

# Complications Related to Latarjet Shoulder Stabilization

## A Systematic Review

Chul-Hyun Cho,\* MD, Sang Soo Na,\* MD, Byung-Chan Choi,\* MD, and Du-Han Kim,\*<sup>†</sup> MD

*Investigation performed at Keimyung University School of Medicine, Daegu, Republic of Korea*

**Background:** In cases of recurrent anterior shoulder instability with a glenoid defect, Latarjet procedures are widely used for stabilization. Although complications with this procedure have been reported, few studies have comprehensively analyzed issues related to the Latarjet procedure.

**Purpose:** To identify the overall complication rate of the Latarjet procedure used for anterior shoulder instability and to compare the rate of complications between arthroscopic and open approaches.

**Study Design:** Systematic review; Level of evidence, 4.

**Methods:** PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed by using the PubMed, EMBASE, Scopus, and Cochrane Library databases. Data on complications were extracted and classified as intraoperative, postoperative, or instability-related for further analysis. Quality assessments were performed with criteria from the Methodological Index for Nonrandomized Studies (MINORS). A quantitative synthesis of data was conducted to compare the complication rates between arthroscopic and open approaches.

**Results:** A total of 35 articles were included in this analysis. The MINORS score was 11.89. A total 2560 Latarjet procedures (2532 patients) were included. The overall complication rate was 16.1% ( $n = 412$ ). The intraoperative complication rate was 3.4% ( $n = 87$ ) and included a 1.9% ( $n = 48$ ) incidence of nerve injuries and a 1.0% ( $n = 25$ ) incidence of iatrogenic fractures. Screw problems, vascular injuries, and conversion arthroscopic to open surgery each occurred at a rate of  $<1\%$ . The postoperative complication rate was 6.5% ( $n = 166$ ), and the most common complication was nonunion (1.3%;  $n = 33$ ). The instability-related complication rate was 6.2% ( $n = 159$ ) and included a 1.5% ( $n = 38$ ) rate of redislocation, a 2.9% ( $n = 75$ ) rate of positive apprehension test, and a 1.0% ( $n = 26$ ) rate of instability. Overall, 2.6% ( $n = 66$ ) of patients required an unplanned secondary operation after the initial surgery. The arthroscopic approach was associated with a higher rate of intraoperative complications compared with the open approach (5.0% vs 2.9%;  $P = .020$ ) and a lower rate of instability-related complications (3.1% vs 7.2%;  $P < .001$ ).

**Conclusion:** The Latarjet procedure for anterior shoulder instability results in an overall complication rate of 16.1% and a reoperation rate of 2.6%. However, serious complications at short-term follow-up appear rare. When the arthroscopic approach was used, the rate of intraoperative complications was higher, although instability-related complications were lower when compared with the open approach.

**Keywords:** Latarjet; complication; instability; dislocation; stabilization; shoulder

<sup>†</sup>Address correspondence to Du-Han Kim, MD, Department of Orthopedic Surgery, Keimyung University Dongsan Hospital, Keimyung University School of Medicine, 1035 Dalgubul-ro, Dalseo-gu, Daegu, 42601, Republic of Korea (email: osmdkdh@gmail.com).

\*Department of Orthopedic Surgery, Keimyung University Dongsan Hospital, Keimyung University School of Medicine, Daegu, Republic of Korea.

Submitted February 20, 2021; accepted May 17, 2021.

The authors declared that they have no conflicts of interest in the authorship and publication of this contribution. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Arthroscopic Bankart repair is widely performed in cases of primary shoulder anterior dislocation; however, repair of soft tissue alone in shoulders with a bony glenoid or humeral defect can lead to poor outcomes.<sup>9,12,39,52</sup> Various procedures emphasizing glenoid reconstruction have become the standard treatments for patients with recurrent anterior shoulder instability associated with a bony defect.<sup>34,41,53</sup> Among them, the use of bone-block augmentation, including the Latarjet procedure, has increased over the past 2 decades. From 2004 to 2013, the percentage of shoulder stabilization cases that used bone-block augmentation surgery increased 10-fold from 0.14% to 1.4%.<sup>22</sup>

