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Are Cervical Disc Arthroplasty Medicare Reimbursement Trends Sustainable?

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ABSTRACT

Background: Cervical disc arthroplasty (CDA) was originally approved by the US Food and Drug Administration (FDA) in 2007 as a motion-sparing procedure to treat cervical degenerative disc disease. Since then, promising results from randomized control trials have led to increasing popularity. However, data discussing monetary trends are limited. The aim of this study was to determine how utilization, hospital charges, and Medicare physician reimbursement for CDA have changed over time.

Methods: In this retrospective cohort study, International Classification of Diseases procedure codes were used to identify all patients who underwent CDA from 2007 to 2017 in the National Inpatient Sample database. The Physician Fee Schedule Look-up Tool from the Centers for Medicare and Medicaid Services was queried for primary CDA using current procedural terminology codes to determine Medicare physician reimbursement from 2009 to 2021. Nominal monetary values were adjusted for inflation using the Consumer Price Index and inflation-adjusted data reported in 2021 US dollars.

Results: A total of 33,079 weighted patients who underwent CDA were included for analysis. CDA utilization increased by 183% from 2007 to 2017, with Medicare beneficiary utilization increasing 149%. Inflation-adjusted total hospital charges for CDA increased by 22.4%. However, inflation-adjusted Medicare physician reimbursement fell by 1.20% per year, demonstrating a total decrease of 12.9%, starting at $1928 in 2009 and declining to $1679 in 2021.

Conclusions: While utilization and total hospital charges for CDA continue to rise, Medicare physician reimbursement has not shown the same trend. In fact, inflation-adjusted reimbursement has seen a steady decline since FDA approval in 2007. If this trend persists, it may become unsustainable for physicians to continue offering CDA to Medicare patients. As disproportionate increases in hospital charges incentivize a transition to outpatient CDA, stricter patient selection criteria associated with outpatient procedures may create health care disparities for Medicare patients and those with higher comorbidity burden.

Clinical Relevance: This study shows the decreasing reimbursement trends for CDA, which may disproportionately affect Medicare patients and those with increased comorbidities.

Level of Evidence: 3.

Cervical Spine

Keywords: cervical spondylosis, disc degeneration, health expenditures

INTRODUCTION

Neck pain represents a large burden to the aging population and was recently found to be a leading cause of disability worldwide.[1] Cervical degenerative disc disease (DDD) is a known cause of neck pain, cervical radiculopathy, and myelopathy.[2] Historically, treatment for cervical DDD refractory to nonoperative management included anterior cervical discectomy and fusion (ACDF), which was originally described in the 1950s, and many studies have showed improved and sustained clinical outcomes after surgery.[3–5] However, complications from fusion, including adjacent segment disease and pseudarthrosis, can lead to increased revision rates, particularly in multilevel surgery, and diminished clinical outcomes.[6–11] In part, these limitations led to the advent and evolution of motion-sparing technologies for the anterior column of the cervical spine.

Cervical disc arthroplasty (CDA) was initially approved by the US Food and Drug Administration (FDA) in 2007 and was introduced as a motion-sparing procedure to treat cervical DDD. Initial randomized controlled trials showed promising results, demonstrating mostly noninferior or superior results to ACDF with regard to clinical outcomes and lower rates of adjacent segment disease.[12–16] Recent studies are now examining the efficacy of CDA with expanded indications in patients with cervical spondylosis, myelopathy, or kyphotic alignment, and the initial FDA investigational device exemption studies now have long-term follow-up with maintained results.[17–20]

Given the promising data, utilization of CDA has been increasing. A recent study by Niedzilak et al showed a 20% increase in utilization from 2005 to 2014 in a national database.[21] However, data discussing monetary trends in CDA are limited. The aim of this study was to determine how utilization, cost, and Medicare physician reimbursement for CDA have changed over time.

