The Economic Process Behind Surgical Innovation: Changes in Coding and Compensation Correlate with Increased Minimally Invasive Sacroiliac Joint Fusion in the National Surgical Quality Improvement Program (NSQIP) Database

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Objective: To analyze trends in open and minimally invasive (MIS) sacroiliac joint fusion (SIJF) that coincide with changes in compensation models and Current Procedural Terminology (CPT) codes.
Design: Database analysis
Setting: American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) Database
Patients/Participants: Underwent SIJF, based on CPT codes, from 2007-2018
Intervention: Open and MIS SIJF
Main Outcome Measurements: Proportion of open versus MISJ SIJF, proportion of inpatient vs outpatient SIJF, relative value units
Results: There were 744 total SIJFs performed. Open SIJFs totaled 683, while 65 MIS SIJFs were performed. The number of SIJFs increased yearly, apart from two years, with a similar trend noted when controlling for the number of NSQIP entries per year. From 2014-2018, MIS SIJF made up a significantly larger proportion of total SIJFs ($p<0.0001$) and the proportion of outpatient SIJFs increased over the entire study period ($p=0.0002$).
Conclusions: SIJF is being increasingly utilized, coinciding with regulatory approval and the American Medical Association's formal recognition of MIS SIJF. Related changes to coding and compensation serve as a model for the economic processes behind surgical innovation, highlighting the importance of surgeon advocacy along the way.
Level of Evidence: III; Retrospective Cohort Study
Keywords: Sacroiliac joint; arthrodesis; fusion; minimally invasive; NSQIP, economics, compensation, policy

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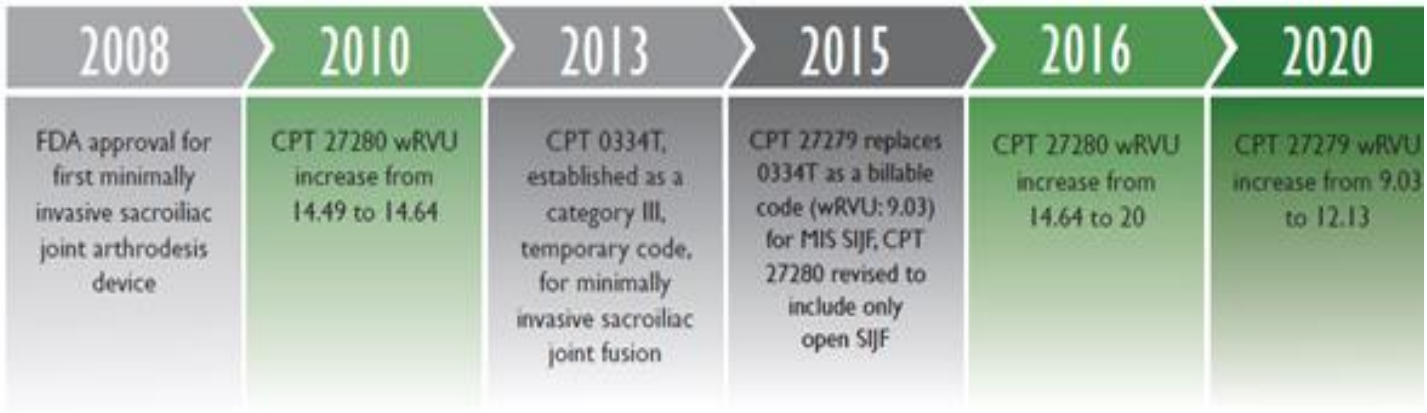
INTRODUCTION

