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Original Article

Arthroscopic Latarjet Learning Curve: Operating Time Decreases After 25 Cases

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Purpose: To demonstrate the learning curve associated with the arthroscopic Latarjet procedure and create a timetable to proficiency. **Methods:** Using retrospective data of a single surgeon, consecutive patients who had an arthroscopic Latarjet procedure performed between December 2015 and May 2021 were initially reviewed for inclusion in the study. Patients were excluded if medical data were insufficient for accurate surgical time record, their surgery was transitioned to open or minimally invasive, or if their surgery was performed in conjunction with a second procedure for a separate issue. All surgeries were performed on an outpatient basis and sports participation was the most common reason for initial glenohumeral dislocation. **Results:** Fifty-five patients were identified. Of these, 51 met the inclusion criteria. Analysis of operative times for all 51 procedures demonstrated that proficiency with the arthroscopic Latarjet procedure was obtained after 25 cases. This number was determined by 2 methods using statistical analysis ($P < .05$). The average operative time over the course of the first 25 cases was 105.68 minutes and beyond 25 cases was 82.41 minutes. Male gender was seen in 86.3 percent of the patients. The average age of the patients was 28.6 years old. **Conclusions:** With continued transition towards bony augmentation procedures for addressing glenoid bone deficiency there is an increasing demand for the arthroscopic bony glenoid reconstruction procedures including the Latarjet procedure. It is a challenging procedure with a substantial initial learning curve. For a skilled arthroscopist there is a significant decrease in overall surgical time after the first 25 cases. **Clinical Relevance:** The arthroscopic Latarjet procedure has advantages over the open Latarjet approach; however, it is controversial because it is technically challenging. It is important for surgeons to understand when they can expect to be proficient with the arthroscopic approach.

Shoulder instability is often depicted as a disease of adolescence and early adulthood. In the very young pediatric population, shoulder instability does not appear to have the same natural history as it does with older age.[1] In the young athlete group, it is now well established that age of first dislocation plays an important role in the rate of recurrence of anterior shoulder instability. Literature supports redislocation rates for people younger than the age of 20 to be between 70% and 90%.[2] This of course is exacerbated by contact sports, as well as overhead athletes, who seem to be at an even greater risk for shoulder dislocation and shoulder instability.[3] Due to this unacceptably high rate of repeat dislocation, there has been a move away from nonoperative management of first-time dislocations, with surgeons electing instead to treat first-time dislocations with a variety of surgical stabilization procedures.[4] The exact procedure, however, remains a lively

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debate. Different algorithms have been created to help guide a surgeon's decision-making process.[5] We have not reached consensus on the perfect stabilization procedure; however, we know nonoperative management is no longer a viable option for young contact athletes.[6]

When discussing surgical procedures for patients after a shoulder dislocation, it is important to classify them into 3 categories: no bone loss, subcritical bone loss, and critical bone loss, respectively. The no bone loss category is likely more theoretical than practical. Literature now shows anterior glenoid bone loss in first-time dislocations can range from 1 to 10 mm and averages approximately 3 mm of bone loss.[7] The preferred treatment method for recurrent dislocations in the face of subcritical bone loss remains controversial and is also actively debated. Some surgeons may prefer to attempt soft-tissue procedures, whereas others may look at the risk factors for the patient and move toward a bony procedure even with only 10% to 15% bone loss. Haroun et al.[8] reviewed this topic in a recent meta-analysis. It is also important to discuss humeral sided defects that contribute to the bipolar nature of anterior shoulder instability. In 2007, Yamamoto et al.[9] first described the idea of bipolar lesion and the resulting concept of on-track, off-track lesions. This concept was further expanded on by Di Giacomo, Itoi, and Burkhart in 2014.[10]

Consensus is growing in regard to the need for bony procedures for patients with critical bone loss, or engaging Hill–Sachs deformity. The gold standard for bony glenoid stabilization has been the open Latarjet for many decades. However, over the last decade, there has been a growing interest in performing the Latarjet arthroscopically, which was made popular by Laffose. Many critics of the arthroscopic Latarjet cite greater complication rates as well as a greater level of technical skills required to perform the surgery. Several papers have shown that despite its steep learning curve, the arthroscopic Latarjet has many benefits compared with the open procedure while maintaining a low complication rate and high success rate.[11-14]

There is limited literature examining the learning curve and proficiency of the arthroscopic Latarjet to date. The literature that does exist cites 20 to 25 cases as an average learning curve.[12,13] The purpose of this study was to demonstrate the learning curve associated with the arthroscopic Latarjet procedure and create a timetable to proficiency. We hypothesized that there would be a significant decrease in operative time as the number of operative procedures increases.

