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Medicare Spending and Evidence-based Approach in Surgical Treatment of Thumb Carpometacarpal Joint Arthritis: 2001–2010

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Abstract

Background—Despite equivalent outcomes among surgical treatments of thumb carpometacarpal (CMC) arthritis, little is known about variation in spending. Owing to its complexities, we hypothesized that trapeziectomy with ligament reconstruction and tendon interposition (LRTI) when compared to other surgical procedures incurs the greatest cost to Medicare.

Methods—Using a random 5% sample of Medicare beneficiaries diagnosed with thumb CMC arthritis, we examined total and out-of-pocket spending for 3,530 patients who underwent a surgical treatment, between 2001 and 2010. We used generalized linear regression models, controlling for patients' characteristics and place of surgery to examine variation in spending.

Results—89% of patients who underwent surgery received trapeziectomy with LRTI, with *total* and *out-of-pocket* spending of \$2,576 (CI: \$2,333 – \$2,843, $p < 0.001$) and \$436 (CI: \$429 – \$531, $p < 0.001$), respectively. Simple complete trapeziectomy was the least expensive procedure, performed only among 5% of patients, with *total* and *out-of-pocket* spending of \$1,268 (CI: \$1,089 – \$1,476, $p < 0.001$) and \$236 (CI: \$180 – \$258, $p < 0.001$), respectively. Owing to increasingly higher facility costs, performing the same procedure in a hospital outpatient setting compared with an ambulatory center would increase Medicare spending by more than two folds ($p < 0.001$).

Conclusions—With a consistent rise of healthcare spending, adherence to evidence-based approach in medicine is more important than ever. Most surgeons continue to perform trapeziectomy with LRTI, the most expensive surgical option. Medicare could potentially save \$74 million annually if simple complete trapeziectomy was the procedure of choice.

Keywords

thumb carpometacarpal; osteoarthritis; Medicare; trends; total cost; out-of-pocket cost

INTRODUCTION

There is unanimous agreement that the current trend in healthcare spending in the U.S. is not sustainable. By 2020, it is expected that healthcare spending will account for one-fifth of the gross domestic product (GDP), up from 17.4% in 2013.¹ Owing to a sluggish economy, aging population, and expanded coverage under the Affordable Care Act (ACA), healthcare spending is expected to grow even faster in coming years.^{1,2} To curb the increasing rate of healthcare spending, many argue that eliminating unnecessary and wasteful expenditures should be the main strategic policy.^{1,3}

Degenerative arthritis of the thumb carpometacarpal (CMC) joint is a chronic disease that increasingly affects a growing segment of our population.⁴⁻⁸ Approximately 8% of men and 25% of women ages 50 years and older are afflicted with thumb CMC arthritis; up to 20% of them require some form of treatment to prevent severe pain and joint deformity.⁸⁻¹⁰ Surgical treatment of thumb CMC arthritis includes four main surgical procedures: (1) trapeziectomy with ligament reconstruction and tendon interposition (LRTI), (2) simple complete trapeziectomy, (3) CMC joint arthrodesis and (4) prosthetic CMC joint arthroplasty.^{9,11} Research reveals comparable effectiveness and outcomes among these procedures.¹² Recent studies, however, still depict the overwhelming popularity of the use of trapeziectomy with LRTI compared to simple trapeziectomy.¹³

Owing to our aging population in the U.S. and the increasing prevalence of certain chronic conditions, non-adherence to evidence-based approach in medicine can lead to unnecessary and excessive healthcare costs.¹⁴ Today, despite the popularity of trapeziectomy with LRTI among hand surgeons treating thumb CMC arthritis, little is known about the variation in direct healthcare spending associated with each of the main surgical interventions. The two main pillars of the 2010 healthcare reform in the U.S. are to improve quality of care and to restrain growth of healthcare costs.¹ In order to keep Medicare a sustainable program for our senior citizens, it is essential to find ways to define and eliminate excessive healthcare expenditures.