METHODS

Database Description

The International Classification of Diseases (ICD) procedure codes were used to query the National Inpatient Sample (NIS) database to identify and analyze patients who underwent CDA.[22] NIS is the largest publicly available all-payer inpatient health database, with a 20% stratified sample of all discharges from US community hospitals participating in the Healthcare Cost and Utilization Project, beginning from 2012. The large sample size of 35 million hospitalizations and 7 million hospital stays yearly allows for identification of uncommon treatments, special patient populations, and rare conditions. The NIS is the only national database that uses discharge weights, which allow accurate estimations of nationwide incidence of diseases and procedures.[22]

Patient Selection

Procedure codes ICD-9-Procedure Coding System (PCS) 84.62 and ICD-10-PCS 0RR30JZ were used to identify patients undergoing CDA, and the number of cases was documented from 2007 to 2017. The NIS database contains data pertaining to patient disease status, procedure type, and demographics as well as hospital characteristics. Descriptive variables included in our analysis include total charges, age, sex, race, primary payer method, median household income, length of stay, bed size, ownership of hospital, and teaching status. Total charge is presented with inflation-adjusted 2021 US dollars (USD).[23] Each of the aforementioned elements was charted against the same time frame of 2007 to 2017.

Physician Reimbursement

The American Academy of Orthopedic Surgeons coding reference was queried to determine the CPT codes most frequently utilized in primary CDA.[24] Next, the Physician Fee Schedule Look-up Tool from the Centers for Medicare and Medicaid Services was queried for primary CDA using CPT code 22856.[25] The reported reimbursement data average Medicare physician surgeon fees from over 100 different centers across the United States for each year between 2000 and 2021. While the Physician Fee Schedule Look-up Tool contains data from 2000 to 2021, CDA was not recognized as an individual CPT within this database until 2009; thus, only the years 2009 through 2021 were included in our analysis.

All nominal monetary values were adjusted for inflation using the Consumer Price Index, and inflation-adjusted data were reported in 2021 USD. The latest Consumer Price Index data were acquired from the US Department of Labor's Bureau of Labor Statistics.[26] Physician fee and procedure charge trends were analyzed based on inflation-adjusted 2021 USD.[27] The average annual and total percentage change in reimbursement were calculated based on these trends.

All databases used in this study are publicly available national databases without patient identifiers. Therefore, institutional review board approval and informed consent were not required to complete the study.

Statistical Methods

We stratified the cohort by year, 2007 to 2017, and looked at various patient and hospital characteristics. Linear regression was then conducted to obtain *P* values, indicating whether there was a relationship between these characteristics and year of surgery. STATA version 16.1 (Stata Corporation) was used to perform all analyses, and a *P* value of <0.05 was considered statistically significant.

RESULTS

Demographic Data

Our query of the NIS database resulted in 33,079 weighted patients who underwent CDA from 2007 to 2017. The majority were Caucasian (72.92%, $P < 0.001$), had private insurance (64.8%, $P < 0.001$), and had a household income above the 75th percentile (29.0%, $P < 0.001$). Most of the procedures were performed at urban teaching hospitals (38.8%, $P < 0.001$).

Length of stay and female gender were both consistent from 2007 to 2017 ($P = 0.185$ and $P = 0.26$, respectively). Age significantly increased over the 10-year period from 46.6 to 47.3 years ($P = 0.0043$). Other patient characteristics of race, insurance type, and patient zip code and hospital characteristics of teaching status, ownership, and region were all significantly associated with year of surgery (Table).

Table. Baseline characteristics of patients who underwent cervical disc arthroplasty per year, from 2007 to 2017.

