N0935 was also entered for patients who received isolated acromioplasty or capsular release (**Table 1**). As a suture anchor is not used in both isolated acromioplasty and capsular release, the authors excluded patients who had isolated acromioplasty and capsular release by identifying patients with the code N0935 and the suture anchor code (D0301–D0303) (**Table 1**). Subsequently, among the remaining patients, we further excluded those with the procedure code for biceps tenodesis (N0941, N0942, N0931), thereby ultimately identifying the patients who received isolated SLAP repair.

Table 1. Procedure codes used in the analysis

Parameters	Code	Description
Operation code	N0935	Isolated acromioplasty Isolated SLAP repair Capsular release
	N0936–N0938	Repair of ruptured rotator cuff with or without acromioplasty Anterior or posterior labral repair Capsular plication
	D0301–D303	Suture anchor

SLAP = superior labral tear from anterior to posterior.

We examined the patient data to identify the year of surgery, age, sex, and type of healthcare institution. In Korea, health care institutions are classified as clinics, hospitals, general hospitals, and tertiary hospitals. The classification criteria are based on inpatient bed size for clinics (< 30 beds), hospitals (30 to < 100 beds), and general hospitals (\geq 100 beds), and tertiary hospitals are defined as general hospitals that are approved to provide most types of advanced medical care and treat severely ill patients with a minimum of 20 departments.¹⁴ We investigated the trends in age-adjusted and sex-specific incidence rates of isolated SLAP repair by year. Because a systematic review of SLAP repair included several studies that reported higher failure and complication rates in patients aged \geq 40 years,⁷ we also examined such trends by dividing the patients into two groups according to age, i.e., \geq 40 years and < 40 years. Lastly, we examined the trends in isolated SLAP repair by the type of healthcare institution.

Statistical analysis

We calculated age-adjusted and sex-specific incidence rates per 100,000 persons with isolated SLAP repair using the 2010 United States population as the standard population.¹⁵ Estimated year-specific, age-specific, and sex-specific populations were obtained from the Statistics Korea website (<http://www.kosis.kr>). The annual percentage changes (APCs) in the age-adjusted incidence rates of isolated SLAP repair from 2008 to 2017 were calculated using joinpoint regression analysis (Joinpoint Regression Program, version 4.3.1.0; National Cancer Institute, Bethesda, MD, USA).^{14,16} All other data sets were analyzed using SAS statistical software version 9.13 (SAS Institute, Cary, NC, USA). Univariate analysis was conducted using *t*-test. Statistical significance was set at $P < 0.05$.

Ethics statement

The study protocol was exempted for review by the Institutional Review Board of the Hanyang University Hospital (HYUH 2018-05-022) in accordance with the exemption criteria.

RESULTS

From 2008 to 2017, 27,850 isolated SLAP repairs (27,324 patients) were performed in Korea. The number of isolated SLAP repair cases increased greatly from 486 in 2008 to 4,165 in 2012. However, a decreasing trend was noted since 2012; the number decreased to 2,540 in 2017. Similarly, age-adjusted incidence rate of isolated SLAP repair increased by 692% from 1.07/100,000 in 2008 to 8.48/100,000 in 2012, which decreased to 5.28/100,000 in 2017 (Table 2 and Fig. 1). Joinpoint regression analysis revealed a transition of APC of age-adjusted incidence rate around the year 2012. The mean APC from 2008 to 2012 was 46.8% (95% confidence interval [CI], 19.3%, 79.6%), which was statistically significant with the incidence of isolated SLAP repair increasing each year ($P = 0.005$), whereas that from 2012 to 2017 was -10.1% (95% CI, -18.1%, -1.3%), which was significant with the incidence decreasing ($P = 0.032$).

Table 2. Number of cases and age-adjusted rates (per 100,000 persons) of isolated SLAP repair from 2008 to 2017

Years	No. of cases			Age-adjusted incidence rates ^a		
	Total	Men	Women	Total	Men	Women
2008	486	355	131	1.07	1.52	0.59
2009	1,503	1,090	413	3.15	4.46	1.74
2010	2,369	1,660	709	4.87	6.66	2.93
2011	3,063	2,124	939	6.24	8.49	3.82
2012	3,990	2,677	1,313	8.48	11.56	5.16
2013	4,165	2,896	1,269	8.12	10.74	5.27
2014	3,625	2,560	1,065	7.38	10.28	4.23
2015	3,352	2,361	991	6.90	9.62	3.93
2016	2,757	1,940	817	5.72	7.99	3.24
2017	2,540	1,767	773	5.28	7.33	3.05
Overall	27,850	19,430	8,420	-	-	-

SLAP = superior labral tear from anterior to posterior.

^aUnited States population in 2010 as the control.

