RESEARCH ARTICLE

Is Arthroscopic Latarjet a Cost-Effective Procedure? A Decision Analysis

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Abstract

Objectives: Arthroscopic Latarjet for glenohumeral stabilization has emerged as an alternative to the open approach; however, the evidence to date has questioned if this technique delivers improved outcomes. This analysis provides an assessment of the cost and utility associated with arthroscopic versus open Latarjet.

Methods: The cost-effectiveness of Latarjet stabilization was modeled over a ten-year period. Institutional cases were reviewed for equipment utilization. Cost data from ambulatory surgical centers was obtained for each piece of equipment used intraoperatively. Based upon prior analyses, the operating room cost was assigned a value of $36.14 per minute. To determine effectiveness, a utility score was derived based upon prior analysis of shoulder stabilization using the EuroQol (EQ) 5D. For reoperations, a utility score of 0.01 was assigned for a single year for revision surgeries for instability and 0.5 for minor procedures. Probability of surgical outcomes and operative time for arthroscopic and open Latarjet were taken from prior studies comparing outcomes of these procedures. Decision-tree analysis utilizing these values was performed.

Results: Based upon equipment and operating room costs, arthroscopic Latarjet was found to cost $2,796.87 more than the equivalent open procedure. Analysis of the utility of these procedures were 1.330 and 1.338 quality adjusted life years obtained over the modeled period for arthroscopic versus open Latarjet, respectively. For arthroscopic Latarjet to be cost-equivalent to open Latarjet, surgical time would need to be reduced to 41.5 minutes or the surgical equipment would need to be provided at no expense, while maintaining the same success rates.

Conclusion: With nearly identical utility scores favoring open surgery, the added cost associated with arthroscopic Latarjet cannot be supported with available cost and utility data. To provide value, additional benefits such as decreased post-operative narcotic utilization, decreased blood loss, or lower complications of the arthroscopic approach must be demonstrated.

Level of evidence: IV

Keywords: Arthroscopic latarjet, Cost analysis, Latarjet procedure, Shoulder instability

Introduction

The Latarjet procedure is used to treat anterior shoulder instability with glenoid bone loss or patients who have failed previous anterior soft-tissue stabilization procedures. There has been an increased utilization[1,2] of the Latarjet procedure over the last two decades due to improvements in surgical training, studies establishing the importance of anterior glenoid bone loss,[3–7] and patients at high-risk for failure[8] following soft-tissue stabilization procedures.

The Latarjet procedure was originally described as an open procedure[9] in 1954 and in 2007 Lafosse *et al.*[10] modified to an all-arthroscopic technique. Potential benefits of the arthroscopic technique include decreased wound complications, ability to assess and treat concurrent lesions, reduced postoperative stiffness, quicker rehabilitation and return to sport.[11] However, these benefits have not been

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realized in the literature[12,13] and there are concerns regarding accurate graft placement and the learning curve.[14–17]

Cost-effectiveness of a procedure has become increasingly important in our cost-conscious health-care environment.[18] In a systematic review by Randelli *et al.*, the direct cost of arthroscopic Latarjet was double compared to open Latarjet (€2335 vs €1040).[19] They estimated direct cost based on hourly operating room costs in Italy and based on open Latarjet procedure times in their institutional experience.

The purpose of our study is to utilize the existing evidence to assess the cost-utility of arthroscopic Latarjet compared to open Latarjet. The hypothesis of this analysis is that open Latarjet is more cost-effective than arthroscopic Latarjet.

Materials and Methods

The cost-effectiveness of Latarjet stabilization was modeled over a ten-year period using Silver Decisions software to perform a decision-tree analysis. Decision tree models use probabilities and values to simulate sequential events while taking some degree of uncertainty from independent events into consideration. The outcomes represent expected value or utility based on a combination of sequential decisions and independent events. Two separate decision trees were created to compare arthroscopic to open Latarjet – one using utility score as the main criterion, and the other using cost as the main criterion.

