Winter ■ 2019

Spine Section Newsletter

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

American Association of Neurological Surgeons and the American Association of Neurosurgeons

Congress of Neurological Surgeons — Education and Innovation

Greetings!

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, we present interviews with our Meritorious Award Winners for Neurosurgery, Bob Heary, and Orthopedics, Rolando Garcia, who will both be honored at the Spine Summit this spring. Also, Scott Zuckerman provides a fascinating account of spine surgery medical mission work in Tanzania. In our Peripheral Nerve learning corner, TJ Wilson and Zack Ray describe nerve transfers for spinal cord injury patients. Finally, Luis Tumialan, Charlie Sansur and John Ratliff explain how the efforts of the Rapid Response Team of our DSPN Section made a key difference in reversing a critical error in spine surgery coding policy.

We look forward to seeing you at the Spine Summit Meeting in Miami, March 14-17, 2019!

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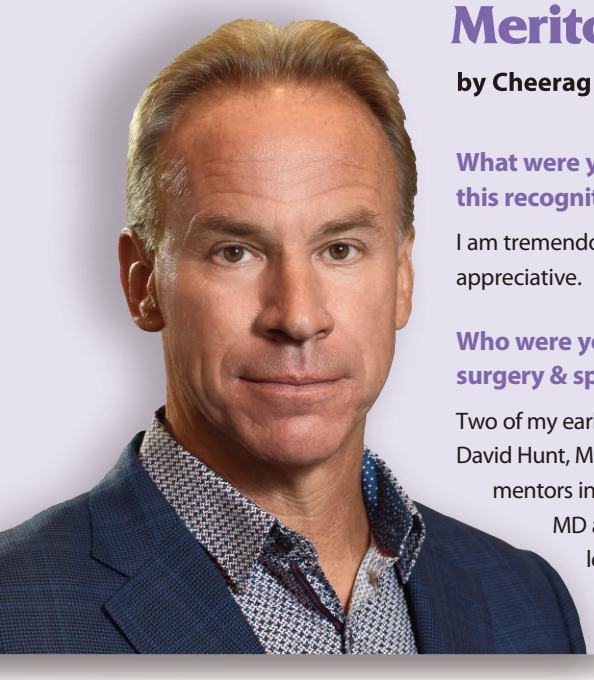
Interview with Robert Heary, MD

Meritorious Award Recipient, Neurosurgery

by Cheerag Upadhyaya



What were your initial thoughts regarding this recognition?

I am tremendously honored, humbled and appreciative.

Who were your early mentors in neurosurgery & spine surgery?

Two of my earliest mentors in neurosurgery were David Hunt, MD and Ed Benzel, MD. Also, my mentors in spine surgery included Alex Vaccaro, MD and Todd Albert, MD from whom I learned how to do spine surgery.

What prompted you to 1) switch from general surgery and into neurosurgery and 2) apply for an orthopedic spine fellowship?

I wasn't sure where I was going with general surgery as I hadn't identified a focus that I truly loved. I had rotated in neurosurgery and found it very interesting and immediately considered an opportunity to switch into neurosurgery. This was one of the best decisions I have made in my professional life. The second best decision was choosing to do a complex orthopedic spine fellowship at the Rothman Institute.

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Interview with Robert Heary, MD

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I was one of the very first neurosurgeons to do an orthopedic spine fellowship and the first neurosurgeon trained at the Rothman Institute. I chose to pursue a complex orthopedic spine fellowship as I felt that the operative experience, the didactic experience, and the overall clinical experience offered some of the best opportunities for a career in spine surgery.

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

One of my main contributions over my twenty plus year career has been always obtaining a postoperative CT after I've placed instrumentation into a patient. I have found this to be very valuable for resident education and has helped me become a better surgeon. It can be humbling to see that you may not have done the surgery as well as you thought. First and foremost, you must be critical of yourself to improve.

Additionally, I have always followed my patients for a minimum of two years. Follow-up of shorter durations simply does not allow for improvement. For example, how do you know the patient fused? Did the patient's quality of life improve over the long term? This too has been tremendously valuable in becoming a better surgeon and in training my residents.

Bottom line: short term imaging and long-term clinical follow-up.

What do you believe is the future of spine surgery?

An emphasis on judgement and indications. I believe they are the key to recognize that not every single patient requires metal. Further and further along in my career, I am finding that in many cases a simple decompression without instrumentation can offer your patient significant benefit. Of course, I also think that one needs to know how to do complex spine surgery as it is often necessary; but judgement in determining when you need to offer a small surgery versus a bigger operation is a key aspect of the future.

I have some concerns about the direction of minimally invasive spine surgery. I am seeing many patients for revision surgery after a failed minimally invasive spine surgery. While we have become very good at minimally invasive decompression and fusion, I do believe we must continue to work on improving minimally invasive fusion.

What is needed to improve outcomes in spine surgery?

A focus on indications. Don't operate on people who don't need surgery. Don't do big surgery when a small surgery is adequate. Paying attention to long term clinical outcomes – what works and doesn't work for your patients. Examining your results closely.

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

To continue to develop better and closer relationships. Now a days all you need is a good surgeon who treats the patient and family with respect and knows what they are doing.

I see that you published on the Open Payments Database and found the accuracy of the database wanting. What are your thoughts regarding the relationships between spine surgeons and industry?

Public perception is a challenging issue. Many of the techniques that we employ today are the result of a fruitful collaboration between surgeons and industry. However, we must be careful not be to become too greedy.

