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Disclosures

Peter Gerszten, MD, is a consultant for Zimmer Biomet. L. Dade Lunsford, MD, is a consultant for DSMB and Insightec. He is also a stockholder in Elekta AB.

Instructions

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Minimally Invasive Sacroiliac Joint Fusion

by Erin Paschel, PA-C and Peter Gerszten, MD, MPH, FACS

Low back pain is the second most common complaint in the primary care setting, and 85 percent of adults experience low back pain at some point in life. While the majority of back pain is due to lumbar disease, another source of pain may be related to the sacroiliac joint (SIJ). Sacroiliac joint pain is frequently overlooked, as the diagnosis can be difficult to determine. However, it contributes to 13 to 30 percent of cases of low back pain. Historically, treatment options were limited. In recent years, a minimally invasive approach to surgically treating the sacroiliac joint has been developed and adopted at UPMC.

The sacroiliac joint is the largest axial joint in the human body. It is important for weight bearing, transmitting loads from the upper to lower body. The intricate design of anterior and posterior ligaments allows for little motion within the SIJ, typically 1 to 2 degrees in men and 2 to 4 degrees in women. Problems arise when the joint becomes arthritic, such as with degenerative aging, or related to trauma. Dysfunction can also be related to a previous lumbar fusion most commonly at L5-S1, considered adjacent segment disease.

Diagnosis relies upon exclusion of lumbar and hip pathology. Patients typically present with low back, unilateral hip, groin, and gluteal pain without associated neurological deficits. Common complaints include difficulty with sitting on the affected side and inability to stand or walk for any amount of time. Tenderness to palpation of the SIJ is the classic physical exam finding, as well as reproduction of pain using provocative maneuvers, such as FABER (Flexion ABduction External Rotation) or compression tests. The gold standard for diagnosis of SIJ dysfunction is an image-guided SIJ injection. Diagnosis is confirmed with significant pain relief on two separate occasions. Long-term therapeutic

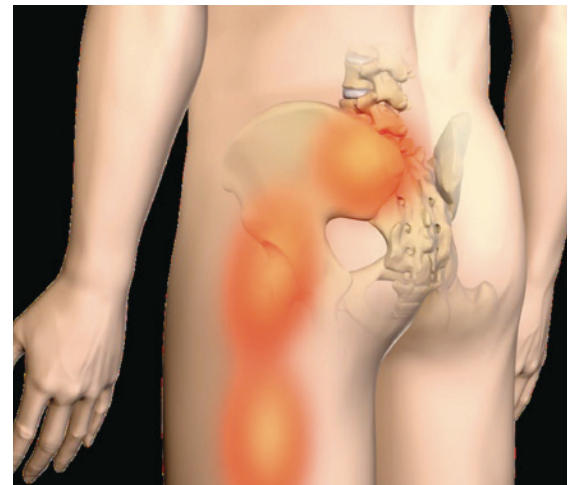


Figure 1: Classic distribution of sacroiliac joint pain originating at the sacroiliac joint (SIJ).

benefit may be achieved with repeated injections. Other nonsurgical treatment modalities include NSAIDs, pelvic floor physical therapy, external fixation with a sacral belt, and radiofrequency ablation of the SIJ. A patient may be considered a surgical candidate after six months of failed conservative treatment.

Historically, the surgical treatment of SIJ dysfunction was performed with an open fusion, which required a significant dissection and disruption of normal tissues to expose the joint and allow for arthrodesis. This led to lengthy hospital stays with a higher rate of complications. More recently, a percutaneous approach has been developed and proven effective in reducing the rate of complications and reoperation rates.

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Chairman's Message

Innovation



Having hosted the recent Peter J. Jannetta Symposium focusing on the history and future of innovation in neurosurgery, I stood in awe of all that has been done at the University of Pittsburgh Department of Neurological Surgery. It is quite impressive and humbling to recognize the number of luminaries in neurosurgery who have trained in our program and to acknowledge those who have served here to inspire and set

new boundaries in our field. The accomplishments of the past are always important to salute, yet the innovators of the present and future are far more critically important to develop and encourage.