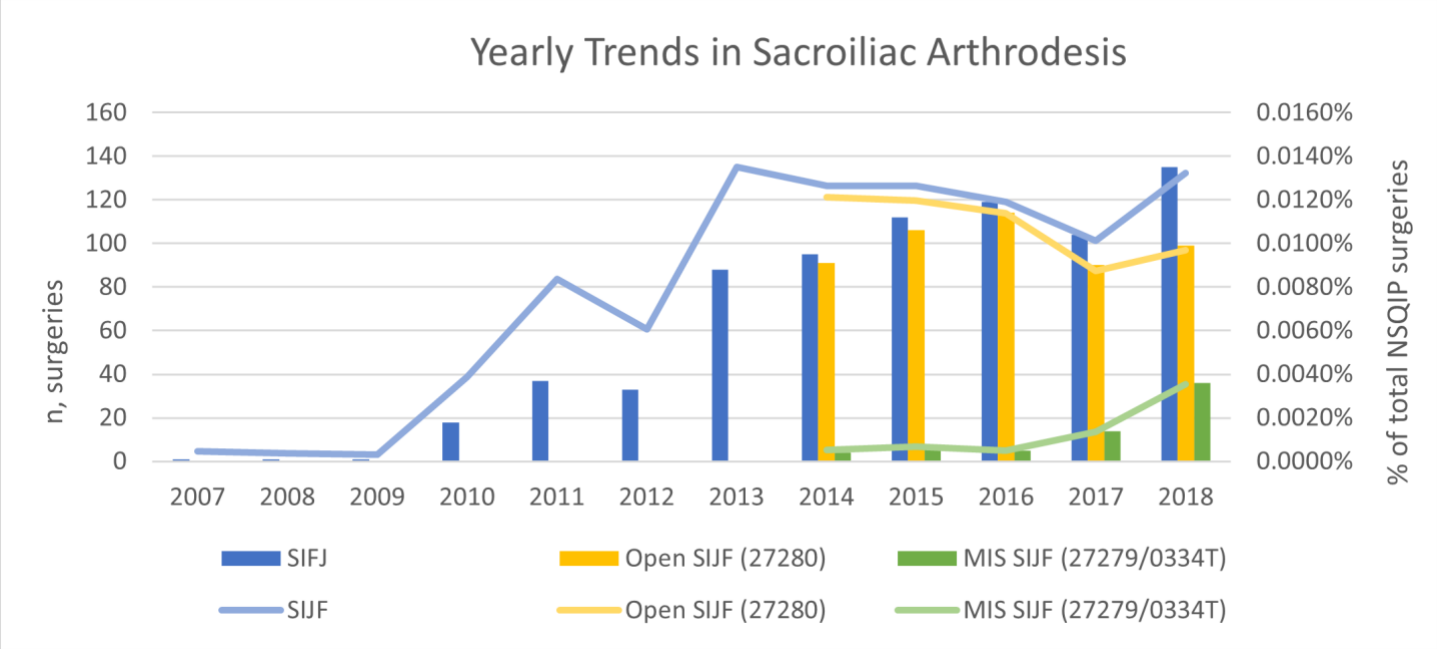
Sacroiliac joint (SIJ) dysfunction is a debilitating condition that has been historically underdiagnosed, but is a significant contributor in a large proportion of low back pain complaints.[1] Over the previous decade, SIJ dysfunction was largely treated conservatively with non-surgical management. In refractory cases SIJ fusion (SIJF) was performed through an open approach, but given the morbidity, few surgeons regularly performed these procedures.[2, 3] However, as is often the case in medicine, perplexing problems tend to drive innovation. More recently, a wave of new minimally invasive implants and techniques have been brought to market, spurring interest in this condition.

As surgical capabilities evolve, so must coding and compensation models. Prior to 2013, Current Procedural Terminology (CPT) codes did not distinguish between open and minimally invasive (MIS) SIJF, with CPT 27280 as the designation for both operations. The American Medical Association CPT Editorial Panel acknowledged this distinction at the urging of physician led organizations and created a temporary, category III code (0334T) in 2013 for MIS SIJF.[4] A year and a half later this code was transitioned to a billable code (27279), validating MIS SIJF as a treatment modality and creating a foundation for continued growth.[5, 6]

This study seeks to use the National Surgical Quality Improvement Program (NSQIP) database to quantify trends in SIJF over 12 years with emphasis on MIS SIJF and reference to concurrent changes to policy, coding and compensation models. We hypothesize that along with the known changes to CPT codes, SIJF and particularly MIS SIJF will show significant growth over the study period.