Cases at a single institution were reviewed to determine equipment utilization. Cost data from a single ambulatory surgery center was obtained for each piece of equipment used during open and arthroscopic Latarjet procedures [Table S1, Table S2]. Cost data for arthroscopic Latarjet included a commercially available arthroscopic Latarjet system. Cost data for open Latarjet included cancellous screws. The value of indirect costs was determined from prior literature. Based on a prior study by Childers and Maggard-Gibbons, the operating room cost was assigned a value of $36.14 per minute.[20]

To determine effectiveness, a utility score was determined from prior analysis of shoulder stabilization using the EuroQol (EQ) 5D.[21] The EQ-5D is a validated survey often used to determine a procedure's impact on a patient's quality of life by inquiring about mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Quality-adjusted life years (QALYs) are calculated based on responses.

In cases where re-operation was required, a utility score of 0.01 was assigned for a single year of the ten-year model for revision surgeries for instability and 0.5 for minor procedures.[21] Probability of surgical outcomes for arthroscopic and open Laterjet were established based on previous systematic review of studies comparing the two procedures.[12] The following probabilities were assigned to arthroscopic and open Latarjet, respectively: surgical success of 95.9% and 97% of cases, need for revision for recurrent instability of 2% and 1.4%, need for screw removal of 1.1% and 0.8%, and need for other surgical procedures of 1% and 0.8%.[12] Operative times were also based on prior literature[12], with 112 minutes assigned for arthroscopic compared to 93 minutes assigned to open [Table 1].

In the setting of revision for recurrent instability, a single open revision procedure of 120 minutes utilizing the equipment for open Latarjet was assumed. A 10% failure rate after revision surgery was assumed, and in this case the patient was considered to have shoulder instability for the remaining nine years in the model.

TABLE 1: MODEL ASSUMPTIONS BASED ON PREVIOUS LITERATURE[12]

Outcome	Arthroscopic	Open
Surgical Success	95.9%	97%
Revision for Recurrent Instability	2%	1.4%
Need for Screw Removal	1.1%	0.8%
Operative Times	112 minutes	93 minutes

Results

Using the previously published utility scores of 1.330 and 1.338 quality-adjusted life years for arthroscopic and open Latarjet, respectively, the decision-tree analysis resulted in equal expected utility and cost between arthroscopic and open Latarjet [Figure 1, Figure 2].

Using equipment cost from our institution and previously published operating room times,[12] the decision-tree analysis resulted in an expected cost of $6,768.03 for arthroscopic Latarjet compared to $3,971.16 for open Latarjet. Arthroscopic Latarjet cost $2,796.87 more than the equivalent open procedure. Excluding costs outside of the operating room, the cost-effectiveness for the 10-year study period is $5,088.7 and $2,967.98 per QALY offered for arthroscopic and open Latarjet, respectively.

Based on equipment and operating room costs, in order for the cost of the arthroscopic Latarjet to be cost-equivalent to the open procedure, the operative time of the arthroscopic Latarjet would have to be reduced to 41.5 minutes or the equipment would have to be provided at no expense.

