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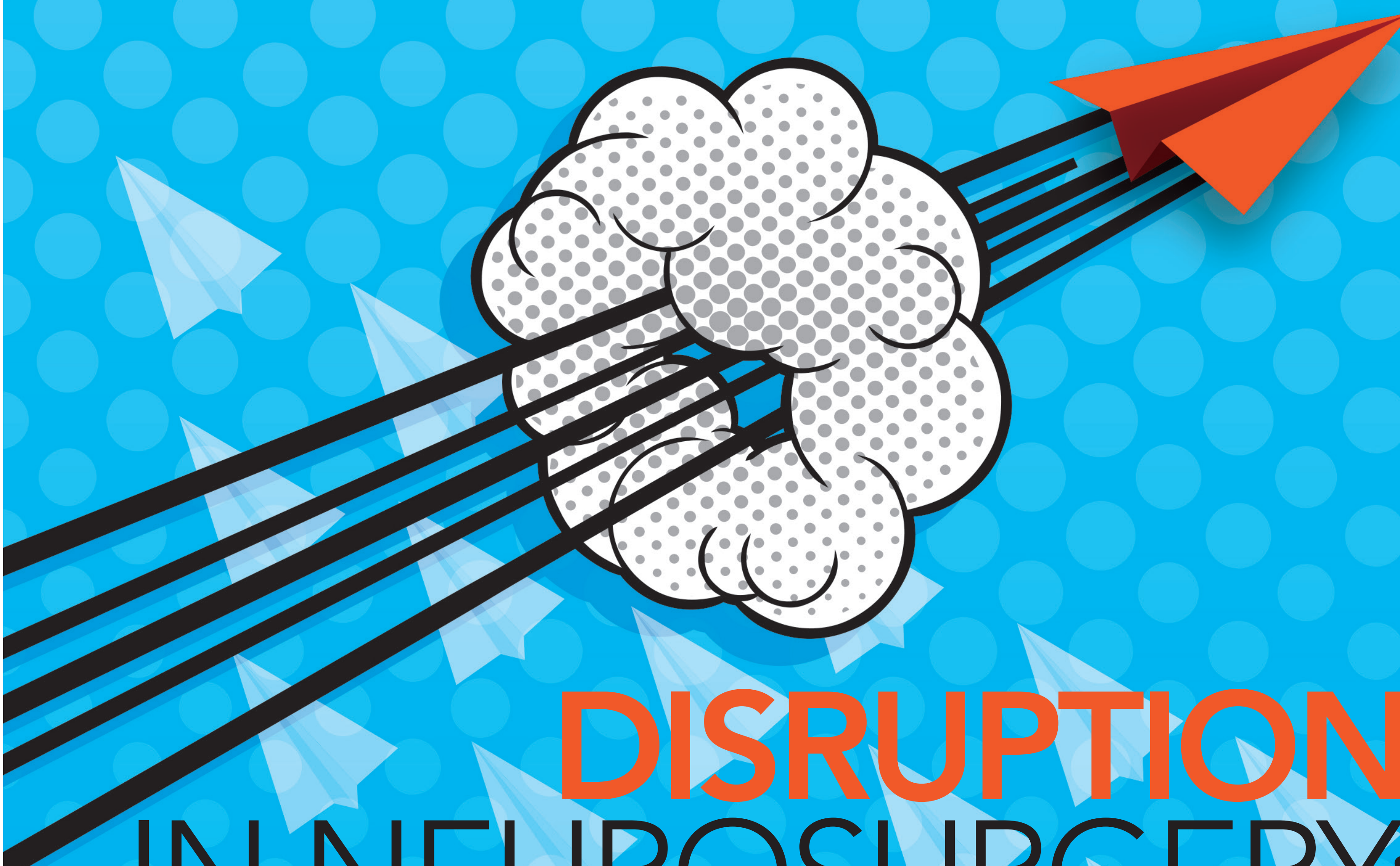

DISRUPTION IN NEUROSURGERY:

Threats and Opportunities

Congress of Neurological Surgeons

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Congress of Neurological Surgeons

EDITOR'S NOTE

Martina Stippler, MD
2018 Editor,
Congress Quarterly

When Amazon emerged out of nowhere in the mid-nineties, the future seemed unsure for brick-and-mortar independent bookstores. Between 1995 and 2000, the number of independent bookstores plummeted 43 percent. First, the chain stores (Borders, Barnes & Noble) out-competed them on price, then Amazon on price and inventory availability.

But then a funny thing happened—technology reemergence—as Ryan Raffaelli, assistant professor in the Organizational Behavior Unit at Harvard Business School, called it. Independent booksellers successfully reframed their market primarily as community and secondarily as inventory. The Swiss watch industry underwent a similar shift, to lifestyle marketing, in the wake of digital watches.

What does the future have in store for healthcare, and neurosurgery especially?

Changes in reimbursement always have been strong drivers of change. How will the practice of the future neurosurgeon look? What must we do to stay relevant and be leaders and pioneers of future care? These are all good questions, and hopefully this issue of the *Congress Quarterly* has some of the answers.

Our past president, Dr. Alan Scarrow, elaborates on disruption in healthcare leadership. Dr. Pedro Ramirez addresses disruption from the perspective of a private practice neurosurgeon, and I discuss how a more diverse neurosurgical workforce might challenge and change neurosurgery for the better.

Will only the infrastructure through which we deliver our care change, or also surgery and care itself? This notion is explored by Dr. Ron Alterman, a leading functional neurosurgeon in Boston, who explores the role artificial intelligence will play in medicine in general and neurosurgery specifically. We cannot have an issue that talks about disruption without exploring emerging technologies and how they will influence our role in the operating room. See Dr. Daniel Refai's and Dr. Osama Kashlan's feature on emerging technologies and Dr. Nicholas Theodore's piece on robots in spine surgery. Another possible paradigm shift in neurosurgery could be who will treat patients with mild complicated TBI care. Drs. Batjer, Aoun and Bellal are exploring this controversy.

If neurosurgery changes, the way we train the next generation of neurosurgeons must evolve too. One of the threats to, or opportunities for, neurosurgery—depending on whom you ask—is the question of whether spine surgery should be its own specialty. Read all about it in the *Congress Quaterly*.

Disruption—a threat to the status quo—is also an opportunity to gather and rethink our core values, strengths, and weaknesses and emerge better and stronger than before. This is exactly what happened in independent bookstores. Between 2009 and 2015, the number of independent booksellers grew by 35 percent.

I hope you enjoy reading this issue as much as I enjoyed curating the content.

Sincerely,
Martina Stippler

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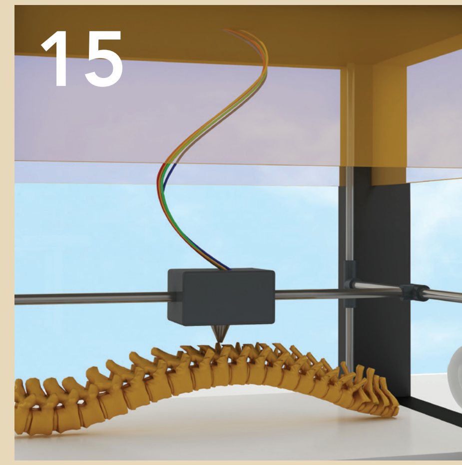


PRESIDENT'S MESSAGE

Ashwini D. Sharan, MD
President, Congress of
Neurological Surgeons

Disruption has been a buzz word in the business and tech worlds since Napster and the mp3 player turned the music industry on its head. In fact, the forces of technological innovation and changes in consumer expectations have spurred disruption in countless industries over the recent decades, but medicine has historically been slower to respond.

Still, there is no denying that the acceleration of technological advances, changes in the regulatory environment and a rise in patient-centric care models have left us vulnerable to disruption. This issue of *Congress Quarterly* illustrates a number of these disruptive forces—from the use of artificial intelligence to technological advances in robotics, imaging and 3D printing, to changes in hiring and employment practices for neurosurgeons. Each author thoughtfully outlines the forces at play and their impact on our specialty.

I have always been a big tech fan, forever keeping an eye out for the next gadget. It's one of the factors that led me to specialize in functional neurosurgery. I enjoy learning about and contributing to the development and application of new medical technology, and I get excited about the impact each innovation could have for my patients. But even I must admit that the pace of change in medicine can be difficult to keep up with. It is important for neurosurgeons to come together and examine these changes, share our experiences and collaborate on the best ways to move forward.

The Congress of Neurological Surgeons has long been dedicated to innovation—both in our commitment to following and educating our members on the latest innovations in the field and in our pursuit of new educational platforms and delivery vehicles. Over the past few years, we have refined our focus to ensure that our educational programs, publications and resources are not only qualitatively excellent and innovative in their approach, but also relevant to today's neurosurgical practice. In doing so, we aim to help our members identify the forces weighing upon our specialty and adapt appropriately.

You'll see this manifest in our Annual Meeting next month, where we've retooled our Practical Course offerings to address current topics most relevant to each subspecialty—including new technologies and approaches, as well as healthcare delivery models. We've added a new full-day symposium on Robotics in Neurosurgery that partners neurosurgeons with engineers to help them learn the nuances of robotic technologies and give them an opportunity to help shape the future of this technology and transform neurosurgical performance in the OR. Plus we are bringing back the Innovator of the Year Award, searching for the new technologies, techniques or processes that will have the greatest impact on our specialty. Three finalists will present

Dr. Peter Nakaji, a member of CNS' Education Division, gives a demo of Nexus, just one of the new products launched last year. This new case-based repository of operative techniques and approaches allows surgeons to quickly review a case like their own before heading into the OR. Learn more at cns.org/nexus their innovations in the CNS Xperience Lounge during a Monday break and attendees will vote to select a final winner.

Another program designed specifically to address some of the disruptive forces in neurosurgery is the CNS Leadership in Healthcare program. This growing program was developed to help aspiring and emerging neurosurgical leaders be more effective leading multi-disciplinary teams in today's evolving health care delivery environment. The program has expanded to include courses for both early and mid-career neurosurgeons, each of which combines a live course with small group work and a mentorship component to help the leadership fellows address a specific project or challenge within their organization. This year's fellows are helping their home institutions manage disruptive forces impacting their

2018 Leadership Healthcare Fellows and alumni gather after the May course. Many course alumni have gone on to hold leadership roles on the CNS EC and to lead within CNS Standing Committees and Education Division workgroups.

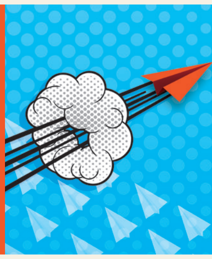
Beyond innovating educational programs, the CNS is constantly innovating its services for members. In the past year we've completely reinvented our signature member experience with areas like the CNS Xperience Lounge and CNS Central at the Annual Meeting. These community hubs bring attendees closer to the action and take member service to new levels.

More than 2,000 attendees at the 2017 Annual Meeting participate in a Guiness Record Breaking attempt for the most individuals simultaneously viewing virtual reality displays.

operations, working on projects that range from increasing clinical volume and throughput to establishing a comprehensive data registry or implementing a regional telehealth network.

Even for clinical courses, the CNS education division maintains a focus on how new technologies and other forces are impacting neurosurgical care. Our Acute Stroke Symposia, held this spring, were developed to improve outcomes in patients with acute ischemic stroke by creating a team-based training approach for the multidisciplinary neurocritical care team. The curriculum also addressed novel diagnostic modalities and the impact of telestroke. Likewise, our new MIS Cranial Course coming in February is designed to help general neurosurgeons learn about the latest technologies in neuro-navigation, endoscopy and Laser Interstitial Therapy and how to incorporate them into practice in order to stay relevant.

It is not always possible to predict when the next disruptive innovation will strike, but you can trust that the CNS will continue to monitor this rapidly advancing specialty to develop timely and relevant courses and tools to help you anticipate and adapt to the change.



Alan Scarrow, MD, JD
CNS Past-President

Disruption in Healthcare Leadership

We are living through a remarkable moment in history—a time of revolution. Over the past 200 years, our ancestors lived through three other industrial revolutions: looms and textiles in the early 19^{th} century, steam and rail in the late 19^{th} century, and oil and mass production in the 20^{th} century. Today we are in the midst of a fourth revolution in computing and digital technology that began in the 1970s. Each of the three prior revolutions set off a string of disruptions that changed our culture in profound ways. This one is no different.