In 1954, Latarjet described a coracoid bone-block technique in which the horizontal limb of the coracoid process was fixed to the anteroinferior margin of the glenoid with

a screw.<sup>47,54</sup> The procedure has traditionally been performed via an open approach; however, several authors have recently advocated performing it arthroscopically and have reported positive results.<sup>36,44-46,50</sup> The Latarjet procedure is commonly used in cases with large glenoid bone loss (>20% of the glenoid surface) and significant risk factors for recurrence, such as contact sports at a competitive level or failed previous stabilization surgery.<sup>6,13</sup> Importantly, this procedure has been relatively successful in preventing recurrent dislocation and instability.<sup>28,35</sup>

Latarjet procedures have a unique set of intraoperative or postoperative complications, including hardware problems, graft fracture, nonunion, and neurovascular injury.<sup>34,37</sup> In a systematic review of 1904 shoulders, Grieser et al<sup>34</sup> found that 30% of patients had complications, including recurrent instability, after the Latarjet procedure. Hurley et al<sup>37</sup> reported that the Latarjet procedure resulted in excellent functional long-term outcomes and a high rate of return to sport. Notably, no study has comprehensively analyzed complications after the Latarjet procedure, and little is known regarding a comparison of the arthroscopic and open approach methods. The purpose of the current study was to identify the overall complication rate of the Latarjet procedure for anterior shoulder instability and to compare the rate of complications between the arthroscopic and open approach. We hypothesized that the Latarjet procedure would be a successful technique for the treatment of shoulder instability but would be associated with a risk of intraoperative, postoperative, and instability-related complications.

## METHODS

### Search Strategy

A systematic review was conducted according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. An extensive literature search was conducted on April 2, 2020, in PubMed, EMBASE, Scopus, and Cochrane Library databases. Using a Boolean strategy, the following field search terms were used: Search (((Latarjet) OR (shoulder stabilization)) OR (coracoid transfer)) AND (outcome)) OR (complication). The citations in the included studies were screened, and unpublished articles were reviewed by conducting a manual search. The bibliographies of the relevant articles were subsequently cross-checked for articles that were not identified in the search.

### Eligibility Criteria

Studies that met the following criteria were included: (1) written in English, (2) full-text available, and (3) clinical studies of the arthroscopic or open Latarjet procedure. Exclusion criteria were as follows: (1) no information on the specific complications, (2) no mention of approach or surgical technique, and (3) review articles, technical notes, case reports, or biomechanical studies.

### Study Selection

Two reviewers (S.S.N., D.-H.K.) independently reviewed studies returned from the initial database search. When a decision could not be reached for an article, it was submitted to a third blinded author for review and final decision. Throughout the search, the content of each article and its reference list were screened for overlap of patients from other studies.

### Method of Review and Data Extraction

Complete versions of selected publications were reviewed, and data were extracted by 2 authors with a focus on patient demographic data (the number of shoulders, mean age, sex ratio, mean duration of follow-up, dominant extremity), surgical approaches (arthroscopy or open), complications (intraoperative, postoperative, and instability-related), and reoperation.

### Quality Assessment

The level of evidence was evaluated based on guidelines set by the Oxford Centre for Evidence-Based Medicine. The methodological quality of the articles included in this meta-analysis was assessed using criteria from the Methodological Index for Nonrandomized Studies (MINORS), a validated tool to discern the methodological quality of nonrandomized studies. The highest possible score is 16 for noncomparative studies and 24 for comparative studies.<sup>60</sup> Two authors independently applied the MINORS, and a final score was reached by consensus.

### Reporting of Complications

Complications were categorized as intraoperative, postoperative, or instability related. Our review included nerve injury, vascular injury, fracture, screw problem, and conversion to open approach as intraoperative complications. Nonunion, infection, bone resorption, screw problem (backing out, bending, breakage), wound problem, stiffness, bone-block migration, pseudoarthrosis, and avascular necrosis were included as postoperative complications. Redislocation, positive apprehensive test, subluxation, and instability were included as instability-related complications.