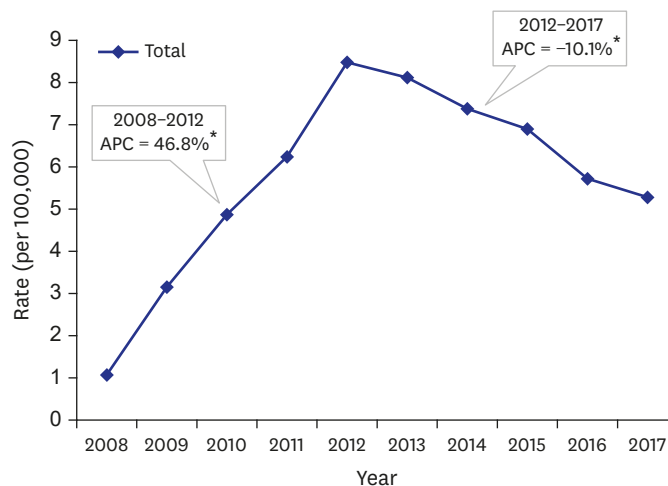


Fig. 1. Age-adjusted incidence rates per 100,000 persons of isolated SLAP repair. SLAP = superior labral tear from anterior to posterior, APC = annual percentage change. **P* < 0.05.

Of the overall cohort, 19,430 (69.8%) and 8,420 (30.2%) were men and women, respectively. Sex-specific age-adjusted incidence rate was 2.32 times higher in men than in women; however, both groups showed similar increasing trends until 2012 and decreasing trends thereafter (Fig. 2). The mean age of the patients who underwent SLAP repair was 40.0 ± 12.9 years. The mean age for men was significantly lower (37.2 ± 12.9 years) than that for women (46.4 ± 10.3 years) (*P* < 0.001). Moreover, in men, the age group-specific incidence rate was highest in the 30–39 year age group (12.32/100,000), which was followed by the 40–49 year age group (11.97/100,000) and the 20–29 year age group (9.39/100,000) (Fig. 3). The age group-specific incidence in women was highest in the 40–49 year age group (8.87/100,000), which was followed by the 50–59 year age group (5.86/100,000) and the 30–39 year age group (3.16/100,000) (Fig. 3).

Among patients aged ≥ 40 years, the incidence of isolated SLAP repair increased significantly from 2008 to 2012 (APC, 48.7%; 95% CI, 23.4%, 79.1%; *P* = 0.003) and declined significantly after 2012 (APC, -11.5%; 95% CI, -18.5%, -3.9%; *P* = 0.01) (Fig. 4). Among patients aged < 40 years, the incidence of isolated SLAP repair increased significantly from 2008 to 2012 (APC, 44.6%; 95% CI, 13.6%, 84.0%; *P* = 0.01) and decreased slightly after 2012; however, the decrease was not statistically significant (APC, -8.5%; 95% CI, -18.1%, 2.4%; *P* = 0.10) (Fig. 4).

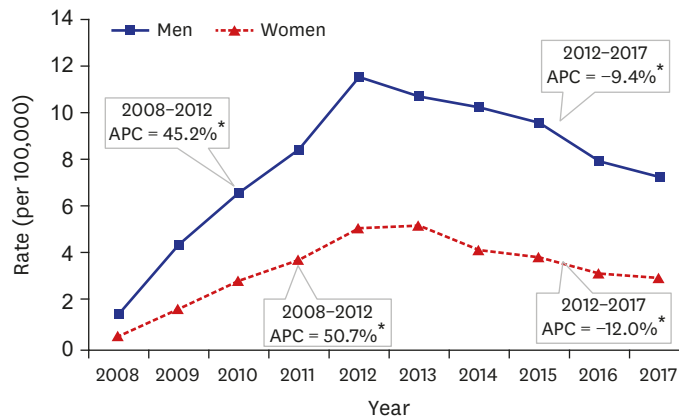


Fig. 2. Sex-specific age-adjusted incidence rates per 100,000 persons of isolated SLAP repair. SLAP = superior labral tear from anterior to posterior, APC = annual percentage change. * $P < 0.05$.