Using the 2001 to 2010 Medicare claims data for a 5% random sample of patients 65 years of age and older who were diagnosed with thumb CMC arthritis, we examined the total and out-of-pocket spending of four main surgical treatments of thumb CMC arthritis. Our specific aims were: (1) to examine the national trends in total and out-of-pocket spending stratified by surgical procedure, place of surgery, and surgeon's reimbursement fee, (2) to examine factors associated with direct total and out-of-pocket spending on surgical treatment, and (3) to examine variations in spending based on surgeon's reimbursement fee and place of surgery. We hypothesized that trapeziectomy with LRTI, compared with other surgical procedures, was the most expensive procedure. Additionally, we hypothesized no substantial differences in spending between outpatient hospital settings and surgical ambulatory centers.

METHODS

Data source

We used Medicare claims data for a 5% random sample of Medicare beneficiaries with thumb CMC arthritis diagnosed between 2001 and 2010. We used a collection of Medicare claims files, including Beneficiary Summary, Medicare Provider and Analysis Review, Outpatient, Carrier, and Carrier Line files. Claims data can be linked using the de-identified unique Medicare beneficiary identification number and claim id. To define the specific surgical procedures performed, we used: (1) diagnosis (*International Classification of Diseases, Ninth Revision, Clinical Revision, Clinical Modification [ICD-9-CM]*), (2) procedure (*Current Procedural Terminology 4 [CPT-4]*), and (3) the healthcare Procedural Coding System. We used each year's Master beneficiary file to exclude patients with Medicare Managed Care as no claims data were collected for these patients. Additionally, we used claim line files (linkable to Carrier and Outpatient files based on beneficiary and claim identification numbers) to determine the physician reimbursement amount for the surgical procedures performed.¹⁵ Our Institutional Review Board approved the use of restricted Medicare claims data.

Sample Selection

To define thumb CMC patients who underwent a surgical procedure, we first searched the ICD-9-CM diagnosis codes for thumb CMC arthritis. Second, we extracted required information for all patients who had received a surgical intervention using CPT codes. Patients without an ICD-9-CM diagnosis of hand osteoarthritis or any manifestations of the condition (such as joint crepitus, arthralgia, and joint instability) were excluded. The CPT code used for simple complete trapeziectomy (25210) is not specific. Thus, we excluded patients with the ICD-9-CM codes for wrist arthritis, carpal fractures, non-unions, and avascular necrosis. Additionally, following previous research on this topic, we excluded patients with an ICD-9-CM diagnosis code for rheumatoid arthritis.

Our study included 3,530 patients ages 65 and older with both a diagnosis of hand osteoarthritis and surgical treatment using one of the following four procedures: (1) trapeziectomy with LRTI, (2) simple complete trapeziectomy, (3) thumb CMC arthrodesis with or without bone graft, and (4) prosthetic arthroplasty-interposition or total joint replacement. After excluding patients with missing values, our final sample included 3,501 thumb CMC patients who underwent one of the above surgical treatments between 2001 and 2010. A schematic diagram of our final sample size is presented in Figure A1 in Appendix.

Dependent and Independent Variables

The direct total and out-of-pocket healthcare spending for surgical treatment of thumb CMC arthritis were our two outcomes of interest. Owing to the small number of patients who underwent CMC joint arthritis or CMC joint prosthetic arthroplasty, we combined the two groups together. Thus, the adjusted predictive total and out-of-pocket spending were estimated for three categories of surgical procedures: (1) trapeziectomy with any LRTI, (2) simple complete trapeziectomy, and (3) CMC joint arthrodesis or CMC joint prosthetic arthroplasty. We measured beneficiaries out-of-pocket spending by adding deductible and

coinsurance liability amounts. Total spending was measured by adding the amounts paid by Medicare, beneficiary, and a secondary insurance, if any.

Our explanatory variables included patient characteristics such as age, sex, race/ethnicity, socioeconomic status, number of comorbid conditions, place of residence (urban versus rural), which we extracted using Master Beneficiary Summary Files (MBSF), and place of medical service, which was obtained from Carrier and Outpatient files. The age variable was presented as a set of categorical variables of 65–74, 75–84, and more than 84. Using Elizhauser's comorbidity algorithm,³ we identified all diagnosed comorbid conditions for each patient and categorized the number of conditions as: fewer than two, between two and four, and more than four. Additionally, we merged the national census data from the year 2000 with the MBSF to include zip-code level household median income and percentage with college education based on beneficiary's place of residence. Median household income was defined using three mutually exclusive categories: (1) low income (less than \$25,000), (2) middle income (between \$25,000 and \$50,000), and (3) high income (more than \$50,000). Finally, we included the year of surgical encounter to control for the year fixed effect in our models, with the 2001 being the reference year.