As to the Open Payments Database, I understand the rationale, but I'm not sure it is achieving its intent. The accuracy needs to improve. However, to some extent, patients are interested in knowing they can trust the information offered by their surgeon.

How do we counteract the often negative image of spine surgery in the media?

First, I think it is important to be careful on patient selection and indications. Choose patients for surgery that have significant problems that you are confident you can help. A practice with a great majority of patients with great results will improve your reputation and nothing helps your reputation more than good results. Well indicated surgery with good results can offset the negativity.

Second, I often tell patients that when they search the internet, they will often find mostly negative stories. I explain there is an inherent bias in the media as the patients who are doing great are living their lives and do not often post their positive stories.

Third, the spine registries have an important role in A) helping identify which patients may benefit from a smaller surgery versus a larger surgery and in B) encouraging long term follow-up of patients. Registries have a marked value not only for the field of neurosurgery, but also for the individual practice.

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

Spend some time with an experienced spine surgeon not only in the operating room, but also in the office. The one thing that I do today that I also did while in residency and fellowship is seeing patients in the office. Practically everything else that I do is markedly different

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than when I was a resident and fellow. What hasn't changed is seeing patients, talking to patients. Nothing helps gain judgement, wisdom, and an understanding of indications than seeing patients. Everyone looking at a training situation should have an outpatient experience in addition to the technical training experience.

What are your thoughts on the incorporation of deformity training into neurosurgery? Should this be something that requires a fellowship?

I think if you are going to do major deformity surgery on a regular basis, then it behooves you to at least commit one year of training to deformity surgery. This is not something that you can learn overnight or at a weekend course. I was involved in the AANS Spine Deformity Course for residents and fellows. This is a great environment to explore deformity surgery and determine if a fellowship is the right thing for you.

What advice would you give to a young neurosurgeon who aspires to develop a successful research career?

It's challenging now in today's world. I do both clinical research and basic science research. It is harder to get funding for basic science research. If you are interested in basic research, then teaming up with a basic scientist is critical. For clinical research, teaming up with your friends around the country and doing multicenter trials is much easier then attempting to do the clinical research by yourself. Make friends and team up and we all learn and benefit.

What advice would you give someone who wants to become more involved in the section?

Get in touch with leadership and make your interests known. I have been fortunate to have served in many leadership positions over my career, including Chair of the Spine Section. Leadership wants to have young people involved but are often not sure who is interested. Make your interests known, look for opportunities for tasks and jobs. We are always looking for young, bright, energetic neurosurgeons to step up and report for duty.

How do you balance the competing priorities of clinical work, basic science research, clinical research, education, and family?

It is difficult. If you are interested in clinical practice, clinical research, and basic research; then that will eat into your personal life to some extent. The best you can do is to constantly work on achieving balance with your practice and your family.

Figure 1: *Operating theatre in Bugando Medical Center in Mwanza, Tanzania, performing a posterior thoracic fusion.*

Spine Surgery in Tanzania:

A Neurosurgery Resident's Experience

Scott L. Zuckerman, MD, MPH

As a PGY-7 resident at Vanderbilt University Medical Center, I recently spent 2 weeks in Tanzania alongside our Chairman, Dr. Reid Thompson. The first week was spent at Bugando Medical Center, a 950-bed teaching hospital in Mwanza, Tanzania. The facility is staffed by one neurosurgeon and two registrars (the equivalent of a mid-level resident) with a catchment area of over 16 million, drawing patients from neighboring Kenya, Uganda, Rwanda, Burundi, and the Democratic Republic of the Congo. **(Figure 1)** In our second week, we operated at the Mnani Mmoji Hospital in Zanzibar with the Neurosurgery Education and Development (NED) Foundation.[1] Local neurosurgery teams included 4 registrars, 2 at each hospital. We preformed 20 surgeries, from degenerative and traumatic spine pathology to brain and spine tumor resections. I was incredibly fortunate to be offered this life-altering experience.

My interest in this area was sparked by the outstanding work of my colleagues at Vanderbilt. Dr. Christopher Bonfield started his international experience as a resident, and now, as an attending, regularly visits Peru to perform craniofacial surgery and Africa for general and pediatric neurosurgical care.[2] My co-resident, Dr. Michael Dewan, spent 9 months in Uganda under the mentorship of Dr. Ben Warf, both providing pediatric neurosurgical care and teaching the techniques of ETV/CPC. Michael also conducted impactful research that defined the burden of neurosurgical disease worldwide and identified the highest volume and lowest resourced developing countries.[3] Another Vanderbilt resident, Dr. Ahilan Sivaganesan, organized an Emergency Neurotrauma course in his homeland of Sri Lanka for over 200 nurses, medical students, residents, and attendings. The outstanding work and humble passion of my own colleagues was infectious.

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Differences

The greatest difference between spine surgery in the U.S. and developing nations is resources. Meticulous planning is required to perform successful surgery. Below are important differences:

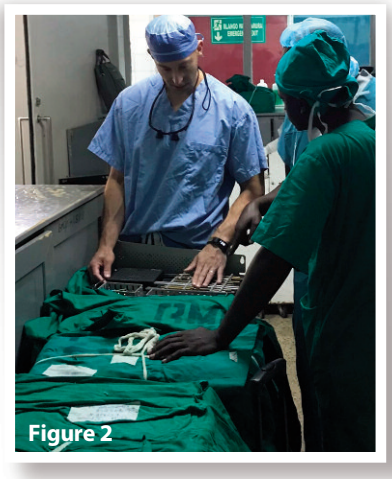


Figure 2: *Ensuring adequate hardware is available for the upcoming posterior cervical at Bugando alongside the OR manager Luta.*

1. Surgical planning. Spine trauma often presents days to weeks after injury, and the conventional treatment is months of bedrest. The primary goal of surgery becomes stabilization for mobilization – any reduction is an added bonus. Forming a surgical plan that can be accomplished in a 2 to 3 hour surgery is imperative to avoid anesthetic and blood loss complications.

