Human infants are born with a kyphotic curvature to their lumbar spines. The lordotic arch typically develops as they learn to stand and walk in the upright position. This development remains unique to human beings, distinguishing us from the great apes and facilitating our ability to walk erect on two feet.

As humans age, the discs shrink, degenerate, and collapse, causing the spine to straighten and lose the curvature that had previously kept us standing strong and tall. We begin looking more like our primitive ancestors: hunched over, with limited flexibility and motion. This phenomenon is termed “flat back” and can lead to an overall spinal imbalance.

As we consider the development of lumbar lordosis and its implications to our ability to stand and walk in an upright posture, it is not unexpected that this loss would lead to hindered ambulation with progressive pain and disability.

It is the spine surgeon’s obligation to recognize spinal imbalance and to recreate the arch to preserve a balanced spine and pelvis. Contemporary spine practices — such as the UPMC Comprehensive Spine Care Center — use patient-derived outcomes surveys that have revealed unequivocally that correction of spinal malalignment conveys a concomitant improvement in quality-of-life measures. Correspondingly, ignoring these principles of spinal biomechanics, or simply delaying their correction, can lead to advanced disease progression, disability, reliance on pain medications, and diminished prospects for future spine health and independence.

The ever-changing health care environment continues to precipitously cut costs and minimize expenses, with spine surgery at the top of the list. Health plans across the board oblige strict adherence to spine care algorithms that promote treatment plans relying increasingly on cost-saving methodologies in lieu of science and clinical data. This inevitable mandate by an overburdened health care system has secondarily obligated surgeons to spend more time on the phone obtaining insurance approvals than in the operating room addressing the pathology.

Maintaining a modern spine practice is a continuously evolving challenge, as are the advancements within the field and the accrual of data to support such change. The benefits of spinal realignment and the subsequent improvements in quality of life are widely recognized throughout contemporary spine practices; the onus is now upon us to work with patients and insurers to maximize spine health and minimize the morbidity associated with improper or delayed interventions.

The human spine has evolved to find the perfect balance between flexibility and stability, but this balance can be lost. The same can be said for our evolving health care system. It is our goal at UPMC to restore the equilibrium between spine and pelvis, to diminish incongruence between providers and insurers, and to do so in a judicious fashion that promotes spinal health and patient satisfaction alike.
Chairman’s Message

Tackling the Spine from All Angles

Human evolution from a horizontal quadrupled species to a vertical biped has required a number of important adaptations. In particular, this transition required the human spine to withstand different and greater vectors of stress. In addition, as human longevity has significantly increased over the past century, age-related impact on degenerative changes on the spine have increased. Therefore, back pain and spinal disorders have reached epidemic proportions.

Spinal structural disease can be thought of broadly in a few categories: pediatric issues, acute changes in the young or elderly spine, and chronic degenerative changes. Each one of these categories requires a different but often complementary diagnostic and therapeutic strategy. In the era of value-based health care, we must take a comprehensive approach to spine disease. Understanding the cost (financial, physical, and emotional) of the whole episode of care is critical in order to decide how to best approach the disease from a population standpoint and, just as importantly, how to personally tailor care.

Advances in the management of spinal disorders have been impressive over the past two decades. Many of them are described in this issue of Neurosurgery News. The first critical component is to better understand the natural history of the problem, in particular which individuals will likely get better with conservative management and which individuals will most likely require an intervention at some point. This is one of the most important decision points and one that requires the most judgment and experience. Practicing at the busiest academic neurosurgery department in the nation, our spine surgeons are extremely adept at making these critical decisions.

If the intervention is warranted, the goal must be to perform a surgical procedure taking into consideration all available options for the patient. The proliferation of new approaches — as well as instrumentation — has changed the landscape of spine surgery significantly. These new approaches provide physicians with a multitude of “weapons” to defeat the disease, improving short-term and, more importantly, long-term patient outcomes.

The Comprehensive Spine Care Center at UPMC is a leader in the development of novel therapeutic approaches for the comprehensive management of patients with spinal disorders. We have a wealth of experience, in a wide variety of approaches, for a full range of patients. Our experience is unmatched, and our commitment to excellence is demonstrated one patient at a time.

Robert M. Friedlander, MD, MA
Chairman and Walter E. Dandy Professor of Neurological Surgery

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Affiliated with the University of Pittsburgh School of Medicine, UPMC is ranked among the nation’s best hospitals by U.S. News & World Report.
Anterior cervical discectomy and fusion (ACDF) is a very common procedure performed by neurosurgeons. It has been the mainstay of surgical treatment for many types of conditions of the cervical spine. Such conditions include degenerative disc disease and cervical spondylotic myelopathy. The most common condition for which patients undergo an ACDF procedure is for a herniated disc of the cervical spine causing radiculopathy or arm pain. The disc herniates into the neural foramen, leading to pressure on the exiting nerve roots that supply sensation and motor control to the arms and hands. This pressure on the nerve roots and possibly on the spinal cord may cause symptoms of pain in the neck, shoulders, arms, and hands; weakness of the arms or legs; numbness and tingling in the upper extremities; and difficulty walking or imbalance.