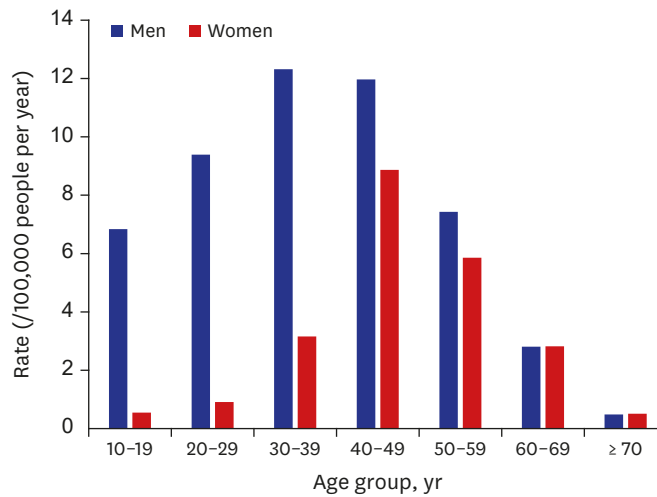


Fig. 3. Sex-specific incidence rates per 100,000 persons of isolated SLAP repair by age group from 2008 to 2017. SLAP = superior labral tear from anterior to posterior.

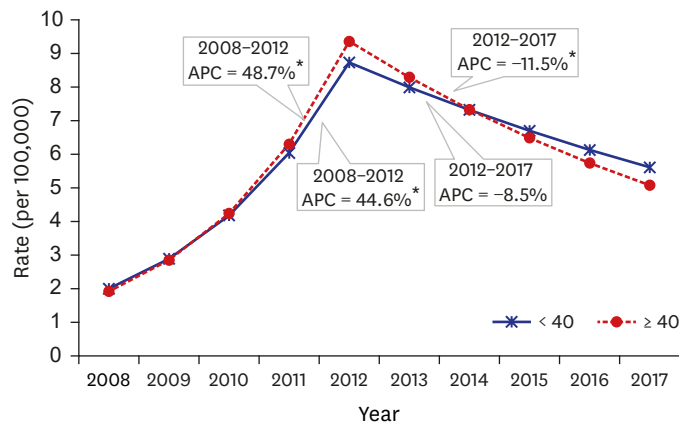


Fig. 4. Incidence of isolated SLAP repair in the < 40 years and ≥ 40 years age groups. SLAP = superior labral tear from anterior to posterior, APC = annual percentage change. * $P < 0.05$.

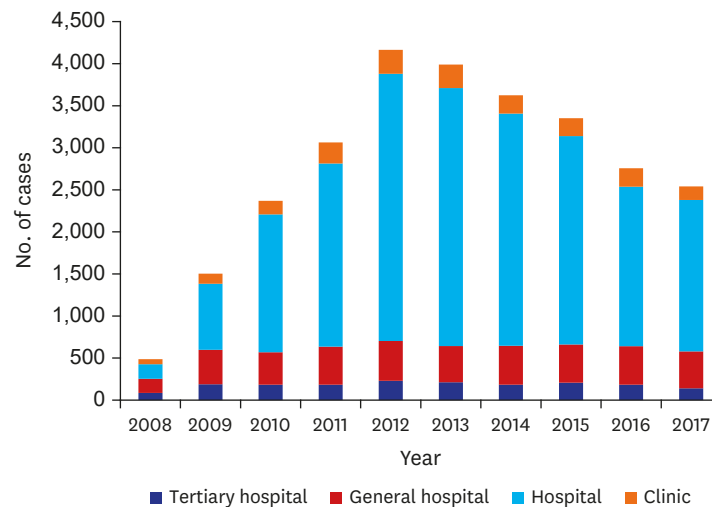


Fig. 5. Total isolated SLAP repair cases according to the type of healthcare institution from 2008 to 2017. SLAP = superior labral tear from anterior to posterior.

Furthermore, the incidence of isolated SLAP repair increased from 2008 to 2012 in all healthcare institutions and showed a decreasing trend since 2012 (Fig. 5). The rate of change was greatest in hospitals with 30-100 beds, with the number of surgeries increasing by 18.5-fold, i.e., from 172 cases in 2008 to 3,178 cases in 2012, but decreasing to 1,800 cases in 2017. The average age of patients by type of healthcare institution was highest in hospitals with 30-100 beds (40.8 years), which was followed by general hospitals (40.4 years), clinics (38.0 years), and tertiary hospitals (36.9 years).

DISCUSSION

This study evaluated the trends in isolated SLAP repair in Korea over the past 10 years. Interestingly, there was a sharp growth during the first half of the study period but a decrease in the later half. The decreasing trend in the later half was particularly evident in patients aged ≥ 40 years. Although both men and women showed a similar trend, i.e., an initial increase followed by a decrease, a discrepancy between sexes in the most affected age groups was observed. Moreover, trends according to the type of healthcare institution showed a rapid increase in the incidence of isolated SLAP repair, especially in hospitals with 30–100 beds; however, a sharp decline in the past 5 years was found.