Methods

Institutional review board approval was determined to not be necessary for this study. A database that included deidentified patient information was collected and reviewed. Data sets were created to evaluate differences between operative time, patient age, patient sex, operative shoulder (right vs left), and complication rate and particular complications.

Inclusion criteria required undergoing an arthroscopic Latarjet between December 2015 and May 2021. Patients must have had a minimum of 6 months' follow-up to evaluate for operative, perioperative, and postoperative complications. Exclusion criteria included incomplete medical record data that limited the ability to obtain operative time, which included patients who had incomplete time data, as well as patients who were lost to follow-up before the minimum 6- month follow-up. All surgeries were performed on an outpatient basis. All surgeries were performed in beach chair positioning using the same arthroscopic technique.

All surgeries were completed by a single surgeon (S.K.B.), who is a sports medicine fellowship-trained orthopaedic surgeon with more than 15 years of experience. Clinical follow-up assessment was performed by a senior-level resident or sports medicine fellow, and all patients were evaluated by S.K.B. in office prior at each visit.

The portal placement for this procedure has been previously described by Laffose.[11] Arthroscopic A, D, E, I, J, H, and M portals are used (Fig 1). All patients initially underwent diagnostic arthroscopy of the shoulder. The humerus was evaluated for Hill–Sachs deformity. The shoulder was moved through internal and external rotation, and evidence of engaging lesion was evaluated. Following diagnostic arthroscopy, arthroscopic Latarjet was completed following the technique guide as described by DePuy Mitek in the surgical technique guide for Bristow-Latarjet Instability Shoulder System. Following surgery, all patients were placed into a padded abduction sling. All patients remained in the sling for 4 weeks, and physical therapy was initiated at 2 weeks. Return to sports was allowed once bony healing was evident and range of motion and strength returned to functional for their specific sport.

The primary outcome measured was operative time. This number was calculated using incision time, or "Doctor Start" time recorded in the chart and "Doctor Closing" time, also recorded in the chart. Each patient had a third time stamp available, which correlates with "Surgery End"; however, this time includes skin closure, dressing, and sling application. For this reason, it was not used for calculating procedure time.

Each data set was then statistically analyzed for differences in group characteristics. Unpaired *t*-tests were run on each data set. Statistical significance was set at a *P* value of .05.

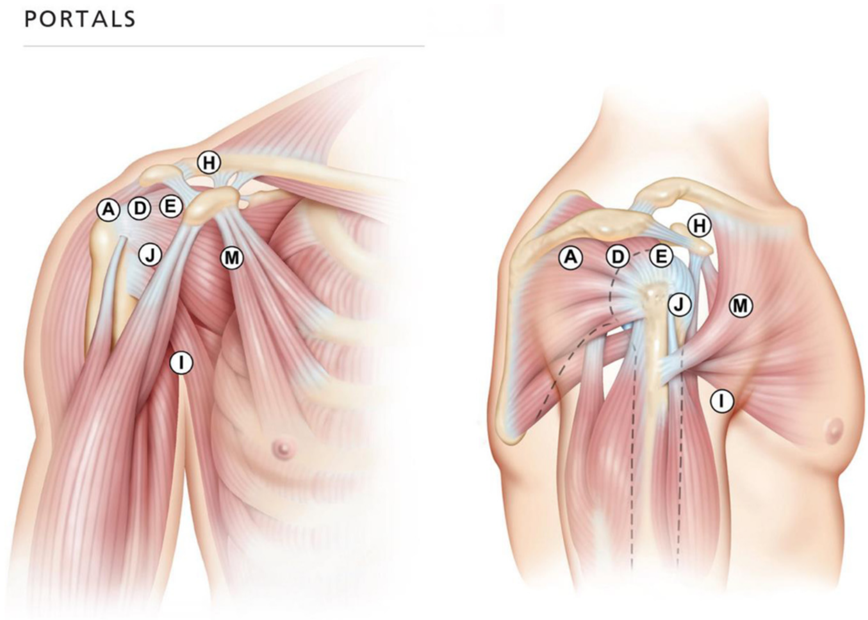

Fig 1. Illustration of the portals used for the arthroscopic Latarjet procedure. These images are taken directly from the surgical technique guide. Portals A, D, E, H, I, J, and M allow for improved visualization and instrumentation around the anterior shoulder and coracoid.

