Distal biceps tendon repair: cost analysis of single- versus double-incision techniques in an ambulatory surgery center

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Level of evidence: Level IV; Economic Analysis

Background: The purpose of this study was to compare the cost differences for single- versus double-incision distal biceps repair at an ambulatory surgery center (ASC) given that similar clinical outcomes have been reported between these methods.

Methods: A retrospective review of financial and medical records was completed for patients who underwent distal biceps tendon repair over a three-year period at a single private orthopedic practice. Variables analyzed include the cost to the ASC of operative time and the cost of differential surgical supplies, specifically implants and disposable supplies.

Results: A total of 10 surgeons performed 104 repairs. Nine surgeons performed repairs through a single incision with use of cortical button or suture anchor fixation, and one surgeon performed transosseous suture fixation through a double-incision approach. The median tourniquet time and procedure length were 31 (interquartile range [IQR] 27-40) and 44 (IQR 39-54) minutes for single-incision repairs and 68 (IQR 61-75) and 110 minutes (IQR 103-113) for double-incision repairs which were significantly different across groups (P < .001, P < .001). The total surgical cost (operative time, implants, and disposables) for single-incision repairs was a median of $738 (IQR 732-803) compared with $606 (IQR 567-629) for double-incision repairs (P < .001). However, the procedure cost with implants (not including disposables) was not significantly different for single- (median $552 [IQR 514-564]) and double-incision repairs (Mdn $552 [IQR 514-564]) (P = .14) although the procedure cost with disposables (not including implant costs) favored single-incision repairs (Mdn = $478 [IQR 452-523]) over double-incision repairs (Mdn = $606 [IQR 567-629]) (P < .001).

Conclusion: In a single surgery center, single-incision distal biceps repairs utilizing an implant were performed more expeditiously than double-incision repairs with a transosseous technique but incurred greater surgical costs. Differences in surgical time cost between the two approaches could be consequential for ASCs and other stakeholders.

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Rupture of the distal biceps results in significant losses to flexion and supination strength at the elbow if left untreated, whereas surgical repair of the tendon can restore these strength parameters and is routinely advocated for young and active patients.1-3 Various methods of distal biceps repair have been the subject of extensive research, but currently, there is no consensus on the clinical superiority of one approach or fixation method over the other.1,3,8,10-12,15

Historically, distal biceps repair was performed through an extensile anterior approach which carried a high risk of nerve complications. In the early 1960s, Boyd and Anderson published a two-incision technique to mitigate these risks, but encountered problems with limited forearm rotation due to synostosis related to subperiosteal dissection of the ulna.2 Morrey eventually modified Boyd and Anderson’s two-incision technique, by using a transmuscular posterior approach to decrease the risk of this complication.9 Morrey’s modified approach subsequently gained popularity; however, recently, there has been a shift back to single incision performed through a more minimally invasive approach with use of various implants for fixation.3,8

A multitude of comparative studies have demonstrated similar outcomes between modern single- and double-incision...
approaches. In the absence of strong clinical evidence in favor of one method, an analysis of other factors, namely, surgical time and cost, might help supplement decision-making. Therefore, the purpose of this study was to compare cost differences for single- versus double-incision distal biceps repairs performed at a single ambulatory surgical center.

Materials and methods

A retrospective review was performed to identify all patients who underwent distal biceps repair at a physician-owned ambulatory surgery center (ASC) from September 2014 to December 2017. The study period included all the cases performed with two-incision approaches from the start of the senior author’s practice until the time of study initiation. The inclusion criterion was a surgical repair coded with CPT 24342 in the electronic medical record. No cases were excluded; however, all patients were over 18 years of age, none required graft augmentation, and none were revision procedures.

Financial records were compiled for each case to include all data relevant to a comprehensive cost analysis. Cost data were provided by the outpatient surgical center’s chief financial officer. Given the similarity of the two procedures, the fixed costs for each procedure were not included (eg, processing of nondisposable surgical sets). The main independent variables analyzed were the costs of disposable surgical sets and implants, other single-use disposable instruments, and the cost of the operating room based on procedure duration. Procedure duration was defined as the time out of the operating room. The operating room cost was obtained by multiplying the recorded procedural time by $5 per minute. $5 per minute was derived from the billable total cost of $300/hour for the operating room. The electronic medical record was reviewed for demographic information and operative details.

The usefulness and validity of a cost analysis depend on the perspective from which it is performed because different costs for an operation affect involved parties in different ways. The contingents include patients, surgeons, the ASC, and the payer as shown in Table I. In the present study, the authors sought to examine cost primarily from the perspective of the ASC. Therefore, certain costs that might have varied between the operations but were not paid by the ASC (eg, anesthesiologist professional fees) were not included in the analysis.

Statistical methods

Statistical analyses were conducted in R, version 3.6.2, using the RStudio integrated development environment. The tidyverse and janitor packages were used to transform data before analysis. Continuous variables are reported as median and interquartile range (IQR), and categorical and ordinal variables are reported as proportions of the total cohort. Procedure and total surgical cost comparisons were evaluated using Wilcoxon signed-rank tests, with a nominal α set at 0.05, using the gsummarize package. Implant costs were treated as a categorical variable and were compared using Fisher’s exact test.