What constitutes a worthwhile innovation? Innovation must ultimately result in the improvement in the manner in which we evaluate and treat our patients. True innovation is a multiphase process.

At the outset, there must be a seminal idea...the need to develop a solution to a current condition or problem. The idea must be relevant and achievable. This is the most critical step. Innovation can be a new surgical procedure, an improvement to an existing procedure, the development of a new device or instrument that enhances the safety or efficiency of performing a procedure,

a new biologic therapy, or the development of a new drug. These are the most relevant categories of innovation in neurosurgery.

Following the idea, the real work begins. The innovation must be developed into reality and evaluated for safety and efficacy. Fiscal responsibility is important as well. Newer approaches must be worth the inherent increase in cost. Testing must be done in a rigorous manner. Proving the innovation is real and beneficial to our patients is our biggest calling.

We cannot lose focus of our mission as leading academic neurosurgeons. We must provide the very best care to our patients. We strive to be the best, continuously pushing the boundaries of knowledge and therapeutic efficacy. Our patients deserve no less as they travel from around to world, seeking out our expertise.

We proudly build on the history of the giants that have preceded us. We are innovators. It is our privilege and responsibility to do the very best we can to provide care to our patients and advance our field.

Robert M. Friedlander, MD, MA

*Chairman and Walter E. Dandy Professor of Neurological Surgery
Co-Director, UPMC Neurological Institute*

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Incidence of Position-Related Upper Extremity Neuropraxia in 4,313 Consecutive Patients Undergoing Spine Surgery: Role of SSEP Monitoring

by Gurpreet S. Gandhoke, MD

Peripheral nerve injuries represent a third of all anesthesia-associated medicolegal claims in the United States. Rates of position-related neuropraxia have been reported to be 1.8 to 15 percent in smaller series. No large population study reports on the incidence of peripheral nerve injury or the role of intra-operative neurophysiological monitoring (IOM) in prevention of position-related neuropraxia during spine surgery.

We conducted an observational cohort study on 4,489 consecutive patients undergoing spine surgery at the University of Pittsburgh Medical Center over a period of three years.

Bilateral median or ulnar nerve somatosensory evoked potentials (SSEPs) were recorded during patient positioning. SSEP alarm criteria was defined as a persistent and consistent 50 percent reduction in the primary somatosensory cortical amplitude and/or a prolongation of latency > 10 percent from baseline of any response. Incidence of new upper extremity peripheral nerve injury attributed to positioning among these patients was studied. We also reported on the propensity of the type and length of surgery, patient-related variables (including age, sex, body mass index), and patient co-morbidities (including diabetes, hypertension, coronary artery disease, cerebrovascular disease, and smoking) on the development of a new peripheral nerve injury.

Data from 4,313/4,489 patients was available for analysis. Seventy-two (1.6%) patients developed significant upper extremity (UE) SSEP changes that met alarm criteria attributed to positioning. In all cases, these SSEP changes were rectified by repositioning maneuvers, including, but not limited to, loosening shoulder tape, further padding points of imminent friction, repositioning of arm/shoulder or neck, and repositioning the patient on the OR table. None of these 72 patients developed a postoperative neuropraxia.

Of the 4,241 (98.3%) patients who had no reported significant SSEP changes, 13 (0.3%) developed a new postoperative upper extremity neuropraxia, Figure 1. We are currently investigating whether these 13 patients incurred any UE SSEP changes that did not meet the alarm criteria for a significant event, which would suggest that the alarm criteria should be adjusted to incorporate less severe SSEP changes.