Demographic	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total	*P* Value
Age, y	46.60 ± 1.2	45.76 ± 0.8	46.34 ± 0.7	45.79 ± 0.8	47.56 ± 0.9	45.86 ± 1.0	46.78 ± 0.9	47.29 ± 0.9	47.18 ± 0.8	46.63 ± 0.7	47.32 ± 0.7	46.7 ± 0.3	0.0043
Length of stay, d	1.72 ± 0.2	1.62 ± 0.2	1.74 ± 0.2	1.50 ± 0.2	1.72 ± 0.2	1.67 ± 0.2	1.67 ± 0.2	1.56 ± 0.4	1.65 ± 0.1	1.48 ± 0.1	1.59 ± 0.1	1.6 ± 0.1	0.1853
Female	163 (51.4)	273 (49.9)	333 (49.9)	323 (52.1)	286 (48.8)	192 (45.6)	234 (49.1)	303 (50.2)	371 (53.7)	446 (52.5)	451 (53.1)	3375 (50.9)	0.26
Caucasian	206 (65.0)	384 (70.2)	485 (72.7)	469 (75.7)	410 (70.0)	316 (75.1)	335 (70.2)	421 (69.8)	511 (74.0)	655 (77.1)	641 (77.1)	4833 (72.9)	<0.001
Medicare payment	29 (9.2)	24 (4.4)	49 (7.3)	42 (6.7)	56 (9.6)	34 (8.1)	45 (9.4)	66 (10.9)	84 (12.2)	88 (10.4)	107 (12.6)	624 (9.4)	<0.001
Private insurance	318 (68.8)	360 (65.8)	397 (59.61)	356 (57.5)	354 (60.7)	262 (62.5)	331 (69.5)	381 (63.5)	444 (64.3)	541 (63.7)	550 (64.8)	4294 (64.8)	
75^{th}–100^{th} zip code quartile	86 (27.1)	146 (26.7)	149 (22.3)	148 (23.9)	196 (33.4)	126 (29.9)	151 (31.7)	182 (30.2)	205 (29.7)	257 (30.2)	274 (32.3)	1920 (29.0)	<0.001
Large bed size	150 (47.3)	317 (58.0)	390 (58.5)	332 (53.5)	388 (66.2)	247 (58.7)	295 (61.8)	273 (45.3)	328 (47.5)	417 (49.1)	433 (51.0)	3570 (53.86)	<0.001
Private, investment hospital	65 (20.5)	107 (19.6)	86 (12.9)	129 (20.8)	127 (21.7)	90 (21.4)	127 (26.6)	131 (21.7)	154 (22.3)	187 (22.0)	176 (20.7)	1631 (24.6)	<0.001
Urban	158 (49.8)	250 (45.7)	373 (57.5)	302 (49.2)	219 (54.9)	199 (47.3)	239 (50.1)	157 (26.0)	208 (30.1)	254 (29.9)	214 (25.2)	2573 (38.8)	<0.001
Rural	10 (3.15)	32 (5.85)	23 (3.54)	20 (3.26)	13 (2.24)	17 (4.04)	11 (2.31)	27 (4.48)	35 (5.07)	26 (3.06)	26 (3.06)	240 (3.6)	
Western region	69 (21.77)	130 (23.77)	131 (19.64)	131 (21.13)	219 (37.37)	126 (29.93)	151 (31.66)	180 (29.85)	185 (26.77)	257 (30.24)	288 (33.92)	1867 (28.2)	<0.001

Note: Data are reported as *n* (%) except for age and length of stay, which are reported as mean ± SD. Significance was obtained through linear regression with $P < 0.05$ as significant.

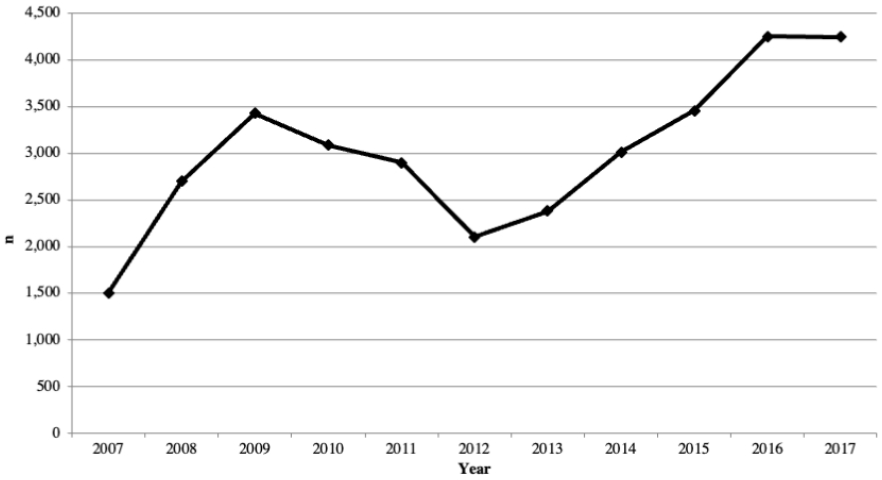

Figure 1. Total cervical disc arthroplasty utilization from 2007 to 2017.

