Cost Comparison of Shoulder Instability Treatment Pathways for Recurrent Shoulder Instability Using Patient-Level Pathway Modeling Decision Tree Analysis

Patrick J Tansey, Jad Jack Lawand, Kareem Omran, Jeremy S Somerson

INTRODUCTION: Recurrent anterior shoulder instability is a common problem in young, active patients, often requiring surgical stabilization to prevent long-term morbidity. While isolated Bankart repair remains widely used, Bankart plus Remplissage (BR) has demonstrated lower recurrence rates, particularly in patients with Hill-Sachs lesions. However, BR incurs higher upfront costs, prompting the need for data-driven analysis of its long-term economic impact. As healthcare shifts toward value-based care models, understanding the long-term economic implications of these procedures is essential for optimizing both patient outcomes and resource allocation. To address this, we developed a pathway-based cost model incorporating real-world revision patterns, literature-based failure rates, and institutional cost data to estimate and compare the expected average cost per patient for Bankart repair versus BR versus latarjet through a decision tree analysis.

METHODS:

A decision-tree model simulated 100,000 patients undergoing Bankart or BR as their index procedure, with each patient's care pathway tracked across a maximum of four surgical events. All decisions beyond the index surgery were modeled using fixed pathway probabilities as modeled in figure 1. Following surgical failure defined as a one-time risk per procedure based on published rates, patients either pursued physical therapy (PT) and 50% underwent revision surgery, with 38% receiving Revision BR and 62% undergoing Latarjet. If Latarjet failed, patients received iliac crest autograft (ICA) as a final surgical option. Patients could undergo a maximum of four surgeries, after which care defaulted to PT. Failure rates for revisions were based on published data: 15.9% for Revision Bankart, 23.8% for Revision BR, 12% for Revision Latarjet, and 7.1% for ICA. Procedure costs were obtained from a retrospective review of our institution's billing records from 2025. Costs included supply, implant, and operating room (OR) time, with OR minutes valued at $30.95. Total average costs were: Bankart ($5,429), BR ($6,341), and Latarjet ($4,555). PT was modeled at $2,235.50 for a 10-session course. Failures of ICA or patients reaching the four-operation limit entered permanent "PT". Published failure risks were applied to each procedure (Bankart: 22%, BR: 8%, Revision Bankart: 15.9%, Revision BR: 23.8%, Latarjet: 12%, ICA: 7.1%). Cost estimates for all procedures, revisions, and PT were drawn from our institution's 2025 financial data and are summarized in Table 1. The expected cost per patient was calculated by summing the cost of each pathway weighted by its probability, as expressed in the accompanying figure 2.

RESULTS:

The average total cost per patient was $6,287.03 for Bankart repair and $6,659.00 for BR, resulting in a modest cost difference of $353.95 favoring Bankart. While the BR index surgery cost more on average ($6,341 vs. $5,429), this was largely offset by its lower failure rate (8% vs. 22%), which reduced the likelihood of downstream revision surgery. Revision Bankart averaged $6,277.50 and Latarjet $4,658.10. ICA was modeled as cost-neutral, while PT was estimated at $2,235.50 per course. Most patients remained stable after their initial procedure—over 90% in the BR group and 77% in the Bankart group. Only 0.002% of patients underwent four surgeries, well below the <5% ceiling reported in clinical literature. Despite the complex revision architecture, the cost contribution from downstream failures was minimal at the population level.

DISCUSSION AND CONCLUSION:

Bankart plus Remplissage provides better clinical durability than Bankart repair and, despite higher initial costs, results in only a modest increase in average per-patient cost due to its lower revision burden. This patient-level model demonstrates that cost-effective surgical planning should consider not only index procedure pricing but also failure risk and revision complexity. These findings support BR as a high-value strategy for patients at elevated risk of recurrence and highlight the importance of probabilistic decision modeling in guiding care for shoulder instability.

Figure 2: Probabilistic Model for Calculating Expected Costs in Shoulder Stabilization Strategies

Expected Cost Calculation

The expected average cost per patient, denoted as $E[C]$, was calculated by summing the costs of each unique patient pathway C_i weighted by the probability of that pathway occurring P_i:

$$E[C] = \sum_{i=1}^{N} (P_i \times C_i)$$

where:

- "N is the total number of unique pathways in the decision-tree simulation."
- "P_i is the probability of a patient following pathway i, computed as the product of one-off failure risks and revision choice probabilities at each decision point in the tree."
- "C_i is the total direct medical cost for pathway i, including index and revision surgeries, as well as physical therapy if applicable."

Each simulation iteration represents an individual patient's journey through the decision tree, with final costs and probabilities empirically derived by aggregating the results from 100,000 simulated patients per treatment strategy (Bankart vs Bankart + Remplissage). This approach captures the heterogeneity of patient experiences and ensures that even rare, complex revision pathways are accounted for in the final expected cost estimate.

Table 1: Institutional Derived Cost Data for Shoulder Instability Procedures

Procedure	Supply Cost Avg	Implant Cost Avg	Minutes Avg	OR TIME (Minutes x 30.95 min / hr)	AVG TOTAL OR COST
Bankart	1833	1040	82.6	2556	**5,429**
Bankart Remplissage	1750	1785	90.6	2806	**6,341**
Latarjet	902	104	114.6	3549	**4,555**

Figure: Treatment Pathway Model for Bankart Repair vs. Bankart + Remplissage
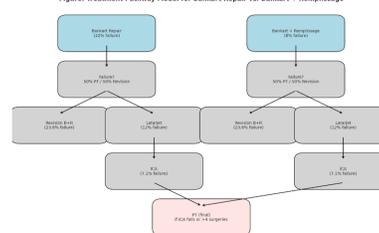
Pathways:

1. Bankart → PT vs B+R → PT vs Revision B+R → PT vs Latarjet → PT
2. Bankart → PT vs B+R → PT vs Latarjet → PT vs ICA → PT
3. Bankart → PT vs Latarjet → PT vs ICA → PT
4. B+R → PT vs Revision B+R → PT vs Latarjet → PT vs ICA
5. B+R → PT vs Latarjet → PT vs ICA → PT

B+R: Bankart + Remplissage, ICA: Iliac Crest Autograft, PT: Physical Therapy