

SpineSection

NEWSLETTER

AANS/CNS Joint Section on Disorders of the Spine and Peripheral Nerves

Welcome

We are pleased to present you with the latest Newsletter of the Joint Section on Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and Congress of Neurological Surgeons.

In this issue, Zo Ghogawala presents an eloquent appraisal of the recent publications on the role of fusion in degenerative spondylolisthesis with stenosis. We also have two excellent interviews: Cheerag Upadhyaya chats with Ed Benzel and Line Jacques speaks with Robert Spinner. From the Peripheral Nerve corner we have a review of traumatic nerve injuries from Zack Ray and Thomas Wilson and an

update on peripheral nerve educational offerings. And finally we have updates on the RUC from John Ratliff and payor policy issues from Kurt Eichholz.

See you in Las Vegas for the Annual Meeting, March 8-11, 2017!

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American Association of Neurological Surgeons
and the American Association of Neurosurgeons



The NEJM Trials for Degenerative Lumbar Spondylolisthesis: Now What?

Zoher Ghogawala MD FACS

Degenerative lumbar spondylolisthesis with symptomatic spinal stenosis is often treated with decompression and fusion. In April 2016, the New England Journal of Medicine published results of two conflicting trials on the topic: The Swedish Spinal Stenosis Study¹ and the Spinal Laminectomy versus Instrumented Pedicle Screw (SLIP) study.² The Swedish study concluded that fusion was not beneficial for patients with lumbar stenosis with or without spondylolisthesis. The SLIP study found significant benefit to adding a fusion when performing lumbar laminectomy for treating grade I degenerative lumbar spondylolisthesis. Both studies provided relatively long-term follow-up data.

The two RCTs differed in two important ways: Study Population and Primary Outcome Measure. The Swedish study randomized

247 patients with 1- or 2-level lumbar spinal stenosis with or without spondylolisthesis. The Swedish study did not characterize the radiographic stability of patients. No flexion-extension radiographs were performed. Conversely, the SLIP study contained a homogenous population of non-mobile single-level Grade I spondylolisthesis patients. It is therefore not surprising that the Swedish study did not identify any benefit from fusion based on a heterogeneous study population, while the SLIP study, which randomized a homogeneous group of 66 patients with single-level grade I spondylolisthesis did identify a significant benefit from fusion.

Not only were the study populations different, the primary outcomes of the studies were also different – The Swedish study used Oswestry Disability Index (ODI) as the primary outcome measure, while SLIP used

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the SF-36 physical component summary (SF-36 PCS). The SLIP study did use ODI as a secondary outcome measure and although the study was underpowered for ODI, patients treated with fusion had less disability over time. At 4 years the difference in ODI scores between groups was 9 points favoring fusion ($p=0.05$). Using a minimum clinically important difference (MCID) of 10 points for ODI, 85% of patients treated with both fusion and laminectomy achieved the MCID, while only 61% of patients treated with laminectomy alone achieved the MCID ($p=0.04$).³

It is important to attempt to place these two trials into the context of current evidence-based guidelines, which currently provide a Grade B-level recommendation indicating moderate support for fusion when treating patients with lumbar stenosis with degenerative spondylolisthesis.³ Very recently, Resnick and colleagues examined the two NEJM trials and concluded the SLIP study provides Level I evidence for the efficacy of fusion to improve health-related quality of life outcomes and lower reoperation rates in these patients. They also concluded that the Swedish study, using a disease-specific tool as a primary outcome measure, provides Level II evidence that the addition of a fusion does not have significant benefit within a heterogeneous population.⁴

Despite their differing patient populations, the two studies both provide valuable data that future studies can build upon regarding the value of lumbar fusion. Each study supplies important long term data that is vital to understanding the durability of outcome. Value is defined through cost, clinical benefit, and durability. Value can be expressed as cost/quality adjusted live years (QALYs), which are derived from health-utility measures, such as the EQ-5D or the SF-36.⁵

Considering overall value and durability, one of the differences between the studies was the re-operation rate. The Swedish study observed no difference in re-operation rates between their study groups. The SLIP study, on the other hand, found a re-operation rate of 34% for laminectomy over 4 years versus 14% for the fusion group.² This difference might have enormous implications for the overall value of fusion surgery. Future economic analyses will be important to determine the overall cost-effectiveness of lumbar fusion over the long term. It is very likely that those patients who require re-operation will have significant increases in health resource utilization over time before and after re-operation. Lumbar fusions, which have high upfront costs, may prove to be cost-effective if there is evidence to support durable clinical benefit.^{6, 7}

The evidence provided by both trials is useful but is not the end of the story. In the future, we will require systems to collect patient-reported outcome and patient-specific data including radiographic information so that we can continue our quest to generate meaningful comparative effectiveness data that will promote optimal care for our patients. It is vital to generate these data from and for specific patient populations in order to provide all stakeholders the type of information that will advance the profession.

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What's up with the RUC?

John Ratliff, MD

There are a number of coding changes that will affect spine practices starting in 2017. In this article I will review some of those changes and note the proposed wRVU values for the new codes. The final numerical descriptors for these codes have not been published yet, so the codes I use are preliminary. Since some of these changes have a pretty big financial impact, I want to get that information out now, prior to the final CPT 2017 publication with the code descriptors. It will hopefully make sense as we go forward.