2. Securing necessary equipment. Without an experienced scrub technician or instrumentation representative, it is the responsibility of the surgeon to ensure that all instruments are present and sterilized. Pedicle probes, screws of appropriate size, rods that fit in the screws, set screws, and screw drivers for both screws and caps are the minimum required. **(Figure 2)**

3. Instrumentation placement. Without access to c-arm fluoroscopy, localization and instrumentation placement becomes reliant on local anatomy. Studying the posterior element fracture pattern, assessing location of paraspinal muscle damage, using adjacent structures such as iliac crest and scapula, and assessing in-vivo instability are all tools to localize the correct level. "Free-hand" pedicle screw placement is the standard method employed.

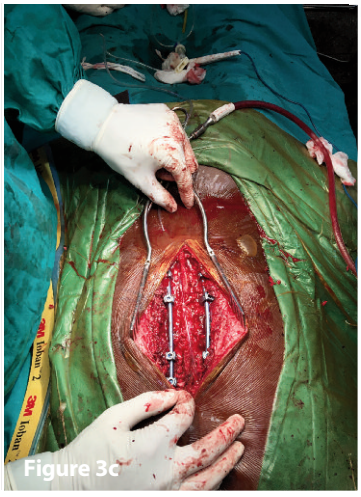
4. Hemostasis. Meticulous hemostasis is important in any spine case, yet even more important when access to blood may not be feasible. Peroxide soaked sponges take the place of thrombin-soaked cottonoids and surgifoam.

5. Postoperative care. Nursing staff are often not accustomed to drain management and pain control. Techniques such as drain stripping, maintaining suction, or dropping to the floor should be deliberately communicated, as should the importance of scheduled pain medication and postoperative ambulation.

Cases

In total, we performed 10 spine surgeries during our trip – including posterior cervical and thoracic/lumbar fusions, degenerative lumbar decompression and fusion, and intramedullary spinal tumor resections. Below are some notable cases.

- **Case 1.** A 29-year-old male s/p MVC 2 weeks prior who suffered a T8/9 chance fracture with significant kyphosis. He was neurologically intact but confined to bedrest for 3 months until the fracture healed. We performed a T6-11 posterior spinal fusion and T7/8 laminectomy. He was able to ambulate on postoperative (POD) #1 and discharged on POD#3. These were some of the most satisfying cases, treating unstable fractures in neurologically intact patents that allowed them to return to work and contribute to their local communities. **(Figure 3)**
- **Case 2.** A 19-year-old male s/p MVC with an L2 burst fracture presented initially as ASIA D, but because no spine surgeon was available, regressed to ASIA B with 1-2/5 strength in BLE and



Figures 3a, 3b, 3c & 3d: *Case 1.*

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Spine Surgery in Tanzania

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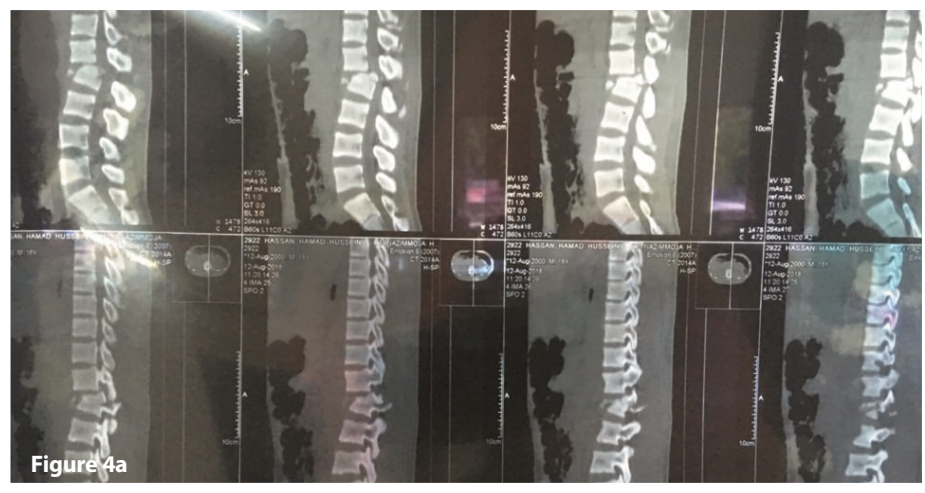

Figure 4a & 4b: *Case 2.*

urinary retention. Ten days after the injury, we performed a T12-L4 posterior spinal fusion and L2 laminectomy, with little hope for neurologic recovery. On POD#1, he was able to sit-up and his pain was improved. To our surprise, 3 weeks later he was able to walk with near full strength and void spontaneously. **(Figure 4)**

- **Case 3.** A 46-year-old, wheelchair-bound male with significant leg weakness, long tract signs, and new upper extremity paresthesias was found to have an upper thoracic intramedullary spinal cord tumor with extensive edema. We performed a laminectomy and tumor resection to prevent ascending weakness and loss of function in his upper extremities. Though still unable to ambulate, his pain and paresthesias improved and he maintained use of his upper extremities. **(Figure 5)**

