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Inpatient temporal trends in open and minimally invasive sacroiliac joint fusions

Kanwar Parhar*, Benjamin R. Caruso, Gabriel Alemayehu, Richard Rapport

Washington State University Elson S. Floyd College of Medicine, Spokane, Washington, USA

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***Correspondence:**
Dr. Kanwar Parhar,
E-mail: kanwarpartap.parhar@wsu.edu

ABSTRACT

Background: Lower back pain is a leading cause of disability worldwide, with sacroiliac joint dysfunction implicated in 15-30% of chronic cases. For this a sacroiliac joint fusion (SIJF) may be performed using either open or minimally invasive surgery (MIS) techniques. Prior to the introduction of unique ICD-PCS codes in 2015, there was limited data on the surgical variables for the different techniques. This study aims to evaluate open and MIS inpatient case trends from 2016-2020.
Methods: A retrospective analysis of the national inpatient sample database from 2016 to 2020 was conducted. Patients were identified using ICD-10 PCS codes for open and MIS SIJF procedures. Temporal trends and geographic distribution were analyzed, with demographic and procedural data compared using statistical tests including Mann-Kendall, t-tests, and Chi-square.
Results: Among 38,660 inpatient SIJF procedures, 34,590 were open and 3,890 were MIS. The procedures were primarily performed on females, identifying as white, Medicare payers and in urban teaching hospitals ($p<0.001$). No significant temporal trends in procedural volume were observed for open ($p=0.807$) or MIS ($p=0.462$) SIJF from 2016-2020. However, regional analysis revealed majority of the procedures taking place in the Southern region of the United States ($p<0.001$).
Conclusions: Inpatient SIJF volumes remained stable from 2016-2020, with most procedures performed in the South. These findings align with the increasing shift toward outpatient MIS SIJF, as inpatient volumes did not rise despite greater MIS adoption. Future studies should examine outpatient trends to further characterize this shift.

Keywords: Sacroiliac joint dysfunction, Lower back pain, Sacroiliac joint fusion

INTRODUCTION

Lower back pain is the leading cause of activity limitation and the inability to work worldwide.[1] Studies suggest that 15% to 30% of chronic low back pain cases are attributed to dysfunction of the sacroiliac joint (SIJ).[2] The SIJ is a key anatomical region in the spine that facilitates shock absorption and stability during weight-bearing activities.[3] Sacroiliac joint dysfunction (SIJD) can arise due to trauma, aging, and structural abnormalities, often leading to symptoms such as localized and radiating pain, stiffness, and compensatory mobility changes that may affect activities of daily living.[3,4] Importantly, SIJD has now been shown to be a common outcome after lumbosacral fusions.[5]

Initial strategies for SIJD treatment often involve conservative treatments, such as the use of cold therapy, NSAIDs, and muscle relaxers for acute management. Physical therapy and core strengthening exercises are considered first-line treatments by many clinicians, as they provide stability and alleviate symptoms.[2,6] More advanced interventions may include local anesthetics, which play a role in both diagnosing and relieving pain associated with SIJ dysfunction.[7] Radiofrequency denervation is considered when conservative treatments

fail to provide long-term relief, but there has been significant variability in outcomes with this approach.[8] Intra-articular steroid injections decrease inflammation and pain in the short term but numerous studies have shown poor long-term resolution of symptoms.[9,10]

For pain that is refractory, a sacroiliac joint fusion (SIJF) may be indicated to alleviate these issues.[11] Within this procedure the sacrum and ilium are fused, effectively eliminating movement within the SIJ joint.[12] This procedure has already shown promising results by demonstrating greater clinical outcomes, decreased opioid use and better work status when compared to conservative treatment.[13] There are two primary approaches to SIJF: the traditional open technique, and the minimally invasive surgery (MIS) approach, with the later gaining popularity due to its favorable outcomes.[14,15] With growing literature supporting the use of MIS SIJF, its nationwide utilization has been difficult to understand due to the absence of unique current procedural terminology (CPT) codes for the respective SIJF procedures.

However, on January of 2015, this issue was solved facilitating a more systematic approach to diagnosing, processing insurance claims, and making clinical decisions. Most importantly, these developments allow us to now gain a comprehensive understanding of the different SIJF approaches, providing surgeons with valuable information regarding the utilization and outcomes. While SIJF is routinely performed in the outpatient setting, our study focused on understanding variables on the inpatient use of SIJF.

In this study, we evaluated patients who had undergone inpatient SIJF from 2016-2020 using the national inpatient sample (NIS) database. The purpose of this study is to analyze the temporal trends in utilization for both open and MI inpatient SIJF. We hypothesize that inpatient MI SIJF procedure volume will increase over time.