The Councils of Medicare and Medicaid Services (CMS) employ screens of procedure codes to identify when codes may be mis-valued. This may have significant impact on physician reimbursement. When a potential mis-valued code is identified, it is referred to the RBRVS Update Committee (RUC) for review.

Intervertebral Device

We have reviewed in multiple "What's up With the RUC" columns how we are anticipating re-valuation of 22851 *Application of intervertebral biomechanical device(s) (eg, synthetic cage(s), methylmethacrylate) to vertebral defect or interspace*. This code has been picked up by multiple screens, previously in 2009 under the CMS Fastest Growing procedure screen and more recently on a high expenditures screen.

When we looked at 22851, it was noted that this one code was used in over a 100 separate procedures, from single level fusions to extensive multi-level corpectomies. It was not felt that we could complete an accurate survey with a code that could be used in a wide variety of different ways.

Hence we took the code to the CPT committee and developed 3 new codes, each describing a different version of insertion of an intervertebral body device. Since the 2017 CPT text has not been published, I have to report these with the preliminary descriptors. These are not the final codes; the final codes will not have "X" in them. The three new codes that will take the place of 22851 are:

1. 22X81 *Insertion of interbody biomechanical device(s) (e.g., synthetic cage, mesh) with integral anterior instrumentation for device anchoring (e.g., screws, flanges) when performed to intervertebral disc space in conjunction with interbody arthrodesis, each interspace*. This would be used for insertion of a PEEK or other spacer after a TLIF or ACDF. Note the descriptor includes integral anchors, so for a stand-alone ACDF implant the only thing you would report is 22X81, without reporting anterior plate fixation (22845). The wRVUs recommended by the RUC for this code was 4.88, CMS has proposed a value of 4.25.

2. 22X82 *Insertion of intervertebral biomechanical device(s) (e.g., synthetic cage, mesh) with integral anterior instrumentation for device anchoring (e.g., screws, flanges) when performed to vertebral corpectomy(ies) (vertebral body resection, partial or complete) defect, in conjunction with interbody arthrodesis, each contiguous defect*. Here the device is to reconstruct a corpectomy defect, with the goal of fusion. This is in contradistinction to placement of PMMA into a corpectomy

defect, as one might do when reconstructing a pathologic fracture. This code would be reported with arthrodesis codes, same as 22X81. Note the same prohibition with regard to integral anchors. The RUC recommended a value of 5.50 and this was accepted by CMS.

3. 22X83 *Insertion of intervertebral biomechanical device(s) (e.g., synthetic cage, mesh, methylmethacrylate) to intervertebral disc space or vertebral body defect without interbody arthrodesis, each contiguous defect*. This code was designed to parallel the original description of 22851, reconstruction of a vertebral body defect with PMMA. Here, you are not anticipating a fusion and you would not report arthrodesis codes. The recommended value from the RUC for this code was 6.00 wRVUs, CMS has proposed a value the same as 22X82, 5.50 wRVUs.

We are appealing the lower valuations proposed by CMS for the 22X81 and 22X83 codes.

Interlaminar Stabilization

4 codes were brought through the CPT panel and valued by the RUC covering interlaminar or interspinous process stabilization. These 4 codes are:

1. 228X1 *Insertion of interlaminar/interspinous process stabilization/distraction device, without fusion, including image guidance when performed, with open decompression, lumbar; single level*. This code covers placement of a spinous process spacer and the decompression done concurrently. The CMS recommended value for this code is 13.50 wRVUs.

2. 228X2 *Insertion of interlaminar/interspinous process stabilization/distraction device, without fusion, including image guidance when performed, with open decompression, lumbar; second level*. This is for additional levels when you are doing a concurrent laminectomy. The CMS value for this code is 4.00 wRVUs.

3. 228X4 *Insertion of interlaminar/interspinous process stabilization/distraction device, without open decompression or fusion, including image guidance when performed, lumbar; single level*. This code is used when you are placing a spinous process distraction device and you do not do a concurrent decompression. The value of this code as proposed by CMS is 7.03 wRVUs.

4. 228X5 *Insertion of interlaminar/interspinous process stabilization/distraction device, without open decompression or fusion, including image guidance when performed, lumbar; second level*. This is for additional levels of 228X4. The value proposed by CMS for this code is 2.34 wRVUs.

There are other new codes to learn about for 2017, but these have the biggest potential impact, hence I am including them in this edition of the Newsletter. I will let you know what comes out of our appeal to CMS about their reduction of the RUC recommended values for these codes.

We encourage all members who receive a survey to honestly and accurately fill it out; the survey process is laborious but is also the best way for your RUC advisors to make sure that spine procedure codes remain appropriately valued!

90 Day Global Period

CMS' Proposal and What It Means for Neurosurgeons

Kurt Eichholz, MD, FAANS, St. Louis Minimally Invasive Spine Center

The Proposal

In July of 2014, the Centers for Medicare & Medicaid Services (CMS) proposed the elimination of all 10- and 90-day global periods, reducing these global periods to 0 days. While the proposed institution of this policy was initially scheduled for 2017 (10-day globals) and 2018 (90-day globals), this has been delayed until 2019. However, data is currently being collected to determine the future valuation of global surgical codes. We will examine the proposal, how it emerged, and what it means to neurosurgeons.