Figure 2: Timeline of Relevant Policy, Coding and Compensation Related Changes to SIJF Over Twelve Years





METHODS

The American College of Surgeons (ACS) NSQIP database was queried to identify all patients who underwent open and MIS SIJF over a 12-year period from January 1, 2007 to December 31, 2018. NSQIP collects data on patients undergoing surgery from over 700 hospitals in the United States and Canada. NSQIP data collection is performed by certified staff and includes demographic information, perioperative variables, and 30-day morbidity and mortality. CPT codes 27280 (2008-2015: SIFJ, 2015-2018: open SIJF), 0334T (2013-2015: MIS SIFJ) and 27279 (2015-2018: MIS SIFJ) were used to identify entries. Prior to 2013 there was no distinction between open and MIS SIJF. On July 1, 2013 the American Medical Association CPT Editorial Panel created 0334T as a temporary category III CPT code for MIS SIJF. This code, which was created to track utilization, provided no compensation as it was designed to be coupled with 27280 at the time. On January 1 2015, 0334T was subsequently replaced with a standalone code, 27279, while 27280 was modified to denote only open SIJF.

To analyze trends over time the number of SIJF procedures per year were compared. Sub-analysis included open and minimally invasive procedures for a given year. Results were normalized based on the total number of NSQIP database entries and total number of SIJFs performed for a given year. Linear regression was then performed. Categorical variables were compared using chi-squared tests or Fisher exact tests and continuous variables were analyzed using Student's T-tests. Significance was defined as $P < .05$. SPSS 18 software (IBM Corp, Armonk, NY, USA) was used for statistical analyses.

RESULTS

From 2007 to 2018 there were 744 total SIJF procedures performed. The average age for patients undergoing SIJF was 57.4 $\pm$ 13.5 years with 67.8% of patients being female. Orthopedic surgeons performed 64.7% of the procedures with neurosurgeons accounting for the other 35.3%. Further demographic data can be found in Table 1. CPT 27280 was the primary surgical code for 454 cases, and a secondary code or concurrent procedure for another 229. There were 65 MIS SIJFs performed (27279, 0334T), yet 27279 was never listed as a primary procedure. The most frequent CPT codes for primary, secondary and concurrent procedures along with the most frequently recorded International Classification of Diseases (ICD) 9 and 10 codes can be found in Table 3.

Apart from two years, the total number of SIJFs increased yearly with a comparable trend noted when controlling for the number of NSQIP entries for a given year. From 2014 to 2018 MIS SIJF made up a significantly larger proportion of total SIJFs ($p<0.0001$) (Figure 1). Similarly, an increase in outpatient SIJF procedures was noted over the study period ($p=0.0002$).

The Food and Drug Administration (FDA) approved the first MIS SIJF device in 2008 and at present there are at least twelve different FDA approved devices. The American Medical Association Current Procedural Terminology (CPT) Editorial Panel recognized this approval in 2013 creating CPT 0334T (work relative value units (wRVU): 0) as a category III, temporary code, for sacroiliac joint stabilization for arthrodesis, percutaneous or minimally invasive (indirect visualization) to provide greater distinction to CPT 27280 (arthrodesis, sacroiliac joint, wRVU: 14.64). In 2015, CPT 27279 (wRVU: 9.03) replaced 0334T and CPT 27280 was amended to include only open arthrodesis. CPT 27280 and CPT 27279 received increases in wRVUs in 2016 and 2020, respectively, however CPT 27279 remains valued nearly 8 wRVUs lower. Figure 2 provides a timeline of events regarding these regulatory, coding and compensation changes.

