Cost and Cost-Driver Analysis of Transtibial Pull-Out Meniscal Root Repair Techniques Using Time-Driven Activity Based Costing

Brandon Stradel, Haley Diane Puckett, Kehinde S Agoro, Rebekah Kleinsmith, Saral Patel, Brian Cunningham

INTRODUCTION:

Transtibial pull-out meniscal root repairs have grown in incidence with generally favorable outcomes. Little has been reported on the cost of this procedure. The purposes of this study were to use time-driven activity-based costing (TDABC) to (1) calculate total costs of care for meniscal root repair and (2) to evaluate the impact of implant choice and disposable instruments on meniscal root repair surgery costs. We hypothesized that there would be significant variability in cost between surgeons and choices of implant and disposable instruments.

METHODS:

A retrospective review of 370 patients was conducted to evaluate the costs associated with transtibial pull-out techniques for meniscus root repair using TDABC. All patients within a single healthcare system who received operative fixation of primary isolated meniscal root repairs with a transtibial pull-out technique from October 2016 – February 2025 were eligible for inclusion.

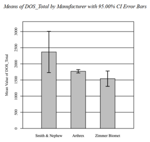
RESULTS:

370 patients met inclusion criteria. A total of 16 surgeons performed repairs. The average total implant cost was $518.55 ± $293.65. The average direct DOS cost was $1,496.58 ± $440.93, and the average indirect DOS cost was $269.38 ± $79.37. The average total DOS cost was $1,765.96 ± $520.30. The largest singular contributor to variance in total DOS cost was total implant cost, which accounted for 56.7% of variance. Collectively, age, smoking status, implant manufacturer, year of surgery, operating surgeon, anesthesia time, operative time, recovery time, and implant cost account for 99.6% of the variance in total DOS costing.

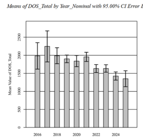
DISCUSSION AND CONCLUSION:

This study uses TDABC to assess direct and indirect costs associated with transtibial pull-through meniscal root repair with significant variability reported between surgeons and techniques. Without a clear difference in patient reported outcomes, cost difference should be considered when choosing a technique and implants to provide value-based care.

Means of DOS_Total by Manufacturer with 95.00% CI Error Bars



Means of DOS_Total by Year_Nominal with 95.00% CI Error Bars



Means of DOS_Total by Lead_Surgeon_Provider with 95.00% CI Error Bars

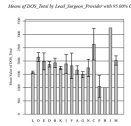


Table 1. Patient Demographics & Surgical Characteristics (N = 370)	
Age (years)	52.0 ± 11.2
Sex	
Male	97 (26.2)
Female	273 (73.8)
BMI[a] (kg/m²)	31.2 ± 6.2
Smoking Status	
Never	274 (74.1)
Former	76 (20.5)
Current	18 (4.9)
Unknown	2 (0.5)
ASA[b] Score	
1	84 (22.7)
2	235 (63.5)
3	48 (13.0)
Not Documented	3 (0.8)
Laterality	
Right	186 (50.3)
Left	184 (49.7)
Implant Manufacturer	
Smith & Nephew	7 (1.9)
Arthrex	337 (91.1)
Zimmer Biomet	26 (7.0)
Year of Surgery	
2016	3 (0.8)
2017	13 (3.5)
2018	36 (9.7)
2019	61 (16.5)
2020	41 (11.1)
2021	52 (14.1)
2022	41 (11.1)
2023	57 (15.4)
2024	59 (16.0)
2025	7 (1.9)
Preoperative Time (minutes)	89.7 ± 37.0
Anesthesia Time (minutes)	96.3 ± 24.9
Operative Time (minutes)	62.0 ± 22.6
Recovery Time (minutes)	160.9 ± 157.4

Categorical data presented as n/N (%). Continuous data presented as average ± standard deviation. Note: Percentages may not equal 100% due to rounding. [a]BMI = Body Mass Index; [b]ASA = American Society of Anesthesiologists.

Table 2. Implants Used for Meniscal Root Repairs (N = 370)	
Button	47 (12.7)
SwiveLock	310 (83.8)
SutureLoc	13 (3.5)

Categorical data presented as n/N (%). Note: Percentages may not equal 100% due to rounding.

Table 3. Day-Of-Surgery Costing for Meniscal Root Repairs (N = 370)	
Total Implant Cost	$518.55 ± $293.65
Direct DOS[a] Cost	$1,496.58 ± $440.93
Indirect DOS[a] Cost	$269.38 ± $79.37
Total DOS[a] Cost	$1,765.96 ± $520.30

Categorical data presented as n/N (%). Continuous data presented as average ± standard deviation. All costing data measured in 2024 United States dollars. Note: Percentages may not equal 100% due to rounding. [a]DOS = Day-Of-Surgery.

Table 4. Effects of Patient and Surgical Characteristics on Total DOS[a] Costing (N = 370)

Characteristic	Univariate p-Value	Multivariable p-Value
Age	<0.001	0.261
Sex	0.555	---
BMI[b]	0.152	---
Smoking Status	0.013	0.240
ASA[c] Score	0.591	---
Laterality	0.062	---
Implant Manufacturer	< 0.001	< 0.001
Year of Surgery	< 0.001	< 0.001
Surgeon	< 0.001	< 0.001
Preoperative Time	0.201	---
Anesthesia Time	< 0.001	< 0.001
Operative Time	< 0.001	< 0.001
Recovery Time	< 0.001	< 0.001
Implant Cost	< 0.001	< 0.001

Continuous data presented as average ± standard deviation. Costs represented in United States dollars ($). Bold text indicates statistical significance (i.e. p ≤ 0.05). [a]DOS = Day-Of-Surgery; [b]BMI = Body Mass Index; [c]ASA = American Society of Anesthesiologists.