METHODS

NIS database

The NIS of the healthcare cost and utilization project, sponsored by the Agency for Healthcare Research and Quality, was used for this study. This administrative database is the largest inpatient hospitalization-related healthcare dataset in the United States. This database includes hospitalized inpatient data from all states taking part in HCUP, which approximates to roughly 95% of the US population. The patients within this database compose a 20% stratified sample of all discharges from hospitals across the nation. The dataset captures approximately 8 million hospital stays annually from more than 100 hospitals. After applying sampling weights, the data estimate over 35 million hospitalizations nationwide, providing a representation of the entire United States.[16] The database utilizes billing CPT codes to confer inpatient clinical and nonclinical data for each hospital stay.

Study patients

A retrospective analysis was conducted using data from the NIS database spanning from 2016 to 2020. Patient inclusion for the study was based on the presence of CPT codes for open SIJF (CPT code: 27280) and MIS SIJF (CPT code: 27279). These codes were converted into ICD-10 PCS codes for inpatient identification. Patients were further dividing patients into two groups: open and MIS. Open included the following ICD-10 PCS codes, 0SG704Z, 0SG707Z, 0SG70JZ, 0SG70KZ, 0SG70ZZ, 0SG804Z, 0SG807Z, 0SG80JZ, 0SG80KZ, 0SG80ZZ. These codes include both right and left sided procedures and the use of autologous, non-autologous and synthetic substitutes for SIJF fusions. MIS included the following ICD-10 PCS codes 0SG734Z, 0SG737Z, 0SG73JZ, 0SG73KZ, 0SG73ZZ, 0SG744Z, 0SG747Z, 0SG74JZ, 0SG74KZ, 0SG74ZZ, 0SG834Z, 0SG837Z, 0SG83JZ, 0SG83KZ, 0SG83ZZ, 0SG844Z, 0SG847Z, 0SG84JZ, 0SG84KZ, 0SG84ZZ. These codes include, both left and right sided procedures, percutaneous and endoscopic approaches, internal fixations procedures and the use of autologous, nonautologous and synthetic substitutes for MIS fusions.

Data and outcomes

Data collection included patient demographics such as gender (female, male), age, insurance type (Medicare, Medicaid, private insurance, self-pay, no charge, other), race (White, Black, Hispanic, Asian/Pacific Islander, Native American, other), region (Northeast, Midwest, South, West), and location/teaching status of the hospital (rural, urban non-teaching, urban teaching). Procedural volumes for open and MIS during each year obtained for temporal analysis. As the NIS database contains no patient identifiers and complies with the Health Insurance Portability and Accountability Act (HIPAA) regulations, this study was exempt from IRB approval and the requirement for informed consent, in accordance with 45 CFR 46.104(d)(4).

Statistical analysis

Statistical significance was determined using p values, with a threshold set at $p<0.05$. Trends and comparisons were analyzed over the five-year span using Mann-Kendall test, t-tests were used for continuous variables and chi-square tests for categorical variables. All statistical analyses were performed using statistical package for the social science (SPSS) version 27.

RESULTS

A total of 38,660 inpatient SIJF procedures were included in this study. From these 34,590 were open SIJF procedures and 3,890 were MIS. The average age of patients increased slightly over the study period, from 58.46 years in 2016 to 60.75 years in 2020.

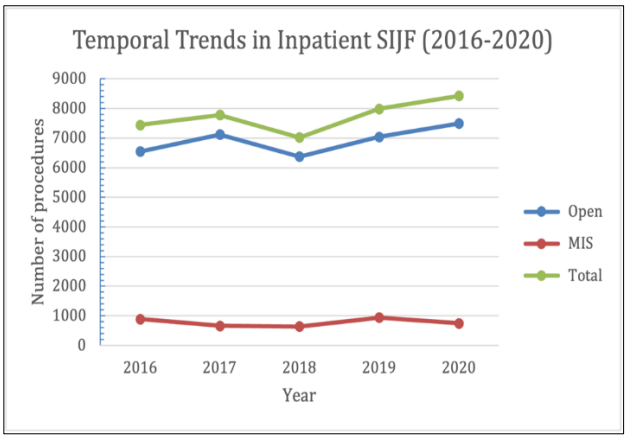

Figure 1: Temporal trends in inpatient SIJF from 2016 to 2020. The graph illustrates the number of SIJF procedures performed annually, stratified by surgical approach: open (blue), minimally invasive surgery (MIS) (red), and total procedures (green). No significant temporal trends were observed in open (p=0.807) or MIS (p=0.462) SIJF procedure volumes over the study period.

Overall, the procedures were predominantly performed on female patients (p<0.001), with this distribution remaining stable throughout the study period as well.

When comparing patient demographics, insurance coverage for SIJF procedures predominantly consisted of Medicare payers (p<0.001). The surgeries were predominantly conducted in urban teaching hospitals (p<0.001). As for the racial demographics, the majority patient population identified as White (p<0.001) (Table 1). These differences remained stable across the study period.

A statistically significant difference was seen between open and MIS procedure volumes, with the majority of procedures being open (p<0.001). Temporal analysis using Mann-Kendall test on the open and MIS procedure volumes from 2016 to 2020 showed no statistically significant difference over the years (p=0.806, 0.462 respectively) (Table 2) (Figure 1). Regional analysis revealed significant disparities in the distribution of procedure volume (p<0.001), with the highest number of procedures performed in the South (41.6%) (Table 3).