It is not a question of whether computing and digital technology is disrupting our culture, it is only a matter of timing and degree. Industries like media, entertainment, and banking that create a product or service more easily digitized, were disrupted early. Others that rely heavily on manpower and expensive assets to provide a product or service like agriculture, manufacturing, and healthcare have been more insular. But automation is a deep and unstoppable force. Even people who resisted transformation in an insular industry like automobile manufacturing could not remove the opportunity for others to do so. Cars built by hand in the third industrial revolution are now largely made by robots. But eliminating the physical labor of manufacturing cars has merely been a check point on the way to further automation. During this fourth industrial revolution, those cars no longer require people to drive them.

What was not obvious at the beginning of the digital revolution was that technology does not play favorites between physical and mental labor. All industries, no matter how insular, are being disrupted in ways that threaten old ways of thinking and working. Today, money can be invested without financiers, legal work done without lawyers, buildings designed without architects, and coding completed without programmers.

Neurosurgery is no different. The forces of technology, culture, economics, and education are making their impact and disrupting our profession in ways that were hard to foresee even a few years ago.

Culture

Compared to past generations, we are living in a moment that feels even more temporary. In the 1950s, the average lifespan of an S&P 500 company was sixty years—today it is fifteen[1]. As a result, people can no longer rely on a single company or organization to fund a salary, benefits and retirement over the course of their career. Millennials sense this more than Generation Xers or Baby Boomers. By the end of 2020, two out of three millennials expect to have moved from their current job with only 16% expecting to be at the same company in a decade.[2]

When we switch jobs, those jobs are predominantly short term or, in Millennial-speak, "gigs". Net employment growth between 2005 and 2015 came entirely from alternative employment such as consulting, freelance, self-employment, independent contracts or part-time work.[3] The temporary nature of this work is making an impact on the teams formed within those organizations that are responsible for executing new initiatives and bringing about change.

Traditionally, organizations have been enabled by what they and the people employed by them know, own or control. When that exclusivity is gone, the value those organizations deliver is also gone. For example, as legal knowledge has disseminated from attorneys to the Internet in the form of sites like LegalZoom, there is less need for attorneys. As a result, applications to law school are down 40% over the past 10 years[4]. This same phenomenon is now happening in healthcare as knowledge that was once exclusive to physicians is broadly distributed amongst sites like WebMD and open source journals.

Dr. Scarrow addresses the audience at the CNS Annual Meeting about disruption in healthcare leadership.

While this change has come slower to neurosurgery, other medical specialties are feeling it more acutely. Traditional OB/GYN practice in some areas are being "bio-hacked" by a group of self-help oriented lay women who offer services such as urinalysis, cervical cancer screening, and menopause therapies. These self-described "GynePunks" may have a radical approach from the perspective of most physicians, but what they are doing is possible only because there is demand for a service that is either unavailable or unaffordable to the patients they serve in a more conventional setting[5].

Besides the broad distribution of medical information, there is another, more disturbing explanation for the rise of alternative healthcare providers—people have less trust in traditional medicine. Over the past decade, public trust surveys show that trust in "people like me" has reached higher levels than academic experts or doctors.[2] Thus when information is freely distributed, light is cast into areas of darkness that can erode traditional models of power and leadership.

Many contemporary organizations are sensing this power shift and taking action. They are creating leadership structures that are not led by individuals but rather are comprised of crowds that connect and share information to solve specific problems. The nature of these leadership structures is not necessarily less engagement, but less permanence and less dominance by individuals—particularly those that are achievement oriented.

Another consequence of the broad distribution of information and automation in this fourth industrial revolution is that there is less need for individual brainpower. College graduates with higher cognitive skills in areas like math, engineering and science are using those skills less. Brainpower required by college graduates peaked in the year 2000 and is now at levels comparable to 1980 as jobs that were once the exclusive purview of people, are increasingly done by computers.[6]

A common pattern for the automation of higher cognitive skill jobs is that they are first outsourced to the countries that can do it cheapest. For example, coding, web applications and customer support are often outsourced to countries with large numbers of college graduates willing to work for less than U.S. college graduates. But that is only a temporary strategy. As technology advances, jobs or tasks that can be outsourced are eventually automated. When rules of thought can be written down, those rules can be turned into algorithms. Algorithms can then be turned into code that can run a computer or guide a robot to eventually accomplish the same jobs and tasks.

While cognitive skills may be less valuable in 2018, what has increased in value are the "soft" skills—those that enable individuals to collaborate, build relationships, empathize, influence and lead. Those skills are less easy to automate because they are innately human, person-to-person activities that require trust. Industries like healthcare and education are filled with jobs that require those skills. As a result, education and healthcare jobs have doubled as a percentage of total jobs since the 1970s. Today there are 16.7 million people in healthcare with an 18% increase expected in the next 10 years[7].

Education

The rapid distribution of knowledge has educated more people and made it possible for those people to create even more knowledge. The expansion of knowledge has driven greater specialization in almost every industry. Greater financial information drove the need for chief financial officers in the 1970s, more knowledge about marketing drove the creation of the chief marketing officer in the 1980s and as data sharing between employees became more important in the 1990s, chief information officer positions were created. Healthcare is no different. The general internist of the 1950s has now specialized into cardiology, interventional cardiology, interventional diagnostic cardiology and interventional therapeutic cardiology because more knowledge created the need for focus and specialization.

As individuals have become more specialized, teams have had to become bigger in order to solve broad, complex problems. The most influential work in medicine, science and engineering is done by such teams. Team publications are 530% more likely to be frequently cited than those done by individuals.[6] Additionally, those teams are more diverse as measured by race, ethnicity, sex, and language. This is particularly evident in healthcare. While only 35% of physicians are female, 85% of Advance Practice Nurses and 90% of Registered Nurses are female. Today, nearly two-thirds of healthcare workers are white but that will change over the next ten years as people of Hispanic heritage become a larger portion of the population[8].

> IN ADDITION TO THE COGNITIVE AND TECHNICAL SKILLS NECESSARY TO PROVIDE STATE-OF-THE-ART NEUROSURGICAL CARE, SUCCESSFUL SURGEONS MUST ALSO BE CAPABLE OF LEADING TECH SAVVY, COLLABORATIVE TEAMS THAT ARE FOCUSED ON SHORT-TERM, SPECIFIC PROBLEMS. <

Economic

There is a great deal of concern about the cost of healthcare in the U.S, particularly its effect on individual wallets and long-term national debt. Today, the fastest growing health insurance plan in the U.S. is the high deductible health plan. In these plans, the first $1,350 of cost is the responsibility for individuals and the first $2,700 for families. What makes that a problem for hospitals and physicians is that 57% of Americans have less

than $1,000 cash and 39% have no cash at all[9]. With many not having the resources to meet healthcare costs, both hospital and public debt has risen. In 2017, U.S. hospitals took on $27.7 billion in new debt compared to $9.4 billion in 2014[10] while net operating margin for non-profit hospitals dipped to an unsustainable 2.7%[11]

At a federal level, debt continues to climb up to levels hard to comprehend. Today U.S. debt sits at just over $20 trillion, which is 106% of gross domestic product (GDP)—a percentage not seen since World War II[9]. Going forward, the greatest contributor to growth in the deficit will be the interest on the existing debt while the second largest contributor of growth will be healthcare costs. This may not be an existential threat to our generation but very well may be to our children and grandchildren.

Going Forward

The collective impact of technology, cultural, educational and economic trends during this fourth industrial revolution has been profound and will progressively disrupt healthcare. Technology is allowing the collection of huge amounts of physiologic, behavioral and cost data. That data is enabling a shift in focus to population metrics such as cost per patient, case mix index, all-cause outcomes and net operating income. As this technology evolves, more digitized and instrumented technologies will drive care to become more algorithmic.

In order for neurosurgeons to be successful in this environment, we will need to adapt and shift our skill set. In addition to the cognitive and technical skills necessary to provide state-of-the-art neurosurgical care, successful surgeons must also be capable of leading tech savvy, collaborative teams that are focused on short-term, specific problems. Care teams must be able to empathize with one another and communicate effectively across ethnic, cultural and language differences. In addition, neurosurgical leaders with a working knowledge of government regulation and drivers of cost will have an additional advantage as government involvement and a focus on cost control will spur further disruption in healthcare.

Successful neurosurgeons will also embrace a paradox in the coming years as greater knowledge and information stimulates further specialization while also requiring collaboration with larger teams of specialists, advance practice providers, nurses, therapists and other healthcare workers. That shift will reward the "soft skills" of leadership and management that are less emphasized today. The ability to influence through emotional and social intelligence in a fashion that feels more peer-to-peer and less leader-to-subordinate will advance success even further.

Disruption in healthcare and our profession is happening quickly. Technological, cultural, educational, and economic changes are accelerating this disruption. As a profession, let us not be caught flat footed and commit ourselves to developing skills that will allow neurosurgeons to continually succeed during this time of revolution.

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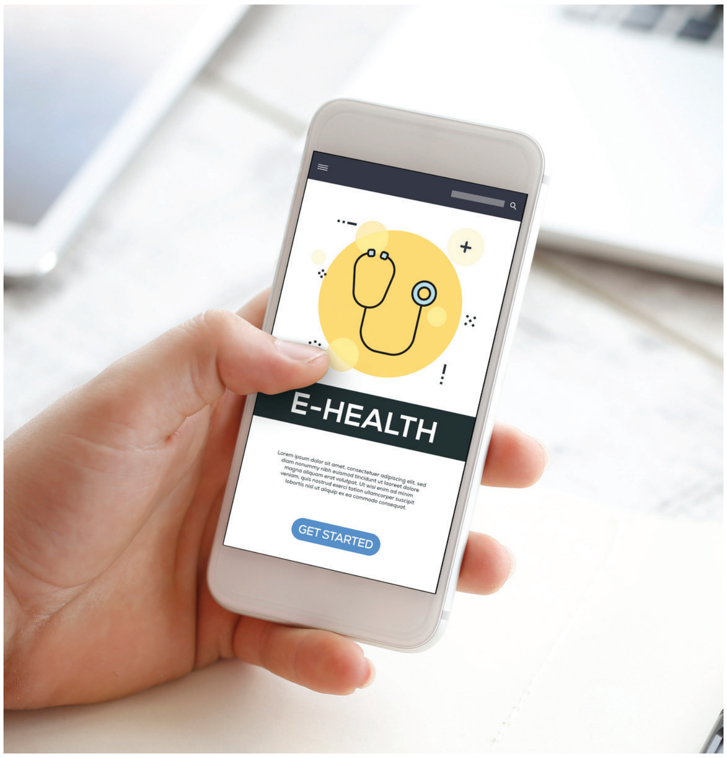
Ron Alterman, MD

The Algorithm Will See you Now.

How Artificial Intelligence is Changing Medicine



When AlphaGo, the machine learning algorithm that plays the ancient Chinese game 'Go', defeated Ke Jie, the world's top-ranked Go player, what was remarkable was not only that the algorithm won, but that it employed strategies that no human had imagined in the 2000 years the game has been played. Commenting on the match, Ke stated, "Last year, it (AlphaGo) was still quite humanlike when it played, but this year it became like a god of Go."[1] Similarly, while one may easily imagine that an algorithm could grade diabetic retinopathy from digital retinal images more reliably than humans, one might not anticipate that the same algorithm could also use those images to predict an individual's risk of cardiovascular disease, their systolic blood pressure or their gender (with 97% accuracy).[2] This is the power and potential of artificial intelligence (AI): the ability to analyze huge data sets and discover correlations that humans simply cannot imagine. Machine learning is rapidly transforming our economy and society, and make no mistake, it is ideally suited to transform the practice of medicine.

In the 20th century, physicians were selected for their ability to absorb and retain vast quantities of information and apply that information in the clinical setting while taking into account (as best we could) the infinite combinations of personal, social, cultural, and medical attributes that make each patient unique. We acquired that knowledge and its associated language in elite educational institutions, enjoyed almost exclusive access to that knowledge, and were entrusted by society to apply that knowledge equitably and in good faith. We embraced this vaunted role and protected it defiantly, claiming that medicine was an 'art' too complex to be subject to centralized planning or prescribed clinical decision algorithms. The practitioner's 'expert' opinion was what mattered.