Utilization

The weighted total number of CDA procedures is represented in Figure 1. Over the entire study period, there was a 183% increase in the total number of CDA procedures, from 1502 in 2007 to 4245 in 2017. From 2007 to 2009, there was a sharp increase in case volume to 3428 annual cases followed by a steady decline in case volume to 2105 in 2012. More recent years have demonstrated an increase in annual cases to 4245 in 2017. Medicare beneficiary utilization has increased by 149% over the study period, starting at 43 per 100,000 in 2007 and increasing to 107 per 100,000 in 2017 (Figure 2).

Cost Data

Inflation-adjusted total hospital charges for CDA demonstrated an overall increase of 22.4% from 2007 to 2017, starting at $76,117 in 2007 and increasing to $93,172 in 2017 (Figure 3). Prior to inflation adjustment, physician reimbursement remained constant throughout the study period, from $1556 in 2009 to $1679 in 2021, with an average change of +0.62% per year. When correcting for inflation, the physician reimbursement for CDA has seen a steady decline from 2009 to 2021 (Figure 4). Values either consistently fell or remained similar from year to year, starting at $1928 in 2009 and declining to $1679 in 2021. Over the study period, there was an average decrease in reimbursement of 1.20% per year and a total decrease of 12.9%.

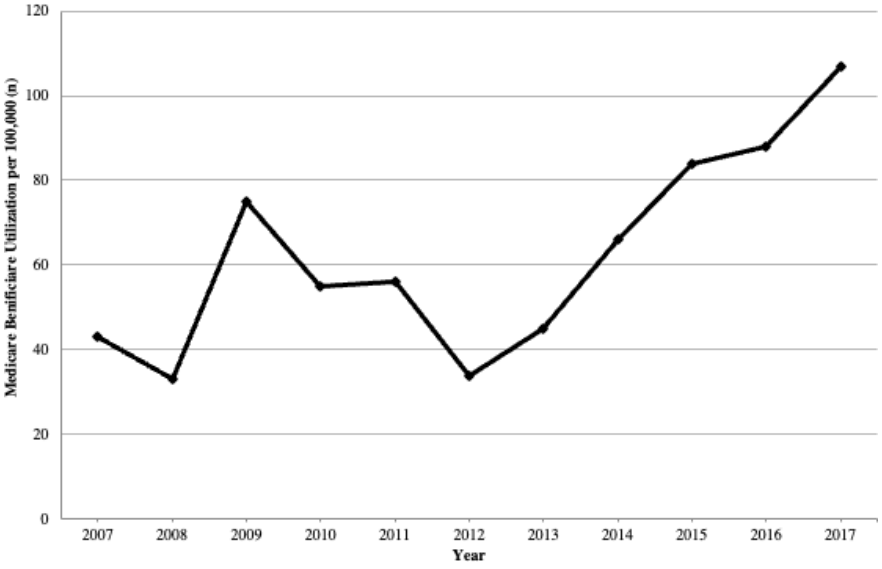

Figure 2. Medicare beneficiary cervical disc arthroplasty utilization from 2007 to 2017.