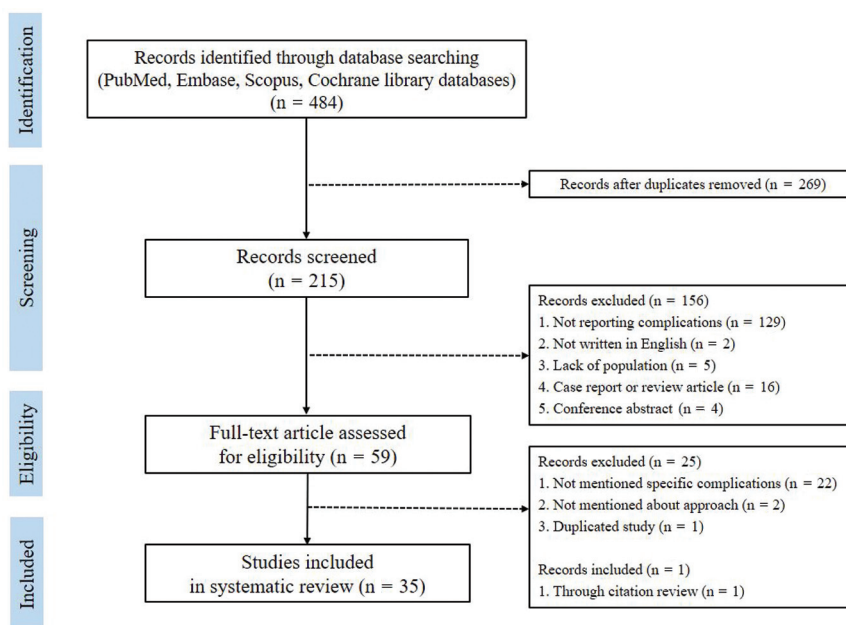
### Statistical Methods

Endnote (version 9.0; Clarivate Analytics) was used to manage data, and analysis was done with SPSS (Version 24.0; IBM). The Fisher exact test was performed to assess the statistical significance between the arthroscopic and open groups. A *P* value of <.05 was considered statistically significant.

## RESULTS

### Search Results

The primary search yielded 484 articles. After screening for duplicates, 269 articles were excluded. A further 156



**Figure 1.** Preferred reporting items for systematic meta-analyses flow diagram.

articles were excluded after screening abstracts according to the exclusion criteria, and 59 full-text articles were retrieved and assessed for eligibility. Of these, 34 articles were deemed suitable for inclusion, and 1 additional study was identified after a review of the references in the included articles, resulting in 35 suitable studies for inclusion in the final systemic review (Figure 1).<sup>‡</sup> Included studies scored a mean  $11.9 \pm 2.7$  (range, 10-18) using the MINORS criteria.

### Demographic Data

In total, 2560 Latarjet procedures performed in 2532 patients were reported in the systematic review. Bilateral Latarjet procedures were performed in 28 patients. The mean age of patients was 28.0 years, and the mean follow-up period was  $48.2 \pm 44.3$  months (Table 1).

### Overall Complications

The overall complication rate was 16.1% ( $n = 412/2560$ ). The intraoperative complication rate was 3.4% ( $n = 87$ ), the postoperative complication rate was 6.5% ( $n = 166$ ), and the instability-related complication rate was 6.2% ( $n = 159$ ).

### Intraoperative Complications

Nerve injury was the most common intraoperative complication, at a rate of 1.9% ( $n = 48$ ). Of the nerve injuries that occurred, 19 involved injury to the axillary nerve. There were 18 musculocutaneous nerve injuries, 6 suprascapular

**TABLE 1**  
Patient Data

	Value
Procedures, n	2560
Age, y, mean (range)	28.0 (15.7-37.2)
Sex, n (%)	
Male	1725 (81.9)
Female	381 (18.1)
Follow-up, mo, mean $\pm$ SD	$48.2 \pm 44.3$
Dominant extremity, n (%)	856 (33.4)
Surgical approach, n (%)	
Arthroscopy	606 (23.7)
Open	1954 (76.3)

nerve injuries, 2 radial nerve injuries, 1 ulnar nerve injury, and 2 unspecified nerve injuries. In most cases, the nerve symptom was transient ( $n = 35$ ) or recovered after nerve decompression or neurolysis ( $n = 4$ ). In total, 4 of the 48 nerve injuries remained permanent, all of which were axillary nerve injuries. The rate of intraoperative fracture was 1.0% ( $n = 25$ ), most of which were bone-block coracoid fractures ( $n = 24/25$ ; 96.0%), and only 1 case was a glenoid fracture. Hardware problems, vascular injury, and conversion to an open approach occurred at a rate of <1% each.

### Postoperative Complications

The postoperative complication rate was 6.5% ( $n = 166$ ). The most common complication was nonunion (1.3%;  $n = 33$ ). Infection occurred at a rate of 1.2% ( $n = 30$ ) in 17 studies, and graft resorption was 0.8% in 7 studies ( $n = 21$ ). Other complications included hardware problems, wound problems, postoperative stiffness, bone-block migration, pseudoarthrosis, and avascular necrosis (Table 2).