Figure 5a & 5b: *Case 3.*

Future

Though we helped the patients on whom we operated, many were too complex or far from injury to benefit from surgery, such as this 25-year-old male with a T11/12 thoracic fracture dislocation and spondyloptosis. **(Figure 6)** We realized that the most meaningful opportunities for sustainable change was through teaching. Dr. Hans Mhagama and Dr. Misso Lubigisa were the two registrars at Bugando and both extremely talented despite not having entered a formal neurosurgical training program. As Dr. Thompson imparted cranial and skull base knowledge to Hans, I operated alongside Misso, teaching the principles of freehand pedicle screw placement and taking him through his first posterior cervical fusion **(Figure 7).**

Figure 6: *T12/L1 fracture dislocation and spondyloptosis. The patient was ASIA A and 6 weeks from injury, confined to 3 months of bedrest.*

Along with the sage advice of those with extensive international experience, I would recommend the following ways to become involved, not all requiring significant time away from work:

1. Look to senior leaders. We are fortunate to have some outstanding examples, such as the work done at Duke creating a residency in Uganda[4] and Cornell led by Dr. Roger Hartl in Tanzania[5]. Read about their work over the last decades and reach out with interest.

2. Listen. Once a relationship is started, listen and gather information on how the surgeons and patients can be helped most. Something as

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Figure 7a, 7b & 7c: *Starting a C3-T2 fusion with Bugando Medical Center registrar, Dr. Misso Lubigisa (left) and Dr. Hans Mhagama (right).*

simple as postoperative order sets or non-operative treatment of degenerative spine conditions may make an enormous difference in patient care, rather than an expensive microscope that canont be used due to electricity constraints.

3. Invest in trainees. The path to becoming a fully trained neurosurgeon in Africa is complex, long, and expensive. Many young surgeons spend years as registrars, functioning as interns without an actual neurosurgery training program, before they start formal neurosurgical training. These registrars are often in need of senior mentorship and letters of recommendation to gain access to an accredited training program.

4. Spinal instrumentation. At Bugando, the registrars were well versed in thoracic and lumbar pedicle screw placement, yet patients with spine fractures stayed bed-bound for months. Why? No set screws were available. U.S. spine companies often have extra implant sets that can be put to great use in resource-limited markets. Ask your local spine reps for sets that can be donated.

5. Educational materials. During our trip, we brought several spine textbooks for the registrars. Furthermore, many texts are now available in PDF format, allowing easier exchange of educations materials.

Figure 8: *Placing lumbar pedicle screws with Vanderbilt University Medical Center Chairman and skull base surgeon Dr. Reid Thompson.*

This was a life-changing experience. After seven years of residency, the chance to use the acquired knowledge and skillset to help those without access to care was powerful. Placing pedicle screws with my skull base chairman was simultaneously exciting, nerve-racking and rewarding **(Figure 8).** The people of Tanzania were warm and incredibly appreciative. Conversely, one cannot ignore feelings of helplessness and sadness seeing patients who could not be helped with our services due to end-stage pathology, but may have been helped if seen earlier. We are left with a renewed sense of worth and meaning in the work we do.

While much of the burden of disease in neurosurgery globally rests in conditions such as hydrocephalus, spina bifida, and traumatic brain injury, there is a tremendous deficit in the provision of spine surgery in many countries. Personally, this trip ignited my own interest in continuing this work. At the conclusion of my residency, I will be spending a significant portion of next year back in Tanzania as a fellow in Dr. Roger Hartl's International Neurosurgery Fellowship, based in Dar es Salaam, Tanzania. I am grateful to be able to share my experience and welcome further discussion on the topic (zuckerman.scott@gmail.com).

References

1. Qureshi PH PJ, Mahmood. , NED Foundation: Neurosurgery, Education and Development, https://nedfoundation.wordpress.com/,

2. Bonfield CM, Shabani HK, Kanumba ES, Ellegala DB, Nicholas J (2013) The use of IV-tubing as a closed-suction drainage system during neurosurgical cases in Tanzania. *Surg Neurol Int* 4, 76.

3. Dewan MC, Rattani A, Fieggen G, Arraez MA, Servadei F, Boop FA, Johnson WD, Warf BC, Park KB (2018) Global neurosurgery: the current capacity and deficit in the provision of essential neurosurgical care. Executive Summary of the Global Neurosurgery Initiative at the Program in Global Surgery and Social Change. J *Neurosurg*, 1-10.

4. Haglund MM, Warf B, Fuller A, Freischlag K, Muhumuza M, Ssenyonjo H, Mukasa J, Mugamba J, Kiryabwire J (2017) Past, Present, and Future of Neurosurgery in Uganda. *Neurosurgery* 80, 656-661.

5. Coburger J, Leng LZ, Rubin DG, Mayaya G, Medel R, Ngayomela I, Ellegala D, Durieux ME, Nicholas J, Hartl R (2014) Multi-institutional neurosurgical training initiative at a tertiary referral center in Mwanza, Tanzania: where we are after 2 years. *World Neurosurg* 82, e1-8.