Global Definition

The global period for any specific CPT code includes services provided by the surgeon before, during, and after a surgical procedure. This includes history and physical examinations performed the day of surgery, and all services provided for the procedure, as well as all services in the hospital or clinic provided during the global period. Hospital visits and clinic visits outside of this period are billed under Evaluation and Management (E&M) coding, with separate claims submitted to Medicare when outside of the global period. Currently, all hospital and clinic visits for a given procedure for the first 90 days are included in the payment and claim for the surgical procedure.

Of the approximately 10,000 Current Procedural Terminology (CPT) codes, 4200 of these are categorized as either 10- or 90-day global codes. Almost all surgical procedures

provided by neurosurgeons are categorized as 90-day global codes, and the elimination of global codes would have a significant impact on both reimbursement and patient access to care for your practice.

Why Change the Global?

The impetus for the change was a 2012 Office of Inspector General Report¹ which showed that global surgery fees in many cases did not reflect the number of E&M services provided. In this report, the OIG estimated that Medicare paid a net \$49 million for E&M services that were included in musculoskeletal global surgery fees, but not provided during the global surgery periods in 2007. This was based on a sample of 300 surgeries, which found that 89 of the 300 surgeries had fees that reflected the actual number of E&M services; In 165 of the 300 surgeries, physicians provided fewer E&M services than included, and in 46 cases, provided more E&M services than included in the global surgery fees. In 65 cases, the surgery was one of multiple surgeries, and the OIG was unable to determine whether the E&M services were related to the sampled surgery or to one of the other surgeries performed during the global period.

Based on that report, the OIG recommended that the CMS adjust the estimated number of E&M services with in the global surgery fee to reflect the "actual" number of E&M services provided. The OIG's own report stated that this change would have reduced payments to surgeons by \$49 million in 2007, but this may be a gross underestimate.

The Effect on Your Practice

At issue is the difference between valuation of services provided under a 90 day global CPT code, and a separately reported E&M code. The 90 day global CPT codes include valuation for practice expenses and liability costs that are associated with the postoperative visits, which would not be included in separately billed E&M codes. Therefore, surgeons would be penalized twice....once by losing the valuation of the CPT code under the current 90 day global period, and then by having to submit for reimbursement under the lower valued E&M coding. However, the practical penalty would be much higher in reality.

For each surgery performed, every postoperative visit, either in the hospital, or in the office, would need to be a separately submitted claim. As an example, for a patient who spends 4 days in the ICU after a craniotomy after an aneurysm, and then 4 days on a surgical floor, and then returns to the office for postoperative visits at 4-6 weeks and 2-3 months, that would be a minimum of 10 additional claims that the surgeon's office staff would be required to submit to CMS (8 visits in the hospital, 2 visits in the office). In addition, these claims would be at the lower reimbursement of the E&M codes. Even an uncomplicated microdiscectomy performed as an outpatient procedure would have two to four additional E&M claims per procedure, depending on how many times the patient was seen in follow-up.

A 2004 NERVES survey² showed that neurosurgeons performed an average of 335 cases

per year (academic practices averaged 239 per year, while single specialty practices averaged 345, and multispecialty practices averaged 393). Considering that reimbursements are lower now than in 2004, and that more operations are being performed on an outpatient basis, one would expect that the average number of cases per neurosurgeon is higher now than in 2004. However, using the data above, if the average neurosurgeon performs 335 cases per year, and using a conservative estimate of 7 additional E&M claims per cases, one would expect that the average neurosurgeon's office would be submitting an additional **2345** claims per year, per surgeon. Consider how much time an office staff would need to submit this additional number of claims, for lower reimbursement, and for the same amount of work by the surgeon. For any given office, this may require additional hours, or additional office staff, and would significantly increase overhead.

In 2012 a joint statement on the Neurosurgical Workforce³, it was reported that there are 3,689 practicing board certified neurosurgeons in the US, not including those practicing prior to board certification. Therefore, in examining neurosurgery alone, it would be expected that a minimum **8.6 million** additional claims per year would be submitted for reimbursement under the new proposal. Considering that neurosurgery is a small specialty which comprises approximately 0.5% of all physicians in the US, the actual number of claims submitted would be exponentially higher.

In looking only at the additional work of office staff in submitting these claims, and the additional overhead incurred to do so, while additionally suffering lower reimbursement, the effect on neurosurgical practices would be enormous. For patients with commercial insurance, it is unclear how the implementation of elimination of global periods would be effected. However, one would expect that, at a minimum, those patients would have copays for visits that normally would have been covered under the global period, which may potentially lead patients not to seek care when necessary.

Where We Stand Now

The policy for elimination of 10- and 90-day global periods was finalized by CMS in November 2014, despite strong opposition by numerous surgical societies, including the American College of Surgeons. Passage of the Medicare Access and Children's Health Insurance Program Reauthorization Act of 2014 (MACRA) included the repeal of the Sustainable Growth Rate (SGR) formula, and also prevented CMS from implementing the transition of 10- and 90-day global codes. MACRA requires CMS to collect data from a **representative sample** of surgeons who utilize the 10- and 90-day global codes, no later than January 1, 2017, and use that data to revise global services starting in 2019.