Statistical Analysis

First, we examined the unadjusted trends in total and out-of-pocket spending, including the surgeon's reimbursement fee for the three main surgical procedures performed for treatment of thumb CMC arthritis. T-tests were utilized to identify the differences in unadjusted costs among surgical procedure groups, stratified by place of medical service (hospital outpatient facility vs. surgical ambulatory center). We then used two generalized linear regression models (GLM)¹⁶ to examine the association between patient characteristics, procedure performed, place of service, and total and out-of-pocket spending of surgical treatment. Healthcare cost data are not normally distributed and variation from average spending is not constant. Therefore, using unadjusted data or ordinary least square regression (OLS) models may provide misleading results. In our GLM, we used a gamma distribution family, which can take a wide range of shapes and is the recommended distribution for healthcare cost data.¹⁶ Next, based on our regression models, we estimated the adjusted predictive total and out-of-pocket spending for each of the three main surgical procedures and calculated the statistical significance of the estimated differences. Using the Consumer Price Index (CPI),¹⁷ all prices were inflated to reflect 2010-dollar values. We used SAS 9.3 for all statistical analyses.

RESULTS

Table 1 presents characteristics of patients who underwent a surgical treatment. 89% of all patients who chose to undergo surgical intervention underwent trapeziectomy with LRTI. The majority (2,806 or 79%) of patients who underwent surgical treatment were female. More than 97% of thumb CMC patients who chose surgical treatment were White, and 70% of them were between 65 and 75 years of age. There were no significant differences in demographic and clinical characteristics of patients among the three surgical intervention groups.

Table 2 presents the unadjusted mean and median of total spending, stratified by place of service and type of medical service (surgeon/physician's reimbursement fees vs. facility and other fees). Ambulatory surgical center is an independently identifiable entity that operates exclusively to provide surgical services that do not required hospitalization. Additionally, the expected time of service does not go beyond 24 hours.¹⁵ For all three surgical procedures, cost of surgery was substantially higher in hospital outpatient settings compared with ambulatory surgical centers. For example, for trapeziectomy with LRTI, the average total spending in a hospital outpatient setting was \$4,186 (CI: \$4,075 – \$4,296) compared with \$1,766 (CI: \$1,723 – \$1,809) in an ambulatory surgical clinic. For the same procedure, physician fees were higher in ambulatory surgical clinics compared with hospital outpatient settings (Medicare pays a higher rate for physician fees in ambulatory settings, but does not pay extra for other facility expenditures).¹⁵ For example, for trapeziectomy with LRTI, surgeon's reimbursement fee in a surgical ambulatory center was \$580 more than a hospital outpatient setting ($p < 0.001$). Regardless of place of service, surgeon's reimbursement fee was substantially higher for trapeziectomy with LRTI compared with other two surgical procedures.

Figure 1 shows the unadjusted national trends between 2001 and 2010 of total spending (a), out-of-pocket spending (b), surgeon reimbursement fees (c), and spending based on place of service (d) for the three main surgical procedures. Over the study period, trapeziectomy with LRTI was the most expensive procedure. The average inflation adjusted total spending for the procedure increased by 37% from \$1,856 (CI: \$1,703 – \$2009) in 2001 to \$2,534 (CI: \$2,336 – \$2,733) in 2010 (Figure 1a). Throughout the study period, on average, patients paid more out of pocket for trapeziectomy with LRTI than for simple complete trapeziectomy (Figure 1b). Figure 1c reveals an 8% increase in physician reimbursement fee for trapeziectomy with LRTI and a 53% decrease for simple complete trapeziectomy, over time. About 20% of all procedures performed in a hospital outpatient setting. Our findings indicate a substantial upward trend in total spending at outpatient facilities. The average total spending in a hospital outpatient setting increased by 65% from \$3,032 (CI: \$2773 – \$3792) in 2001 to \$5,009 (CI: \$4,713 – \$5,304) in 2010 (Figure 1d).