<sup>‡</sup>References 1-5, 7, 10, 11, 14, 16-21, 24-31, 33, 40, 43, 49, 51, 56-59, 61, 63, 64.

TABLE 2  
Intraoperative and Postoperative Complication  
Rates After the Latarjet Procedure

Complication	n	%
Intraoperative		
Nerve injury	48	1.9
Fracture	25	1.0
Hardware problem	7	0.3
Conversion to open approach	6	0.2
Vascular injury	1	0.0
Total intraoperative complications	87	3.4
Postoperative		
Nonunion/fibrous union	33	1.3
Infection	30	1.2
Bone resorption	21	0.8
Hardware problem	19	0.7
Wound problem	18	0.7
Stiffness	16	0.6
Bone-block migration	15	0.6
Pseudoarthrosis	13	0.5
Avascular necrosis	1	0.0
Total postoperative complications	166	6.5

### Instability-Related Complications

The instability-related complication rate was 6.2% (n = 159). Positive apprehensive test and recurrent dislocation rates were 2.9% (n = 75) and 1.5% (n = 38), respectively. Instability and subluxation rates were 1.0% (n = 26) and 0.8% (n = 20). A total of 2.6% (n = 66) of procedures resulted in an unplanned reoperation after the Latarjet procedure (Table 3).

### Subgroup Analysis (Arthroscopic vs Open Approach)

In a comparison of arthroscopic versus open approach techniques, 23.7% (n = 606) of procedures entailed an arthroscopic approach, whereas 76.3% (n = 1954) of procedures used an open deltopectoral approach. The overall complication rate was lower with the arthroscopic approach versus the open approach (13.9%, n = 84/606 vs 16.8%, n = 328/1954, respectively;  $P = .088$ ).

The total intraoperative complication rate was statistically significantly higher after the arthroscopic approach versus the open approach (5.0%, n = 30 vs 2.9%, n = 57, respectively;  $P = .020$ ). Nerve injury was significantly higher with the open approach versus the arthroscopic approach (2.6%, n = 44 vs 0.6%, n = 4, respectively;  $P = .009$ ), and the intraoperative fracture rate was significantly higher after the arthroscopic approach (2.5%, n = 15 vs 0.5%, n = 10;  $P < .001$ ).

No significant difference was seen between the groups regarding the rate of total postoperative complications. However, the rates of hardware problems and bone-block migration were significantly higher after the arthroscopic approach ( $P = .005$  and  $P = .002$ , respectively), and bone resorption was higher after the open approach ( $P = .039$ ).

The instability-related complication rate was significantly lower after the arthroscopic approach (3.1%; n = 19)

TABLE 3  
Instability-Related and Total Complication  
Rates After the Latarjet Procedure

Complication	n	%
Instability-related		
Positive apprehensive test	75	2.9
Recurrent dislocation	38	1.5
Instability	26	1.0
Subluxation	20	0.8
Total instability-related complications	159	6.2
Total complications	412	16.1
Reoperations	66	2.6

compared with the open approach (7.2%; n = 140;  $P < .001$ ). Among these complications, the rate of positive apprehensive test was significantly higher after the open approach versus the arthroscopic approach (3.7%, n = 73 vs 0.3%, n = 2, respectively;  $P < .001$ ) (Table 4).

### DISCUSSION

The primary aim of the current study was to provide a comprehensive, evidence-based summation of complication rates after the Latarjet procedure. For the 2560 procedures included, the overall complication rate was 16% and the reoperation rate was 2.6%. Previous authors have reported similar overall complication rates. Hurley et al<sup>37</sup> systematically reviewed studies to ascertain the clinical outcomes after the open Latarjet procedure with a minimum of 10 years of follow-up. The review found high patient-reported functional outcome scores after the Latarjet procedure, with 86% of patients achieving good to excellent outcomes and >90% satisfied with the procedure at an average of 16 years after surgery. Moreover, the recurrent instability rate was 8.5%, and the revision rate was 3.7%. There were arthritic changes in 38.2% of patients and residual shoulder pain in 35.7%. Long-term results such as arthritis or residual pain were reported, but this study did not report specifically on the breakdown of when the complications occurred. In another systematic review, Griesser et al<sup>34</sup> analyzed 45 studies that included 1904 shoulders (all level 4 studies), reporting outcomes with complication and reoperation rates after original or modified versions of the Bristow or Latarjet shoulder stabilization procedures. The total complication rate was 30%, and the reoperation rate was 7%.