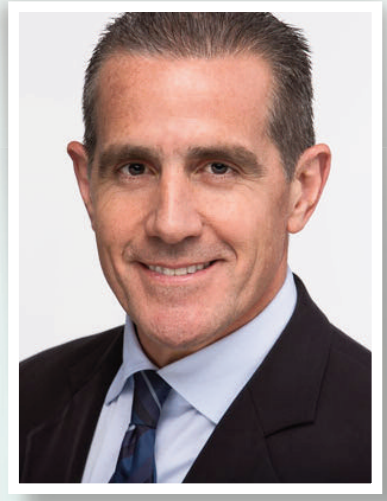
Interview with Rolando Garcia, MD

Meritorious Award Recipient, Orthopedic Surgery

By Khoi Than

Dr. Garcia, congratulations on your Meritorious Award, Orthopedic Surgery at this year's Spine Summit. Thank you for taking the time to allow me to interview you.

Most readers of our newsletter are neurosurgeons who might be less familiar with you and your accomplishments. Can you please tell us a bit about you, your upbringing, and your education?



Rolando Garcia, MD

I will try to tell you a little about myself, which I must admit feels a little awkward. I was born in Holguin, Cuba, which is in the eastern part of the island. We left Cuba when I was 2 years old due to the political situation there, and we were given asylum in Spain. After two tough years in Spain we moved to Puerto Rico where I grew up. I went to high school in Puerto Rico, then attended college, medical school, and residency at Tulane in New Orleans. I graduated summa cum laude from college with a major in biology. I did a combined MD and MPH degree at Tulane, and was the Chief Resident of my graduating class in residency. I first became interested in research when I was in college. I volunteered doing research in endocrinology while a junior, and was lucky enough to get a letter of recommendation for medical school by Dr. Andrew Victor Schally, a Nobel laureate in Medicine.

How did you become interested in spine surgery, and who were your mentors?

My interest in spine was really the product of the mentorship of our program chairman, Dr. Thomas Whitecloud, III. Dr. Whitecloud was a wonderful human being and a great surgeon. I also decided to pursue spine surgery because I felt that in 1996, when I finished my residency, spine was still in the dark ages, and that the golden age of spine was yet to come.

I did my spine surgery fellowship in Chapel Hill, North Carolina, with two very busy deformity surgeons. We did our own anterior approaches including thoracotomies, and typical cases included long thoracolumbar fusions and pelvic fixation. I remember putting thoracic screws without fluoroscopy and awake cervical osteotomies for ankylosis spondylitis.

During my fellowship I first became interested in lumbar motion preservation. I asked my fellowship attendings about the idea and they told me I was insane, which made me more interested in the concept. I started doing research, which back then meant going to the library, and I found a couple of old articles about the Charite prosthesis. I was able to track a French surgeon, Dr. Thierry David, who agreed to let me visit him in the summer of 1999. Visiting Dr. David was a real career changing experience and my passion for lumbar arthroplasty was cemented.

After my fellowship in 1997, I joined an orthopedic group here in Miami, and have remained in the group for the last 21 years. I have served as Chief of the Orthopedic Department of Aventura Hospital, and also served on the Board of Trustees of the hospital. I have participated in six FDA trials mostly dealing with cervical and lumbar arthroplasty. While in private practice I have published four book chapters, and over 10 peer reviewed journal publications. I serve as the Chairman of the Continuing Medical Education Committee for the International Society for the Advancement of Spine Surgery, and Board Member for the International Advocates for Spine Patients.

Your expertise with lumbar arthroplasty is unparalleled. For our readers who may not perform this procedure (myself included), can you please detail the history, physical examination, and radiographic findings you have found to predict good outcomes after this procedure? In other words, on what kind of patient should this procedure be performed?

Patient selection is without question the most important factor for a successful lumbar arthroplasty. Ideal lumbar arthroplasty patients have normal bone density, single level disease at L4/5 or L5/S1, have mild to moderate disc space narrowing, normal or near normal facets, no pars defect, and BMI < 30. Patients should have primarily, if not exclusively, axial back pain. Patients with previous microdiscectomy with resolution of radicular complaints, but persistent axial mechanical back pain are good candidates, as long as minimal facet resection was done at the time of the microdiscectomy. Just like with cervical arthroplasty, a complete discectomy is important, and sometimes releasing or resecting the PLL is necessary to mobilize the

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segment. The importance of having ample exposure cannot be overstated. I have worked with the same access surgeon for 17 years. He is a cardiovascular surgeon. He started doing exposures with me, and now most of his practice is doing exposures for over 20 spine surgeons. Finally, doing lumbar arthroplasty is much like minimally invasive spine surgery. It requires a commitment from the part of the surgeon.

Where do you foresee spine surgery headed in the next 20 years?

I foresee the future of spine surgery to deal more with diagnosis and less on surgical techniques. I also expect a slow shift from mechanical to biological solutions.

Although you are in private practice, you have been able to be very involved in the field of spine surgery. What advice do you have for non-academic spine surgeons who wish to follow a similar path?

I encourage other non-academic spine surgeons to remain involved in clinical research by participating in clinical trials, by remaining active in specialty societies such as the CNS, and regularly attending society meetings such as the Spine Summit. I would like to say that it is a true privilege to receive this award.

What would you say has been your biggest contribution to the field of spine surgery?

I hope that my biggest contribution to the field of spine surgery is the legitimization of motion preservation as an established and proven technology for well selected patients through the dissemination of objective and well collected clinical research.

Last question: I recently heard that you are a wine expert. Would you agree with my assessment that Oregon pinots are the best in the world?