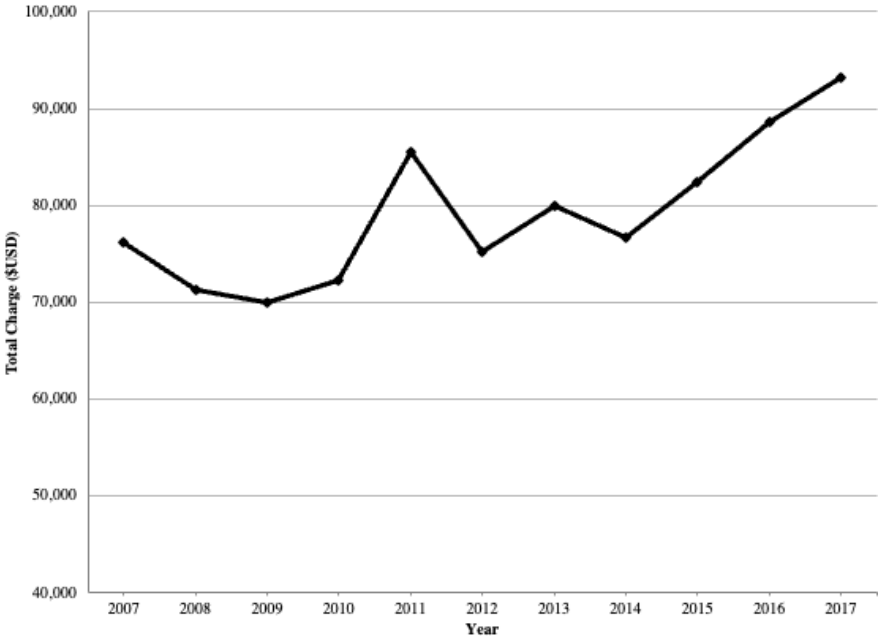

Figure 3. Inflation-adjusted hospital charges for cervical disc arthroplasty from 2007 to 2017. USD, US dollars.

DISCUSSION

In the present study, we found that CDA utilization increased by 183% from 2007 to 2017. Specifically, Medicare beneficiary utilization increased by 149%. The total hospital charge for the procedure increased by 22.4%, while inflation-adjusted Medicare physician reimbursement decreased by 12.9% from 2009 to 2021.

Several randomized trials have shown the benefit of CDA. Initial investigation device exemption studies showed noninferior or superior outcomes when compared with ACDF for both single-level and 2-level CDA.[12,14,28,29] A 7-year follow-up study published in 2021 showed decreased adjacent segment disease in 2-level CDA vs 2-level ACDF and noninferior outcomes of 1-level CDA vs 1-level ACDF.[30] A similar study investigating single-level CDA vs ACDF found a lower rate of reoperation in the CDA cohort compared with the ACDF cohort at 7 years.[13] Furthermore, a 10-year follow-up study confirmed a lower rate of reoperation and concluded that CDA is a safe and effective alternative to ACDF for cervical DDD.[15] In addition, a meta-analysis of 14 randomized

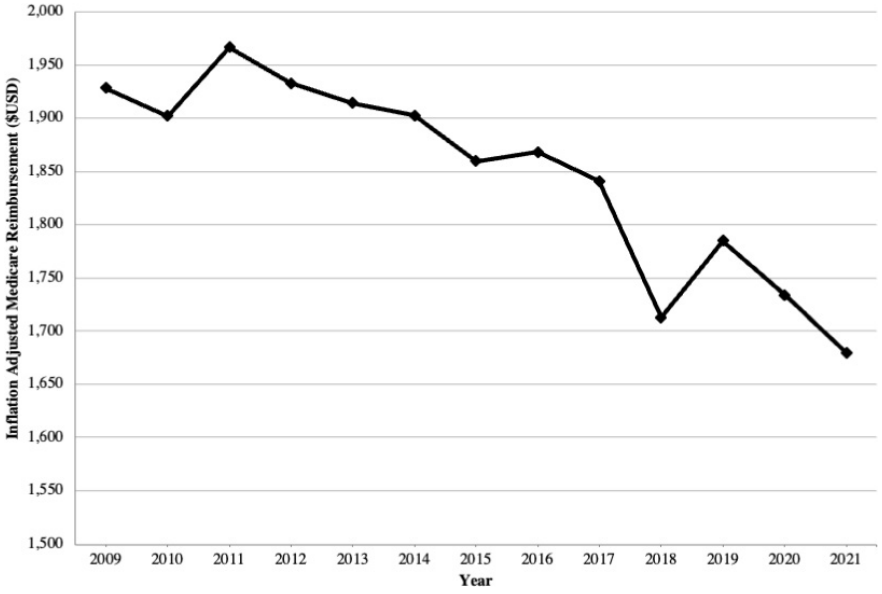

Figure 4. Inflation-adjusted Medicare physician reimbursement from 2009 to 2021. USD, US dollars.