Although the Latarjet procedure has been relatively successful for preventing recurrent dislocation, particularly in patients with large glenoid bone loss, an arthroscopic Bankart repair with remplissage procedure is a good alternative for patients with a large engaging Hill-Sachs lesion without significant glenoid bone loss (glenoid deficit <25%).<sup>17</sup> Arthroscopic remplissage procedures traditionally consist of infraspinatus tenodesis and posterior capsulodesis to fill the humeral head defect in addition to an arthroscopic Bankart repair.<sup>17</sup> Although various studies reported that this combined procedure demonstrated good clinical results, the technique has the



TABLE 4  
Complications of the Latarjet Procedure by Surgical Approaches<sup>a</sup>

Complications	Arthroscopic (n = 606)	Open (n = 1954)	P Value
Intraoperative			
Nerve injury	4	44	.0094 <sup>b</sup>
Fracture	15	10	.0001 <sup>b</sup>
Hardware problem	4	3	.0587
Vascular injury	1	0	.2367
Conversion to open approach	6	—	
Total intraoperative complications, n (%)	30 (5.0)	57 (2.9)	.0204 <sup>b</sup>
Postoperative			
Nonunion/fibrous union	3	30	.0609
Infection	3	27	.0850
Bone resorption	1	20	.0391 <sup>b</sup>
Hardware problem	10	9	.0057 <sup>b</sup>
Wound problem	2	16	.2734
Stiffness	6	10	.2340
Bone-block migration	9	6	.0027 <sup>b</sup>
Pseudoarthrosis	1	12	.3228
Avascular necrosis	0	1	1.000
Total postoperative complications, n (%)	35 (5.8)	131 (7.2)	.4511
Instability related			
Positive apprehensive test	2	73	.0001 <sup>b</sup>
Recurrent dislocation	5	33	.1761
Instability	10	16	.1007
Subluxation	2	18	.1910
Total instability-related complications, n (%)	19 (3.1)	140 (7.2)	.0002 <sup>b</sup>
Total complications, n (%)	84 (13.9)	328 (16.8)	.0490 <sup>b</sup>

<sup>a</sup>Values are expressed as number of complications unless otherwise noted.

<sup>b</sup>Statistical significance.

characteristics of the tenodesis and posterior capsulodesis. It may induce changes in shoulder biomechanics, including changes to the external rotation of motion and muscle strength.<sup>17,42,48,55</sup>

The open Latarjet procedure has proven to be successful in restoring shoulder stability. However, the arthroscopic procedure offers several advantages and has become increasingly more common.<sup>45</sup> The benefits of the arthroscopic approach include more accurate positioning of the graft, faster rehabilitation, better cosmesis, and lower risk of shoulder stiffness.<sup>45</sup> However, the arthroscopic technique is more challenging to master and standardize compared with the open approach, even for the most experienced arthroscopic surgeon. Cunningham et al<sup>19</sup> reported that although outcomes and patient satisfaction seem to be the same in both approaches, complications such as screw problems or recurrence remained higher with the arthroscopic approach due to the long learning curve. Those investigators concluded that 10 arthroscopic Latarjet procedures were needed to overcome the need for conversion and 20 to achieve operating time equivalent to the open technique. Bonneville et al<sup>10</sup> similarly emphasized the extended learning curve of the arthroscopic procedure, noting that operative time improved with surgical experience and was optimized after 30 cases. Zhu et al<sup>64</sup> conducted a comparative study that compared clinical and radiological outcomes between open (n = 44) and arthroscopic (n = 46) Latarjet procedures, finding that both procedures were effective for

the treatment of recurrent shoulder dislocation at >2 years of follow-up. The open group had a better position in the superior-inferior direction compared with the arthroscopic group, although the arthroscopic group showed significantly less coracoid graft resorption. In terms of complications, Hurley et al<sup>38</sup> reported that the 90-day short-term complication and readmission profile of the arthroscopic Latarjet was similar to that of the open Latarjet procedure.