Oregon pinots can indeed be delicious, and my wife and I certainly enjoy their power, fruit, and finesse. We are particularly fond of Maggie Harrison's Antica Terra. A few years ago, we traveled through Willamette Valley and were thoroughly impressed by the abundance of small and excellent producers. Having said that, in my mind (and in my palate) there is nothing as sublime as a well aged Burgundy, particularly a Grand Cru for a top producer. My favorite pinot of all times is the 1999 Domaine Comte de Vogue Musigny Vieille Vignes. It was like having roasted duck, with fully ripe black cherries, topped by vanilla ice cream.

Thanks again for your time Dr. Garcia, and congratulations on your award!

The Anatomy of a Disvalued Code:
The *de facto* Bundling of 63047 and 22630/33

By Luis Tumialan, Charles Sansur and John Ratliff

The Relative Value Scale Update Committee (RUC) is a representative multidisciplinary committee of the American Medical Association (AMA) responsible for describing the resources required to provide physician services, such as a surgical procedure. As such, the committee, made up of representatives from 21 specialties, determines the relative value unit of a particular procedure that corresponds with a current procedural terminology (CPT) code. A series of publications, misconceptions and incorrect applications of the lumbar laminectomy (63047) and lumbar interbody fusion (22630/22633) CPT codes led to a de facto bundling of these two codes, despite the fact that these two codes underwent a rigorous and representative process by the RUC. The outcome of that valuation process determined these two codes do not represent overlapping work, a principle that has been upheld by the RUC for the past 2 decades. The de facto bundling of these codes by the Centers of Medicare and Medicaid Services (CMS) in January 2015 has resulted in an inaccurate representation of a surgeons' work when performing a laminectomy with an interbody fusion. The de facto bundling was further codified by a clinical vignette published in CPT Assistant, an AMA publication, which is the very body that established the value and application of the codes to begin with. Commercial payers, to include Aetna and Cigna, quickly adopted this interpretation of codes into their coverage determination policies.

The rationale for the value of these codes lay in their history and evolution, but that history was ignored along with the due process involved in determining the value of these codes. The AANS Coding and Reimbursement Committee along with the Spine Section's Rapid Response Team, led in large part by the efforts of John Ratliff began a long campaign of explaining the origin of the codes, their valuation history and the errant reasoning for attempting to bundle these codes. The three years of communications between the Spine Section and the AMA CPT Assistant editorial panel finally bore fruit this past May when a redaction was printed in the CPT Assistant publication. The Spine Section Rapid Response Team continues to work to apply the correct application of these codes with commercial payers and CMS.

An Option for Spinal Cord Injury: Nerve Transfers

By Wilson Zack Ray & Thomas J. Wilson

Spinal cord injury (SCI) is a significant public health problem with approximately 12,000 new cases each year.[1] Recovery from a complete SCI is exceedingly rare, leaving most patients with significant permanent disability. While a substantial volume of work has been devoted to the investigation of neuroprotective and neuroregenerative strategies following SCI, there remains a major void in therapeutic interventions that produce a reliable and robust improvement in functional outcomes.

More than 50% of SCIs occur in the cervical spine (i.e., tetraplegia), with C5 being the most common injury level, resulting in some or complete loss of arm and/or hand function.[1] Persons with tetraplegia are dependent upon upper extremity function for mobility and activities of daily living, including self-catheterization, transfers, writing, feeding, and manipulation of a wheelchair.[2] Hand and arm function are consistently rated as the most desired function for persons with tetraplegia, above bowel and bladder function, sexual function, standing, and pain control. Recovering even partial arm and hand function can have an enormous impact on independence and quality of life.[3]

Nerve transfers to treat brachial plexus and peripheral nerve injuries have gained significant momentum over the last decade. The basic principle of nerve transfers is the use of a working, functional nerve with either an expendable or duplicated function as a donor to supply axons to an injured, non-functional recipient nerve. The same concept can be applied in the case of SCI. While tendon transfers have a limited established role in the management of patients with SCI and tetraplegia57, only recently have nerve transfers been considered as a potential treatment option in patients with cervical SCIs.[4,5,7-9,13]