However, the CMS has proposed an unfunded policy to collect data on **all** 10- and 90-day global services from **all** physicians who perform these services. According to this proposal⁴, surgeons providing 10- and 90-day global surgery services to Medicare patients will be required to document the type, level and number of pre- and post-operative visits furnished during the global period for every procedure under the 10- and 90-day globals. Every 10 minute increment of services provided would be required to use a new set of G-codes to report that service. These codes have not been validated or tested, and are not comparable to the currently used E&M services. This collection of data is intended to start by January 1, 2017, and the vast majority of offices and practices will not be equipped to collect this enormous amount of data.

What Can You Do?

Surgeon input is imperative to preventing potentially catastrophic change to our practice. This initiative started with an OIG analysis of 300 cases, which is less than one average neurosurgeon does in one year.

The Washington Committee has drafted a letter that has been sent to the CMS which details the opposition of organized neurosurgery to the proposed data collection, and

changes to the 10- and 90-day global periods. However, it is important that each surgeon contact his or her congressman to make sure that our elected representatives in Congress realize the negative impact that the CMS mandated data-collection policy will have on access to care. Representatives Larry Buchson (R-Indiana) and Ami Bera (D-California), both physicians, are asking fellow members of Congress to sign a letter to CMS opposing the global surgery data collection proposal. This letter asks CMS to abandon the current proposal and instead "include policy that reflects the law as passed to collect data from a 'representative sample' that is the least burdensome, yet adequate sample to yield statistically viable results." Encouraging your member of the House of Representatives to sign the Buchson/Bera Global Surgery Letter will help assist this effort.

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Interview with Edward Benzel, MD

**Chairman, Department of Neurosurgery, Cleveland Clinic
Professor of Surgery, Cleveland Clinic Lerner College of Medicine**

Interviewed by Cheerag Upadhyaya, MD

Who were your early mentors in neurosurgery & spine surgery?

Certainly, Dr. Sanford Larson, Chairman of the Department of Neurosurgery at the Medical College of Wisconsin was an important mentor for me, as well as for all of neurosurgery and spine surgery. Additionally, my mentors included Dr. Joseph Cusick, Dr. David Hemmy, and Dr. Glenn Meyer. My chief resident, Dr. Pat Welch, was a guiding light in many regards in my early years.

Those neurosurgeons with a common interest in spine surgery learned to lean on each other to advance spine surgery; these included Dr. Arnold Menezes, Dr. Volker Sonntag, Dr. Regis Haid, Dr. Richard Fessler, and Dr. Vince Traynelis.

How/why did you focus on spine surgery when orthopedic surgeons were dominant?

At the Medical College of Wisconsin, the neurosurgery service was responsible for the management of patient's with thoracolumbar trauma. We (on the neurosurgical service) were surgically responsible for the exposure, decompression, interbody strut/bone graft placement and wound closure; while orthopedic spine surgery would perform the placement of the spinal instrumentation. Given my early interest in spine surgery, I would stay in the operating room to assist the orthopedic spine surgeons with placement of instrumentation. Consequently, Dr. Larson suggested that I add instrumentation to my and the Medical College of Wisconsin Neurosurgery service's repertoire. Such we did, and the rest is history.



Due to this more extensive experience, we were able to continue to advance spine surgery as neurosurgeons, despite considerable resistance from our orthopedic colleagues. When I moved to Shreveport, Louisiana at the LSU Medical Center, and assumed an academic position at Louisiana State University, I was able to further the neurosurgical influence in the spine arena. I was not alone. Many players contributed. These included but were not limited to David Kelly, Volker Sonntag, Rick Fessler, Arnold Menezes, Regis Haid, Vince Traynelis and many, many others.

I then moved on to the University of New Mexico. At the University of New Mexico I continued to face resistance as I sought to advance the role of spine surgery within the Department of Neurosurgery. Dr. Larson was instrumental in certifying my prior experience and training in spine surgery at the Medical College of Wisconsin. He provided a 'fellowship certificate', which I had not requested previously. Such provided a means to open doors at the

University of New Mexico regarding the neurosurgical involvement in complex spine surgery.

Others shared the challenges that I faced. These include Drs. Sonntag, Menezes, Haid, Traynelis, Fessler and many, many others. Over time, we were able to gradually gain the respect of our orthopedic colleagues and demonstrate that neurosurgeons were just as competent in performing spine surgery as orthopedic spine surgeons.

The formation of the Council of Spine Societies was an important endeavor that was instrumental in helping to bring neurosurgeons and orthopedic spine surgeons together. Dr. Edgar G Dawson, Professor of Orthopedic Surgery at the University of California Los Angeles, was the first Chairman. I served as the second Chair. Through these collaborations, neurosurgeons were able to educate both our orthopedic colleagues, as well as our neurosurgery colleagues, on neurosurgery's technical capabilities and knowledge of spine surgery. We were also able to learn from each other and share our respective specialties' strengths.

How do you see neurosurgeons and orthopedic spine surgeons interacting in the future?

Increasing partnerships between orthopedic surgery and neurosurgery, both in national organizations as well as within large health systems, provided a broad and deep forum for collaboration.

For example, the Spine Section has become one of the premier spine meetings and now rivals the Cervical Spine Research Society as one of the annual "must go to" meetings.