In the early part of the 21st century, the foundations of that model have been severely eroded. Evidence-based clinical guidelines are known to reduce costly variations in care and improve outcomes.[3] The field of behavioral economics has shown how all humans are subject to unconscious biases that lead us to make poor decisions, whether they are financial, personal, or other.[4] Studies of resident performance have demonstrated that our already flawed human decision-making further degrades when we are tired or stressed.[5] The institute of medicine estimates that hundreds of thousands of Americans die each year in hospitals as a result of human error.[6]

The internet has democratized access to medical knowledge so that patients often come to office visits knowing as much about their illness and treatment options as their physician does. Crowd-sourcing has been shown to neutralize individual biases and encompass multiple individual's incomplete knowledge sets into a more complete picture of complex systems.

Healthcare delivery researchers such as Atul Gawande have demonstrated both the sloth with which medicine adopts successful new treatment strategies as compared to other high-risk industries[7] and how regional and individual practice variations that have no impact on outcome drive up the cost of healthcare.[8] At the same time, rapid genomic and RNA sequencing techniques are allowing treatments to be tailored to a patient's specific genetics—an approach that is already yielding improved survival rates for some cancers. The

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> **> THE REALITY WE CURRENTLY FACE IS THAT MEDICAL KNOWLEDGE IS SIMPLY TOO VAST AND EXPANDING TOO QUICKLY FOR EVEN THE BEST OF US TO KEEP UP. <**

reality we currently face is that medical knowledge is simply too vast and expanding too quickly for even the best of us to keep up.

Recognizing this, industry will in all likelihood turn to AI as a means both to contain the costs of healthcare and to improve healthcare outcomes. Large corporations such as CVS and Walmart will deliver basic healthcare services in a customer-friendly setting, employing allied healthcare providers equipped with advanced clinical decision algorithms based on more clinical data (i.e., experience) than any one physician could ever acquire. Machine learning algorithms will likely prove superior to humans when interpreting mammograms, chest x-rays, pathology slides, or any information that can be digitized and presented in conjunction with clinical outcome data in sufficient quantities for the algorithm to decipher key associations.

So, what does this mean for American Neurosurgeons? My guess is that a rapid adoption of AI into clinical decision making will result in a loss of autonomy as payors increasingly apply algorithms to dictate care (within reasonable boundaries), particularly for common and costly interventions (i.e., chronic pain and degenerative spine disease). Machine learning will likely allow for rapid and accurate interpretation of CT perfusion scans at all hours, determining which patients are eligible for clot retrieval procedures. Algorithms may prove superior to humans when predicting from CT scans which TBI or stroke patients will require decompressive hemicraniectomy, or interpreting MR spectroscopy to distinguish radiation necrosis from recurrent tumor without the need for biopsy. Likely, AI will impact neurosurgery in a manner that is totally unexpected.

Some will point to the recent high-profile layoffs from the IBM Watson team[9] as evidence that the potential for AI is just hype and that human clinical decision-making will continue its long reign for the foreseeable future. To those individuals, I point to the Internet Bubble of 2000, when many early internet companies folded. Eighteen years later, the internet is the central technology of our lives, the means through which we accomplish almost everything. I would also point to the profound impact advanced document search programs have had on the legal profession, decimating armies of junior associates, who once were required to read documents and research precedents. In many respects, AI represents the fruition of the electronic medical record, finally putting all of that data we have so dutifully been uploading to good use. Certainly, AI will impact the so called 'cognitive' sub-specialties more than ours, at least for now. Luckily for us, it will likely be some time before our collective abilities to perform complex, life-sustaining procedures are surpassed by tireless robots guided by even more advanced algorithms. But it is foolish to think that AI will not soon play a significant role in our professional lives, and it is better for all that we embrace it.

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Martina Stippler, MD

How Women Will Disrupt Neurosurgery

There are very few neurosurgeons (3,600) compared with the number of physicians in other medical specialties. For example, there are more than 46,000 anesthesiologists and 25,000 orthopedists in the U.S. There are even fewer female neurosurgeons. The most recent data show there are 219 women in the United States who are board certified in neurosurgery, for about five percent of all neurosurgeons, which makes us a superminority. But this will change, as the percentage of female neurosurgery residents has increased from 12% in 2011 to 19% in 2017. This trend is and will continue to disrupt neurosurgery for the better.

This is not an article about who is better; this is an article about diversity and how it can lead to positive change. Is there an inherent difference between genders? A recent article in Harvard Business Review argued that there are wild variations among women and men, but studies have shown that on average the sexes are far more similar in their attitudes and abilities than we think.[1] The perceived differences in women compared with men—poor negation skills, low confidence, risk–averse behavior, not putting required hours in at work, valuing their family more than their careers—do not stem from fixed gender traits but rather are in response to a biased organizational structure.[2]

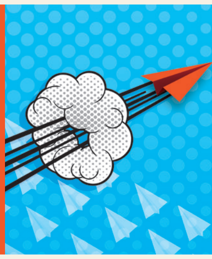
For example, a sole woman in a room with no other women present to support her might not speak up. This is often perceived as being less outspoken or lacking confidence. The problem of assuming women are less capable or have intrinsic weaknesses leads to workshops and interventions to "fix" women instead of changing the circumstances that give rise to the behavior in the first place.

Surgery is a team sport, and diverse teams perform better than homogenous ones. Diverse teams are proven to be more successful. Fortune 500 companies with diverse leadership are more profitable.[3]

Women have been differently socialized and offer distinctive strengths, views, and problem-solving strategies. Self-awareness, support for employees, hands-on leadership, embracing leadership as a learning opportunity, toughness, compassion, and empathy are hallmark characteristics of effective leaders. Women, due to different upbringings and experiences, might have a leg up on some of these traits. Anna Terry, a fellow neurosurgeon at Duke University School of Medicine stated, "These perspectives, skill sets, and backgrounds generate the collective wisdom that translates into real-world effectiveness." This is how women will disrupt neurosurgery and other male-dominated fields.

Dr. Maryam Rahman in action in the operation room. Although women currently represent about 5% of board certified Neurosurgeons in the US, the rise of women in neurosurgical residency predicts a demographic shift ahead.

What ensues when a super-minority grows into less of a minority, or even becomes a majority? This happened in my institution. There were a couple of years when there have been more female general surgery residents than male residents. I asked one of the female residents what changed once they morphed from a minority to the majority. She said, "We are not afraid anymore. We don't tolerate



Gail Rosseau in Dar Es Salaam, Dept of Neurosurgery Rounds, while visiting to attend the CAANS Third Continental Meeting in Abuja, Nigeria.

abuse anymore. We stand up for each other." It struck me that this is what men have been doing for each other for centuries. This lack of support is a core problem that women face in male-dominated fields.

To disrupt the status quo, women need to ask for, even demand, support from male colleagues. Chairs and program directors need to go out of their way to make social interaction gender neutral (i.e. have social gatherings at lunch, not around dinnertime). Sponsor female-only gatherings if there is more than one female resident. Dr. Ashwini Sharan, the Neurosurgery Program Director at Thomas Jefferson University Hospital, told me that he is doing just that. He noticed, "[Women] are coming out of their shell when they are among themselves; they are more confident." Dr. Sharan was the first President of the CNS who recognized that, "minorities need people that look like them" on a board. Under Dr. Sharan's and Dr. Scarrow's leadership, there are now four women on the CNS EC.

This isn't just about gender, it's also about dual-career couples. The way neurosurgery currently is practiced lends itself to the fully supported worker or "unbounded" talent.[1] Once upon a time, spouses—mostly female—did not have competing careers, so they managed home and family life, freeing up the neurosurgeon to meet the demands of a 24-7 job. Today in almost half of the two-parent households in the United States (compared with 31% in 1970), both parents work full time. Over the past three decades, assortative mating—the tendency of people with similar outlooks and levels of education and ambition to marry each other—has risen by almost 25%. Although more households are now dual career/dual income households, women still perform the lion's share of household duties and child responsibility.[4] Therefore, women must pave the way to change neurosurgery by making it more attractive for women and dual-career couples.

This will be disruptive—surgeons will have to be willing to cover for their partners, and departments will have to offer flexile work hours, give credit for work done after hours, and change the culture so the stigma of "leaving early" does not hold women surgeons (who are not fully supported workers) back. And as more neurosurgeons come from dual-career couples, many men might find themselves in similar shoes of not being a fully supported worker. In the end, all genders will profit from these efforts and institutions will benefit from being able to retain and recruit the best and brightest.

Women will help neurosurgery evolve into a more balanced and diverse specialty with the best talent who will improve the outcome of our patients.

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Pedro M. Ramirez, MD

Disruptive Forces for the Private Practice Neurosurgeon

Dr. Ramirez with a patient during clinic

The signs are clear that a disruptive force is approaching. But it is not clear where, when, or what the extent of the impact will be. Disruption in private practice can be a positive process that neurosurgeons can benefit from, only if we identify the disruption and prepare adequately. What distinguishes disruptive individuals from the status quo are a maverick spirit, a willingness to fight for what they believe is right, and the ability to motivate others to embrace their fresh ideas. In the next few years, private practices that don't think differently, quickly, and innovatively will not flourish. This article will present some of the disruptors in private practice to help us understand what is coming.

Self-employment allows for autonomy over lifestyle. We made a career decision based on passion, prestige, money, and lifestyle. We all know that lifestyle was not our top priority. Most neurosurgeons are workaholics since that is how we made it through residency. We bring that to our practice. Private practice means being on call 24/7, no help from residents, plus added time managing the business. Private practice neurosurgeons have to design and maintain a high-quality service to be competitive. We must never lose our sense of meaning and purpose. We must separate work from personal life and enjoy every minute of our day. Above all, life is what you make of it.

Is very difficult to maintain a balance between the different options of employment for neurosurgeons and there are several factors to consider when transitioning to practice. We have seen a shift of physicians leaning more towards hospital employment rather than private practice. Residents are rarely exposed to private practice models and have very little or no exposure to the business side of medicine. Medical school graduates have a large amount of debt, which can easily double after 7 years of Neurosurgery training. Private practice models often offer increased autonomy and greater income potential, but fewer physicians are pursuing this option. This is most likely due to the rapidly changing healthcare environment with increased regulatory and administrative burdens, high malpractice costs, and high operational overheads. Private practice has the advantage of having physician ownership not only in the form of shareholder status, but also with intellectual property. Private practice neurosurgeons also have the ability to have an ownership stake in ambulatory surgery centers.

Disruptive decentralization is a mechanism that reduces cost in healthcare. For decades health systems have been centralized in hospitals. Private practice has to compete with hospitals that are now health care systems that provide wellness and pre-emptive care, rather than merely sick/acute care. Pursuing profit and differentiation in head-on competition amongst similar business models generally adds cost. The decentralization that follows centralization is just beginning in health care and is driven by independently owned imaging centers, surgery centers, and medical groups. Private practices contribute to the decentralization of healthcare by having relationships with multiple hospitals and healthcare systems that help broaden geographic reach while diversifying referral networks.

> WITHIN ANY DISRUPTION IS AN OPPORTUNITY FOR THOSE WHO SEE IT. PRIVATE PRACTICE NEUROSURGEONS WHO LEARN HOW TO EFFECTIVELY LEVERAGE CHANGING DEMANDS WILL LIKELY LEAD AND PROFIT FROM THIS DISRUPTION. <

The transition to value-based care and CMS' physician incentive programs will either increase or decrease payment to providers. The incentive programs, known as the Merit-Based Incentive Payment System (MIPS) and Alternative Payment Models (APM) will start to move all physicians toward a goal to be reimbursed not for services rendered, but instead for outcomes. High-value care will be defined by measures of quality and efficiency and providers will earn, more or less, depending on their performance against those measures. MACRA is a disruptive force in healthcare. Within any disruption is an opportunity for those who see it. Private practice neurosurgeons who learn how to effectively leverage changing demands will likely lead and profit from this disruption. But implementation of regulations will not be easy and overhead costs will be added to the practice.

Patients are the most important players in the disruption of neurosurgery private practice. Patients expect their healthcare experience to be seamless and integrated with technology, so they can participate more in their care. Patients want to book appointments online, access care outside the doctor's office or hospital through remote patient communications such as tele-health. Enhancing the patient experience through technology is real and rapidly growing. Healthcare has a long way to go before it can be considered consistently customer centric. Information sharing offers patients qualities they look for: convenience, attentiveness, timeliness, value, and price transparency. In health care, most technological enablers have failed to lower costs and increase quality. Technology is making it easier and faster for patients to get care but is also increasing the operational cost of a private practice.