Table 3 presents the results of our GLM regression models for total and out-of-pocket costs of surgical treatment of thumb CMC arthritis. Compared with CMC joint arthrodesis or CMC joint prosthetic arthroplasty, trapeziectomy with LRTI was associated with a higher total cost of operation by a factor of 1.16 (beta=0.15, CI: 0.03–0.26, $p=0.011$) and simple complete trapeziectomy was associated with lower total cost of operation by a factor of 0.57 (beta=-0.56, CI=-0.72 – -0.40, $p < 0.001$). Performing the procedure in a hospital outpatient setting compared with a surgical ambulatory center was associated with higher total spending by a factor of 1.95 (beta=0.67, CI: 0.61 – 0.72, $p < 0.001$). Our results also indicated an upward temporal trend in total spending. For example, compared with 2001, performing the procedure in 2010 was associated with an increase in total spending by a factor of 1.31 (beta=0.27, CI=0.14 – 0.39, $p < 0.001$). For out-of-pocket spending, compared with CMC joint arthrodesis or CMC joint prosthetic arthroplasty, simple complete trapeziectomy was associated with a lower out-of-pocket cost by a factor of 0.58 (beta=-0.54, CI=-0.68 – -0.40, $p < 0.001$). Performing the procedure in a hospital outpatient

setting compared with a surgical ambulatory center was associated with higher spending by a factor of 3.42 (beta=1.23, CI: 1.19 – 1.28, $p < 0.001$).

Figure 2 presents the adjusted predictive total and out-of-pocket spending, stratified by the surgical procedure. Between 2001 and 2010, the adjusted predicted total average spending of simple complete trapeziectomy was \$1,268, which was \$1,308 ($p < 0.001$) lower than the total adjusted predicted cost of trapeziectomy with LRTI and \$957 ($p < 0.001$) lower than CMC joint arthrodesis or CMC joint prosthetic arthroplasty. Similarly, the adjusted predicted out-of-pocket spending of simple complete trapeziectomy was \$236, which was \$200 ($p < 0.001$) lower than the adjusted predicted out-of-pocket spending of trapeziectomy with LRTI and \$171 ($p < 0.001$) lower than CMC joint arthrodesis or CMC joint prosthetic arthroplasty.

Discussion

The impact of thumb CMC arthritis on U.S. healthcare expenditures will continue to increase as the population of people over the age of 65 almost doubles from 36.9 million in 2009 to approximately 72.1 million people by 2030.¹⁸ Despite reported comparable outcomes in symptom relief, preservation of function, and patient satisfaction among the main surgical treatments of thumb CMC arthritis,^{12,19,20} variation in surgical treatment persists. In this study, we examined total and out-of-pocket spending of various surgical procedures used for treatment of this condition. Our results indicate that trapeziectomy with LRTI was the most expensive surgical treatment. Second, owing to higher facility costs, performing the surgery in a hospital outpatient setting versus in a surgical ambulatory clinic substantially increased the total and out-of-pocket spending. Finally, there was an upward trend in surgeon's reimbursement fee for trapeziectomy with LRTI over the last decade, which may have deterred surgeons to follow an evidence-based approach in adopting the less costly simple trapeziectomy procedure.

Clinical trials indicate no significant difference among surgical treatments of thumb CMC arthritis. Wajon et al.'s 2005, 2009, and 2015 Cochrane systematic reviews include four studies of comparisons between simple trapeziectomy and trapeziectomy in combination with LRTI.^{21–26} Pooled data from all four studies indicate equivalent pain relief with both techniques and data pooled for measures of physical function from two of the four studies show equivalent outcomes as well.^{23–26} Although one of the most enduring concerns with simple trapeziectomy is a weak thumb, pooled data from three of the four studies that performed strength comparisons showed equivalent outcomes with both techniques.^{23–25} Additionally, Belcher et al. measured scapho-metacarpal distance (trapezial space) and found no significant difference between techniques.²⁴ Furthermore, other studies have failed to find an association between trapezial space and outcomes.^{27,28} Despite these findings, and in agreement with other research, our results indicate that trapeziectomy with LRTI continues to be the dominant surgical procedure.