Age was the only variable that significantly predicted the development of a new postoperative neuropraxia, with older age increasing the likelihood. BMI, duration of surgery, smoking status, procedure performed, and baseline SSEP abnormalities were not found to be significant predictors of the development of a postoperative neuropraxia. IOM likely averted a new

postoperative neuropraxia in all 72 patients by alerting the surgical team in a timely fashion and allowing subsequent intervention. Intervention resulted in an improvement in SSEP recordings, garnering a 71 percent sensitivity and 100 percent specificity. We attribute our low incidence (the best in the available literature) of new postoperative neuropraxia to astute and continuous IOM by a highly trained team and great care taken in patient positioning in every spine procedure.

Jaspreet Kaur, MD; Parthasarathy Thirumala, MD; Donald J. Crammond, PhD; Jeffrey Balzer, PhD; and Adam S. Kanter, MD, also contributed to this article.

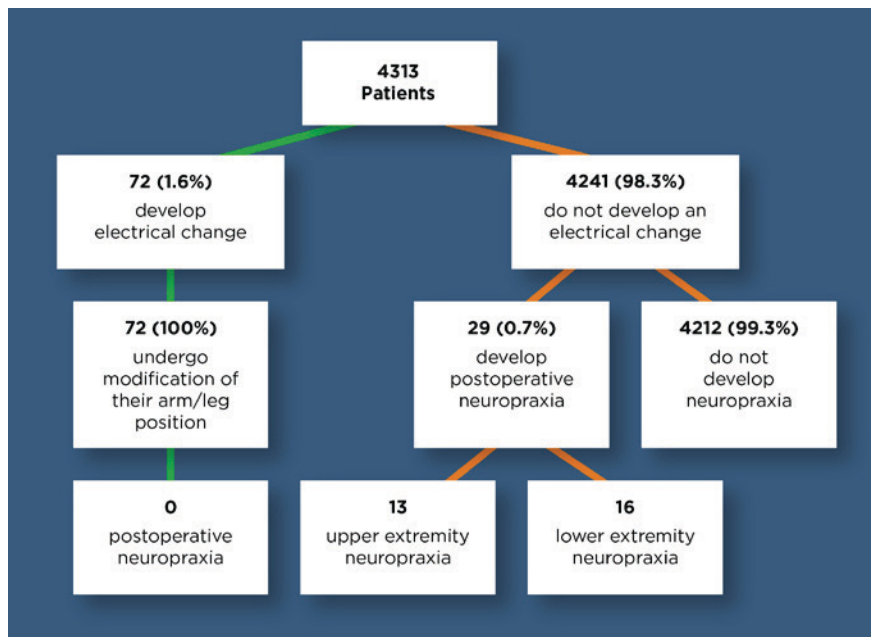


Figure 1: Flow chart depiction of results of SSEP monitoring in 4,313 patients, and the development of a position-related neuropraxia.

Risk Factors That Increase the Risk of Neurological Deficits Following Thoracolumbar Spinal Fusion Surgery

by Enyinna Nwachuku, MD

Spinal fusion (or arthrodesis) remains an important therapeutic option for the treatment of a variety of spinal pathologies that have proved refractory to conservative management. Due to a number of technological advancements, the rates of spinal fusion surgery performed in the United States and globally have increased significantly in the last 10 to 15 years, with a 220 percent increase in the 1990s and a subsequent 135 percent increase in the early 2000s. The indications for these technically evolving operations include, but are not limited to, trauma, congenital or idiopathic spinal deformity, degenerative spine disease, vascular malformations, and malignancy. However, these procedures are not without their risks. Previous studies have yielded overall complication rates ranging from 2 to 3 percent, depending upon the type of spinal fusion performed. Among the most devastating complications that may result from spinal fusion surgery of the thoracic and lumbar regions are neurological deficits, including spinal cord injury, nerve root injury, and cauda equina syndrome.

In the Department of Neurological Surgery at UPMC, our surgeons are constantly creating opportunities for innovative changes in the field of spine surgery. Our center is a regional tertiary care referral center for patients with highly complex spinal disorders that result from failed back surgical procedures, congenital disorders, scoliosis, tumors, and trauma, among other causes.