Social media has inarguably taken the world by storm. It can be used to improve or enhance professional networking and education, organizational promotion, patient care, and patient education. Social media has also given patients the platform to vent their frustrations and to follow up on causes they feel compelled to join. This can present potential risks to private practice neurosurgeons. The distribution of poor-quality information, damage to professional image, breaches of patient privacy, violation of personal–professional boundaries, and licensing or legal issues can be devastating. Private practice neurosurgeons who want to reach larger audiences or interact better with existing audiences should be active on social media but follow guidelines issued by health care organizations and professional societies to provide sound and useful principles and avoid pitfalls.

In most industries, disruption comes from startups. Yet almost all health care innovation funded since 2000 has been for sustaining the industry's business model rather than disrupting it. Private practice neurosurgeons cannot rely on someone else's great foresight capabilities for long-term growth. We need to identify opportunities, constraints and threats. Neurosurgeons with good business intuition will identify disruptions that others can't see and will transform it into a growth engine.

Alan Friedman, MA

Personality Assessment Utilization is Changing Organized Neurosurgery to Improve Patient Satisfaction, Quality and Safety Initiatives and Physician Leadership

In organized neurosurgery, neurosurgery residents are selected based on personality[1]. Practicing neurosurgeons are coached throughout their professional careers to address the critical role that personality and leadership skills play in the complex practice of medicine[2]. This trend has the potential to improve clinical outcomes, enhance patient safety, and may ultimately reduce physician burnout.

We have worked extensively with many neurosurgical departments and programs on resident selection, leadership development, coaching, wellness, and stress management. This mirrors our work in other specialties as well, including orthopaedics, otolaryngology, emergency medicine, anesthesiology, family medicine, internal medicine, and pediatrics. Our work shows the importance of using a data-based approach to understand personality traits in order to gain greater insight into interpersonal interactions. Personality, thought processes, and behavior are all separate constructs that can be measured with both personality and behavioral assessments.

The German psychologist Kurt Lewin postulated that behavior is a function of a person's personality and their environment[3]. An individual's motivational profile ultimately determines what behavior is exhibited. This is a significant and appreciable foundation for thinking about different traits that are the underpinning of how we behave. Lewin's equation can be expanded further to explain the relationship between a person's behavior, thought processes, and personality. Consider the following equation:

Behavior = Thought Processes = f (P + E + M)

P: PERSONALITY, E: ENVIRONMENT, M: MEANING

Behavior is a direct representation of positive and negative thought processes. Both behavior and thought processes are a function of personality, environment, and meaning. Personality can be evaluated using the Five-Factor model and produces consistent results in both observation and self-assessment[4]. Yet, it is often ignored or, worse, analyzed using assessments that have not been validated.

Personality assessment is an effective tool for professionals in all industries. This is especially true in healthcare, where professionalism is directly related to patient satisfaction and quality of care. Effective organizations and departments dedicate time and resources to understanding each variable of the aforementioned formula.

In the modern clinical environment, teamwork is key. Every member of a neurosurgical team brings a diverse and valuable set of personality attributes. To leverage the strengths and mitigate the challenges of the individuals who comprise the team, it is important to use the proper tools to provide this data. This can then be used to promote and encourage behaviors conducive to improvements in clinical outcomes and patient safety. Chairs, program directors, members of the faculty/partners, residents, allied health professionals and staff benefit from the self-awareness that is created by this process[5].

Additionally, these types of assessments can play an important role in selecting medical students for residency. There are several effective ways to evaluate whether a potential neurosurgical trainee has the cognitive capacity and technical skills to manage complex diagnoses and interventions. However, it is more difficult to determine whether a candidate has the nontechnical skills necessary to make difficult decisions under pressure, successfully manage/lead others and build rapport with his/her patients.

Another way to think about this type of process is to analogize it to how medical students and residents are trained. A variety of disparate data points are ordered and collected, this information is then combined with expertise, judgment and experience to positively impact an outcome. The same algorithm can be applied to behavior.

Assessments allow us to find commonalities between groups of potential

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residents. For example, in a survey of 54 applicants for Cleveland Clinic's 2014-2015 resident program, participants who had published a higher-than-average number of papers (more than ten) scored higher on a specific personality trait linked to neuroticism. Their responses suggested more even-tempered and composed reactions in stressful situations. Applicants who had attended lower-ranking medical schools (below 40th) scored higher on creative and imaginative thinking. With a more objectively based understanding of each applicant's personality, the selection committee in this case had a better understanding of the usual tendencies, stress tendencies and motivations of the applicants.

The ACGME Neurological Surgery Milestone Project requirements state that residents must demonstrate competency in six domains[6]. Two are Interpersonal Communication Skills and Professionalism. More recently, the addition of the ACGME Common Program Requirements[7] including wellness and stress management help ensure a clinical learning environment that fosters development of the skills, knowledge, and attitudes necessary to take personal responsibility for patient care. Understanding personality can help with all these requirements and assist in creating a culture of open communication, which is important for team effectiveness.

Personality assessments have value beyond the resident selection process. These tools can be used as an effective way to facilitate coaching and development for residents, practicing neurosurgeons and other members of the organized neurosurgical community. Each individual has a unique personality. The more extremity in a person's personality, the more energy that will need to be expended to regulate those tendencies from becoming behaviors that can work either for or against the goals of the individual, program, etc.

This capability can impact (positively or negatively) reputations, ruin professional relationships and ultimately can compromise patient care. Using personality as a basis to understand the intrapersonal perspective (from within) can help neurosurgeons at every stage of their career to become more self-aware of their innate traits. With this awareness, they can learn how to better harness their strengths and avoid allowing their challenges to impede their clinical effectiveness. This foundation was recently provided to interns who participated in the SNS New England Intern Boot Camp[8].

The increased attention being placed on the link between personality and behavior follows a national trend. Businesses across the country are adopting the agile practices of the tech industry, which include more frequent performance assessment and management that focuses on the team rather than the individual. With this movement, healthcare leaders can facilitate an environment in which each team member can understand and navigate their behavior with as much proficiency as they manage technical skills.

Author

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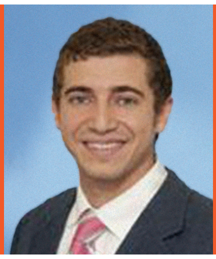

Daniel Refai, MD

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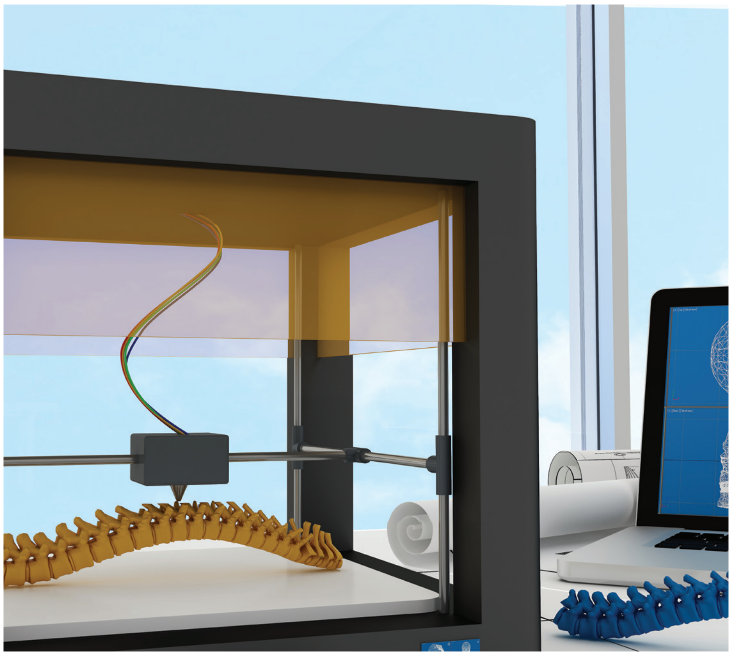
Five Technologies that Will Disrupt Spine Surgery by 2020



"Never before in history has innovation offered promise of so much to so many in so short a time."

Bill Gates' wise words ring true for the innovative technologies being developed in spine surgery. In the past few decades, there have been substantial improvements in spine instrumentation, biologics, and intraoperative neuronavigation that have drastically improved patient outcomes and further advanced technologies in the field.This exponential burst of technological innovation in spine surgery does not show any signs of slowing down. Here are five technologies that are expected to have the largest impact on spine surgery by 2020:

1 Metallurgy of Instrumentation

Historically, metals used in spinal instrumentation have been mostly composed of cobalt chrome, titanium, and stainless steel. The physical properties of the metals currently used in spine surgery and the amount of bony contact and in-growth needed for adequate strength have inhibited the ability to decrease the size of the hardware. The tide has changed recently with the influx of new metal alloys, such as molybdenum-rhenium that provides stronger, more durable constructs, while allowing for smaller sized products. The impact of utilizing this technology would be tremendous. For example, having smaller rods with smaller pedicle screw heads would provide for lower profile constructs that would decrease the prevalence of protruding, painful hardware in cachectic patients. Smaller hardware would be helpful in minimally invasive spine surgery. As an added benefit, molybdenum-rhenium alloys provide for decreased biofilm formation and allergenicity when compared to the traditional metals used in spine surgery.

2 3D Printed Implants

3D printing is a technology that has already been implemented in neurosurgery. Neurosurgeons have used custom 3D printed cranial implants and 3D printed models of complex spine cases for preoperative planning. However, a growing interest in spine surgery is 3D printed implants. The benefits of 3D printed implants are multiple. First, these implants can be shaped and molded to custom fit the patient uniquely. Second, 3D printing is less wasteful in terms of materials because it uses additive manufacturing technology that builds a model up, rather than more traditional subtractive manufacturing that starts with a "block" and cuts it down to the shape needed. More importantly, utilizing additive manufacturing allows for personalization of porosity and pore size depending on a specific patient's bone quality. Studies performed in sheep demonstrate that 3D printed porous titanium alloy cages had increased peri-

implant osteogenesis and ingrowth when compared to commercially available polyetheretherketone (PEEK) and plasma sprayed porous titanium coated PEEK implants. Lastly, 3D printed implants can have randomization of porosity and pore size, which may also improve integration and scaffolding. Until now, these technologies have been inhibited by cost and preparation time, but multiple developers have recently been successful in alleviating these challenges.

3 Nanotechnology Use in Spinal Implants

Novel implants utilizing nanotechnology blend the benefits of PEEK, its modulus of elasticity similar to bone and its improved ability to assess for fusion formation radiographically, and titanium, which allows for improved implant-endplate contact. This is performed with implants having interconnected porous titanium scaffolds molded around a PEEK core. Historically, most implants were smooth on a nanoscale. In contrast, new implants are manufactured with nanotopographies and nanoroughness that enhance signaling pathways to enhance bone growth and decrease implant related complications. As an added benefit, these implants can be coated with antibiotics to decrease the incidence of postoperative infections.

4 Operating Room Automation and Connectivity

Over the past 20 years, we have seen the remarkable effect navigation has had on spine surgery, specifically on placement of hardware. More recently, robotics have been introduced into spine surgery to assist with instrumentation. This field will disrupt spine surgery not in the placement of hardware, but in more advanced iterations of these products. Artificial intelligence will utilize machine learning and predictive analytics to assist in performing procedures such as laminectomies, diskectomies, rod formation, and interbody fusions through significantly smaller incisions. One can imagine a situation where complete automation of spine surgery is performed under the watchful eye of a surgeon. A robot formulates an appropriately sized incision at the correct level, docks a minimally-invasive tube, performs a hemilaminectomy and facetectomy, chooses an appropriately sized interbody cage and biologic, places it via a transforaminal approach, chooses appropriately sized pedicle screws and places them, formulates an appropriately sized rod with a perfect amount of lordosis, places and tightens set screws, and closes the incision at the end of the case. A surgeon may visualize the robot's progress either via virtual or augmented reality, a technology already utilized in spine education, or via a small endoscope attached to the robot arm. This automation may seem far-fetched to occur by 2020, but multiple companies are in process of developing a combination device similar to that described above.

5 Endoscopic Spine Surgery

Surgeons have utilized endoscopy in spine surgery for over two decades. However, with recent improvement in surgical instruments and imaging, this field is apt to expand drastically by 2020. With the ability to perform operations through a pencil-sized incision and respecting muscle plains, these procedures have the potential benefits of decreased postoperative infections, hospitalization times, time out of work, and chance of developing instability requiring future fusion. These operations are performed by a minority of surgeons in the U.S., but have grown more widespread elsewhere around the world in Asia, Europe, and South America. The industry sees this trend and is working on expanding or introducing endoscopic technologies into their product lines.