Owing to its complexity, it is not surprising that trapeziectomy with LRTI is the most expensive procedure. It is a more complicated procedure, takes longer, and requires more resources.¹⁹ Thus, physician reimbursement fees are much higher. Additionally, because of their complexity, there is a higher probability for them to be done at hospital outpatient

facilities versus in surgical ambulatory centers. Despite a large body of research revealing comparable effectiveness and outcomes, Medicare continues to reimburse surgeons who perform trapeziectomy with LRTI at an increasingly higher rate over the last decade.

Behavioral economic literature indicates that financial incentive is an effective tool in changing population-based behaviors.²⁹ Wearing seatbelts,³⁰ smoking cessation,³¹ safe sex,³² and weight loss³³ are just a few examples. In medicine, financial incentives such as higher reimbursement rates have been associated with the higher utilization of certain techniques.^{34,35} For example, physician-owned hospitals specializing in cardiac care have significantly higher rates of coronary artery bypass grafting and percutaneous coronary intervention than do general hospitals with cardiac surgery programs, whose surgeons are salary based.³⁶

Furthermore, in order to investigate deviation between clinically based evidence and actual surgical practice, we must consider major factors involved in the surgical decision-making process. The surgeon's preference considered being the most important factor in decisions regarding what surgical procedure to perform. It is plausible that factors such as surgeon's previous training, familiarity with a specific technique, and past habits are associated with surgeon's decision about which procedure to perform. But perhaps the strongest reason why the evidence was not adopted is that the level 1 evidence was derived from a single center in the U.K. where the techniques may be different from those used in the U.S., where patient expectations are less stringent, and when no confirmation of the evidence had been conducted in the U.S.

Additionally, place of surgery substantially contributes to current cost variation. Medicare pays differently to hospital outpatient facilities than it does to independent surgical ambulatory centers.¹⁷ Medicare does not pay separately for facility expenditures for ambulatory centers. Instead it pays higher fee to physicians to cover other estimated expenditures. Patients with more comorbid conditions have higher risk of complications. Thus, it is safer to treat these patients in hospital outpatient settings with ready access to required services if emergent need arise. However, considering that the cost of performing a surgical procedure can be two fold higher in a hospital outpatient setting than in a surgical ambulatory center, use of ambulatory center should be preferred.

This study had a few limitations. First, administrative claims data lack the granularity needed to determine the severity of a clinical condition, which may influence treatment choice.⁴⁰ Additionally, Medicare claims data are created for billing purposes. Thus, report of some services such as anesthesiology is not reported consistently. Thus, we were unable to break down the total spending further to pinpoint to other potential sources of higher expenditure. Finally, because Medicare claims data do not include information about beneficiaries with Medicare Managed Care (MMC) plans, we had no way of comparing patterns of use and spending between the two groups. Despite these limitations, this is the first study using nationally representative data on adults 65 years and older to examine the total and out-of-pocket spending for the main surgical treatments of thumb CMC arthritis.

Over the next couple of decades the influx of baby boomers will continue to increase the number of Medicare beneficiaries. Despite the recent slowdown, between 2015 and 2022, the cost of U.S. healthcare is projected to grow by an average annual rate of 6.2%. The ACA aims to substantially reduce Medicare spending. To make Medicare sustainable in the years ahead, policy makers and physicians must strenuously follow an evidence-based approach in medicine.

Simple complete trapeziectomy has been the least expensive surgical procedure, and research shows it has been as effective as any other surgical intervention for treatment of thumb CMC arthritis. However, owing to a host of plausible reasons, including the surgeon's higher reimbursement rate, only 5% of surgical interventions for thumb CMC arthritis use simple complete trapeziectomy. Without considering Medicare population growth projections, we estimated that Medicare would save \$74 million annually if surgeons use simple complete trapeziectomy instead of trapeziectomy with LRTI $[(3,530/0.05) * \$1,308 * 0.80 = \$74 \text{ million}]$.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Inflation adjusted total and out-of-pocket spending for surgical treatment of the thumb CMC arthritis

Source: Medicare claims data between 2001 and 2010.

Figure 2.
Adjusted predictive total (A) and out-of-pocket (B) costs of surgical treatment of thumb CMC arthritis

Source: The 2001–2010 Medicare claims data

Note: Results are based on the GLM regressions presented in Tables 2 and 3.