For such difficult cases, we attempt to adopt advanced techniques to improve patient outcomes and at the same time avoid complications.

To this end, the department investigated, via a national database called the Nationwide Inpatient Sample (NIS), the risk factors associated with perioperative neurological deficits in patients undergoing thoracolumbar fusion surgery. Additionally, the department was interested in the contribution of perioperative neurological deficits to in-hospital mortality and morbidity.

The goal of the investigation was to elucidate what characteristics put patients who undergo thoracolumbar spinal fusion surgery at risk. Knowledge of such risk factors might allow for the implementation of methods to decrease the known complication rate within the department and hopefully for other spine centers as well. The data obtained consisted of patients between the ages of 18 to 80 years who underwent thoracolumbar fusion between the years of 1999 and 2011.

This retrospective analysis of a longitudinal, large dataset demonstrated that advanced patient age, higher comorbid burden, and preoperative neurological deficit significantly increased the risk of perioperative neurological deficits.

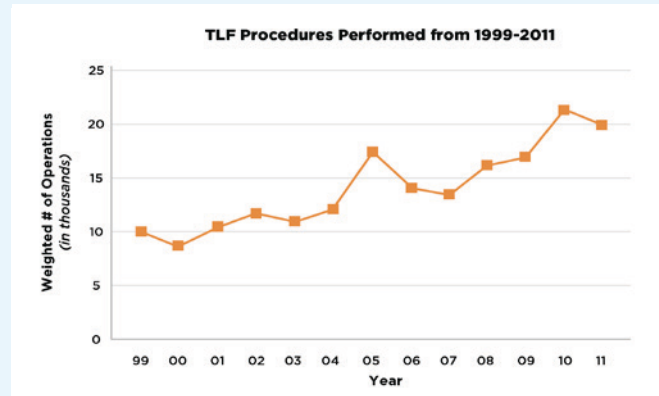


Figure shows the increase in thoracolumbar fusion procedures performed between 1999-2011. The number of procedures performed went from a weighted 10,000 in 1999 to a peak of 22,000 in 2010, more than doubling in the time period covered by our study.

Interestingly, female gender and hypertension were found to be associated with lower rates of postoperative neurological deficits. Furthermore, perioperative neurological deficits were found to be an independent risk factor for in-hospital mortality and morbidity after thoracolumbar fusion. Current work within the department is comparing these results with our own institutional data. The Center for Clinical Neurophysiology within our department, which is responsible for the electrophysiological monitoring of patients during spine surgery, is working to develop better methods for intraoperative monitoring for those patients at highest risk. These data will hopefully assist with a patient stratification for those patients at highest risk who require thoracolumbar arthrodesis.

Variables	Perioperative Neurological Deficits (n=37,899)		
	Odds Ratio	95% CI	p-value
Age	1.023	1.018 - 1.029	<0.001
Female Gender	0.789	0.653 - 0.952	0.013
VWR 5-14	1.535	1.054 - 2.235	0.025
VWR >14	1.398	0.631 - 3.098	0.409
Congestive Heart Failure	1.001	0.536 - 1.870	0.996
Pulmonary Circulatory Disorders	1.032	0.420 - 2.533	0.946
Paralysis	2.551	1.674 - 3.886	<0.001
Coagulopathy	1.204	0.825 - 1.756	0.335
Electrolyte Disorder	1.233	0.899 - 1.689	0.193
Cardiac Arrhythmias	1.324	0.929 - 1.887	0.121
Hypertension	0.604	0.467 - 0.780	<0.001
Rheumatoid Arthritis/Collagen Vascular Diseases	1.399	0.869 - 2.250	0.167

Improving the Health and Wellness of the Neurosurgeon

by Joseph C. Maroon, MD; Robert Friedlander, MD; and L. Dade Lunsford, MD

Overworked, overwhelmed, overcommitted, overanxious, and overextended. No wonder more than half of all doctors report symptoms of burnout! For nonacademic neurosurgeons, the rate is even higher: 63 percent experience burnout, and the most recent Gallup poll found 40 percent of American workers were so stressed that they felt no borders between work and life outside of their job.