Results

Patient Demographics

Fifty-five consecutive arthroscopic Latarjet procedures were performed by a single surgeon (S.K.B.) between December 2015 and May 2021. In total, 51 patients met criteria for inclusion—44 male and 7 female. Four patients were excluded due to conversion to an open procedure. The average age was 28.6 years. Thirty shoulders were right and 21 shoulders were left. Zero patients experienced continued instability, and no patients experienced a postoperative dislocation. Three of 51 patients experienced a complication. Appendix Table 1 (available at www.arthroscopyjournal.org) shows the complete breakdown of patient demographics.

Operative Time

The average operative time for the first 25.0 cases was 105.7 minutes. The average operative time for cases after the initial 25 is 82.4 minutes (Fig 2). This represents an overall decrease of 23.3 minutes. This finding shows a statistically significant decrease in operative time after 25 cases ($P = .00088$). Figure 3 shows the operative time trend over the 6-year period with a scatter plot for the overall trend of operative time that flattens out after the first 25 to 30 cases (r value −0.5685275852). This represents the "steep learning curve" that is associated with arthroscopic Latarjet.

Complication Rate

The overall complication rate was 3 of 51 (5.8%). One patient had a transient axillary-nerve neuropraxia and graft failure. A revision surgery was necessary to remove a portion of the graft and complete an axillary-nerve neurolysis. He remained stable, and his symptoms completely resolved over 18 months and did not require any surgical intervention. One patient had screw irritation that was completely resolved with screw removal. One patient sustained a graft failure when he fell on postoperative day 0. This required a revision open surgery with free tibial bone block as the coracoid graft was not salvageable. He has had no other issues or complications to date. Two of the 3 complications occurred within the first 25 cases (8%) and one occurred in the next 26 cases (3.8%). There was no significant difference in complication rate between the first 25 cases and beyond 25 cases. There was no difference in patient age, sex, or hand dominance between the first 25 cases and all cases after 25 (P values of .271, .652, and .198, respectively).

Discussion

The key finding of this paper is that at 25 cases, there is a statistically significant decrease in operative time moving forward. This finding is consistent with the work of other authors.[12-15] Deciding the value for what "proficiency" is defined as remains difficult. Every

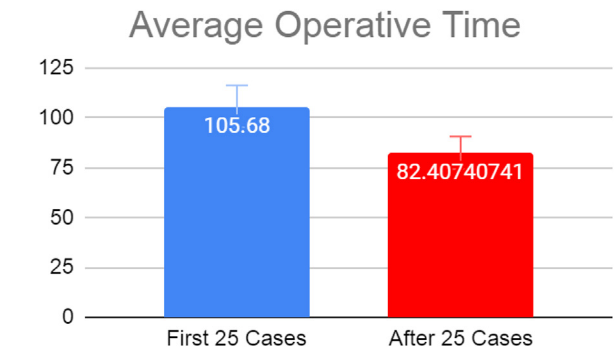

Fig 2. Average operative time in graph form during the first 25 cases compared with all cases following the first 25. During the initial 25 cases, the average surgical time was 105.7 minutes. The average time for the same surgeon for every case after the 25th case was 82.4 minutes. This difference represents a clinically significant difference (*P* value .00088).

attempt was made to analyze the data in a way that would provide the lowest value that reached statistical significance while maintaining power within each data set.

