

# Direct Variable Cost Comparison of Endoscopic versus Open Carpal Tunnel Release: A Time-Driven Activity-Based Costing Analysis

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## INTRODUCTION:

To improve the delivery of value-based health care, a deeper understanding of the cost drivers in hand surgery is warranted. Time-driven activity-based costing (TDABC) offers a more accurate estimation of resource utilization compared to traditional accounting methods. This study utilized TDABC to compare the facility costs of open carpal tunnel release (OCTR) and endoscopic carpal tunnel release (ECTR).

## METHODS:

We identified 845 consecutive, unilateral CTR (516 open, 329 endoscopic) performed at an orthopaedic specialty hospital between 2015 and 2021. An established TDABC algorithm was developed by a third-party vendor and utilized TDABC to calculate direct variable facility costs, which included supply and personnel costs (Figure 1). Patient demographics, comorbidities, surgical characteristics, and itemized costs were compared between OCTR and ECTR. Multivariate regression was performed to determine the independent effect of endoscopic surgery on true facility costs.

## RESULTS:

Endoscopic CTR patients were younger ( $57 \pm 10$  vs.  $66 \pm 14$  years,  $P < 0.001$ ), had a higher BMI ( $32 \pm 6$  vs.  $31 \pm 7$  kg/m<sup>2</sup>,  $P < 0.001$ ), and were more likely to be male (52% vs. 41%,  $P < 0.001$ ) and Hispanic (16% vs. 11%,  $P = 0.029$ ) (Table 1). Surgery-related personnel cost was the primary cost driver for OCTR (38%), while other supply cost was the main driver of total facility cost for ECTR (41%) (Figure 2). Total facility costs were \$352 higher in ECTR compared to OCTR (\$882 vs. \$530) (Table 2). ECTR cases had higher personnel costs (\$499 vs. \$420), likely due to longer surgical (15 vs. 11 mins) and total operating room time (35 vs. 27 mins). ECTR cases also had higher supply costs (\$383 vs. \$110). Controlling for demographics and comorbidities, ECTR was associated with an increase in personnel costs of \$35.74 (95% CI, \$26.32–\$45.15), supply costs of \$230.28 (95% CI, \$205.17–\$255.39), and total facility costs of \$265.99 (95% CI, \$237.01–\$294.97) per case (Table 3).

## DISCUSSION AND CONCLUSION:

To deliver value-based care amidst declining reimbursement rates for elective hand procedures, more cost-conscious approaches for surgical management have become increasingly essential for maintaining practice sustainability. Using TDABC, ECTR was found to be 66% more costly to the facility compared to OCTR. Additionally, ECTR was independently associated with a \$230.28 increase in total supply costs. To reduce the costs related to endoscopic surgery, efforts to utilize cheaper, single-use disposable ECTR blade systems, implants, and single-use arthroscopes are warranted.

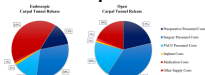
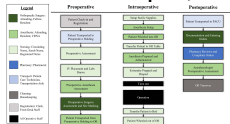


Table 1. Univariate Analysis of Patient and Surgical Characteristics

Variable	All patients	OCTR	ECTR	P-value
Age	62.1 (15)	66.1 (14)	57.1 (10)	<0.001
Sex				
Male	371 (49)	205 (41)	166 (51)	
Female	474 (57)	311 (60)	313 (95)	
Ethnicity				
Hispanic	100 (12)	100 (20)	100 (31)	
White	100 (12)	100 (20)	100 (31)	
Black	100 (12)	100 (20)	100 (31)	
Other	116 (14)	116 (23)	116 (36)	
Body Mass Index	31.1 (6)	31.1 (6)	32.1 (6)	0.001
Diabetes Mellitus	11.1 (1)	11.1 (2)	11.1 (3)	0.881
Arthritis	21.1 (3)	21.1 (4)	21.1 (6)	0.681
Preoperative ROM (°)	21.1 (4)	21.1 (4)	21.1 (4)	0.681
Preoperative NDI score	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Postoperative ROM (°)	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Postoperative NDI score	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Length of stay (days)	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Cost	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Facility cost	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Supply cost	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Personnel cost	21.1 (2)	21.1 (2)	21.1 (2)	0.681
Total cost	21.1 (2)	21.1 (2)	21.1 (2)	0.681

Table 2. Cost and Time of Open and Endoscopic Carpal Tunnel Release

Variable	Total Cases	OCTR	ECTR	P-value
Facility cost	845 (\$530)	516 (\$530)	329 (\$882)	<0.001
Personnel cost	845 (\$420)	516 (\$420)	329 (\$499)	<0.001
Supply cost	845 (\$110)	516 (\$110)	329 (\$383)	<0.001
Total cost	845 (\$650)	516 (\$650)	329 (\$764)	<0.001
Operating room time (mins)	845 (27)	516 (27)	329 (35)	<0.001
Surgical time (mins)	845 (11)	516 (11)	329 (15)	<0.001
Postoperative ROM (°)	845 (21)	516 (21)	329 (21)	0.681
Postoperative NDI score	845 (21)	516 (21)	329 (21)	0.681
Length of stay (days)	845 (2)	516 (2)	329 (2)	0.681
Cost	845 (21)	516 (21)	329 (21)	0.681
Facility cost	845 (21)	516 (21)	329 (21)	0.681
Supply cost	845 (21)	516 (21)	329 (21)	0.681
Personnel cost	845 (21)	516 (21)	329 (21)	0.681
Total cost	845 (21)	516 (21)	329 (21)	0.681

Table 3. Multivariate Linear Regression for Association between Endoscopic Surgery and Increased Costs

Variable	95% CI	P-value
Facility cost	\$265.99 (\$237.01–\$294.97)	<0.001
Personnel cost	\$35.74 (\$26.32–\$45.15)	<0.001
Supply cost	\$230.28 (\$205.17–\$255.39)	<0.001
Total cost	\$532.01 (\$506.90–\$557.12)	<0.001

CI, confidence interval; ROM, range of motion; NDI, North Hand, Middle and Ring; SF-12, Short Form 12; NDI, North Hand middle and ring.

OCTR, open carpal tunnel release; ECTR, endoscopic carpal tunnel release; ROM, range of motion; NDI, North Hand, Middle and Ring; SF-12, Short Form 12; NDI, North Hand middle and ring.

OCTR, open carpal tunnel release; ECTR, endoscopic carpal tunnel release; CI, confidence interval; ROM, range of motion; NDI, North Hand, Middle and Ring; SF-12, Short Form 12; NDI, North Hand middle and ring.