Every year we are seeing more and more orthopedic surgeons attending the Spine Section Annual Meeting, as both speakers and attendees. I believe that orthopedic surgeons had traditionally felt like 2nd class citizens with regard to this meeting; however we are working hard to change this perception. Similarly, neurosurgeons have become increasingly active in traditionally orthopedic dominant spine societies, such as the Cervical Spine Research Society, North American Spine Society, and the Scoliosis Research Society.

At the Cleveland Clinic, we have established the Cleveland Clinic Center for Spine Health - a virtual spine department where neurosurgeons, orthopedic spine surgeons, medical spine specialists, and pain management collaborate in a multi-disciplinary manner.

What do you believe is/are your main contribution(s) to neurosurgery and spine surgery?

First and foremost – I am an educator and someone who has stood by his principles. If these are true, then these stand as my major contributions to neurosurgery and spine surgery.

My interest in education spans my entire academic career and my involvement in organized neurosurgery. Early in the 1990's, we were struggling with how to best disseminate knowledge such as placement of pedicle screws. The first AANS spine course was taught by me, Dr. Philip R Weinstein, among several others. Of note, Dr. Cloward taught at some of the early didactic sessions. This then quickly evolved into cadaver courses. Nancy Bashook played an instrumental role in helping coordinate these early courses. She had a Master's in Education and was seminal in helping us understand the principles we use today to transmit new skill sets.

My interest in educating neurosurgeons on the physical principles of spine surgery in

an easy to understand manner led to the publication of my book *-Biomechanics of Spine Stabilization*. My focus on education was what drove me to establish a neurosurgery residency program and spine fellowship at the University of New Mexico and to help establish the Cleveland Clinic Center for Spine Health and further the development of the Department of Neurosurgery at the Cleveland Clinic

In which direction do you think neurosurgery spine should be moving? What do you believe is the future of spine surgery - not necessarily technical advancements, but also in terms of integration and centers of excellence?

While I will always remain a neurosurgeon first and a spine surgeon second, I do believe that the days of the renaissance neurosurgeon are nearing an end. Endovascular and then vascular neurosurgery has increasingly become sub-specialized as have functional and epilepsy neurosurgery. Neurosurgeons who focus on spine surgery will increasingly become integrated into multidisciplinary teams with orthopedic surgeons, medical spine specialists, and pain specialists. The shift from volume-based care to value-based care will only accelerate this trend. Ultimately, very thoughtful spine surgeons with great outcomes will likely do better financially, while aggressive spine surgeons with average outcomes will become less successful – and eventually become the dinosaurs of modern medicine.

What are your thoughts regarding the relationships between spine surgeons & industry?

We must always remember to recognize and resist our biases. Dr. Casarett at the University of Pennsylvania Perelman School of Medicine described the "therapeutic illusion" - as physicians believing "their actions or tools are more effective than they

"Ed Benzel is the epitome of the true academic surgeon and is someone who leads by example. Education of medical students, residents, and fellows has always been a priority of Ed's, and I was fortunate to be able to spend some time working with him. He helped to inspire my interest in academics and over the years, I have always appreciated his availability and willingness to provide advice."

Paul Park, MD
University of Michigan

actually are, the results can be unnecessary and costly care." Furthermore, as we move from volume to value based care, we will need to redefine our relationship with industry as the next wave will be technology whose primary purpose is to be cost effective and reusable.

What advice would you give to a young neurosurgeon interested in spine surgery?

Do what's right! Spine surgeons - both neurosurgeons and orthopedic spine surgeons - must always remember the Golden Rule and focus on doing what's right for our patients. Only then will be able to develop the multi-disciplinary collaborative teams that I believe will be required as we move towards value, while decreasing our share of excessive health care expenditures.

Peripheral Nerve Interview

Robert J. Spinner, M.D.

**Chair, Department of Neurologic Surgery
Burton M. Onofrio Professor of Neurosurgery
Professor of Orthopaedics and Anatomy
Mayo Clinic, Rochester, Minnesota**

Interviewed by Line Jacques, MD

Jacques: Who was the most significant mentor in your career and why?

Spinner: I have been fortunate to have had three significant mentors in peripheral nerve surgery:

1. My father, Morton Spinner (1928-2003), was a role model as a surgeon and parent. He exposed me to the field of peripheral nerve surgery early on when I typed some of his manuscripts; later on when we discussed his areas of research. He showed me that a person with a good mind, intellectual curiosity, hard work and passion, could make important and lasting contributions even from one's home study, garage, or basement.

2. David Kline has been an influential figure in my life since I was his fellow in 1998-99. In New Orleans, I was exposed to a broad spectrum of peripheral nerve disorders (tumors, entrapments, injuries, and pain). There I learned that it was indeed possible to develop a practice devoted exclusively to a niche subspecialty. He was a great mentor and continues to inspire me. David first introduced me to Martijn Malessy from Leiden at a private dinner in 2002; since then, Martijn and I have been scientific collaborators, dear friends, and kindred spirits.

3. Rolfe Birch has had enormous impact on me. I visited him in 2001 as a CNS Cushing Fellow. At the time, he was heading up the Peripheral Nerve Injury Unit at Royal National Orthopaedic Hospital in Stanmore, United Kingdom, and working with Thomas Carlstedt. Rolfe has unparalleled surgical prowess and a broad armamentarium in peripheral nerve reconstruction given his background in trauma, as well as microvas-



cular and hand surgery. In addition, he is a Renaissance man: he can converse intelligently on any subject and possesses British charm and scintillating wit.