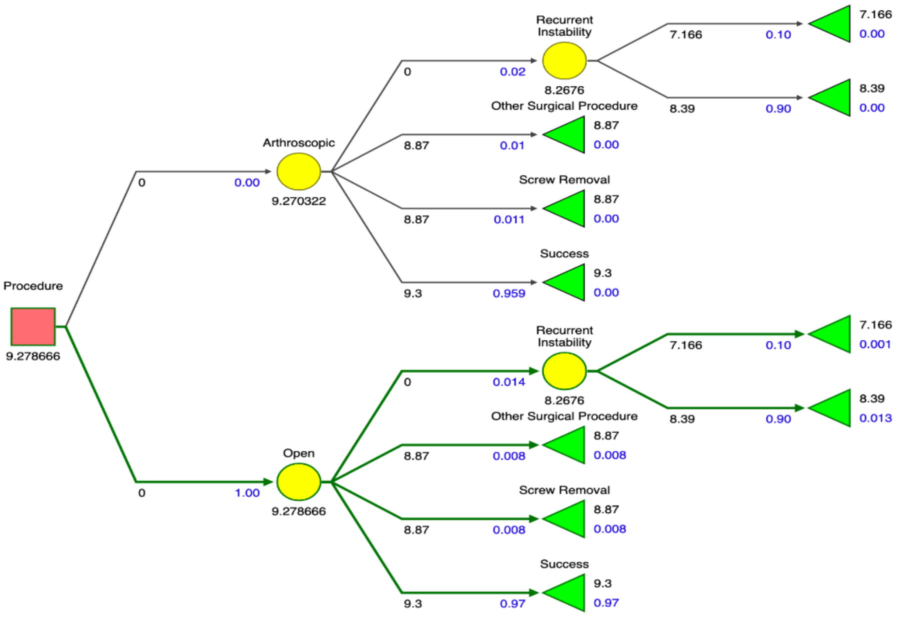

Figure 1. Decision-tree analysis comparing expected utility of arthroscopic vs open Latarjet procedure. Squares represent decision nodes, and in our model represent the decision to have surgery. Circles represent chance nodes, which are the alternative decision options. Triangles represent terminal nodes, which are reactions to previous decisions based on probabilities of such events

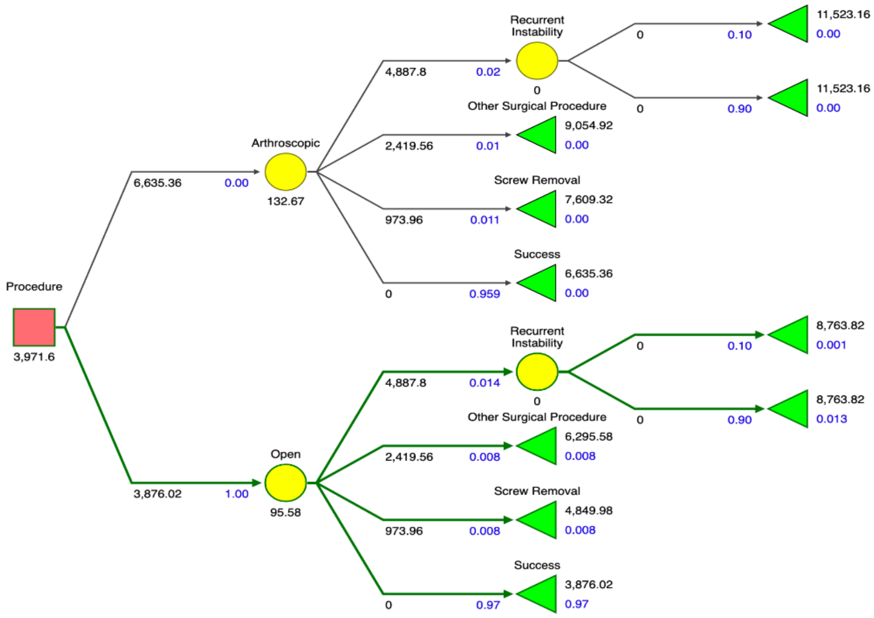

Figure 2. Decision-tree analysis comparing expected cost of arthroscopic vs open Latarjet procedure. Squares represent decision nodes, and in our model represent the decision to have surgery. Circles represent chance nodes, which are the alternative decision options. Triangles represent terminal nodes, which are reactions to previous decisions based on probabilities of such events

Discussion

The Latarjet procedure is considered the gold standard to treat anterior shoulder instability with glenoid bone loss or after failed soft tissue procedures. This study was a single-institution analysis of cost-effectiveness of the arthroscopic Latarjet compared to the traditionally open Latarjet for the treatment of anterior shoulder instability with glenoid bone loss or after a failed soft-tissue only stabilization procedure. The major finding of our study was the arthroscopic Latarjet cost $2,797 more than the equivalent open Latarjet procedure with no difference in effectiveness between procedures.