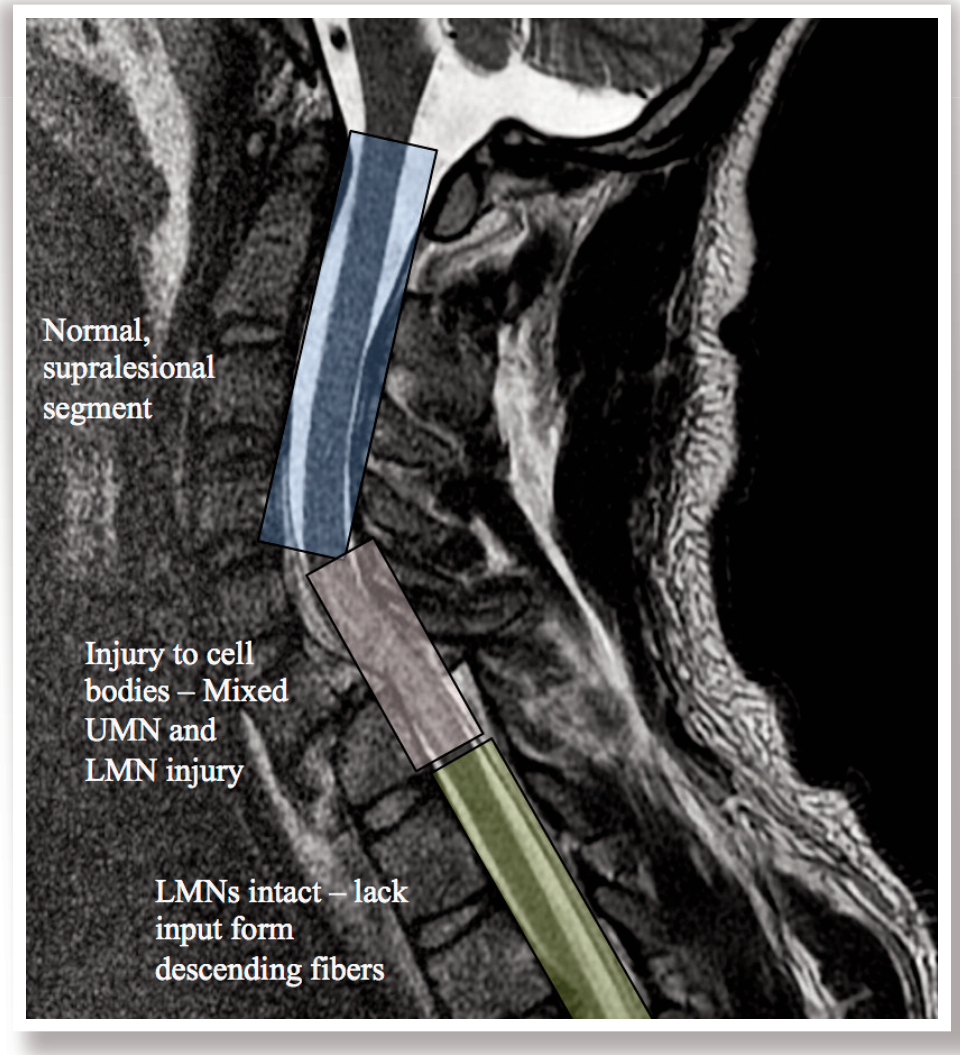

Figure 1: *Depicted are the zones of injury, Blue – the supralesional zone has normal cortical control, Gray - the zone of injury has a mixed upper and lower motor neuron injury, Green - below the zone of injury nerves remain in continuity with distal motor endplates, receptive to reinnervation.*

Nerves originating from spinal segments above the zone of injury **(Figure 1)** can be used as donors. Nerves originating from the zone of injury have a mixed upper and lower motor neuron injury pattern. Due to

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lower motor neuron involvement, when targeting these nerves as recipients, the typical time constraints for reinnervation that apply to peripheral nerve injuries are applicable. However, when targeting nerves originating from spinal segments below the injury, the lack of lower motor neuron injury means that nerve transfers can be performed in a delayed fashion. This provides two distinct windows of opportunity for subacute treatment (3-6 months) after SCI and chronic treatment (>12 months) after injury.[13,15]

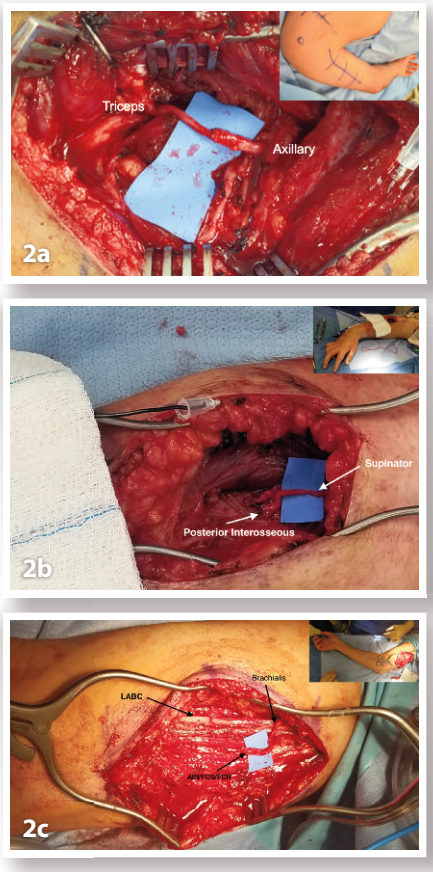

***Figure 2a:** Intraoperative view of the axillary to triceps nerve transfer. **2b:** Intraoperative view of the supinator to PIN nerve transfer. **2c:** Intraoperative view of the brachialis to AIN/FDS nerve transfer.*

Nerve transfers for SCIs are targeted at restoring specific movements that have the potential to significantly impact quality of life. One example is elbow extension, which is important for aiding in transfers and for powering a wheelchair. Triceps branch of the radial nerve to axillary nerve transfer is a familiar option for the restoration of shoulder abduction in patients with upper trunk brachial plexus injuries. The reverse transfer, axillary nerve to triceps branch using a fascicle to the posterior deltoid, has been reported to provide reliable and robust restoration of elbow extension in a SCI patient population.[2,6,12] As depicted in **Figure 2A**, the short distance required for axonal regeneration and nice donor/recipient size match makes this transfer a viable option for restoring active elbow extension.

Finger extension for the purpose of aiding in grasp and release is another important target movement. The supinator branch of the radial nerve to posterior interosseous nerve (PIN) transfer provides finger extension and active release **(Figure 2B)**. This transfer has been described in detail for both brachial plexus lower trunk injuries and SCI.[10,14]

The brachialis branch of the musculocutaneous nerve to anterior interosseous nerve (AIN)/flexor digitorum superficialis (FDS) nerve transfer **(Figure 2C)** provides key pinch and improved grasp.[3,11,14] The brachialis is a less critical elbow flexor, allowing one to safely transfer the entire branch without downgrading elbow flexion.

