

Surgeon Variation in Arthroscopic Treating for Acetabular Labral Tears

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INTRODUCTION: Amidst mounting pressure to reduce health care spending, strategies for identifying and eliminating unwarranted variation in costs have garnered significant attention. Inter-surgeon cost variation remains unexplored in the context of hip arthroscopy, despite its growing utilization. Thus the purpose of the present study is to (1) characterize variation in the cost of hip arthroscopy between surgeons using time-driven activity-based costing (TDABC) and (2) identify patient demographics, intraoperative findings, and operative procedures underlying such variation in costs.

METHODS: Employing TDABC, we measured the intraoperative cost of 890 outpatient hip arthroscopy cases performed by five surgeons at four single-institution surgery centers from 2015-2022. Costs were normalized to protect confidentiality. Surgeon-specific mean costs were calculated with and without adjustment for patient characteristics, surgical personnel, operative factors, and surgery center. Additionally, we estimated the proportion of inter-surgeon variation attributable to different cost subcategories, including labor, implant/allograft, and other supply costs.

RESULTS SECTION: The normalized intraoperative cost per patient ranged from 38.2 to 212.8, with a 1.6-fold variation in the average cost between the highest and lowest cost surgeons. Operating surgeon alone explained 53.4% of the observed variation in costs. Controlling for case-specific features significantly improved explanatory power to 91.8% ($p < 0.001$), yet the adjusted variation in costs between surgeons remained essentially unchanged (decreased by <3%). Each of the five surgeons generated costs that deviated significantly from those predicted based on case-specific factors, with mean surgeon deviations ranging from -5.0% to 21.8% ($p < 0.001$ for all). Drivers of cost variation differed between surgeons but generally stemmed from labor or “other” supply costs, rather than implant/allograft expenditures.

DISCUSSION: The cost of outpatient hip arthroscopy varies widely between surgeons. While within-surgeon cost variation was effectively explained by patient and operative characteristics, most between-surgeon variability remained unexplained by observable factors. These insights may support cost reduction efforts and facilitate better alignment of reimbursement rates with costs.

SIGNIFICANCE/CLINICAL RELEVANCE: By incorporating TDABC analysis to assess inter-surgeon cost variation, the present study helps to identify potential factors to help reduce cost and better align reimbursement rates within hip arthroscopy.

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IMAGES AND TABLES:

Table 1. Characteristics of the study population (n = 890)*

| Variable | Mean (SD) or No. (%) | Variable | Mean (SD) or No. (%) |
|--------------------------------------|----------------------|--|----------------------|
| Year | 2019.6 (1.9) | Capsule management | |
| Age | 37.1 (12.7) | Interportal capsulotomy with repair | 259 (29.1) |
| Body mass index (kg/m ²) | 26.6 (4.7) | Interportal capsulotomy without repair | 120 (13.5) |
| Gender | | T-capsulotomy with repair | 206 (23.1) |
| Female | 515 (57.9) | T-capsulotomy without repair | 8 (0.9) |
| Male | 375 (42.1) | Puncture capsulotomy | 297 (33.4) |
| Race | | BMAC or microfracture | 243 (27.3) |
| Asian | 23 (2.6) | Labral tear size (degrees) | 74.8 (21.9) |
| Black or African American | 22 (2.5) | Beck classification of labral damage | |
| White | 806 (90.6) | Normal | 5 (0.6) |
| Other | 21 (2.4) | Degeneration | 311 (34.9) |
| Unavailable | 18 (2.0) | Full-thickness tear | 374 (42.0) |
| Ethnicity | | Detachment | 191 (21.5) |
| Hispanic or Latino | 34 (3.8) | Ossification | 9 (1.0) |
| Not Hispanic or Latino | 831 (93.4) | Number of suture anchors | |
| Unavailable | 25 (2.8) | 0-2 | 253 (28.4) |
| ASA score | | 3 | 432 (48.5) |
| 1 | 380 (42.7) | 4 | 143 (16.1) |
| 2 | 476 (53.5) | 5-7 | 62 (7.0) |
| 3 | 34 (3.8) | Surgeon | |
| Previous ipsilateral surgery | 30 (3.4) | Surgeon #1 | 297 (33.4) |
| Previous contralateral surgery | 85 (9.6) | Surgeon #2 | 275 (30.9) |
| Osteoplasty type | | Surgeon #3 | 231 (26.0) |
| Acetabuloplasty | 162 (18.2) | Surgeon #4 | 52 (5.8) |
| Femoroplasty | 224 (25.2) | Surgeon #5 | 35 (3.9) |
| Combined | 407 (45.7) | Surgery center | |
| None | 97 (10.9) | Surgery center A | 366 (41.1) |
| Labrum procedure | | Surgery center B | 254 (28.5) |
| Debridement | 84 (9.4) | Surgery center C | 177 (19.9) |
| Repair | 521 (58.5) | Surgery center D | 93 (10.4) |
| Augmentation | 266 (29.9) | | |
| Reconstruction | 19 (2.1) | | |

*Data presented as mean (standard deviation) or No. of patients (%).