In the current study, we found the arthroscopic Latarjet cost $2797 more than the open Latarjet ($6,768 vs $3971). Randelli et al. found the average arthroscopic Latarjet cost double of the open Latarjet (€2335 vs €1040 [$2636 vs $1174]).[19] For their cost analysis, they used the sum of operating room time by minute cost (€1415 vs €1000), cost of implants (€170 vs €40), and specific instruments cost (€750 vs €0) for arthroscopic and open Latarjet, respectively. Makhni et al. reported that Latarjet cost less ($13,672 vs. $15,287) and is more effective (43.78 vs 36.76 QALYs) than revision arthroscopic Bankart repair for treatment of recurrent instability after a failed arthroscopic Bankart repair.[22] Subsequently, Min et al. evaluated the cost-effectiveness of arthroscopic Bankart repair versus open Latarjet for the treatment of primary shoulder instability and found the Bankart repair to be more cost effective ($4214 vs $4681, incremental cost-effectiveness ratio). The authors stated it was likely due to the lower healthy utility associated with a failed Latarjet procedure in their analysis.[21] They reported the actual cost of procedure was more expensive for open Latarjet than arthroscopic Bankart ($21,389 vs. $20,385). The higher cost in their study compared to ours is likely related to their calculation including the cost included of implants, anesthesia, surgical fees, and all charges on the day of surgery. Furthermore, in comparing cost-effectiveness studies, regional differences in operating room cost per minute and equipment should be considered.

While both open and arthroscopic Latarjet have been associated with excellent clinical outcomes,[12,13,19,23] neither procedure has shown clear superiority in the literature. Horner et al. performed a systematic review analyzing clinical outcomes and complications of open and arthroscopic Latarjet. The authors found multiple studies indicating that one procedure had superior outcomes compared to the other; however, the findings were not consistent.[12] Arthroscopic Latarjet was associated with less pain in the first month postoperatively, but pain scores equalized at all time points thereafter.[12] The complication rates of arthroscopic and open Latarjet are similar and range from 3.8% to 11.9% and 6.4% to 13.8%, respectively.[12,13] A recent meta-analysis found similar rates of recurrent instability between arthroscopic and open Latarjet, at 2.4% and 2%, respectively.[13] Horner et al. compared all studies investigating graft and screw positioning between the two techniques and found no significant difference or superiority.[12] Given the similarity in outcomes and complications, it is warranted to consider relative cost when choosing which procedure to perform in patients with anterior shoulder instability and glenoid bone loss.

The arthroscopic Latarjet has been described as a technically challenging procedure with a steep learning curve.[8,12,13,19] Early reports suggested that between 15 to 30 cases were required to reach operative time plateau.[14–16,24] However, Valsamis et al. found high-volume shoulder specialists require 30-50 arthroscopic Latarjet procedures to reach steady-state operative efficiency.[25] In their study, they evaluated the learning curve of the arthroscopic Latarjet from 12 surgeons across 5 countries including a total of 573 patients. They found accuracy of bone-block positioning on postoperative CT demonstrated constant improvement without reaching a plateau after 53 cases. The authors recommended that only surgeons expecting to undertake the arthroscopic Latarjet in high volume should consider learning this procedure.[25]

One might question why the higher costs or longer operative time of other arthroscopic shoulder procedures, such as rotator cuff repairs, are deemed acceptable, while arguing against that the increased cost of arthroscopic Latarjet is not warranted. The advantages of arthroscopic rotator cuff repair, such as improved visualization, ability to mobilize and release the rotator cuff, ability to treat glenohumeral joint pathology, and decreased trauma to the deltoid, are perceived advantages. An analysis of trends in rotator cuff repairs in the United States from 1996 to 2006 found that arthroscopic repair rates increased by 600%.[26] The arthroscopic Latarjet has not gained the same popularity among surgeons, possibly because of the technically challenging nature of the procedure. To justify the use of arthroscopic Latarjet, additional advantages must be demonstrated, such as reducing the need for postoperative narcotics, minimizing blood loss, or facilitating recovery after surgery.

Our study had several limitations. We performed a decision tree analysis based on several assumptions regarding operative times, success rates, recurrence rates, etc. from previously published literature. We only analyzed operating room costs and did not consider any perioperative costs (i.e. physical therapy). We did not assess institutional outcomes – we used utilities reported in the literature and proportion of outcomes from the literature. Our study period was limited to 10 years. Any weaknesses in these studies translate to weaknesses in our cost analysis. This cost analysis was performed with equipment costs specific to the ambulatory surgical centers at our institution and may vary between institutions.