In his presidential address to the Congress of Neurological Surgeons, Nathan Selden cited prolonged work hours, almost inhuman expectations on productivity, and a sea of governmental regulations, all factors that are ubiquitous — particularly in the surgical specialties — as part of the problem. Experiencing emotional and physical exhaustion, depersonalization from patients which can lead to cynicism, and a low sense of personal accomplishment are all part of physician burnout.

As a consequence, symptoms such as depression, anxiety, sleep problems, and even suicidal ideation are frequently observed. Long hours and heavy workloads lead to feeling initially overwhelmed, then apathetic, and finally just plain numb. Furthermore, neurosurgeon burnout has consequences that directly impact both the patients and the hospital, such as increased medical errors, lower quality of care, and more litigation.

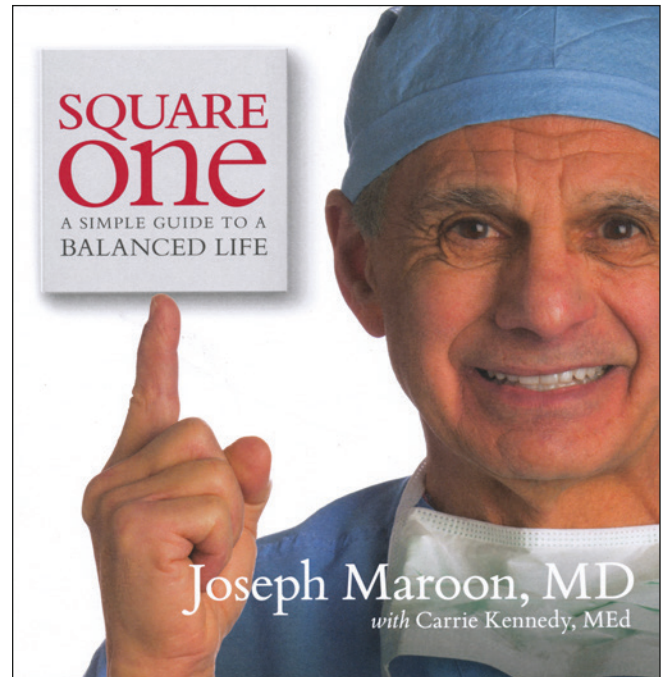
The Department of Neurological Surgery at the University of Pittsburgh is initiating an intervention program, aiming not just to prevent and reduce burnout, but also to increase the general health and wellness of neurosurgery residents and faculty. The main goals of the program are:

- Improving work/life balance
- Decreasing psychological stress
- Increasing social support through activities and mentorship
- Improving general health and fitness by monitoring biomarkers of physical and psychological health

To achieve these goals, the program will target all four sides of life: physical, work, family/social, and spiritual, as outlined in the recently published book, *Square One: A Simple Guide to a Balanced Life*.

Physical

Biomarkers such as heart rate, blood pressure, blood laboratory studies, and general physical and dental health will be assessed annually. Dietary counseling, baseline fitness evaluations, and guidelines for physical fitness will be provided, along with an on-site workout facility exclusively for neurosurgical residents and faculty.



Work

Regular faculty/resident meetings will be held to discuss scheduling and ways to increase efficiency, as well as wellness lectures on depression/mood, nutrition, time management, and relationships.

Family/Social

Services for spouses and significant others will be provided to mitigate home stress. Joint departmental activities, such as softball games, faculty dinners, and inter-residency competitions, will provide a road map for team building and achieving better work-life balance.

Spiritual

Implementation of a mindfulness (and physical fitness) program using smartphone apps, teaching of breathing techniques, and guided discussions on spirituality will be part of the program to strengthen the spiritual side of life.