Abbreviations: SD, standard deviation; ASA, American Society of Anesthesiologists; BMAC, bone marrow aspirate concentrate.

Table 3. Multivariable linear regression evaluating inter-surgeon variation in costs, controlling for relevant patient and case-specific characteristics

| Variable | Mean difference | 95% CI | | P value* |
|---|-----------------|--------|--------|----------|
| | | Lower | Upper | |
| Patient characteristics | | | | |
| Age, per 1-year increase | -0.09 | -0.16 | -0.01 | 0.022 |
| Male gender | 4.51 | 2.64 | 6.38 | <0.001 |
| Beck classification of labral damage, per 1-unit increase | 4.05 | 2.82 | 5.29 | <0.001 |
| Operative year, per 1-year increase | 1.02 | 0.44 | 1.60 | <0.001 |
| Surgical personnel [†] | | | | |
| Resident assistant | 2.96 | 0.08 | 5.84 | |
| Fellow assistant | 4.22 | 0.69 | 7.75 | |
| Physician's assistant | 2.26 | -1.12 | 5.63 | <0.001 |
| Multiple assistants | 10.80 | 6.26 | 15.35 | |
| Operative factors | | | | |
| Acetabuloplasty [‡] | 5.26 | 1.21 | 9.32 | |
| Femoroplasty [‡] | 7.45 | 3.09 | 11.81 | <0.001 |
| Femoral acetabuloplasty [‡] | 12.57 | 8.34 | 16.80 | |
| Labral debridement [§] | -27.31 | -30.82 | -23.79 | <0.001 |
| Labral reconstruction [§] | 50.59 | 44.57 | 56.61 | |
| Interportal capsulotomy without repair [§] | 0.20 | -4.84 | 5.25 | |
| T-capsulotomy with repair [§] | 4.17 | -0.92 | 9.25 | 0.117 |
| T-capsulotomy without repair [§] | -2.30 | -12.98 | 8.38 | |
| Puncture capsulotomy [§] | -23.00 | -67.21 | 21.21 | |
| BMAC or microfracture | 14.57 | 11.33 | 17.82 | <0.001 |

*P values calculated using likelihood-ratio tests. [†]Reference: no assistant. [‡]Reference: no osteoplasty. [§]Reference: labral repair (with or without capsular augmentation). [¶]Reference: interportal capsulotomy with repair. This model also included operating surgeon as a random intercept. Marginal R² = 0.302; conditional R² = 0.814. Boldface denotes statistical significance.

Abbreviations: BMAC, bone marrow aspirate concentrate.

Table 2. Normalized cost and time estimates for outpatient hip arthroscopy, stratified by operating surgeon*

| Variable | Study average | Surgeon #1 | Surgeon #2 | Surgeon #3 | Surgeon #4 | Surgeon #5 | P value |
|--------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| Total cost | 100.0 (98.3, 101.7) | 96.1 (93.9, 98.2) | 81.5 (78.9, 84.0) | 122.3 (119.8, 124.8) | 130.1 (123.8, 136.5) | 87.0 (80.0, 94.0) | <0.001 |
| Labor cost | 46.8 (45.9, 47.7) | 50.4 (49.4, 51.4) | 33.7 (32.8, 34.6) | 52.5 (51.4, 53.7) | 73.6 (70.3, 77.0) | 41.2 (39.0, 43.5) | <0.001 |
| Supply cost | 53.2 (52.1, 54.4) | 45.7 (44.1, 47.2) | 47.8 (45.8, 49.7) | 69.7 (68.1, 71.3) | 56.5 (52.6, 60.4) | 45.7 (39.6, 51.9) | <0.001 |
| Implant and/or allograft costs | 17.2 (16.5, 17.8) | 14.6 (14.1, 15.1) | 19.6 (18.1, 21.1) | 16.2 (14.8, 17.5) | 20.3 (17.7, 22.9) | 21.6 (18.2, 25.1) | <0.001 |
| Other/disposables costs | 36.1 (35.1, 37.0) | 31.1 (29.8, 32.4) | 28.2 (27.2, 29.1) | 53.6 (52.9, 54.2) | 36.2 (33.2, 39.2) | 24.1 (19.4, 28.8) | <0.001 |
| Time in operating room | 171.7 (168.1, 175.3) | 185.3 (181.3, 189.3) | 118.2 (114.6, 121.7) | 196.7 (191.8, 201.5) | 278.5 (265.3, 291.7) | 154.0 (145.2, 162.7) | <0.001 |
| Time from incision to closure | 110.9 (107.9, 113.8) | 117.2 (113.6, 120.7) | 76.1 (72.8, 79.4) | 124.6 (120.1, 129.2) | 209.3 (197.7, 220.9) | 92.8 (84.7, 101.0) | <0.001 |

*Data presented as average normalized cost or average minutes (95% confidence interval). Boldface denotes statistical significance.