Conclusion

In conclusion, our study found that arthroscopic Latarjet cost $2,797 more than the equivalent open procedure. With nearly identical utility scores favoring open surgery, the added cost associated with arthroscopic Latarjet needs further justification. This is likely a result of the already high success associated with the open approach, limiting room for improvement. To provide greater value, additional benefits such as decreased post-operative narcotic utilization, decreased blood loss, or reduction in complications of the arthroscopic approach must be published.

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TABLE S1. EQUIPMENT COSTS FOR OPEN LATARJET PROCEDURE

ITEM	Quantity	Price per unit	Total Cost
TEGADERM	1	$1.07	$1.07
IOBAN	1	$4.71	$4.71
1010 DRAPE	1	$0.81	$0.81
1015 DRAPE	1	$2.81	$2.81
SCALPEL #15	3	$0.28	$0.84
PACK OR TURNOVER	1	$8.78	$8.78
GLOVE	3	$0.31	$0.91
SHOULDER ARTHROSCOPY PACK	1	$71.56	$71.56
BLUE U DRAPE	1	$1.81	$1.81
3/4 DRAPE	1	$1.36	$1.36
YANKAUER	1	$0.33	$0.33
FRAZER TIP	1	$1.72	$1.72

TABLE S1. Continued			
LAP SPONGE	2	$1.40	$2.80
CHLORAPREP	2	$5.72	$11.44
EXOFIN	1	$2.33	$2.33
BOVIE TIP 1#	1	$4.47	$4.47
BOVIE PAD	1	$2.52	$2.52
BOVIE PENCIL	1	$2.78	$2.78
SUTURE MONOCRYL	2	$1.94	$3.88
STIRRUP/CANDY CANE/RING	1	$4.28	$4.28
ALCOHOL PREP	1	$6.17	$6.17
T-MAX FACE MASK	1	$29.93	$29.93
NEPTUNE 4 PORT MANIFOLD	1	$14.50	$14.50
PULSE IRRIGATOR	1	$34.33	$34.33
CANCELLOUS SCREW 4.0X35MM	1	$24.93	$24.93
CANCELLOUS SCREW 4.0X40MM	2	$24.93	$49.86
WASHER 7MM	2	$30.59	$61.18
PIN GUIDE 2.0MM	2	$81.68	$163.36
BULB SYRINGE	1	$0.65	$0.65
MCCONNELL ARM SUPPORT DISPOSABLE	1	$35.00	$35.00
TOTAL	-------	--------	$551.14

TABLE S2. EQUIPMENT COSTS FOR ARTHROSCOPIC LATARJET PROCEDURE

ITEM	Quantity	Price per unit	Total Cost
SHOULDER PACK	1	$79.81	$79.81
ARTHROSCOPE	1	$40.00	$40.00
FLUID	12	$8.00	$96.00
SHAVER	1	$38.00	$38.00
BURR	1	$38.00	$38.00
FOAM TAPE	1	$3.19	$3.19
PROLINE 3-0	2	$4.87	$9.74
TMAX FACEMASK	1	$19.50	$19.50
SPIDER DRAPE KIT	1	$64.50	$64.50
SCREW 28MM TOP HAT	1	$199.00	$199.00
SCREW 30MM TOP HAT	1	$199.00	$199.00
LATARJET DISPOSABLE KIT	1	$632.00	$632.00
K-WIRE SHORT	2	$100.00	$200.00
DRILL BIT GLENOID	1	$594.00	$594.00
GLOVE	3	$0.31	$0.93
STIRRUP/CANDY CANE/RING	1	$4.28	$4.28
1010 DRAPE	1	$0.81	$0.81
1015 DRAPE	1	$2.81	$2.81
IOBAN	1	$4.71	$4.71
VAPOR ABLATOR	1	$159.00	$159.00
TOTAL			$2385.28