Results

Ten surgeons performed 104 distal biceps repairs on 103 patients over the three-year study period. Patients underwent surgery at a median of 16 (IQR 8-31) days from injury, and 75% had a complete distal biceps tendon repair noted at the time of surgery. Table II summarizes the relevant demographic data for the study patients.

Discussion

In this study, at a single ASC, single-incision distal biceps repairs using implants were performed significantly faster but at greater cost than double-incision repairs without implants; however, the implications of these findings are complex. For example, from an ASC administrator’s perspective, a two-incision repair without implants might have a lower cost to the ASC if implants are not...
separately billable to the payer (e.g., the ASC does not pay this cost). However, if implants are billed separately to the payer, then the single-incision technique would clearly have superiority based on both cost and operative time. Even if the ASC was responsible for the implant cost, there exists an indirect financial benefit for surgeons and surgery centers of an hour decrease in operative time because an extra procedure could potentially be added to the day during normal business hours. From the health care system and payer perspective, single-incision repairs with anchors may be disfavored based on total surgical cost. If the patient is paying directly for the procedure or if a portion of the direct cost is passed down to the patient, the two-incision without implant approach may be favored. Higher nonreimbursable costs are also directly relevant to surgeons who have ownership in the ASC where they may be incentivized to lower these costs.

One previous study comparing suture anchors (single incision) and transosseous suture fixation (double incision) had findings counter to the present study, with no difference noted in operative times because an extra procedure could potentially be added to the day during normal business hours. From the health care system and payer perspective, single-incision repairs with anchors may be disfavored based on total surgical cost. If the patient is paying directly for the procedure or if a portion of the direct cost is passed down to the patient, the two-incision without implant approach may be favored. Higher nonreimbursable costs are also directly relevant to surgeons who have ownership in the ASC where they may be incentivized to lower these costs.

Table II
Demographic data for single- and double-incision repairs

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall, N = 104</th>
<th>Single incision, N = 92*</th>
<th>Double incision, N = 12*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>48 (43, 56)</td>
<td>48 (43, 56)</td>
<td>51 (45, 56)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>100 (96%)</td>
<td>88 (96%)</td>
<td>12 (100%)</td>
</tr>
<tr>
<td>Female</td>
<td>4 (3.8%)</td>
<td>4 (4.3%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Dominant arm rupture</td>
<td>39 (46%)</td>
<td>33 (45%)</td>
<td>6 (50%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>19</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Complete rupture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>77 (75%)</td>
<td>65 (71%)</td>
<td>12 (100%)</td>
</tr>
<tr>
<td>Partial</td>
<td>26 (25%)</td>
<td>26 (29%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Work related</td>
<td>55 (53%)</td>
<td>48 (53%)</td>
<td>7 (58%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Time to Surgery (days)</td>
<td>16 (8, 31)</td>
<td>16 (8, 31)</td>
<td>15 (8, 25)</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

*Statistics presented: median (IQR); n (%).

Table III
Single- and double-incision repair cost profiles

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N Overall, N = 104</th>
<th>Single incision, N = 92*</th>
<th>Double incision, N = 12*</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant costs (USD)</td>
<td>104</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>0</td>
<td>12 (12%)</td>
<td>0 (0%)</td>
<td>12 (100%)</td>
<td></td>
</tr>
<tr>
<td>242.25</td>
<td>2 (1.9%)</td>
<td>2 (2.2%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>280.25</td>
<td>90 (87%)</td>
<td>90 (98%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Procedure cost with disposables (USD)</td>
<td>104</td>
<td>483 (453, 544)</td>
<td>478 (452, 523)</td>
<td>606 (567, 629)</td>
</tr>
<tr>
<td>Procedure cost with implants (USD)</td>
<td>104</td>
<td>508 (479, 558)</td>
<td>500 (475, 552)</td>
<td>552 (514, 564)</td>
</tr>
<tr>
<td>Total surgical cost (USD)</td>
<td>104</td>
<td>748 (718, 793)</td>
<td>758 (732, 803)</td>
<td>606 (567, 629)</td>
</tr>
</tbody>
</table>

*Statistics presented: n (%); median (IQR).

*Statistical tests performed: Fisher’s exact test; Wilcoxon rank-sum test.

The present study’s experience at the start of clinical practice represents the entirety of the double-incision group is a significant limitation to this study. However, Grant et al reported a mean operative time of 98 ± 15 minutes for the transosseous, double-incision group (2 surgeons, 28 cases), which is similar to that seen in the present study (1 surgeon, 12 cases). The present study’s double-incision tourniquet times are also similar to those from the study by Dunphy et al, corroborating their finding that single-incision tourniquet times were significantly less than double-incision tourniquet times. Notably, Dunphy et al included 85 surgeons who performed 784 total repairs (145 double incision), with surgeons performing double-incision repairs having 13.8 years of experience, compared with 9.4 years for single incision (P < .001). Finally, given the similarity of surgical setup for single- and double-incision repairs, the study focused on reporting on relevant differences in direct costs and did not fully delineate other indirect costs associated with differences in complications or operating room utilization.

Conclusion
In a single surgery center, single-incision distal biceps repairs utilizing an implant were performed more expeditiously than double-incision repairs with a transosseous technique but incurred greater surgical costs. Differences in surgical time cost between the
two approaches could be consequential for ASCs and other stakeholders.

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References