In their systematic review, Griesser et al<sup>34</sup> reported that the reoperation rate was significantly lower after the all-arthroscopic approach (7.5% vs 2.7%;  $P = .017$ ), although the mean loss of external rotation was significantly greater (16.0° vs 11.7°;  $P = .001$ ). In the current study, although the rate of total complications did not differ significantly between the two groups, the instability-related complications were significantly higher after the open approach. This may be a result of experience, as the arthroscopic approach was carried out by expert surgeons who have performed the Latarjet procedure in many cases using the open procedure. Additionally, the arthroscopic approach could minimize soft tissue damage. In a meta-analysis analyzing the arthroscopic Latarjet-Bristow procedure, Cerciello et al<sup>15</sup> found that the imaging complication rate (lysis or nonunion) was 14.7%, whereas the clinical and surgical complication rate was 15.1%; the recurrence rate, 2.6%; and the reoperation rate, 6.3%.

Presently, the standard fixation method uses metallic screws. However, hardware-related complications,

including rotator cuff irritation, graft loosening, fracture, or nonunion, are often reported.<sup>34</sup> For these reasons, use of the suture-button is increasing. In contrast with screw fixation, the suture-button technique provides flexible fixation, which allows for graft displacement. Minimal displacement occurs when grafts experience impingement produced by the humeral head, which may be minimal with arthropathy.<sup>63</sup> Boileau et al<sup>8</sup> evaluated their suture-button technique in 136 patients, noting a bone-block healing rate of 95%, accurate positioning of the coracoid graft (95% axial, 92% sagittal), a 3% recurrence rate, and a 2.5% revision rate. There were no neurologic complications and no hardware-related complications. Xu et al<sup>62</sup> modified their technique to use only 3 portals and fixed the bone grafts through special procedures in which an antirotation design was added. They reported the outcome was satisfactory after the suture-button Latarjet procedure, although absorption of the graft occurred on edge and outside the “best-fit” circle of the glenoid. However, the strength of fixation could be debated. In the study by Boileau et al,<sup>8</sup> the fibrous union rate was 9%. Xu et al<sup>62</sup> reported that 3 high-strength sutures in the proximal tunnel of the bone block were passed into the tunnel of the glenoid for sufficient fixation, and they achieved bone union in all cases.

Of all complications, nerve injury is one of the most severe. The overall nerve injury rate was 1.9% (48/2560; range, 0%-18.4%) in the current study. There is concern that the nonanatomic transfer of the coracoid alters the anatomic structure of the surrounding nerves.<sup>32</sup> It was shown in a cadaveric study that the Latarjet procedure resulted in a significant alteration of the anatomic relationships of the axillary and musculocutaneous nerves.<sup>32</sup> According to an intraoperative neuromonitoring study, these nerves are at risk during glenoid exposure and graft insertion.<sup>23</sup> A previous systematic review concluded that this procedure has a 1.8% rate of neurovascular complication and that the musculocutaneous nerve was the most common nerve injury reported (0.6%).<sup>34</sup> Woodmass et al<sup>61</sup> proposed that a nerve stretch-reduction protocol, which was a modification of the surgical technique, could reduce the incidence of nerve injury during the Latarjet procedure. Their protocol detailed the arm position during surgery, retractor positioning, graft position, stage of the operation, and surgical duration.

There were limitations to the current systematic review. First, all studies were level 3 or 4 evidence and were retrospective. Second, given that the reported complication rate was extracted from retrospective data, it likely underestimates the true complication rate as authors of the analyzed studies may not have reported various complications that occurred. Third, there was a lack of information regarding patient characteristics, including risk factors for recurrence such as glenoid or humeral bone defect, previous instability events, and the presence of general laxity. Despite these limitations, the present systematic review is powerful in that it contains 35 studies and analyzed 2560 shoulders, which constitutes the largest examination of complications related to the Latarjet procedure in the literature to date.

## CONCLUSION

This current study examined data regarding complication rates in a large, cumulative series of the Latarjet procedure. The overall complication rate, including intraoperative, postoperative, and instability-related complications, was 16.1%. Notably, serious complications were rare. Intraoperative complications were more frequent, and instability-related complications were lower in the arthroscopic approach. These numbers describe a unique set of complications that warrant discussion with patients both before and after surgery. Moreover, additional well-designed studies are needed to further investigate ideal surgical candidates for the Latarjet procedure.

## ACKNOWLEDGMENT

The authors thank Eun-Ji Jeon for support with data collection.

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