The five technologies listed above have tremendous potential to improve patient outcomes and surgical efficiency, and will be disruptive to the field of spine surgery by 2020. When the benefits of these new technologies outweigh the costs of innovation, the steep learning curves required, and the health economic barriers to widespread implementation, seismic disruption will occur in neurosurgery.

Nicholas Theodore, MD

Robots Will Change the Field of Spine Surgery

Conflicts of Interest: The Excelsius GPS™ robot was co-invented by me and is manufactured by Globus Medical. I am entitled to royalty payments on sales of the robot and am also a paid consultant to Globus Medical and own Globus Medical stock.

At the beginning of the 20th century, our neurosurgical forefathers Harvey Cushing and Walter Dandy helped develop and pass on the skill of cranial localization, an anxiety-provoking exercise for young neurosurgeons that needed to be repeated with every operation. Since that time, however, cranial neurosurgery has been completely transformed—first, by refinements in imaging including computed tomography and magnetic resonance imaging; and secondly, and perhaps even more importantly, by frameless stereotaxy. Given the inherent risks associated with operating deep within the brain, adoption of this technology for surgery on intracerebral pathologies has become nearly universal.[1-3]

Although navigation in spinal surgery has been available for more than 20 years, its current adoption is only about 11%.[4] This is true even though navigation technology has been proven to increase accuracy in placing pedicle screws when compared with fluoroscopic and freehand techniques.[5] There are multiple reasons for the poor adoption rate, including lack of equipment, high cost of the technology, inadequate training, and difficulty integrating navigation into the spine surgical workflow.[4]

Moving beyond freehand navigation, the concept of robotics in spine surgery has been around for several years. The Czech writer Karel Capek was the first to coin the term "robot" in his 1920 play *Rossum's Universal Robots*. His story is about a scientist who fabricates artificial people (ie, robots) that are put to work performing menial tasks. Initially content to serve their human masters, the robots ultimately lead an organized rebellion that causes the extinction of the human race. This and other science fiction tales may be the reason that robots have become feared entities, with industrial and skilled laborers (and some surgeons) terrified by the notion that they could lose their jobs to these machines.

In his book *Rise of the Robots*, Martin Ford argues that the evolution and increased dependence on robots is inevitable and will ultimately benefit mankind. In medicine, which has always embraced new technology, there are many examples of robots in use today. Neurosurgeon John Adler's CyberKnife® (Accuray Inc) debuted in 1994 and revolutionized the concept of the medical robot in a frameless radiosurgery system. The next major advance came with the release of the DaVinci® robot by Intuitive Surgical in 2000. This master–slave device allowed surgeons to work endoscopically, manipulating small end-effectors while sitting at a console several feet (or even miles) away from the patient. It has become extremely popular in urologic and gynecological surgery.

In the field of spine surgery, my mentor Curtis Dickman used the Aesop® robot (Computer Motion) to hold an endoscope while performing delicate thoracoscopic surgeries in the mid 1990's. Although my co-residents and I were probably the first casualties of robots in medicine, the rigid arm and coordinated movements of the device liberated us from holding the endoscope for hours on end, an undeniably tedious task.

The concept of using a robot to help place pedicle screws has evolved over the past 15 years. The first robots to aid in this task included the SpineAssist™, Renaissance™ (Mazor Surgical Technologies), and the Rosa™ robots (Medtech). The ExcelsiusGPS™ (Globus Medical) received FDA clearance in August 2017 and has joined the ranks of these sophisticated devices. In their review of the use of robots in neurosurgery, Joseph et al.[6] thoughtfully discuss reasons for the limited adoption of this robotic technology in early years, even though there appears to be a distinct benefit related to decreased radiation exposure to the surgeon and improved accuracy of pedicle screw placement.

The addition of robotics to spinal surgery changes the workflow of the spinal surgeon. Even those who have adopted image-guided surgery note that the inclusion of robotics technology fundamentally changes the setup and pace of a procedure. And while there seem to be significant benefits of this technology, there is still a learning curve. The question is whether the benefit of automating accuracy in our procedures outweighs the "fiddle factor" and anxiety

>MANY PATIENTS SEEK CUTTING-EDGE SOLUTIONS FOR THEIR SPINAL PROBLEMS, EVEN IF UNPROVEN, INCLUDING LASERS, STEM CELLS, AND ROBOTICS.<

of learning something new. I have spoken with many senior spinal surgeons who have said that they have mastered the technique of screw placement; therefore, they don't need the help of a robot. But would less experienced surgeons benefit from some assistance?

I believe that several factors will ultimately lead to the adoption of robotics in spinal and even cranial neurosurgery. Our current trainees, the millennials, will drive the widespread adoption of this technology in large part. Born between the early 1980s and mid 1990s, this generation will be trained in the era of residency work-hour regulations and explosive technological growth. Having grown up with the luxuries of the internet and smart phones, this generation depends and thrives on technology. In teaching residents the tenets of image-guided and robotic spine surgery, I have been impressed with their ability to easily grasp the computer interface and technical issues associated with image-guided robotics in the operating room. The adoption of advanced technology will hopefully dispel the perception that today's surgeons in training are far less prepared than their forefathers after completion of neurosurgical residency.

Another driver of robotic technology adoption in spinal surgery will be the consumer. Many patients seek cutting-edge solutions for their spinal problems, even if unproven, including lasers, stem cells, and robotics. While neurosurgery is not the same as many retail industries, patients are asking about and demanding minimally invasive approaches and advanced technologies in neurosurgery on an ever-increasing basis.

Ultimately, I believe that robotics will become commonplace in spinal surgery. Neurosurgeons in training and those still early in their careers will embrace the latest technological advances in imaging, registration, motion control, and user interfaces that enable navigation and robotic-assisted surgery. Even older surgeons may see a benefit to incorporating this technology into their workflow. No longer should robots be feared as devices designed to replace workers, but rather, as useful tools for surgeons that can help elevate their art.

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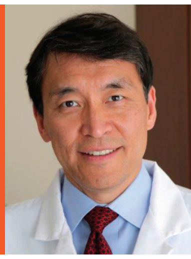
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Should spine surgery become its own specialty?

Spine Surgery Should Be Its Own Specialty

> **"You see things; and you say, 'Why?' But I dream things that never were; and I say, 'Why not?'"**
>
> George Bernard Shaw

It is the dream of many Neurological and Orthopedic Spine surgeons to make Spine surgery its own specialty. While this may seem far-fetched at the present time, history suggest that this is likely to become reality within the next several decades.

During their formative years, both Neurological and Orthopedic Surgery were divisions of General Surgery and in some universities, they remained as divisions until very recently. General Surgery fought hard to keep both as divisions but several factors led to their emancipation as independent departments. First, and foremost, it was recognized that trainees needed to spend more time learning to perform operations in their designated specialty. With the explosive growth in the number of procedures, time spent learning General Surgery meant less time learning specialty procedures. Both patients and trainees were better served by making the majority of the training specialty-specific. Second, because of the differences in reimbursement for General Surgical versus specialty procedures, Neurosurgeons and Orthopedic surgeons subsidized the rest of the department. As a result, the American Academies of both disciplines advocated for establishing their own departments. Eventually, the inability to attract top talent to Chair divisions of Neurosurgery and Orthopedics under a General Surgery Department led to the establishment of separate departments.

The same sensible arguments for secession are even more relevant concerning complex spinal procedures. The explosive growth in spinal procedures makes it difficult for trainees to gain proficiency even after 7 years of Neurosurgery or 5 years of Orthopedic training, which is why many opt for fellowship training. Even after fellowship, there can be significant variation in proficiency and approach between the disciplines. For this reason, many top spine fellowships include both Neurosurgery and Orthopedic training. It is well-recognized by most academic spinal surgeons from both specialties that much of the training in both Neurological Surgery and Orthopedic Surgery might not be necessary for those destined to become spine surgeons. Because diagnosis and treatment remain exceedingly nuanced, we would serve both trainees and their future patients much better if spine trainees spent the vast majority of their training with spine cases. Many Neurosurgery residencies recognize this and include an "in-folded" spinal fellowship.

What logically will occur with collaboration occurring between both specialties practicing spinal surgery? First, spine surgeons are beginning to consider themselves not as Neurological or Orthopedic Spine Surgeons but simply as Spine Surgeons. This will foster a formal commitment to working together for the common good and for the sake of our patients and trainees. Nearly every academic spine society and conference now includes both specialties. We will be more successful in obtaining federal funding to support spinal research to advance patient care by combining the expertise of both Neurological and Orthopedic surgeons as unified spinal surgeons. Second, academic institutions should follow the examples of top institutions such as The Cleveland Clinic and Duke who have created a unified Division of Spine Surgery. Trainees in both specialties will be exposed to attendings in both specialties. Optimal spinal education occurs through a collaborative effort from both fields. Third, the two specialties should establish a disciplined and high-quality American Board of Spinal Surgery to ensure a core competency for all trainees. Fourth, we should work in collaboration with the Residency Review Committees as well as the American Boards of both Orthopaedic and Neurological Surgery to develop a program that optimizes training in spine and limits disruption to our parent specialties. A proposed program for spine trainees might consist of either 4 years in Neurosurgery followed by 2 years in Spine or 3 years in Orthopedics followed by 3 years in Spine. It would be difficult to argue that this would not result in better-trained surgeons, which in turn would lead to better outcomes for our patients. Who amongst us would rather entrust one of our family members to a newly-minted product of our current system over the proposed one?

Finally, the above proposal is certainly not one that is likely to happen without a concerted effort on the part of a united Spine specialty. Academies and Departments of Neurosurgery and Orthopedics may still place self-interest ahead of patient outcomes, much as General Surgery stood in the way of Neurosurgery and Orthopedics becoming their own departments. But history has shown us that in the end, the march to ever-greater sub-specialization is inexorable and inevitable. The Hippocratic dictum exhorts us to first do no harm; we have to do what is right and ethical for our trainees and best for spine patients. For this reason, we believe that Spinal Surgery should become an independent surgical specialty.

James Harrop

Should spine surgery become its own specialty?

Spine Surgery Should Not Be Its Own Specialty

To answer this question, it is important to re-evaluate the origin and evolution of Neurosurgery as our specialty. Harvey Cushing is considered the Pioneer of Neurosurgery. He was trained as a general surgeon under Halsted and Brigham, the premier teachers and leaders in general surgery. His practice evolved with his interests and patient referrals. He identified a subpopulation of neurosurgery patients who lacked direction or understanding of their disorders and had extremely poor outcomes. He united the treatment of these patients through structured study and investigation of their disorders and created the field of Neurosurgery.

The new specialty of Neurosurgery showed great success. In the beginning of Cushing's career, surgical mortality with treating an intracranial tumor was 100 percent. By the end of his career he had removed over 2,000 tumors due to his success with developing new approaches and management. The General Surgery discipline did not decline with the departure of neurosurgery; instead it also continued to grow.

History has established an inflection point of when a discipline should depart. The "parent" group should neglect the disease treatment, and removal of these treating surgeons should not create a decline in the treatment of the general neurosurgical patient. So we ask these questions:

1. Is spine surgery inadequately treating its patient's in its present structure?
2. Would spine surgery leave Neurosurgery in a better or worse position?

I would argue that the answer to the first question is "No." Over the last several decades, spine patients have witnessed a rapid improvement in the quality care of their care. Our understanding of deformity, biomechanics, instrumentation and spinal cord injury physiology has advanced at full tilt. Neurosurgeons have embraced their Orthopedic colleagues in Spine which has resulted in progressive developments in surgical techniques such as: minimally invasive surgery, robotics, and treatment of deformity. Current spine patients are receiving better overall treatment over the last several decades in terms of understanding their pathophysiology etiology in surgical treatment. Therefore, this does not correlate with Dr. Cushing's experience as changes of isolation may result in a decrease and decline in our present advancement.

Neurosurgery is composed of numerous subspecialty fields: functional, tumor, pediatrics, spinal disorders, cerebrovascular and peripheral nerve issues. Two specialties added requirements and differentiated themselves from the general Neurosurgery community. Pediatric Neurosurgery and Vascular Neurosurgery have separate fellowships and educational paradigms. Has this resulted in improvement in a treatment of an underserved patient population as was seen with Dr. Cushing? Will it affect our overall Neurosurgical community positively or negatively? I do not have these answers but I believe they will be answered over the next several decades.

