EE28

# Identifying Factors Underlying Variation in the Cost of Acetabular Labral Repair or Debridement during Hip Arthroscopy

## *A Time-Driven Activity-Based Costing Analysis*


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## BACKGROUND

- Recent estimates project US health expenditures to grow at an average annual rate of 5.6% for 2016–25 and represent 19.9% of gross domestic product by 2025[1]
- Value-based health care aims to fundamentally restructure health care delivery, measurement, and renumeration to maximize value (health outcomes / costs)[2,3]
- Improving value requires the accurate measurement of costs to
  1. Complete the value equation
  2. Identify opportunities to optimize care pathways[4-6]
- **Time-driven activity-based costing (TDABC)** accurately calculates costs by synthesizing the quantity and per-unit cost of each resource required to deliver care on a case-specific basis[7,8]
- Despite the rapid growth of hip arthroscopy over the past 20+ years, its cost drivers and variability remain unknown[9,10]

## OBJECTIVES

1. Quantify the cost of hip arthroscopy for symptomatic labral tears using TDABC
2. Explore variation in costs based on patient-specific characteristics, operative techniques, and surgical settings
3. Evaluate associations between total costs and common outcome metrics (e.g., length of hospital stay & operative time)

## METHODS

- The Care Measurement software (Avant-garde Health, Boston, MA) was used to identify 1,036 cases of hip arthroscopy cases between June 2015 & November 2022
- **Exclusion criteria**
  - patient <18 years old
  - low volume operating surgeon (<20 cases)
  - labral pathology not addressed during surgery
  - clear documenting errors in EHRs
- These criteria yielded **890 cases** performed by **5 surgeons** at **4 surgery centers** within 1 institution
- TDABC was performed in accordance with guidelines established by Kaplan, Anderson, and other experts.[6,8,11]
- **Briefly, applying TDABC involves**
  1. Developing process maps that encompass all relevant steps in the care pathway
  2. Determining the time and supplies required for each step
  3. Multiplying the quantity of each resource used with its per-unit cost
  4. Summing these products across all expended resources
- Individual process maps were constructed for the preoperative, intraoperative, & postoperative phases and are available online
- Costs were normalized to protect confidentiality. Linear mixed-effects models (with surgeon & surgery center as random effects) were used to identify factors underlying variation in costs

## RESULTS

- ***Patient demographics, comorbidities, and operative characteristics*** (n = 890)
- 515 ***women*** (57.9%) and 375 ***men***
- ***Age*** of 37.1 (12.7) years [Mean (SD)]
- ***BMI*** of 26.6 (4.7) kg/m² [Mean (SD)]
- ***Race***
  - 2.6% Asian
  - 2.5% Black or African American
  - 90.6% White
  - 4.4% other/unavailable

- Use of ***bone marrow aspirate concentrate (BMAC)*** or ***microfracture***: 27.3%
- ***Osteoplasty type***
  - 18.2% acetabuloplasty
  - 25.2% femoroplasty
  - 45.7% both
  - 10.9% neither
- ***Labrum procedure***
  - 8.5% debridement
  - 59.7% repair
  - 29.9% augmentation
  - 1.9% reconstruction

**TABLE 1.** Characteristics independently underlying cost variation

| Variable | Mean Difference | 95% Confidence Interval | | P Value* |
|---|---|---|---|---|
| | | Lower | Upper | |
| **Patient characteristics** | | | | |
| Age, per 1-year increase | -0.07 | -0.14 | 0.00 | 0.059 |
| BMI, per 1-unit increase | 0.02 | -0.15 | 0.20 | 0.80 |
| Male gender | 3.92 | 2.19 | 5.65 | **<0.001** |
| ASA 2† | -0.38 | -2.14 | 1.37 | 0.70 |
| ASA 3† | 1.26 | -3.21 | 5.73 | |
| **Surgical personnel** | | | | |
| Resident assistant‡ | 3.17 | 0.52 | 5.83 | **<0.001** |
| Fellow assistant‡ | 4.77 | 1.50 | 8.04 | |
| Physician's assistant‡ | 4.12 | 1.00 | 7.24 | |
| Multiple assistants‡ | 8.72 | 4.53 | 12.91 | |
| **Case-specific factors** | | | | |
| Year, per 1-year increase | 0.62 | 0.08 | 1.16 | **0.023** |
| Acetabuloplasty§ | 3.80 | 0.05 | 7.54 | **<0.001** |
| Femoroplasty§ | 4.33 | 0.38 | 8.27 | |
| Femoral acetabuloplasty§ | 11.72 | 7.85 | 15.59 | |
| Labral repair¶ | 22.39 | 18.98 | 25.79 | **<0.001** |
| Labral augmentation¶ | 19.88 | 14.69 | 25.06 | |
| Labral reconstruction¶ | 72.47 | 65.99 | 78.95 | **<0.001** |
| BMAC or microfracture | 12.91 | 9.89 | 15.94 | |
| T-capsulotomy# | 6.32 | 2.71 | 9.93 | **<0.001** |
| Puncture capsulotomy# | -45.40 | -82.95 | -7.86 | |