Jacques: What was the contribution that you are the most proud of and why?

Spinner: I like to solve problems, e.g., crossword puzzles. I strive to provide anatomical explanations and understand mechanisms of disease processes. By looking for and recognizing some simple patterns, I have been able to make some advances in the diagnosis, natural history, pathogenesis and treatment of benign and malignant peripheral nerve tumors and tumor-like conditions. My favorite is the intraneural ganglion cyst, which I first learned about the hard way – by missing a question about it on the ABNS Primary Examination that I was taking for self-assessment as a second year neurosurgical resident. I had never heard of it! Almost twenty years later I'm still having fun thinking about it in different ways and establishing new friends through collaborative research: using anatomy and imaging to solve a clinical problem and improve patient outcomes by means of a simple unifying theory.

Jacques: In the last 20 years, what are the most significant changes you implemented in the surgical approach to brachial plexus surgery?

Spinner: Without question, the most revolutionary paradigm shift has been in the novel type and use of nerve transfers (neurotization). Nerve transfers once used for preganglionic injuries in the upper limb are now being used preferentially and increasingly for postganglionic injuries. They are also being applied in innovative ways for patients with injuries affecting the face, the lower limbs, and the spinal cord for limb reanimation and even bladder reinnervation. New distal nerve transfers are being designed and implemented yielding favorable and rapid results that are challenging the role of classic tendon transfers. Nerve transfers are being used in other situations such as following tumor resection, or postradiation or inflammation sequelae. While the majority of nerve transfers have been with the end-to-end technique, the pendulum has included end-to-side and reverse end-to-side techniques. The introduction and evolution of nerve transfers has revolutionized the way we think about peripheral nerve reconstruction.

Jacques: What are the most important metrics to evaluate PNS outcomes?

Spinner: This is a humbling question as we are far from having a gold standard to evaluate outcomes. Grading muscle function consistently and accurately remains the single most important outcome measurement. There are many limitations and difficulties in grading a particular joint function or muscle action, and then in interpreting the data. There are several muscles that may mimic, compensate or do the same function; thus isolation of one is not always easy – how does one best grade individual muscles such as the biceps, brachialis and brachioradialis when

elbow flexion is weak? How does one test supraspinatus or deltoid when grading muscles of abduction? How does one really grade trapezius function in scapular stabilization? Finally, we know that the vast majority of patients who recover “good function” have an MRC grade 4. How do we distinguish between this large group of patients? Clearly we are moving towards the inclusion of biomechanical data to further quantify clinical recovery.

A few caveats: Restoration of function does not imply functional recovery. Examination should not be done by the same surgeon. Surgeons’ grades are not the same as patients’ grades. Excellent muscle function alone is not the only marker of a success. Other factors clearly must be included and incorporated: including but not limited to pain, patient satisfaction, usefulness of the function, return to work. One of my patients with a C6 avulsion who regained outstanding biceps function and bulk following an Oberlin’s procedure, has had unremitting pain despite a DREZ lesion. How does one grade this? Certainly not an outstanding result for the patient!?! Measuring pain is a major problem. Postop DASH scores often don’t include preop values. Patients with excellent functional outcome still may not use that limb, and most patients with severe injuries, even when they return to work in some capacity, do not return to the same job.

We as surgeons need to do better in asking a set of “right” questions in order to obtain the right data.

Jacques: What do you see as pressing needs for the future direction of PNS and what are we missing?

Spinner: Fundamentally, nerve regeneration still is suboptimal and slow. Despite all the research and resources, regeneration still only occurs at an inch per month. Nerve tubes to bridge defects are progressing, but still are not quite equivalent to autologous nerve grafts and have more limited uses (i.e., small gaps, smaller caliber nerves). We are seeking ways to modify, modulate and manipulate conditions for regeneration,

including the microarchitecture, and the cellular and molecular environment.

Practically, we need better treatments and a better understanding of underlying mechanisms of disease processes. Technical advances will improve treatments such as for patients with pan plexal injury. Technological advances will help us image nerve lesions better and neural engineering will help us treat patients better with serious injuries.

This is an exciting time for peripheral nerve surgery. Innovations are coming. The future is bright.

Jacques: Currently, there is only one US center providing nerve fellowship: can you comment on your experience and is this enough?

Spinner: I have been training clinical fellows in neurosurgery, orthopedics and plastic surgery for a decade. This started with informal visits and then more formal rotations, all carefully regulated by Mayo. As the process unfolded, I started a peripheral nerve fellowship in 2008 which became accredited by CAST in 2010 and reaccredited in 2015. I am fortunate in that fellows are paid a salary through Mayo Graduate School of Medical Education. As a fellowship director, I do not have to seek industry support or ask fellows to be supported by their own institution or worse, come self-supported.

My biggest reward and job satisfaction has been the fellowship: i.e., sharing my passion for my work and my field of interest with someone equally engaged. I tend to learn more from and be more inspired by my fellow than he/she. While the fellowship may be one year, the hope is to develop a professional and personal relationship that is lifelong.