Nerve transfers are emerging as a potential adjunct in the comprehensive reconstructive management of patients with subacute and chronic cervical spinal cord injuries. While more outcomes data are needed, what has become clear is nerve transfers may be used in combination with tendon transfers or, in some cases, as standalone procedures to improve upper extremity function.

References

1. Ackery A, Tator C, Krassioukov A: A global perspective on spinal cord injury epidemiology. J Neurotrauma 21:1355-1370, 2004

2. Bertelli JA, Ghizoni MF: Nerve transfers for elbow and finger extension reconstruction in midcervical spinal cord injuries. J Neurosurg:1-7, 2014

3. Bertelli JA, Ghizoni MF: Nerve transfers for restoration of finger flexion in patients with tetraplegia. J Neurosurg Spine 26:55-61, 2017

4. Bertelli JA, Ghizoni MF: Transfer of nerve branch to the brachialis to reconstruct elbow extension in incomplete tetraplegia: case report. J Hand Surg Am 37:1990-1993, 2012

5. Bertelli JA, Ghizoni MF, Tacca CP: Transfer of the teres minor motor branch for triceps reinnervation in tetraplegia. J Neurosurg, 2011

6. Bertelli JA, Kechele PR, Santos MA, Duarte H, Ghizoni MF: Axillary nerve repair by triceps motor branch transfer through an axillary access: anatomical basis and clinical results. J Neurosurg 107:370-377, 2007

7. Bertelli JA, Tacca CP, Ghizoni MF, Kechele PR, Santos MA: Transfer of supinator motor branches to the posterior interosseous nerve to reconstruct thumb and finger extension in tetraplegia: case report. J Hand Surg Am 35:1647-1651, 2010

8. Bryden AM, Hoyen HA, Keith MW, Mejia M, Kilgore KL, Nemunaitis GA: Upper Extremity Assessment in Tetraplegia: The Importance of Differentiating Between Upper and Lower Motor Neuron Paralysis. Arch Phys Med Rehabil 97:S97-S104, 2016

9. Friden J, Gohritz A: Brachialis-to-extensor carpi radialis longus selective nerve transfer to restore wrist extension in tetraplegia: case report. J Hand Surg Am 37:1606-1608, 2012

10. Hahn J, Cooper C, Flood S, Weymouth M, van Zyl N: Rehabilitation of Supinator Nerve to Posterior Interosseous Nerve Transfer in Individuals With Tetraplegia. Arch Phys Med Rehabil 97:S160-168, 2016

11. Hawasli AH, Chang J, Reynolds MR, Ray WZ: Transfer of the brachialis to the anterior interosseous nerve as a treatment strategy for cervical spinal cord injury: technical note. Global Spine J 5:110-117, 2015

12. Klika BJ, Spinner RJ, Bishop AT, Kircher MF, Shin AY: Posterior branch of the axillary nerve transfer to the lateral triceps branch for restoration of elbow extension: case report. J Hand Surg Am 38:1145-1149, 2013

13. Senjaya F, Midha R: Nerve transfer strategies for spinal cord injury. World Neurosurg 80:e319-326, 2013

14. van Zyl N, Hahn JB, Cooper CA, Weymouth MD, Flood SJ, Galea MP: Upper Limb Reinnervation in C6 Tetraplegia Using a Triple Nerve Transfer: Case Report. J Hand Surg Am, 2014

15. Waters RL, Sie IH, Gellman H, Tognella M: Functional hand surgery following tetraplegia. Arch Phys Med Rehabil 77:86-94, 1996

Peripheral Nerve
Updates for DSPN Members

Line Jacques, MD

1. The 2019 Kline lecture will be presented by Dr. Allan Levy (University of Miami) on Wednesday April 17th 2019 during the AANS meeting in San Diego, California. The lecture title: The Biology of the Human Schwann Cell: bench to bedside

2. The Kline Research Award will be offered again this year to support either basic or clinical research related to peripheral nerves with funding in the amount of $10,000. The research award provides means of peer review for clinical projects, and therefore, to enhance competitiveness for potential National Institutes of Health (NIH) funding.

3. Dr. Shelby Burks (Dr. Levy, University of Miami) will present a talk entitled: Schwann cell delivery via enhanced collagen-glycosaminoglycan tubes to improve outcome from critical length nerve gap repairs on Wednesday, April 17th 2019 during the AANS annual meeting in San Diego.

4. Winner of the 2019 Kline Research Award will be announced at the 2018 DSPN meeting in Miami, Florida. Kline Abstract Award, PN Abstract Award and the top PN Kuntz Abstract Award will be offered at the DSPN meeting and the abstracts will be podium presentations.

5. Kline NREF Fund "Honor your mentor" is on the NREF website. If you would like to contribute to the fund please visit Kline NREF Fund website: http://www.nref.org/donate

Note that the Peripheral Nerve Division leadership controls the use of the NREF PN funds (including the Kline fund) for research or education, within the guidelines of the NREF.

6. Upcoming meetings

ASPN annual meeting, February 1-3, 2019 JW Marriott Desert Springs Palm Desert, California
http://www.peripheralnerve.org/meeting

Sunderland Society meeting, plan for October 2019 Israel

21st Narakas meeting, Leiden, Netherlands; May 16-18th 2019

The 5th annual Peripheral Nerve Dissection Course: "The Kline Legacy" in New Orleans, Louisiana will take place on February 16-17th 2019.