Table 1: Patient demographics trends over time.

Categories	2016	2017	2018	2019	2020	P value
Gender						
Female	4831	5175	4623	5137	5349	<0.001
Male	2614	2605	2397	2853	3076	
Age (in years)	58.46	60.1	59.8	60.48	60.75	
Insurance						
Medicare	4095	4414	4058	4479	4820	<0.001
Medicaid	606	628	536	682	636	
Private insurance	2062	2063	1791	2209	2416	
Self-pay	98	114	25	70	61	
No charge	10	3	0	0	0	
Other	574	558	610	550	492	
Race						
White	6255	6584	5967	6768	6943	<0.001
Black	515	532	518	591	623	
Hispanic	402	407	324	357	549	
Asian/Pacific Islander	37	66	67	116	92	
Native American	50	52	34	29	30	
Other	186	139	110	129	188	
Location/teaching status of hospital						
Rural	429	335	301	378	332	<0.001
Urban non-teaching	2147	2264	1575	1799	1495	
Urban teaching	4869	5181	5144	5813	6595	

Table 2: Temporal trend in open and MIS SIJF use from 2016 to 2020.

Categories	2016	2017	2018	2019	2020	P value
Open	6550	7120	6380	7045	7495	0.807
MIS	895	660	640	945	750	0.462
Total	7445	7780	7020	7990	8425	

Table 3: Geographical distribution of total SIJF procedures volume from 2016 to 2020.

Region	2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)	P value
Northeast	968 (13)	1167 (15)	846 (12)	925 (12)	1055 (13)	<0.001
Midwest	1936 (26)	1857 (24)	1808 (26)	1773 (22)	1950 (23)	
South	2903 (39)	3034 (39)	2805 (40)	3595 (45)	3806 (45)	
West	1638 (22)	1712 (22)	1561 (22)	1697 (21)	1614 (19)	

DISCUSSION

Our study provides critical insights into the temporal trends of inpatient SIJF procedures from 2016 to 2020. We observed no statistically significant difference in both open and MIS SIJF inpatient procedures during the studied timeframe, but a significant difference was seen geographically with most procedures being performed in the South. These findings provide valuable insight on the trajectory of open and MIS SIJF utilization in the inpatient setting.

Our study observed a higher prevalence of sacroiliac joint issues in women, along with an increase in the mean age compared to previous research. This directly contradicts a study by Irwin et al which suggests that age and gender may not have a strong correlation with sacroiliac joint pathology.[22] The disparities found in our study align with others that also found a higher prevalence of SIJF in women.[18] The higher prevalence of SIJF in women may be associated with pregnancy related SIJ pain, as illustrated by in a study conducted by Fiani et al which showed that MIS procedures have proven effective in addressing pain and improving function in postpartum women.[23]

With recent advancements in SIJF techniques, MIS is emerging with far more favorable outcomes than the open approach.[14] Despite these advancements, our study found no statistical significant difference in inpatient MIS and open procedure volumes from 2016-2020, which contrasts with previous reports of increasing SIJF volumes during this same time frame. For instance, an analysis conducted by Federico et al using Medicare data indicated a rise in SIJF procedures over time, with the majority of procedures being the MIS from 2015 onwards.[17] Similarly, Ton et al using the Pearldiver database reported an increase in SIJF procedural volume during the same time period.[18] We believe this difference to be in the patient population being analyzed as the Pearldiver and Medicare data include patient procedures that are both inpatient and outpatient, while the NIS database strictly only includes hospitalized inpatient procedures. These findings add to the growing body of evidence of the shift in clinical practice toward outpatient settings for MIS procedures, as highlighted in previous studies.

Hersh et al, when analyzing MIS SIJF trends across the same time period reported over 75% of all SIJF procedures were MIS, with over 50% being done by non-surgical specialties and an increased number offered in the outpatient and ambulatory surgical setting.[19]

Regional analysis revealed significant disparities in the distribution of procedure volume, with the highest number of procedures performed in the South (41.57%). These findings align with those of previous studies that analyzed the temporal trends of SIJF during a similar timeframe.[18,20] The rapid growth of spinal procedures performed in the south is well documented by Moore et al.[21]

Limitations

Our study does not come without its limitations. First, the NIS database is retrospective and does not include outpatient procedures, post-operative follow-up, and associated co-morbidities following discharge. Thus, data on associated procedural co-morbidities are only those reported while the patient is hospitalized post-operatively. Patient identifiers are removed; as a result, readmissions cannot be tracked. Second, the retrospective nature of the analysis limits the ability to establish causality. Lastly, the reliance on the NIS database may introduce selection bias and inaccuracies due to coding errors.

CONCLUSION

Our findings suggest that inpatient SIJF volumes remained stable from 2016-2020, with most procedures performed in the South. These findings align with the increasing shift toward outpatient MIS SIJF, as inpatient volumes did not rise despite greater MIS adoption. Future studies should examine outpatient trends to further characterize this shift.

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