Arthroscopic Latarjet remains controversial despite literature supporting similar complication rates and patient outcomes.[15,16] Although our study did not compare open with arthroscopic Latarjet, we did have an overall complication rate of 6%. Three total patients experienced a complication. Two of the 3 complications occurred within the first 25 cases, with only 1 complication occurring over the remaining 26 cases. This did not represent a statistical difference; however, this is likely due to the low number of complications overall. The complications data are very encouraging. The authors of this paper fully understand the limited sample size we represent; however, it does not take away from the optimism we have that the arthroscopic Latarjet can be a procedure with a complication rate that is less than that of the open Latarjet procedure. Complications were not directly used in this study as a measure of outcome but included for completeness, as well as to show that while time decreased, complications remained unchanged.

This study looks directly at proficiency as a measure of operative time. It is important to note that we did not want to only have a procedure that was done faster but also to accomplish the goal of a stable shoulder without complications. There is a paucity of literature that discusses arthroscopic Latarjet proficiency. The literature that does exist has often looked at proficiency as a secondary measure. Kany et al.[17] examined proficiency in their paper; however, the primary aim of their paper examined bone block placement. This is not to say that the learning curve data from this study are not useful, but it does appear to be arrived upon somewhat randomly compared with our method of determining the learning curve period. In their study, they used the first 30 cases as an initial data point, and then a set of 30 cases later on after allowing for a "learning curve" period. Despite these differences in both studies, the learning curve has been determined to fall between 25 to 30 cases.

Ekhtiari et al.[14] also looked at arthroscopic Latarjet learning curve. Looking at a total of 5 studies that examined Latarjet learning curve, they also found a significant decrease in overall operative time as a surgeon's case count increased. They report an average operative time of 138.7 minutes during the learning phase with reduction to an average time of 108.8 minutes after the learning phase. Comparing our findings, we see an average operative time of 105.68 minutes during the first 25 cases with a reduction to 82.41 minutes after the first 25 cases. Several differences can account for the overall difference in total time of the procedure; however, one aspect that remarkably stands out is the similar decrease in time after the "learning curve." The surgeons had an overall reduction in operative time of 29.9 minutes, whereas our study shows a reduction of 23.27 minutes. Future studies would help highlight whether this similar time reduction is by chance or truly represents a time reduction that can be expected after the learning curve period. While the article by Ekhtiari et al.[14] does not explicitly provide a number associated with their "learning curve," a closer look at the papers included in the study report similar learning curve periods to our paper.

With any procedure, it is important to look at how many surgeries are going to be performed by a surgeon over a given period of time. Some surgeons may perform 25 arthroscopic Latarjet in 1 or 2 years, whereas others surgeons may never reach 25 Latarjet procedures in their career, let alone 25 arthroscopic Latarjet procedures. This point highlights that an important component of proficiency is repetition, but also an important measure of proficiency is time

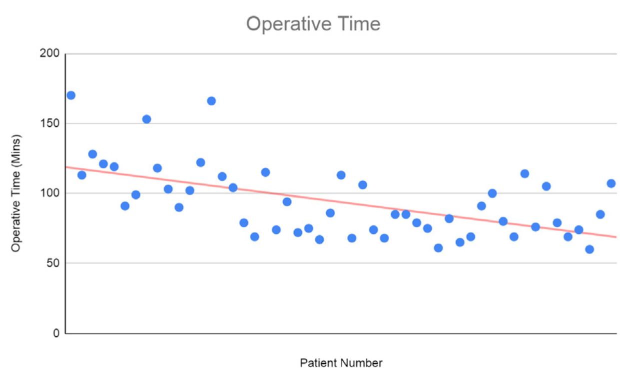

Fig 3. Total number of cases performed and the corresponding surgical time. The scatter plot shows an inverse relationship between number of cases performed and the total operative time. The scatter plot further shows a steep inverse area during the 25 cases that represents the associated steep learning curve (r value −0.5685275852).

between repetitions. Arthroscopic Latarjet may not be a procedure that every shoulder or sports surgeon incorporates into their practice; however, we strongly believe that for those surgeons who wish to incorporate this procedure, these data can be used predictably to base their timeline to proficiency.

It is worth noting that while not a true limitation of the study, body mass index, age, sex, hand dominance, and factors such as this were not strictly controlled. Instead, the patients were taken in order, and all-comers who met inclusion criteria were included in the study. With any human study, small differences between individual patients may make subtle differences in the measured outcome. For this study, there was no significant difference in patient demographics between the first 25 cases and all cases after. The fact we did not specifically control for body mass index had a potential to alter the operative time data; however, it was more important that all cases were used consecutively regardless of patient demographics. We are fortunate in this study that our data were not confounded by differences in population make up across all 51 participants.