All dollar amounts are inflated to the 2010 dollar value.

Abbreviations: LRTI – Ligament reconstruction and tendon interposition

Table 1

Characteristics of patients who underwent surgical treatment for thumb CMC arthritis

	Trapeziectomy with LRTI	Simple complete Trapeziectomy	Joint arthrodesis or prosthetic joint arthroplasty	Total	<i>p</i> ^a
N	3,153	181	196	3,530	
Age:	Mean (SE)	Mean (SE)	Mean (SE)	Number (%)	0.721
Between 65–74	0.70 (0.01)	0.66 (0.03)	0.72 (0.03)	2454 (70)	
Between 75–84	0.28 (0.01)	0.31 (0.03)	0.27 (0.03)	991 (28)	
85 or more	0.02 (0.00)	0.02 (0.01)	0.02 (0.01)	85 (02)	
Female	0.80 (0.01)	0.66* (0.03)	0.78 (0.03)	2806 (79)	<0.001
White	0.97 (0.00)	0.94 (0.01)	0.98 (0.01)	3418 (97)	0.415
Comorbidity Conditions:					0.718
Less than 2	0.51 (0.01)	0.57 (0.04)	0.51 (0.03)	1821 (52)	
Between 2 and 4	0.46 (0.01)	0.41 (0.04)	0.46 (0.03)	1631 (46)	
More than 4	0.02 (0.00)	0.02 (0.01)	0.03 (0.01)	78 (02)	
% with college education	0.32 (0.00)	0.32 (0.01)	0.31 (0.01)	1130 (32)	0.719
Median income at place of residence:					
Less than 25k	0.06 (0.00)	0.05 (0.01)	0.04 (0.01)	192 (05)	0.806
Between 25–50k	0.65 (0.01)	0.64 (0.03)	0.66 (0.03)	2281 (65)	
More than 50k	0.30 (0.01)	0.31 (0.03)	0.30 (0.03)	1057 (30)	
Urban	0.97 (0.00)	0.99 (0.01)	0.97 (0.01)	3440 (97)	0.215

Source: the 2001–2010 Medicare Claims Data.

Note: Data represent the unadjusted average characteristics of patients who underwent a surgical treatment for thumb CMC arthritis.

^aP value represents the significance of unadjusted differences among the three main surgical groups.

* Significant at the 95% CI.

Abbreviations: SE: Standard Error; CI: Confidence Intervals; LRTI: ligament reconstruction and tendon interposition.

Unadjusted mean and median of direct total cost of surgical treatments for thumb CMC arthritis, stratified by place of service and type of medical service: 2001 – 2010

Table 2

	Physician's Fee (\$)		Total Spending (\$)		Total Spending (\$)	
	Number ^b	Mean±SD	Median	Mean±SD	Median	Confidence Interval (\$)
Trapeziectomy with LRTI:						
Hospital Outpatient	597	1,186±555	1,110	4,186±1,375	4,086	4,075 – 4,296
Surgical Ambulatory Center ^a	2152	1,766±1,027	1,559	1,766±1,027	1,559	1,723 – 1,809
Simple Complete Trapeziectomy:						
Hospital Outpatient:	5	783±302	652	3,199±999	3,079	1,959 – 4,439
Surgical Ambulatory Center ^a	145	870±903	601	870±903	601	722 – 1,018
CMC joint arthrodesis or CMC joint prosthetic arthroplasty:						
Hospital Outpatient	44	915±280	891	3,412±1,064	3,087	3,089 – 3,736
Surgical Ambulatory Center ^a	133	1,422±904	1,205	1,422±904	1,205	1,267 – 1,578

Source: Medicare Carrier and Outpatient Claim files 2001 – 2010.

^aIn Surgical ambulatory centers, Medicare does not pay extra for facility charges. However, it does pay extra to physicians to include other overhead costs.

^bTotal number of patients with positive expenditure was 3,076.

Ambulatory surgical center is an independently identifiable entity that operates exclusively to provide surgical services that do not require hospitalization. Additionally, the expected time of service does not go beyond 24 hours.