*P values calculated using likelihood-ratio tests. †Reference: ASA 1. ‡Reference: no assistant. §Reference: no osteoplasty. ¶Reference: labral debridement. #Reference: interportal capsulotomy. This model also included surgeon and surgery center as random intercepts. Marginal $R^2 = 0.397$; conditional $R^2 = 0.887$. Boldface denotes statistical significance.

- ***Additional hypothesis-generating analyses were performed to explore trends between total costs and gender, age, and operative year***

### Male Gender Associations

*(p<0.001 for all)*

- higher supply costs
  - (50.3 vs. 47.6)
- longer operative times
  - (192.2 vs. 156.8 minutes)
- more femoral acetabuloplasties
  - (62.1% vs. 33.8%)

### Younger Patients

*(p<0.001 for all)*

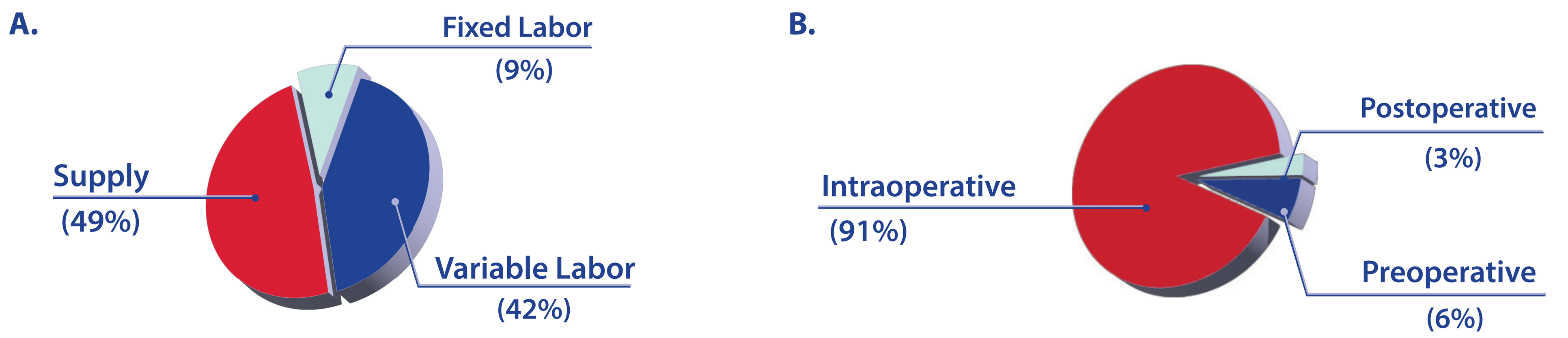
- underwent labral debridement at lower rates
- received osteoplasties & BMAC/microfracture at higher rates
- experienced longer operative times

### Operative Year

*(p<0.001 for all)*

- positive correlations were found between the year of surgical intervention and
  - labor costs (r=0.35)
  - supply costs (r=0.35)
  - operative time (r=0.37)

**FIGURE 1.** Cost composition of outpatient hip arthroscopy stratified by (A.) labor and supply costs and (B.) phases of the care cycle.




## CONCLUSIONS

- We identified *wide variation in costs* that was most effectively explained by the **operating surgeon** and **surgery center**, followed by **case-specific characteristics**
  - (e.g., procedure type, operative technique, provider team)
- Surprisingly, many patient demographics such as age, BMI, and ASA score were not independently associated with costs
- Our findings that the complexity and cost of hip arthroscopy have increased in recent years have implications on equitable health care delivery, given simultaneous reductions in reimbursements[12]
- These insights may support physicians, payers, and other stakeholders to contain costs, implement bundled reimbursement structures, and deliver higher-value orthopedic care

## REFERENCES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