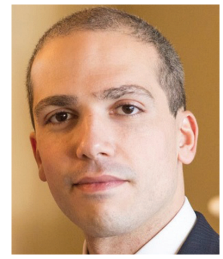
Spinal treatment is drastically different than both Pediatric and Vascular Neurosurgery in that the typical General Neurosurgeon's practice focuses mainly on treating disorders of the spine. Separation and isolation of these disorders would most likely deteriorate overall treatment of neurosurgical diseases. While this isolationism might be tolerated in an academic urban center due to the overlapping care, could this happen in rural areas while maintaining overall care algorithms? Today, a nonacademic neurosurgeon is ,by default, a spine surgeon who also treats other neurological disorders due to their diverse training, education, and dedication to their patients. By separating spine surgery from today's neurosurgical algorithm, there would be an abandonment of patients with significant issues such as – ICH, hydrocephalus, trauma, and peripheral nerve.

Unlike several other fields, the importance of having a diffuse neurological knowledge is paramount in neurosurgery since there is significant overlap in treating neurological disorders. For example, a patient that presents with arm and hand numbness may have carpal tunnel syndrome, cubital tunnel syndrome, cervical radiculopathy, or even an intracranial mass. Without this broad knowledge, these patients would unfortunately fall through the cracks since no definite spine issue is identified. Should these patients be examined with our diffuse knowledge and understanding of neurologic problems? Or should the possibility of a spine problem be simply ignored if the MRI is normal? As a Neurosurgeon, as well as a spinal surgeon, I am able to work through complex differentials and help my patients due to my diversified training. Would Harvey Cushing choose to limit his understanding of neurosurgical problems? Probably not.

In summary, I believe separation of spine surgery from Neurosurgery is not in the best interest of our patients since it does not appear to accelerate our growth and understanding of spine disorders and it would weaken the overall neurosurgery community, limiting patient treatment. Our commitment is to our patients and we should not diverge unless we see a benefit from all sides like other pioneers in our field.

ASK THE EXPERT

Hunt Batjer, MD



Salah Aoun, MD

Tarek Y. El Ahmadieh, MD

Nicole M. Bedros, MD

YES: Neurosurgeons are needed to care for mild TBI with positive head CT.

Traumatic brain injury (TBI) affects more than 1.5 million individuals every year in the United States, leading to 270,000 hospitalizations. The great majority of these injuries consist of a brief change in mental status or a loss of consciousness that lasts less than 30 minutes, and are categorized as concussions. Given the advances in neuro-imaging and the high resolution and widespread availability of computed tomography (CT) scanners, subarachnoid hemorrhage (SAH) is a very common finding in post-concussive patients.

The trauma protocol at most hospitals dictates that TBI patients with a head CT positive for abnormal findings should be admitted for observation for a variable time duration, however consensus in the other aspects of their management is still lacking. Controversial issues include the necessity for admission to the intensive care unit, the need for repeated imaging after a time interval, dealing with patient home antiaggregant and anticoagulant medication, clearance for return to play or return to learn, and management of incidentally-found lesions. While seizure prophylaxis is not routinely recommended in patients with mild TBI regardless of the presence of subarachnoid blood, there are no established randomized controlled trials or protocols in place to guide the management of anticoagulant or anti-platelet medications that patients may have been taking at the time of the injury. These medications can be hazardous, cumbersome, and expensive to stop or reverse, depending on their indication. Reversal requires the administration of blood products and can impose a draining toll on the hospital's blood bank services. Moreover, reversal agents theoretically induce a pro-thrombotic state which can be detrimental and associated with severe adverse effects. Given our aging population, this issue is gaining rapid priority.

In a more delayed fashion, post-concussion syndrome can affect 5% to 30% of patients, and includes cognitive failure, depression, sleep pattern disturbances, and recurrent debilitating headaches. These symptoms, along with knowledge that the trauma was severe enough to cause cerebral hemorrhage, can create significant stress and anxiety for the patient and their family. They can also lead to repeated emergency department re-visits because of recurrent headaches and a fear of ongoing bleeding or seizure-like activity, and be the reason for a loss of productivity and days away from the workplace.

In addition, concussions carry the risk of severe and irreversible neurological injury if they are repeated in tandem. Young patients are particularly vulnerable to this "second impact" phenomenon within two weeks following the initial trauma. Repeated concussions can also lead to chronic traumatic encephalopathy. Heightened social and medical awareness regarding the potentially severe consequences of mild TBI have led to the development of rules regarding return to study for children and young adults, return to play for athletes, and return to active duty for military personnel. The role of the neurosurgeon in this context is to make sure that the initial concussion was not severe enough to prohibit any potential re-exposure, and would not warrant prolonged suspension from return to play that could in extreme cases translate into early retirement. The time for return to school and study should also be weighed carefully, as patients can be at increased risk for prolonged post-concussion syndrome if they are cognitively strained too early.

Finally, modern scanners often reveal incidental lesions that can potentially carry a worrisome prognosis. These include cerebral aneurysms -that can sometimes be the cause of the SAH leading to the trauma and concussion, arteriovenous malformations, cavernous malformations, and benign or malignant tumors. They also include subaxial spine stenosis or trauma that may elude emergency departments, and could potentially lead to subsequent cervical spine injury and myelopathy. These findings often require additional testing and ownership of care by a neurosurgical service for prolonged management and follow-up.

The potential repercussions of concussion mismanagement on the system overall reinforces the role of the neurosurgeon as a gatekeeper for patient care. A neurosurgical opinion can place the patients and their caretakers at ease, by providing expert opinion, follow-up, and counseling that their symptoms will abate despite the presence of SAH, albeit with a prolonged convalescence. It can also provide non-neurosurgical colleagues with reassurance and medicolegal coverage that would enable them to minimize unnecessary or superfluous diagnostic testing, without compromising patient care, while ensuring that incidental findings are addressed appropriately. This paradigm, however, does not require that all TBI patients be transferred to a center where neurosurgical presence is directly available. Telemedicine has been shown to be as efficient as direct neurosurgical involvement in both civilian and military hospitals in the management of these patients after initial triage, and will likely be playing an incremental role in the future.

NO: Neurosurgeons are not needed to care for mild TBI with a positive head CT

Bellal Joseph, MD

Over the past decade, technological improvements in imaging have resulted in the detection of minuscule and clinically insignificant findings on computed tomographic (CT) scans which has led to over-diagnosis of mild TBI.[1] As a consequence, there has been a tremendous increase in the use of healthcare resources due to TBI, the greatest increase is seen in the subgroup of patients with mild TBI. Annually, 282,000 patients are hospitalized due to a TBI resulting in a financial burden of $76.5 billion. Mild TBI accounts for 75% of these admissions.

Despite the advancement in diagnostic modalities, the management protocols for TBI have not evolved. The neurosurgeons comprise the main core for management of TBI. However, over the past decade, the country is facing a severe shortage of neurosurgeons. According to the American Association of Neurological Surgeons (AANS), there is a big discrepancy between the supply and demand of neurosurgery workforce as a result almost 25% of the US population is living in a county without a neurosurgeon. In addition, the neurosurgical workforce is aging with almost 46% neurosurgeons are over the age of 55 which will further aggravate the decline of the workforce in future.[2] Classically, patients presenting with a suspected TBI are initially managed by a trauma surgeon. If an intracranial injury is identified on the CT scan, the common practice in most of the trauma centers is to get a neurosurgical consultation and perform a repeat head CT scan, regardless of the type or size of head bleed, clinical presentation or associated risk factors. This practice has put a burden on neurosurgeons who are already suffering from significant workforce shortage.[3]

Recent literature has opposed this approach because of three principal reasons. First, over 90% of these patients have mild TBI not requiring neurosurgical intervention and these patients usually are managed non-operatively by the critical care physician in the ICU.[4] Second, most patients with mild TBI have benign physical findings that resolve in 7-10 days. As a result, long-term follow-up in this patient population is very low. Around 10% patients may develop a constellation of cognitive, physical and behavioral symptoms after mild TBI referred to as chronic post-concussion syndrome and they are mainly managed by neurologists and primary care physicians.[5] Third, TBI is a clinical diagnosis, and serial clinical examinations can reliably predict the requirement for neurosurgical intervention or a repeat head CT scan in this subgroup of trauma patients.[4]

To improve and streamline the multidisciplinary management of patients with TBI, our institution has developed and implemented the brain injury guidelines (BIG) in collaboration with our neurosurgical colleagues (**Fig 1**). Patient safety is the basic and fundamental objective of these guidelines. BIG was developed by the analysis of 3,803

Variables	BIG 1	BIG 2	BIG 3
LOC	Yes/No	Yes/No	Yes/No
Neurologic examination	Normal	Normal	Abnormal
Intoxication	No	No/Yes	No/Yes
Skull Fracture	No	Non-displaced	Displaced
SDH	< 4mm	5 – 7 mm	> 8mm
EDH	< 4mm	5 – 7 mm	> 8mm
IPH	< 4mm 1 location	5 – 7 mm, 2 locations	> 8mm, multiple locations
SAH	Trace	Localized	Scattered
IVH	No	No	Yes
Therapeutic Plan			
Hospitalization	Observation (6 hours)	Yes	Yes
RHCT	No	No	Yes
NSC	No	No	Yes

BIG: brain injury guidelines: CAMP: Coumadin, Aspirin, Plavix; EDH: epidural hemorrhage; IVH: intra-ventricular hemorrhage; IPH: intra-parenchymal hemorrhage; LOC: loss of consciousness; NSC: neurosurgical consultation; RHCT: repeat head computed tomography; SAH: subarachnoid hemorrhage; SDH: subdural hemorrhage.

Figure 1: *Brain Injury Guidelines*

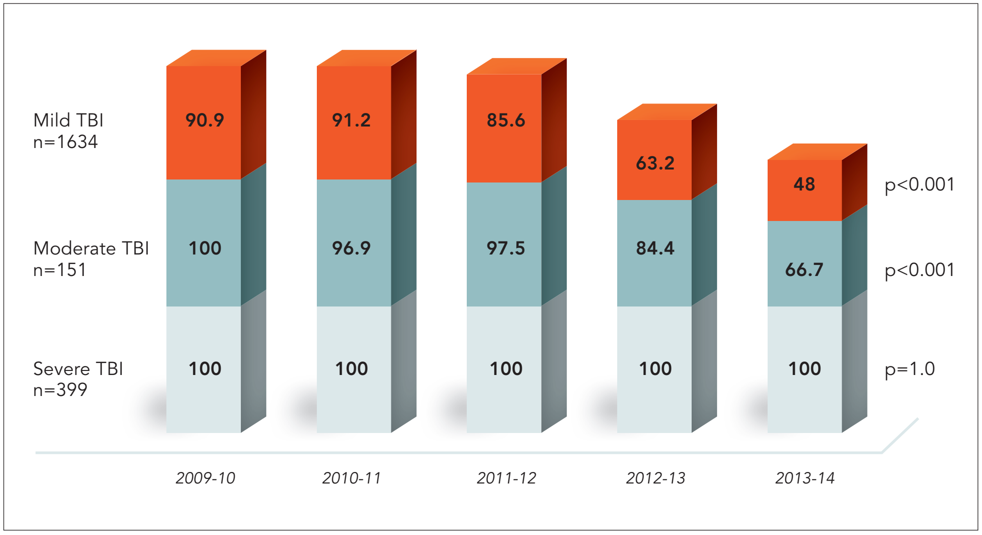


Figure 2a: *Trends in neurosurgical consultations after implication of BIG guidelines.*