Table 1: Overall (2007-2018), Open and Minimally (2014-2018) Invasive Sacroiliac Joint Fusion Demographics

	Overall SIJF (n=744)	Open SIJF (n=500)	MIS SIJF (n=65)	P-Value
Age	57.4 ± 13.5	57.7 ± 13.5	61.9 ± 11.4	**0.0184**
Sex				
Male	32.2%	33.0%	38.5%	0.381
Female	67.8%	67.0%	61.5%	
BMI	30.5 ± 6.7	30.7 ± 6.8	30.5 ± 6.2	0.896
Race				
White, Non-Hispanic	75.4%	77.2%	67.7%	0.377
Hispanic	7.1%	8.2%	12.3%	
Black or African American	6.3%	6.8%	12.3%	
Asian	0.9%	1.2%	1.5%	
Other/Unknown	10.2%	6.6%	6.2%	
ASA				
1-No Disturb	2.6%	1.8%	1.5%	0.970
2-Mild Disturb	44.8%	45%	43%	
3-Severe Disturb	51.5%	52%	54%	
4-Life Threat	1.1%	1.0%	1.5%	
Diabetic	14.1% (105)	14.4% (72)	18.5% (12)	0.750
Smoker	20.3% (151)	19.8% (99)	13.8% (9)	0.251
Surgical Subspecialty				
Orthopedics	64.7%	66.0%	61.5%	0.463
Neurosurgery	35.3%	34.0%	38.5%	

BMI: Body Mass Index; ASA: The American Society of Anesthesiologists Physical Classification System

DISCUSSION

More evidence continues to be published each year as to the benefit of SIJF, with a recent randomized control trial by Dengler et al showing improved pain, patient reported outcomes and functional measures for patients undergoing MIS SIJF compared to conservative management.[7] Furthermore, multiple studies have shown maintained improvements in these metrics with 3 to 6 year follow up.[8-11] However, skepticism remains as many of the initial studies were industry sponsored and results from long-term follow up are still relatively limited. Nonetheless, this study uniquely highlights the growing acceptance of SIJF and MIS SIJF, with increased utilization on a national level for more than a decade.

Patient demand is the catalyst for surgical innovation, but administrative governance is often a more substantial regulator. Focusing on the latter, the FDA approval of MIS SIJF technology in 2008 spurred research and economic expansion of the field, while surgeon advocacy encouraged medical bodies to acknowledge the utility of MIS SIJF. Advocacy from groups like the International Society for the Advancement of Spine Surgery (ISASS) helped to secure MIS SIJFs availability for the greater population, highlighting the importance of clinician perspective in an atmosphere of non-clinical (or non-surgical) gatekeepers.[4]

Table 2: Sacroiliac Joint Fusion Perioperative Data and Complications (2014-2018)

	Open SIJF (n=500)	MIS SIJF (n=65)	P-Value
OR Time (mins)	163 ± 164	323 ± 182	**<0.001**
Length of Stay (days)	3.3 ± 4.8	4.4 ± 4.6	0.0692
% Outpatient	14%	8%	0.326
Need for Transfusion	76	20	**0.002**
Readmission	22	2	0.619
Return to OR	11	2	0.657
Complication			
CV (CVA, MI)	4	0	-
Resp (Pna, vent)	4	5	**<0.001**
Urinary Infection	12	2	0.741
Surgical Site Infection	4	2	0.0920
Superficial Wound Infection	1	1	0.0874
Deep Wound Infection	3	1	0.396
DVT or PE	9	0	-
Death	2	0	-
Composite	39	11	**.0148**

CV: Cardiovascular; CVA: Cerebrovascular accident; MI: Myocardial infarction; Pna: Pneumonia; DVT: Deep vein thrombosis; PE: Pulmonary embolism

Prior to the creation of a CPT code for MIS SIJF in 2013, Lorio et al found that a large proportion of surgeons were already performing MIS SIJF.[12] Coupled with results from the current study, this more clearly equates to sizable variation in wRVU compensation for the same procedure over the past decade, where surgeons performing MIS SIJF from 2010-2014 were receiving 14.64 wRVU per case under CPT 27280, but only 9.03 under CPT 27279 from 2015-2019. From these differences, advocates of MIS SIJF realized that policy not only affected practice, but also compensation and they have worked to obtain wRVU increases as recently as 2020. Through their advocacy they were able to point out inconsistencies in RVU compensation models, revealing a lack of transparency and collaboration in the creation of CPT codes, as well as inappropriate comparisons of surgical techniques to derive RVUs.[13, 14] Their efforts deserve commendation and should serve as an example for future surgical innovation.