By helping neurosurgeons to live a more balanced life, this program will create a mentally and physically healthier neurosurgery work force, with all the benefits that will accrue to the residents, faculty, patients, and hospital personnel.

Brian Jankowitz, MD; Will Ares, MD; Jeff Bost, PA-C; and Christina Mathyssek, PhD, also contributed to this article.

Inaugural Jannetta Symposium Attracts Leaders of Neurosurgery Discussing Latest Innovations in the Field



The inaugural **Peter J. Jannetta Symposium** was held April 8, 2017, at the Hotel Monaco in downtown Pittsburgh. The event was a wide-ranging look at the innovations taking place in the field of neurosurgery, as well as a celebration of the accomplishments of Peter J. Jannetta, MD — innovative former chairman of the University of Pittsburgh

Department of Neurological Surgery who passed away in April of last year.

Prominent figures in the field of neurosurgery, including Stephen Haines, MD; Hae-Dong Jho, MD, PhD; Bruce Pollock, MD; Laligam Sekhar, MD; Chandra Sen, MD; Gregory Thompson, MD; and Howard Yonas, MD, joined department leaders Robert Friedlander,

MD; Paul Gardner, MD; L. Dade Lunsford, MD; David Okonkwo, MD, PhD; Ian Pollack, MD; and Ray Sekula, MD, among others, to discuss the latest advances in skull base surgery, microvascular decompression, vascular surgery, endovascular surgery, radiosurgery, and spine surgery.

The day-long event featured more than two-dozen lectures in five separate sessions and was attended by more than 120 neurosurgeons and residents.

Dr. Jannetta served as chairman of the University of Pittsburgh Department of Neurological Surgery for 25 years, beginning in 1971. He was internationally acclaimed for his development of microvascular decompression (MVD), an innovative procedure that

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Department Chairman and Symposium Course Director Robert Friedlander (right) with Peter Jannetta's wife, Diane (center), and presenter Rudolf Fahlbusch (left), professor and chairman of the University of Erlangen-Nürnberg in Erlangen, North Bavaria, Germany.



Robert Friedlander (right) with presenters Hae-Dong Jho (left), director of the Jho Institute for Minimally Invasive Neurosurgery at Allegheny General Hospital, and Laligam Sekhar (center), director of cerebrovascular surgery and skull base surgery at Harborview Medical Center in Seattle.



Paul Gardner, neurosurgical director of the department's Center for Cranial Base Surgery, delivers a talk on minimally invasive endoscopic surgery.



Brian Jankowitz (center), co-director of the department's Endovascular Therapy program, with fellow former residency program graduates Alan Scarrow (left), president of Mercy Springfield Communities Health System in St. Louis, and Elad Levy (right), chairman of neurosurgery at State University of New York in Buffalo.



Inaugural Jannetta Symposium attendees gather for group photo before dinner.

moved blood vessels away from the trigeminal nerve, alleviating chronic pain and spasms in facial muscles. The procedure became commonly known as the “Jannetta Procedure” and brought relief to thousands.

Dr. Jannetta went on to publish more than 400 scientific articles, abstracts, and book chapters and won several awards for his contributions to the field. Perhaps more importantly, he helped

create one of the most outstanding schools of neurosurgery in the world, training scores of residents, many of whom have gone on to be leaders in the field themselves.

The symposium was hosted by UPMC, the University of Pittsburgh School of Medicine and the Department of Neurological Surgery. The presenting sponsor for the event was The Jannetta Society of The Jannetta Neuroscience Foundation.

News & Notes

Special Lectures and Appearances

Partha Thirumala, MD, was a visiting professor at Tata Memorial Hospital in Mumbai, India, on March 2.

Paul Gardner, MD, and **Carl Snyderman, MD, MBA**, served as co-directors of the Navigated Endoscopic Sinus Surgery: Basic, Advanced, and Skull Base Course held in Maribor, Slovenia, February 2–4.