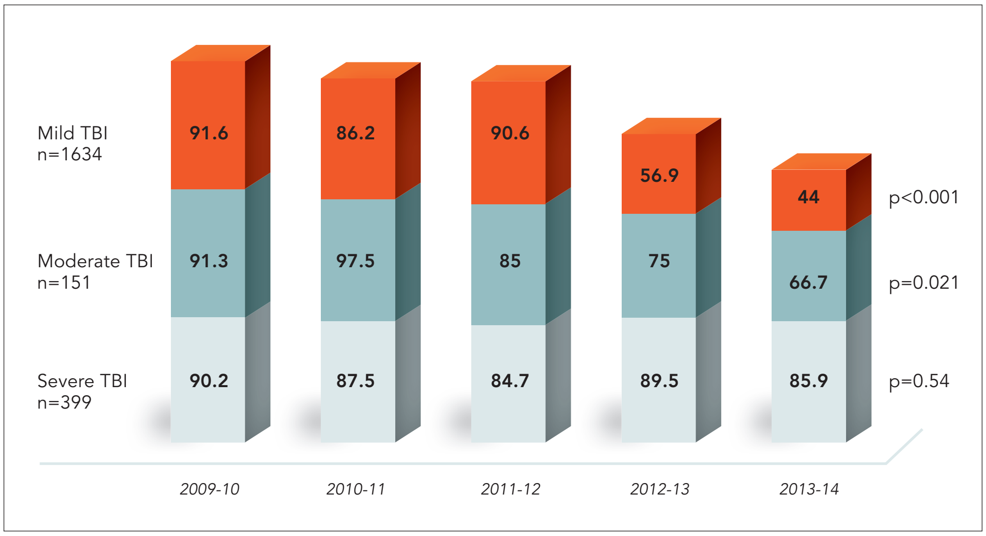


Figure 2b: *Trends in repeat head computed tomographic scans after implication of BIG guidelines.*

patients and prospectively validated and now proven to be safe in over 4,000 cases.[6,7] Since its implementation at our Level-I trauma center, acute care service has been able to manage TBI patients with ICH and bleeds less than 8mm, normal neurological exam, not on any anticoagulant/antiplatelet, and nondisplaced skull fractures by adhering to the protocol. This practice has resulted in a significant decrease in the rate of neurosurgical consultation, repeat head CT scans, hospital costs, and hospital length of stay without any change in mortality (**Fig 2a & 2b**).[8] Five other level I trauma centers have implemented BIG for the management of patients with TBI. In addition, the safety and efficacy of BIG have also been established in the management of mild-TBI among the pediatric population.[9] The application of BIG is especially important for institutions with limited resources. Martin et al. from the University of Cincinnati have validated BIG and concluded that implementation of BIG is both safe and feasible at a Level-III trauma center without an increase in adverse outcomes.[10] Currently, an American Association for the Surgery of Trauma (AAST) sponsored multi-institutional trial is underway to implement BIG on a national level.

Over the last decade, there has been a paradigm shift in the management of patients with TBI. Acute care surgeons have assumed a critical role alongside the neurosurgeons for the management of these patients resulting in an efficient resource utilization and reduction in the unnecessary burden on our neurosurgery colleagues.

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SECTION NEWS

Tumor Section Update

Manish K. Aghi, MD, PhD

This past April, the AANS/CNS Joint Tumor Section transitioned in leadership, as Steven N. Kalkanis, Chair from 2016 to 2018, passed me the baton as new Chair. I am thrilled to be partnering with newly elected Secretary/Treasurer Jason Sheehan and the team of outstanding volunteers that make up our Executive Committee. Jason and I will each serve two-year terms, after which Jason will assume the Chair position.

The Section benefited immensely from numerous initiatives that occurred under Steve's leadership, including:

- Expansion of overall Section **membership** by 10% at a time when membership in professional societies and meeting attendance were dropping
- Hosting a remarkable **Satellite Symposium** in San Diego in 2016 which broke all prior attendance records while honoring multiple luminaries in our field.
- In the spirit of mentorship and service, we launched a brand new **Tumor Section mentorship award** named in honor of the late **Andy Parsa**, and we renamed our **Distinguished Service Award in honor of our founder, Mark Rosenblum**
- In addition to the traditional NREF Tumor Section fellowships, we launched two **new $50,000 fellowship awards: the Andrew Parsa Research Award, and the B*Cured–Tumor Section Award.**
- The Section's Twitter account was launched (**@NSTumorSection**) and became an active voice for the section thanks to **Edjah Nduom**
- Thanks to **Ric Komotar** and industry sponsorship, we launched our first international observership program, which will support an Argentinian neurosurgeon who is observing tumor neurosurgery in the U.S.

Looking forward, we are thrilled to be holding our 13th Biennial Tumor Satellite Symposium immediately before the 2018 CNS Annual Meeting on October 5-6, 2018, at the Houston Marriott Marquis (the headquarters hotel of the main CNS meeting) in Houston, Texas. Event highlights include:

- Keynote lectures from NASA astronaut Gregory Reid Wiseman about the technology and communication advancements needed to explore space
- A comprehensive symposium on the wide-ranging aspects of brain tumor technologies with laser interstitial therapy and fluorescent visualization of tumors
- Top scoring peer-reviewed oral and poster presentations
- On Friday evening, October 5, before dinner there will be three breakout sessions for our younger attendees covering a primer on the basics one needs to know to start clinical trials, advice on starting a basic science lab as a neurosurgeon, and guidance in transitioning from residency to a job.
- On Friday night, October 5, there will be a tumor section gala event with dinner and award presentations at the Four Seasons Hotel in Houston
- On Saturday, October 6 after lunch, the meeting will transition into a symposium honoring the career of Dr. Ray Sawaya, who chaired the neurosurgery department at MD Anderson since its establishment in 1990 until this year

Registration for this meeting is open at https://www.cns.org/meetings/2018-tumor-section-satellite-symposium and will be available onsite in Houston.

ASSFN Update

Robert Gross, MD

Opportunities abound for stereotactic and functional neurosurgery in our mission to provide cutting edge care for patients suffering from disorders of the nervous system. The rapid pace of technological advancements is improving the care of patients typically within our purview, as well as opening up new vistas. This was in great display at the biennial meeting of the American Society for Stereotactic and Functional Neurosurgery in Denver in early June. A record 597 people—including 363 medical registrants (surgeons, neurologists, psychiatrists, scientists, engineers, and others) and 234 exhibitors from 18 countries assembled to present and discuss all the exciting advances in this vibrant and growing field.

Critical factors contributing to this growth are the NIH BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative (originated in 2013; amounted to $270M in grant funding in 2017 alone), as well as several programs of the Defense Advanced Research Projects Agency (DARPA). These programs were reviewed in the opening plenary session, with presentations from each of the agencies (NINDS, NIMH, DARPA), as well as 5 functional neurosurgeon-scientists currently undertaking supported preclinical and clinical research spanning movement disorders, epilepsy, language, memory and neuropsychiatric disorders. The remarkable catalytic effects of this support were shown by a quick headcount at a recent BRAIN investigator meeting, where no less than 11 supported functional neurosurgeons were in attendance, few of whom were supported by traditional NIH mechanisms. The BRAIN mechanisms are so-called 'cooperative' grants, which means that the program officers and NIH staff have a large oversight role in the funded research, not unlike the DARPA grants. While this requires a degree of back-and-forth between researchers and NIH staff, it also imposes risk to the researchers in that the funding is granted from year-to-year, whereas by traditional grants money is granted in 5-year blocks. The cooperative approach derisks the NIH for high risk/high reward projects—as almost all clinical research projects are—and allows for a broader range of projects, such as those in functional neurosurgery, to be funded.

Not only are technological innovations propelling functional neurosurgery, but the opening of new vistas is driving a potential for remarkable growth in our field as we bring new treatments to cohorts of patients previously not helped by neurosurgery—nor unfortunately, by traditional medical approaches. A plenary session at the biennial meeting explored some of these new areas. These include vision disorders, which actually have been a target for neurosurgery for decades (e.g. Richard Normann's lifetime of work at the University of Utah, where he invented the Utah Electrode Array specifically as a visual prosthesis; it subsequently became the basis for the Braingate system used as a motor prosthesis). That dream is closer to becoming a reality with the leveraging of the SecondSight (Symar, CA) thin-film micro-fabricated multielectrode array technology, FDA-approved as a retinal implant, as a cortical prosthesis. Also in the crosshairs are so-called peripheral disorders, such as 'neurocardiology' and 'neuroimmunology' (e.g. Crohn's disease). The latter are being driven forward by another NIH initiative, Stimulating Peripheral Activity to Relieve Conditions (SPARC). This initiative has the potential to bring relief to millions of patients, and to bring millions of patients to the functional neurosurgeon's operating room.

In addition to funding risky clinical programs that utilize technological innovations, the BRAIN and DARPA programs are propelling remarkable advances in those technologies themselves. In fact, the espoused goal of the DARPA Neural Engineering System Design (NESD) program is to record from 10^6 and stimulate 10^5 electrodes, according to program manager Dr. Alfred Emondi. A session highlighting engineering advances included new ultra-thin, hi-density arrays and new microchips that can record from large arrays and provide computational support for handling the data. These go hand in hand; Moore's law is as applicable to neural interfaces as it is to the data sciences. The inexorable increase of processing power and decrease of power consumption is allowing the necessary front-loading of computational burden to the implantable devices, and undoubtedly will be an underpinning to the revolution of neurosurgery. As these powerhouses advance to clinical application in the coming years, we will see applications to disorders, such as memory, that were previously untouchable.

More esoteric and controversial is the use of neurotechnology to "extend cognition", amongst the goals of Kernel. Founder Bryan Johnson gave a provocative interview with past-president Aviva Abosch about the interface of artificial and human intelligence. This was bookended by a highly attended plenary on neuroethics, an area of study that is, by necessity, evolving nearly as quickly as our new technologies. The pace of innovation is becoming so rapid that an emerging threat accompanies it. With the possibility of extending ourselves too far in our efforts to alleviate suffering, bridging the oft-times nebulous boundary between treating dysfunction and improving function is brought to the fore in conditions that affect memory and mood.

Another threat that was addressed at the Denver meeting was cost effectiveness and outcomes. DBS (and all these new technologies) is expensive and, with the increasing numbers of indications being explored, has the potential to go from a rounding error in the CMS budget to an albatross to the healthcare system. We must increasingly consider and document all the downstream expenses that are alleviated and the increased productivity and unquantifiable benefits of improved quality of life that are associated with effective treatments. We must also be responsible stewards by taking a hard look at expensive technologies that, although FDA and CMS approved, may not deliver a sufficient 'bang for the buck'. Working together with all stakeholders, functional neurosurgery needs to continue to strive to move our treatments from 'good to great'.

Figure 1: Keynote lecture on the BRAIN Initiative

James W. Gnadt, PhD, Program Director, Systems and Cognitive Neuroscience, National Institute of Neurological Disorders and Stroke

Figure 2: Attendees at ASSFN Biennial Meeting

Left to right: Stephan Chabardes, MD, PhD, University Hospital, Grenoble, France; Two generations of Ojemanns (George Ojemann, MD, and Steven Ojemann, MD, University of Colorado); Past-President Aviva Abosch, MD, PhD, University of Colorado.

Several major themes have increasingly been percolating through virtually all streams of functional neurosurgery. The first is closed-loop feedback controlled neuromodulation, which includes (1) recording of neural signals, aka 'sensing'; (2) computational analysis of the signals, including the application of machine learning techniques to classify the data for subsequent action; (3) actuation, which includes any means of effecting change upon the nervous system (including electrical stimulation, but also other techniques such as optogenetics); and (4) closing the loop by recording the effects, and using control algorithms to monitor and revise actuation on the basis of its effects.

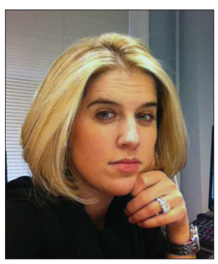
Phil Starr, the honored guest of the ASSFN meeting and a BRAIN and DARPA supported investigator, gave several presentations covering his team's (and other's) remarkable progress in developing closed loop technology for autonomous control of DBS for Parkinson's disease. Other presentations concerned closed loop control in epilepsy, addiction, depression, tremor and neuroprosthetic control. The second, interrelated theme is the use of both structural (e.g. diffusion tractography) and functional (e.g. resting state oscillations) connectivity to characterize the networks involved in both normal and pathophysiological states. This also cuts across most of the areas of functional neurosurgery, since circuits underlie all normal function. Like closed loop control, network analysis also is facilitated by the remarkable advances in computational analysis and data storage. Finally, data science *per se* is the third theme. This spans from advancements in ways to handle the incredible quantity of information coming from large channel count (10^6!) arrays recording at 20 or 30kHz, to the probabilistic analysis of the DBS implanting behavior of surgeons in thousands of cases to identify best targets, to the truly 'big' data from capturing the social media behavior of patients with/without depression. The ability to do big data science is again driven by technological advances in computer hardware and software.

The threads of a remarkable era of neurotechnology innovation, computer innovation, a robust funding environment, and a relatively less risk-averse venture milieu than in the past decade are coming together to propel the area of stereotactic and functional neurosurgery to the forefront of the field of neurosurgery, after arguably being a backwater for most of the 20th century. Increasing demand, with the aging of the populace as well as anticipated increases in the incidence of disorders such as Alzheimer's and Parkinson's disease, will continue to make stereotactic and functional neurosurgery a hotbed for at least the remainder of the 21st century.