The future of peripheral nerve surgery rests on our training the next generation of thought leaders. More centers need to develop fellowships not only to create a cadre of subspecialists but also to maintain the excitement for peripheral nerve surgery within neurosurgery: lest we lose it to other subspecialties. A rich number of diverse, challenging peripheral nerve cases is the

minimum. More important is having a passionate program director, a supportive department, a multidisciplinary team and an academic milieu with a broad spectrum of clinical and basic science offerings. I am proud and excited that many of my fellows are becoming leaders in the field and can maintain the legacy of Dr. Kline: carry the torch and, in turn, transfer to the next generation of peripheral nerve surgeons.

The onus is on us as neurosurgeons to create our future: we need to mentor better and more aggressively. We need to instill our passion for our chosen field and subspecialty. We need to educate our students and impart the excitement of discovery and translational science. As we build the future of neurosurgery, like architects, we need to ensure that each medical center has a peripheral nerve expert (not just someone who can do some peripheral nerve cases), just like we have come to expert in brain or spinal surgery at major sites. “We must cultivate our gardens.”

Jacques: Anything to add for the neurological surgeon who would like a career in PNS?

Spinner: Peripheral nerve surgery is a rich field. It is anatomically based, rewarding and addictive. Peripheral nerve surgery can positively improve the fate of many patients, ones often desperately seeking help. It is a field that is completely open: there are more employment (academic or private practice) opportunities than trained individuals; and more untapped areas waiting for scientific and clinical discovery than you can imagine.

Jacques: How can we recruit more people in PNS and increase our scientific contribution?

Spinner: There are few dedicated peripheral nerve surgeons. This fact by itself offers immediate opportunities. That being said, having a handful of leaders is not enough. We need to increase our footprint so that there are many people actively contributing, innovating and spreading the gospel. Until we develop a community of experts and enthusiasts, peripheral nerve surgery will remain an “orphan drug”.

Management of Traumatic Nerve Injuries for the General Neurosurgeon

Wilson (Zack) Ray and Thomas J. Wilson

All neurosurgeons are likely to encounter traumatic peripheral nerve injuries given they occur in approximately 3% of poly-trauma patients.¹ Multiple classification systems of nerve injuries exist, the most common cited are the Seddon and Sunderland classifications.²⁻⁴ Seddon divided nerve injuries into three classes: neurapraxia, axonotmesis, and neurotmesis.³ In neurapraxic injuries, the axons remain intact but there is a focal, reversible conduction block with focal demyelination. In axonotmetic lesions, the axon is disrupted but the endoneurium remains intact. Finally, in neurotmetic lesions, both the axon and endoneurium are disrupted. Additionally, the perineurium and epineurium may also be disrupted. Sunderland built on Seddon's classification scheme.⁴ He referred to neurapraxic injuries as Class I and axonotmetic injuries as Class II. He further subdivided neurotmetic lesions. Class III injuries are neurotmetic lesions with preservation of the perineurium; Class IV injuries have disruption of the perineurium but intact epineurium; Class V injuries have complete division of the nerve including the epineurium. Sunderland Class I/II injuries have good hope for spontaneous recovery whereas Class IV/V injuries have no hope for spontaneous recovery. The recovery of Class III injuries is variable.

While understanding these classification schemes and the pathophysiology underlying them are important, these schemes do little to inform the neurosurgeon faced with managing a traumatic peripheral nerve injury. Three pieces of data are needed in order to determine the optimal management of traumatic nerve injuries:

- 1. Is there an associated open injury**
- 2. Whether the nerve is transected or in continuity**
- 3. The mechanism of the injury**

In cases of closed injuries, watchful waiting should occur. The patient should be followed for 6 – 12 weeks for evidence of spontaneous clinical or electrodiagnostic recovery. If no spontaneous recovery has occurred, further work-up should be initiated by a peripheral nerve specialist. Ultimately, if there is no spontaneous recovery, consideration can be given to exploration with possible nerve reconstruction with either nerve grafting or nerve transfers.

If the nerve injury is associated with an open injury, the wound should be explored to determine continuity of the nerve(s). This exploration should occur within 3 days to prevent retraction of the nerve ends in the case of a discontinuous nerve. When exploration finds a nerve in continuity, the injury should be managed the same as a closed injury. However, when exploration discloses a transected nerve, management depends on the mechanism of injury. In the case of a sharp laceration such as with a stab wound, the nerve should be primarily repaired. Outcomes are best in the case of primary repair without an interposition graft, with the best opportunity for primary repair coming at the time of initial exploration. When the mechanism of injury is a blast, crush, or dirty, ragged laceration, the ends of the nerve must be considered an evolving area of injury. Primary repair should not be undertaken due to the progressive injury that will occur over the ensuing days. Rather, the ends of the nerve should be tagged by suturing or clipping them to a local structure such as a fascial layer. This both helps prevent retraction and facilitates localization during future operations. Approximately 3 weeks should be allowed for the full extent of nerve injury to occur, and, at that time, a subsequent operation should be performed to resect the injured portion of the nerve ends and then coapt them with or without an interposition nerve graft. Whenever coaptation is performed, whether primary or delayed, doing so in a tension-free fashion is paramount to successful outcomes. Proximal and distal dissection of the nerve should be carried out to free the nerve from any tethers and transposition may be performed in order to create additional length. When coaptation can be performed in a tension-

free fashion without a nerve graft, outcomes are improved. However, if the coaptation cannot be performed in a tension-free manner, a nerve graft should be utilized to bridge the gap.