L. Dade Lunsford, MD, was a keynote speaker at the Northwell Health Annual Meeting on Stereotactic Radiosurgery at North Shore University Hospital, in Manhasset, New York, on March 24.

In the News

David O. Okonkwo, MD, PhD, **Gregory Weiner, MD**, and **David Salvetti, MD**, were featured in the *Pittsburgh City Paper*, March 1, in an article that discussed the use of music in the operating room. Dr. Okonkwo was also featured in a January 29 *Pittsburgh Post-Gazette* article that detailed the spine and trauma expert’s contribution in a rare spinal cord surgery for a special water rescue dog.

Joseph Maroon, MD, was a guest on the *KDKA Radio Morning News Show*, February 14, discussing his new book, *Square One*, an in-depth look at what it takes to lead a healthy, balanced life. (See related article on page 5). Dr. Maroon was also featured in a *Beaver County Times* article, November 7, that talked about his efforts to put together a brain health program across the St. Barnabas Health System, a long-term senior living community in the Pittsburgh area.

Robert Friedlander, MD, and **William Ares, MD**, were featured in an *Altoona Mirror* article, December 15, that showcased how UPMC is utilizing telemedicine in examining post-op patients.

A study published by **Fang-Cheng (Frank) Yeh, MD, PhD**, as the lead author, describing how researchers have developed a way to “fingerprint” the human brain, was featured in a number of science journals across the country this past November.

Congratulations

R. Mark Richardson, MD, PhD, was recently appointed to the Parkinson Foundation Western Pennsylvania board of directors.

Peter C. Gerszten, MD, was elected to serve on The Radiosurgery Society board of directors.

Vincent Miele, MD, was named sports medicine editor for World Neurosurgery.

L. Dade Lunsford, MD, was featured in a UPMC television commercial that showcased the successful treatment of an acoustic neuroma patient. The commercial can be viewed online at upmcstories.com/meet-eddie/.

Congratulations to the following faculty members and residents who contributed to the seventh edition of Youmans and Winn Neurological Surgery: **William Ares, MD; Robert Friedlander, MD; Gurpreet Gandhoke, MD; Paul A. Gardner, MD; Peter Gerszten, MD; Brian Jankowitz, MD; Adam Kanter, MD; Joseph Maroon, MD; David O. Okonkwo, MD, PhD; David Panczykowski, MD; Ian Pollack, MD; R. Mark Richardson, MD, PhD; and Zachary Tempel, MD**. Published by Elsevier, the 70-chapter e-book is widely considered the “bible of neurological surgery” and includes more than 300 videos with commentary.

Nitin Agarwal, MD, was appointed to the American Association of Neurological Surgeons Young Neurosurgeons Committee. Dr. Agarwal was also appointed to serve on the AANS political action committee.

Minimally Invasive Sacroiliac Joint Fusion *(Continued from Page 1)*

Furthermore, a substantial body of evidence supports the benefits of percutaneous SIJ compared to nonoperative management for decreasing pain and improving quality of life.

Percutaneous SIJ fusion is performed in the operating room under general anesthesia. A preoperative CT scan is performed for surgical planning. A 2 cm-length incision is made over the lateral hip, and three threaded compression titanium screws are inserted. Placement across the SIJ is confirmed using lateral, inlet, and outlet views. The wound is closed with absorbable sutures, and the patient is admitted for 23-hour observation. Surgery typically takes one hour. All patients are evaluated by a physical therapist and discharged with crutches or walker to be used for three weeks, until their first postoperative visit.

We have found SIJ fusion to be safe and associated with good outcomes. Patients should be considered as surgical candidates when they present with complaints of pain localized over the SIJ and other nonsurgical treatments have failed to decrease their pain and the patient's quality of life is significantly adversely affected.



Figure 2: Implanted screws in the SIJ.

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