There are several limitations that warrant discussion beyond an acknowledgement of the standard limitations of a database analysis providing 30-day perioperative data. The first is that no assessment can be made as to the proportion of open versus MIS procedures performed prior to 2014 given the lack of distinction in CPT codes at that time. However, one study from Lorio et al showed that 87% of surgeons completing surveys at two specialty meetings were already performing MIS SIJF from 2009-2012, though the forums at which surgeons were queried may bias their result somewhat.[12] Additionally, there is likely significant heterogeneity among the included open and MIS SIJF cases as there were often multiple adjunct CPT codes for each case entry. CPT 27279 (MIS SIJF) was also never listed as a primary code in the database and was at times coded in conjunction with 27280, despite its status as a stand-alone code, highlighting discrepancies in coding practices that can result after CPT updates.

CONCLUSION

In conclusion, it is apparent through analysis of the NSQIP database that SIJF and specifically MIS SIJF are fields of growing interest. Currently, MIS SIJF occupies a unique position along the spectrum of surgical innovation, offering important insight into the processes of regulatory approval, coding and compensation models.

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Table 3: CPT and ICD 9/10 Codes Associated with Sacroiliac Joint Fusion

Primary CPT code (n)		
27280	454	Fusion of sacroiliac joint/Arthrodesis sacroiliac joint w/ obtaining graft
22612	79	Arthrodesis posterior/posterolateral lumbar
22558	33	Arthrodesis anterior interbody lumbar
22633	25	Arthdsis post/posterolatrl/postinterbody lumbar
22610	18	Arthrodesis posterior/posterolateral thoracic
22630	18	Arthrodesis posterior interbody lumbar
Secondary CPT code (n)		
27280	235	Fusion of sacroiliac joint/Arthrodesis sacroiliac joint w/ obtaining graft
22614	185	Arthrodesis posterior/posterolateral ea addl
22848	124	Pelvic fixation other than sacrum
20930	113	Allograft for spine surgery only morselized
22842	90	Posterior segmental instrumentation 3-6 vrt seg
20936	75	Autograft spine surgery local from same incision
22612	62	Arthrodesis posterior/posterolateral lumbar
22216	60	Osteot spi pst/pstlat appr 1 vrt sgm ea vrt sgm
27279	56	Arthrodesis sacroiliac joint percutaneous
0334T	5	Stablj SI joint for arthrodesis perq/min invas
Concurrent CPT code (n)		
22614	29	Arthrodesis posterior/posterolateral ea addl
22216	17	Osteot spi pst/pstlat appr 1 vrt sgm ea vrt sgm
22848	13	Pelvic fixation other than sacrum
27280	13	Fusion of sacroiliac joint/Arthrodesis sacroiliac joint w/ obtaining graft
49010	10	Expl retroperitoneum w/wo bx spx
22612	9	Arthrodesis posterior/posterolateral lumbar
27279	7	Arthrodesis sacroiliac joint percutaneous
ICD 10	**(n)**	
M46.1	100	Sacroilitis, not elsewhere classified
M53.3	45	Sacrococcygeal disorders, not elsewhere classified
M47.898	17	Other spondylosis, sacral and sacrococcygeal region
M48.06	15	Spinal stenosis, lumbar region
M47.818	14	Spondyls w/o myelpath or radiculopathy, sacr/sacrocygl rgn
M96.0	12	Pseudarthrosis after fusion or arthrodesis
M43.16	12	Spondylolisthesis, lumbar region
ICD 9	**(n)**	
724.6	82	Disorders of sacrum
720.2	74	Sacroilitis, not elsewhere classified
737.3	27	Scoliosis (and kyphoscoliosis) idiopathic
996.49	20	Other mechanical complication of internal orthopedic device implant and graft
721.3	18	Lumbosacral spondylosis without myelopathy
724.02	14	Spinal stenosis of lumbar region
996.78	12	Other complications of internal orthopedic device implant and graft

CPT: Current Procedural Terminology; ICD: International Classification of Disease