controlled trials found a decreased risk of adjacent segment disease in CDA compared with ACDF.[16] The cost-effectiveness of CDA has also been studied, with several recent reports finding CDA is more cost-effective than ACDF.[31,32]

These favorable results, in part, explain the increasing utilization of CDA. The increase in utilization demonstrated in the current study is similar to several other studies that analyzed national trends. A 692% and 223% increase in 2-level CDA utilization from 2015 to 2018 in the outpatient and inpatient setting, respectively, were found using the National Surgical Quality Improvement Program database.[33] There was an increase of 150% in CDA utilization from 2006 to 2013 in the NIS database.[34] Niedzelak et al found a 20% increase in CDA between 2005 and 2014 using the Medicare PearlDiver database.[21] Similarly, Jain et al found an increase of 17% per year from 2009 to 2014 in the Humana PearlDiver database.[35]

Despite the promising outcomes of CDA, the increase in utilization, and an increase in hospital charges for the procedure, we found a decrease in physician Medicare reimbursement. While this is the first study to report on Medicare reimbursement for CDA, recent studies have published on Medicare reimbursement for other common orthopedic procedures. Lopez et al recently published a similar study on ACDF procedures.[36] They found an increase in annual procedure volume of 24.2% in the Medicare Part A and B database, while inflation-adjusted physician reimbursement fell 4.3% over the same period. Mayfield et al studied Medicare reimbursement trends for hip and knee arthroplasty and found that inflation-adjusted reimbursement fell by 31.9% and 33.3% for all hip and knee arthroplasty procedures, respectively, from 2000 to 2019.[37] They concluded that this trend in reimbursement was not sustainable for physician practice.

The disproportionate increase in hospital charges compared with physician reimbursement may incentivize surgeons to transition to outpatient CDA, as outpatient procedures are more cost-effective and can result in increased reimbursement.[38] The safety profile of outpatient CDA has been assessed by several recent studies.[33,39] A large national database study found that after propensity score matching, there was no difference in the inpatient vs outpatient CDR 30-day complication profile and readmission rate, citing decreasing reimbursement as a driving factor in increasing outpatient CDA.[40] Cuellar et al found that single- and multilevel CDA in the outpatient setting were both safe and efficient, although the conclusions did caution that careful patient selection was an important consideration in the low complication risk.[41] As reimbursement decreases and an increased emphasis is placed on cost savings, shifts to outpatient surgery centers may lead to stricter patient selection, which will likely disproportionately affect older patients with increased comorbidities.

Limitations

This study has several limitations. It is a national database study, so it lacks granular patient data and is susceptible to bias and medical coding errors. In addition, we utilized the NIS database for utilization trends and the Centers for Medicare and Medicaid Services database for monetary data. This resulted in 2 different time periods, 2007 to 2017 and 2009 to 2021, used in the study. However, we do not believe this affects our results or conclusions. Finally, the NIS database is an inpatient-only database, so we did not capture outpatient procedures in our utilization trend data.

CONCLUSION

In conclusion, CDA utilization has increased by 183% from 2007 to 2017, and the total hospital charges for the procedure have increased by 22.4% over the same period. Medicare beneficiaries increased utilization by 149%. However, physician Medicare reimbursement has decreased by 12.9% from 2009 to 2021. If this course continues, physicians may be unable to sustain offering CDA to Medicare patients. In addition, patients who meet criteria for outpatient surgery may be more likely to be selected for surgery. This has the danger of creating a health care disparity for Medicare patients as well as for patients with increased comorbidities. Policy makers, hospitals, and physicians should be aware of this to ensure equitable access to health care.

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