Abbreviations: SD: standard deviation; LRTI: ligament reconstruction and tendon interposition; CMC: Carpometacarpal

Regression results of the generalized linear model for direct total and out-of-pocket spending of surgical treatment of thumb CMC arthritis

Table 3

Variables	Total Direct Spending				Total Direct Out-of-Pocket Spending					
	Beta	SE	95% CI	P	Beta	SE	95% CI	P		
Surgical procedures:										
Trapeziectomy with LRTI	0.15	0.06	0.03	0.26	0.011	0.07	0.05	-0.02	0.16	0.141
Simple Complete Trapeziectomy	-0.56	0.08	-0.72	-0.40	<.001	-0.54	0.07	-0.68	-0.40	<.001
CMC joint arthrodesis or prosthetic joint arthroplasty (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Age:										
Between 65–74	-0.09	0.09	-0.26	0.08	0.279	-0.11	0.07	-0.25	0.03	0.111
Between 75–84	-0.84	0.09	-0.26	0.09	0.338	-0.13	0.07	-0.27	0.01	0.073
85 and more (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Sex:										
Male (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Female	-0.02	0.03	-0.09	0.04	0.504	-0.02	0.03	-0.08	0.03	0.353
Race:										
Non-White (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
White	0.04	0.08	-0.12	0.19	0.586	0.16	0.06	0.04	0.28	0.009
Number of comorbidities:										
Less than 2 comorbid conditions	-0.13	0.09	-0.54	-0.17	0.154	-0.10	0.07	-0.24	0.04	0.177
Between 2 and 4 comorbid conditions	-0.06	0.09	-0.43	-0.05	0.515	0.00	0.07	-0.13	0.15	0.902
More than 4 comorbid conditions (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Median Household Income:										
Less than 25K	0.009	0.10	-0.21	0.19	0.928	-0.14	0.08	-0.30	0.02	0.081
Between 25–50K	-0.04	0.04	-0.11	0.03	0.257	-0.02	0.03	-0.08	0.03	0.430

Variables	Total Direct Spending					Total Direct Out-of-Pocket Spending				
	Beta	SE	95% CI	P		Beta	SE	95% CI	P	
More than 50K (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Education:										
Percentage with college education	0.01	0.11	-0.12	0.32	0.380	-0.07	0.09	-0.24	0.12	0.452
Geographic location:										
Rural (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Urban	0.07	0.08	0.08	-0.16	0.931	-0.07	0.07	-0.20	0.06	0.312
Place of Surgery:										
Hospital Outpatient	0.66	0.03	0.61	0.72		1.23	0.02	1.19	1.28	<.001
Ambulatory Surgical Center (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Year:										
Year 2001 (ref.)	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Year 2002	0.02	0.07	-0.12	0.17	0.770	0.01	0.06	-0.11	0.13	0.835
Year 2003	-0.03	0.07	-0.16	0.12	0.762	-0.05	0.06	-0.16	0.07	0.411
Year 2004	0.06	0.07	-0.07	0.20	0.344	-0.20	0.06	-0.31	-0.09	0.0003
Year 2005	0.10	0.07	-0.03	0.23	0.140	-0.26	0.05	-0.36	-0.15	<.0001
Year 2006	0.12	0.07	-0.01	0.26	0.073	-0.26	0.06	-0.37	-0.15	<.0001
Year 2007	0.13	0.07	0.00	0.26	0.046	-0.26	0.05	-0.37	-0.16	<.0001
Year 2008	0.14	0.07	0.00	0.27	0.035	-0.12	0.05	-0.23	-0.01	0.027
Year 2009	0.27	0.07	0.14	0.40	<.001	-0.13	0.05	-0.23	-0.02	0.017
Year 2010	0.27	0.07	0.14	0.39	<.001	-0.02	0.05	-0.13	0.08	0.640
Intercept	7.32	0.20	6.95	7.69	<.001	5.65	0.15	5.35	5.94	<.0001
N=3,076 ^a										

Source: the 2001–2010 Medicare Claims Data

Abbreviations: Beta: Coefficient; SE: Standard Error; CI: Confidence Intervals; LRTI: ligament reconstruction and tendon interposition; ref: Reference Category.

^aTotal number of patients with positive expenditure was 3,076.