It is important to remember that regardless of the type or mechanism of injury, in cases of traumatic nerve injury, the neurologic deficit should be maximal immediately following the injury. When neurologic injury progresses in a delayed fashion following trauma, this should prompt concern for a secondary process that requires evaluation. In instances of a growing hematoma or when tissue swelling leads to compression/entrapment, exploration and decompression may be warranted.

References

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4. Sunderland S. *Nerve injuries and their repair: a critical appraisal*. Churchill Livingstone; 1991.

Peripheral Nerve Updates for DSPN Members

Line Jacques, MD and Lynda Yang, MD

1. The peripheral nerve division dinner during the 2016 CNS annual meeting will be held September 27th 2016 at 7:30pm at the Harbour House 831 W Harbour Dr, San Diego, CA 92101-77707, tel 619 232-1141, www.harbourhouse-sandiego.com
2. The 2016 Kline lecture will be presented by Dr. Rajiv Midha (University of Calgary) on April 26th 2017, during the AANS meeting in Los Angeles, CA.
3. The Kline Research Award will be offered again this year to support either either basic or clinical research related to peripheral nerves with funding in the amount of \$10,000. The research award provides a means of peer review for clinical research projects, and therefore, to enhance competitiveness for potential National Institutes of Health (NIH) funding. Awardee Dr. Stepan Capek, MD (Dr. Spinner laboratory: Mayo Clinic) will present a talk entitled "MR elastography of peripheral nerve" on Wednesday, April 26th 2017 during the AANS Annual Meeting in Los Angeles, CA.

4. Upcoming meetings (besides AANS and CNS meetings):

American Society for Peripheral Nerve

(www.peripheralnerve.org)

2017 Annual meeting

January 13-15th 2017

Hilton Waikoloa village Waikoloa, HI

2017 Peripheral Nerve Course- The Kline Legacy in New Orleans

February 4-5, 2017

5. March 2017 Neurosurgical Focus will highlight cutting edge laboratory work, translational science and recent surgical innovations/techniques in peripheral nerve surgery. Submission deadline is November 1st 2016.

Revisions to the DSPN Rules & Regulations for Membership Review

The DSPN Executive Committee has proposed a number of revisions to the Section's Rules & Regulations document. These by-law modifications have been presented to, and ratified, by both the CNS Executive Committee and the AANS Board of Directors. They now require final approval by the DSPN general membership at the time of the Annual Business Meeting during the 2017 DSPN Annual Meeting. The changes are summarized below:

1. Section 3.01, #6 "Adjunct Members".

The stipulations that prospective adjunct members must be, a) sponsored by two Active members and, b) approved by unanimous vote of the DSPN Executive Committee have been deleted. The ability of adjunct members to serve on Section committees has been added, as has the requirement that all adjunct members be duly certified by their national certification board, if such a board exists.

2. Section 3.04 "Applications for Membership".

This section has been extensively revised to reflect current practice. Requirements for submission of application to the DSPN Secretary, publication in the Section Newsletter, and ratification of applications by the general membership have been removed. It is proposed that applications for all membership categories be reviewed by the Membership Committee, with subsequent presentation of all prospective members by the Membership Chair at Executive Committee meetings.

3. Section 3.05 "Dues and Assessments".

Requirement for ratification of any changes to membership dues and assessments by the general membership at an Annual Business meeting has been removed. It is proposed that the Executive Committee will establish all membership dues and assessments and notify the membership of any changes in the Section Newsletter.

4. Section 3.06 "Termination of Membership", #1.

Change to the wording of this section to align it with Section 3.01, #1 (i.e. Active section membership requires membership in either the AANS or CNS, not both).

5. Section 3.06 "Termination of Membership", addition of new #2 stipulation.

This new stipulation states that the termination of DSPN membership will occur if either AANS or CNS membership is revoked following an expulsion decision of the respective parent organization Professional Conduct Committee.

6. Section 3.06 "Termination of Membership", #3.

Change to the timeframe of membership termination related to dues non-payment from one year to two years.

7. Section 3.06 "Termination of Membership", #4.

Change to the designated recipient of a member's letter of resignation from the Section Secretary to the Membership Committee Chair.

8. Addition of a new Section 3.07 "Appeal of Membership Decision" to provide a mechanism for appeal of disapproval of a membership application.

9. Section 4.05 Duties, #4 "Secretary". It is proposed to remove from the duties of the secretary the need to maintain a current roster of the Section membership or to bring forth membership applications for review. These duties will be transitioned to the Membership Committee Chair.

10. Addition of a new Section 5.09 "Membership Committee".

It is proposed to transition the Membership Committee from ad hoc to standing committee status, given the enduring need for an active Membership Committee. The committee structure is defined as consisting of two members, the senior of whom is the Chair. Duties are defined as the need to maintain a current roster of the Section membership and to review all prospective membership applications and to bring forth these applications for EC review.

11. Minor revision to Section 6.05 to allow the secretary flexibility to determine the order of business of Executive Committee meetings.

Prepared by:

**W. Bradley Jacobs, MD,
FRCSC Chair, DSPN Rules & Regulations
Committee**

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Email your suggestions, meeting information, or other newsletter topics to jratliff@stanford.edu.