INSIDE THE CNS

Washington Committee Report

Katie O. Orrico



Alison Dye

Making Progress in Washington

The Washington Committee continues to make progress in advancing organized neurosurgery's legislative and regulatory agenda. Recent activities are highlighted below.

Lawmakers Release "Dear Colleague" Letter to CMS Regarding Prior Authorization

On Aug. 9, Reps. Phil Roe, MD (R-Tenn., and Ami Bera, MD (D-Calif.), released a "Dear Colleague" letter urging their congressional colleagues to join them in sending a letter to Centers for Medicare & Medicaid Services (CMS) Administrator, Seema Verma, MPH, asking CMS to provide guidance to Medicare Advantage (MA) plans regarding the use of prior authorization (PA). The use of prior authorization by health plans has gotten out of control, and the Washington Committee has identified this as a priority topic. Finding a solution is complicated, however, since the individual states regulate most health plans. While the federal government has limited power to address prior authorization abuses in these plans, it does have the power to regulate Medicare Advantage (MA) plans. Since most health plans participate in MA, efforts by Medicare to rein-in these plans may have a spill-over effect in the state-regulated plan practices.

House Ways and Means Red Tape Relief Project Status Report

As a part of its effort to modernize and improve the Medicare program for American seniors and the providers that serve them, the House Ways and Means Committee launched the Medicare Red Tape Relief Project. This initiative seeks to identify opportunities to reduce legislative and regulatory burdens on Medicare providers, improving the efficiency and quality of the Medicare program for seniors and individuals with disabilities. Last summer, the AANS and CNS submitted multiple recommendations on topics including:

- Rescind Medicare Appropriate Use Criteria (AUC) for Imaging
- Prior Authorization reform in Medicare Advantage
- Suspend Medicare Global Surgery Data Collection
- Improve Medicare Quality Payment Program

The committee has continued working on this project throughout the past year, and organized neurosurgery has been part of the ongoing conversations. In this regard, representing the Alliance of Specialty Medicine, Katie O. Orrico, Esq., director of the Washington Office, participated in two roundtable discussion sessions with members of the committee, focusing primarily on prior authorization reform. Responding to our concerns, the committee plans to request that CMS "standardize reporting and billing authorization requirements." A link to the status report is available in the online issue of CNS Q.

House Passes Bill to Repeal the Medical Device Tax

On July 24, the U.S. House of Representatives passed H.R. 184, the Protect Medical Innovation Act. The bipartisan vote was 283-132, with 57 Democrats joining 226 Republicans to advance the measure. Attention now turns to the Senate. While temporarily suspended for two years from 2018-19, the Affordable Care Act's 2.3 percent medical device excise tax may adversely affect medical innovation and patient care. Because America has a long tradition of excellence and innovation in patient care, and because neurosurgeons have been on the cutting edge of these advancements, the CNS and AANS have advocated for the repeal of this tax. In the run-up to the vote, Washington Office staff worked with our industry partners and patient advocacy groups to encourage members of Congress to vote to repeal the tax. On July 23, we participated in a Twitter event using the hashtag #RepealDeviceTax to draw attention to the vote. At one point, this effort was the number 5th highest trending conversation on Twitter.

House Completes Action on Comprehensive Opioid Abuse Legislation

After months of development and deliberation, the U.S. House of Representatives completed its efforts to address the opioid epidemic by passing more than 60 bills. On June 22, the House passed H.R. 6, the Substance Use Disorder Prevention that Promotes Opioid Recovery and Treatment (SUPPORT) for Patients and Communities Act by a 396-14 vote. H.R. 6 is a comprehensive package that includes the majority of the bills previously passed by the House. The package contains policies impacting Medicare, Medicaid, public health and public safety programs that are intended to curb abuse, improve access to substance abuse treatment, and support law enforcement efforts. Other bills direct federal agencies to produce studies, reports and guidelines related to opioid use, abuse, and treatment among other matters. Attention now turns to the U.S. Senate, which has yet to act on opioid-related legislation.

CMS Releases Proposed 2019 Medicare Physician Fee Schedule Rule

On July 12, CMS released the 2019 Medicare Physician Fee Schedule proposed rule. Overall, CMS estimates that the proposed changes result in a net one percent increase in payments to neurosurgeons, due primarily to the impact of changes in malpractice relative value units. The biggest — and most controversial change — a sweeping new plan for evaluation and management (E/M) visit documentation requirements and a corresponding proposal to collapse payment for E/M visit levels 2 through 5 into a single blended payment amount, of $135 for new patient office visits and $93 for established patients. Fortunately, CMS did not recommend any changes in payments for 10- and 90-day global surgery services, however, in 2019, the agency will continue with its global surgery data collection initiative. This program requires neurosurgeons in Florida, Kentucky, Louisiana, Nevada, New Jersey, North Dakota, Ohio, Oregon, and Rhode Island are required to report post-operative visit information furnished during the global period for certain procedures using CPT code 99024. In the document, CMS proposes to continue to ramp-up requirements for the third year of the Merit-Based Incentive Program (MIPS), during which 2019 performance will determine whether clinicians are subject to up to a 7 percent cut in Medicare payments in 2020. At the same time, CMS proposes to maintain certain flexibilities, particularly for small practices. The online issue of CNS Q includes links to a detailed summary of the quality provisions and a CMS Quality Payment Program (QPP) fact sheet on the proposed rule.

CPT Corrects Significant Error for Reporting Decompression with Interbody Fusion

Following vigorous multi-specialty advocacy led by organized neurosurgery, in the May 2018 CPT Assistant publication, the American Medical Association (AMA) has corrected the erroneous October 2018 instruction regarding the use of the decompressive laminectomy CPT code 63047 at the same level as interbody fusion codes 22630 or 22633. The correction appropriately states that codes 22633 and 63047 may be reported for the same interspace when additional work is required to complete a decompression at the same spinal level. The CNS and AANS have always maintained that the CPT coding descriptions for these codes allow for reporting 63047 at the same level as 22633 or 22630 when work for decompression of neural elements is required in addition to the work required to perform the interbody fusion. The need for decompression for clinical scenarios such as neurogenic claudication alongside the need for interbody fusion, such as instability, must be accurately documented in the operative note.

The May 2018 CPT Assistant publication notes that a -59 modifier should be added to 63047 when used with the 22633 or 22630 for non-Medicare patients. Medicare continues to apply a separate National Correct Coding Initiative (NCCI) edit that prevents reporting of these codes at the same interspace. The NCCI edit is inconsistent with the precise definition and spirit of these codes and runs directly counter to the May 2018 CPT Assistant publication. The CNS and AANS continue to object to the NCCI edit and are actively working to have it rescinded.

AMA Releases Opioid Task Force Progress Report

In 2014, the American Medical Association (AMA) Opioid Task Force convened to coordinate efforts that were underway within organized medicine to help end the nation's opioid epidemic. Together, the Task Force identified six recommendations focused on the actions that physicians could take — and the Task Force was committed to measure progress on each recommendation. On Aug. 9, AMA released a status report title "AMA Opioid Task Force Helping Guide Physicians' Progress to End the Nation's Opioid Epidemic," which is aimed at showing what the Task Force organizations have accomplished. CNS executive committee member, Jennifer A. Sweet, MD, continues to represent organized neurosurgery on this task force.

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IMAGES IN NEUROSURGERY

Os odontoideum treated with posterior C1-2 fusion

A 58-year-old male was an unrestrained driver in a high-speed tractor accident who presented to our emergency room with upper extremity paresthesias and pain in the craniocervical region. On physical examination, he had normal strength in both upper and lower extremities, but he was hyperreflexic with a Hoffman's sign in both upper extremities. CT of the cervical spine demonstrated an abnormality called os odontoideum (**Figure 1, arrow, sagittal [A] and coronal [B]**). An os odontoideum is a craniovertebral abnormality in which a smooth, well-corticated odontoid process is separated from the C2 body by an obvious gap. MRI of the cervical spine demonstrated a spinal cord contusion on T2-weighted imaging (**Figure 2A, arrow**) and hyperintensity in the transverse ligament on short tau inversion recovery (STIR) imaging (**Figure 2B, arrow**), which is a sign of acute ligamentous injury. A dynamic x-ray of his neck (**Figure 3**) demonstrated atlantoaxial instability on flexion and extension. We performed a posterior C1-2 fusion using Harms technique followed by a C1 laminectomy (**Figure 4**). He wore a cervical collar postoperatively for six weeks. At last follow-up six months later, he had returned to work and reported complete resolution of neck pain and paresthesias.

Submitted by:
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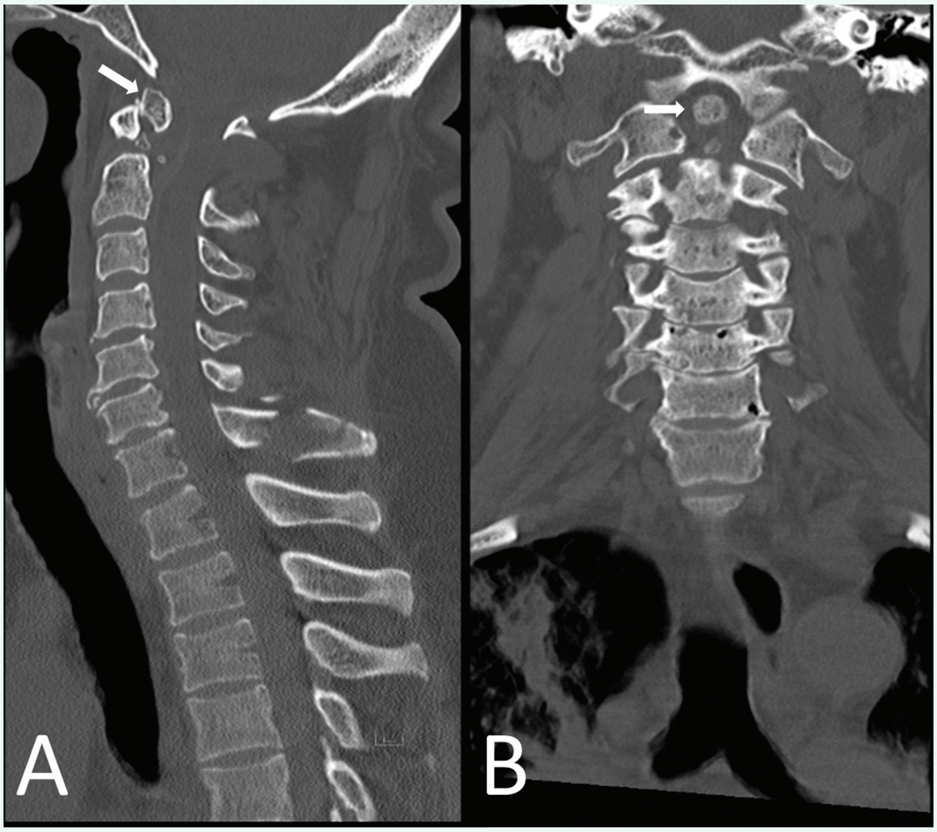

Figure 1

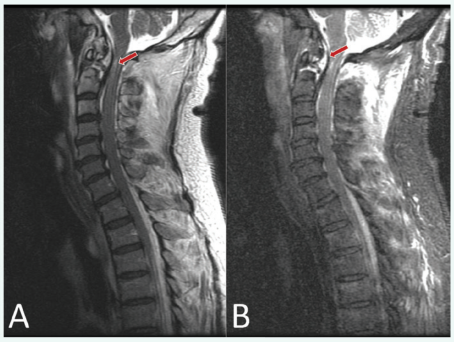

Figure 2

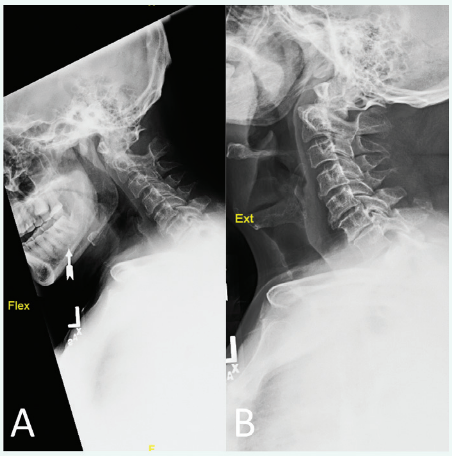

Figure 3

Figure 4

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