Limitations

The most notable limitation of this study is the single-surgeon model. While this is a limitation from a generalizability standpoint, it is a strength from a practical standpoint. By using a single surgeon, each patient was positioned the same, the same proprietary equipment was used for each case, and the same anesthesia group was used for each case. In this study, the use of a single surgeon allowed us to control for many confounding variables that otherwise would make measuring time more difficult. Furthermore, arthroscopic Latarjet has always been a surgery for highly skilled to master-level arthroscopist. It has been well established that arthroscopic Latarjet is a demanding procedure that requires arthroscopic skill. The use of a single surgeon in this study allows us to isolate one high-level arthroscopist and follow his journey from his initial case to well past proficiency.

Conclusions

With continued transition toward bony augmentation procedures for addressing glenoid bone deficiency there is an increasing demand for the arthroscopic bony glenoid reconstruction procedures including the Latarjet procedure. It is a challenging procedure with a substantial initial learning curve. For a skilled arthroscopist, there is a significant decrease in overall surgical time after the first 25 cases.

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Appendix Table 1. Patients Who Met the Criteria to Undergo Arthroscopic Latarjet Procedure, of Whom 44 Were Male and 7 Were Female

Patient ID	Age, y	Operative Shoulder	Sex	Operative Time	Instability	Complication	Specific Complication	Subsequent Procedure
1	16	Right	Male	170	No	No		
2	20	Left	Male	113	No	No		
3	16	Right	Male	128	No	No		
4	37	Left	Male	121	No	No		
5	24	Right	Male	119	No	No		
6	30	Right	Male	91	No	No		
7	23	Right	Female	99	No	No		
8	24	Right	Male	153	No	No		
9	20	Right	Male	118	No	No		
10	25	Right	Male	103	No	No		
11	35	Right	Male	90	No	No		
12	24	Right	Male	102	No	No		
13	53	Left	Male	122	No	No		
14	53	Right	Male	166	No	Yes	Transient axillary nerve injury and graft loosening	Close follow-up until complete resolution
15	17	Right	Male	112	No	No		
16	33	Left	Male	104	No	Yes	Screw irritation, resolved after screw removal	Screw removal
17	31	Right	Male	79	No	No		
18	21	Right	Male	69	No	No		
19	28	Left	Male	115	No	No		
20	22	Left	Female	74	No	No		
21	32	Right	Female	94	No	No		
22	16	Left	Male	72	No	No		
23	35	Right	Female	75	No	No		
24	17	Left	Male	67	No	No		
25	24	Right	Male	86	No	No		
26	22	Left	Male	113	No	No		
27	54	Left	Male	68	No	No		
28	26	Left	Male	106	No	No		
29	16	Right	Male	74	No	No		
30	17	Left	Male	68	No	No		
31	31	Right	Female	85	No	No		
32	24	Left	Male	85	No	No		
33	37	Right	Male	79	No	No		
34	47	Left	Male	75	No	No		
35	19	Left	Male	61	No	No		
36	27	Right	Male	82	No	No		
37	34	Right	Female	65	No	No		
38	33	Right	Male	69	No	No		
39	39	Left	Male	91	No	No		
40	29	Right	Male	100	No	No		
41	19	Right	Male	80	No	No		
42	47	Right	Male	69	No	Yes	Fall postoperative day 0, revised with open distal tibia and doing well	Open distal tibial allograft
43	40	Left	Male	114	No	No		
44	29	Right	Male	76	No	No		
45	42	Left	Male	105	No	No		
46	35	Right	Male	79	No	No		
47	25	Right	Male	69	No	No		
48	18	Left	Female	74	No	No		
49	26	Left	Male	60	No	No		
50	25	Left	Male	85	No	No		
51	24	Right	Male	107	No	No		

NOTE. The average age of patients who received the surgery was 28.6 years old, ranging from 16 to 54 years old. There were 30 shoulder surgeries performed on the right and 21 shoulder surgeries performed on the left. None of the patients experienced postsurgical instability. Three of the 51 patients experienced a complication. All complications resolved in the moderate-term follow-up.