Controversies regarding the optimal treatment of SLAP lesions still exist. Several authors reported a significant improvement in functional capacity and pain relief after isolated SLAP repair.^{4,5,17} The initial increase in the incidence of SLAP repair may be attributed to advances in imaging technologies and the development of arthroscopic surgical techniques and instruments.¹⁸ Nonetheless, more recent studies reported persistent pain, stiffness, chondral injuries, and low rates of return to sports after SLAP repair.^{6,19-21} In 2009, Boileau et al.²² reported for the first time that a greater proportion of patients after biceps tenodesis were satisfied than after SLAP repair in a heterogeneous population. Recent studies showed that proportion of patients managed with biceps tenodesis has increased in frequency, whereas SLAP repair has decreased in frequency.^{10,11} Furthermore, satisfactory clinical outcomes have been reported for non-operative intervention as the primary treatment of SLAP lesions.^{23,24}

Because biceps tenodesis and non-operative intervention have gained popularity for the management of SLAP lesions, the incidence of SLAP repair in Korea is believed to have decreased since 2012. An increasing frequency of SLAP repairs was also reported in the United States before 2010^{6,8,9}; however, a decreasing trend was noted in more recent studies.^{10,11,25}

Several studies showed no significant difference in clinical outcomes after a SLAP repair between patients older than 40 years and those younger than 40 years.^{26,27} However, using a systematic review, Erickson et al.⁷ reported that decreased patient satisfaction and increasing complications including stiffness and reoperations, occur at higher rates as the patient age increases in patients aged 40 and over. Provencher et al.¹² also reported that old age is associated with a higher chance of failure after SLAP repairs. These findings contributed to the significant decreasing trend in isolated SLAP repair in patients aged ≥ 40 years after 2012.

Consistent with other studies, this study also showed that men had more than twice the incidence of isolated SLAP repair than women.^{8,9} Moreover, the average age of men at the time of SLAP repair was considerably lower than that of women. This difference may be attributed to the large number of SLAP tears related to sports activities in young men.^{28,29} However, the incidence of SLAP repair in patients aged ≥ 40 years was similar to that of patients aged < 40 years in this study (**Fig. 4**), which indicates a relatively higher number of SLAP repairs in older populations than the authors expected. These results could be observed not only in Korea but also in the United States.⁹ For the management of SLAP tear, SLAP repair is preferred for younger patients, while biceps tenodesis or tenotomy is preferred for older patients.²⁵ Franceschi et al.³⁰ stated that SLAP repair has no advantage in patients over the age of 50 years with rotator cuff tear and that rotator cuff repair with biceps tenotomy showed better clinical outcomes. In addition, SLAP repair in older patients may cause complications, including stiffness, persistent pain, and need for revision surgery. Therefore, proper education about the surgical indications for SLAP lesions is necessary.

This study demonstrated that the incidence of SLAP repairs, especially in hospitals with 30–100 beds, increased greatly but subsequently declined (**Fig. 5**). The number of healthcare institutions performing shoulder surgeries in Korea has increased dramatically especially in hospitals with 30–100 beds.¹⁴ Most rotator cuff surgeries in Korea were performed by arthroscopy, and many of these operations were performed in relatively small hospitals such as hospitals with 30–100 beds because of low morbidity and mortality.¹⁴ Similarly, the majority of SLAP repairs were performed by arthroscopy; thus, they are often performed in small hospitals. However, the authors are concerned about the fact that the average age is highest for patients at hospitals with 30–100 beds where SLAP repairs are performed most frequently. Careful attention must be paid to overtreatment of SLAP lesions in older patients.

While this study has the advantages of using a large sample size, using a nationwide database, and analyzing trends over 10 years, several limitations exist. First, an exclusive surgical code for SLAP repair does not exist in Korea. Isolated acromioplasty, isolated SLAP repair, and capsular release are all included in a single code: N0935 (**Table 1**). However, as both isolated acromioplasty and capsular release does not use a suture anchor, we were able to identify isolated SLAP repair cases. Second, although it was possible to identify patients treated with isolated SLAP repair, those who received another procedure concurrently with SLAP repair were not identified. In Korea, a higher operation code (N0936–N0938) is entered for patients who are treated with a rotator cuff repair or an anterior labral repair simultaneously with SLAP repair. Thus, this study was only able to analyze the trend in

isolated SLAP repairs. Third, HIRA data did not include any information about the clinical outcomes of SLAP repair. Consequently, we were not able to investigate how the increases or decreases in SLAP repair correlate with the clinical outcomes of SLAP repair. Lastly, some code errors in a large database are possible.

The incidence of SLAP repair in Korea increased dramatically until 2012; since then, the incidence has declined. The decreasing trend was especially evident in patients aged ≥ 40 years; however, the incidence rate remained relatively high in patients aged ≥ 40 years. In addition, with the high frequency of SLAP repairs in small hospitals and the relatively old age of patients, the optimal surgical indications for SLAP repair need to be established.

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