Surgery to remove the disc herniation and alleviate a patient’s symptoms is performed when nonsurgical treatments are unsuccessful. The ACDF procedure with plate fusion for the treatment of cervical disc herniations has been demonstrated to be highly successful in alleviating preoperative symptoms and allowing patients to achieve a full recovery. The most common operation in the United States is for the disc to be removed through an incision in the front of the neck, and then an interbody implant is inserted in its place to maintain intervertebral disc height and encourage fusion across the vertebral bodies. In order to add immediate structural support to the surgical level, a titanium plate is placed over the implant and secured with screws. Many studies have shown that the anterior plate with screws provides enhanced stability and increased fusion rates, allowing patients to return to their normal activities more quickly and obviating the need for a cervical collar after surgery.

This past spring, the world’s first clinical use of the Optio-C™ Anterior Cervical System (Zimmer Spine) was performed by members of the UPMC Department of Neurological Surgery. The Optio-C system (Figure 1) is designed to provide the fusion and strength of a traditional ACDF, with the added benefit of being a modular, zero-profile device. “Zero-profile” means the Optio-C device is contained entirely within the disc space and does not protrude past the anterior wall of the vertebral body, unlike an anterior cervical plate. This positioning is important because, as opposed to a regular cervical plate, this device helps prevent irritation and contact with the adjacent soft tissues, esophagus, and vocal cords that lie just anterior to the cervical spine (Figure 2).

The Optio-C device has three main components: a polyether-ether-ketone (PEEK) interbody spacer, an anterior cervical plate cover, and three bone screws. The device is secured by a one-step, pre-assembled screw locking mechanism constructed to secure all screws simultaneously in order to prevent screw migration. According to the manufacturer, the Optio-C System promotes graft fusion by using a state-of-the-art
Spinopelvic Alignment Can Accurately Predict Future Surgical Needs Following Spinal Fusion

by Zachary J. Tempel, MD, David O. Okonkwo, MD, PhD, and Adam S. Kanter, MD

When a patient undergoes spinal fusion surgery, there is a 5 to 15% chance that the patient will need another surgery at an adjacent level to the original surgery within 10 years. This phenomenon is termed adjacent level disease (ALD), and is presumed secondary to accelerated degeneration of the disc cushion adjacent to a fusion construct. Since definitive treatment for ALD commonly involves additional surgical intervention, this increases patient morbidity and expands the economic burden on an overwrought health care system.

Although the pathophysiology of increased biomechanical stresses leading to ALD certainly makes sense, the question remains why some patients develop ALD and others do not. Despite the fact that many theories have been proposed and risk factors explored, there remains a paucity of data to help surgeons predict which patients are truly at risk for ALD development.

The UPMC Department of Neurological Surgery is closing this gap. Over the past five years, Adam S. Kanter, MD, and David O. Okonkwo, MD, PhD, have led a comprehensive effort at UPMC Presbyterian to catalog all patient demographics and clinical data relating to surgical intervention. This effort has led to the creation of a spinal database that has enabled them to qualitatively investigate the origin of ALD in a manner that employs quantitative scrutiny.

Contemporary spinal deformity treatment has focused on key radiographic parameters that, when corrected with surgery, have proved instrumental in achieving improved clinical outcomes. Dr. Kanter and Dr. Okonkwo theorized that similar principles would apply when treating relatively modest degenerative disc pathology at a single level, and that the loss or inability to maintain a suitable relationship between the spine and the pelvis (spinopelvic alignment) would lead to pathology progression at adjacent levels, necessitating additional surgery.

Simply put, the biomechanical principles that support erect posture and normal ambulation in humans rely upon apposite alignment of the head, shoulders, pelvis, knees, and feet. The relationship between the lumbar spine and the pelvis plays a critical role in influencing this configuration. When malalignment occurs — often due to degenerative aging, trauma, infection, malnourishment, osteoporosis, or other factors — patients can develop painful symptoms and difficulty with ambulation.

Two key components to spinopelvic alignment include the pelvic incidence (PI) and lumbar lordosis (LL) measurements. PI represents the spatial orientation of the pelvis and remains a fixed measurement in adults. LL represents the natural curvature of the lower spine and remains dependent upon the PI. Ideally, the PI and LL should be similar in magnitude and thus counteract one another. As pathology develops and disparity ensues between PI and LL, the mismatch allows one to overcome the other. This leads to abnormal spinopelvic balance accompanied by progressive symptoms of low back pain, leg pain, and weakness.

Dr. Kanter and Dr. Okonkwo queried the spinal database to evaluate whether spinopelvic malalignment increased the risk of symptomatic ALD following spinal fusion surgery. The data revealed that an LL-PI mismatch of greater than 12 degrees led to a dramatically increased risk of developing symptomatic ALD. Using these data, the doctors could predict with near 80% accuracy which patients would require future surgery to treat ALD, based upon their pre- and postoperative spinopelvic measurements.

These findings highlight the importance of assessing and accounting for spinopelvic parameters in the surgical planning of patients with degenerative disc problems. This should encourage innovation and treatment options that aim to reduce this mismatch when correcting even modest spinal pathology.

Case example of a 51-year-old woman who initially presented with back and leg pain refractory to conservative efforts. An MRI (A) revealed disc pathology with herniation and instability at L4/5. She ultimately underwent an L4/5 fusion surgery, and post-operative x-rays (B) revealed a persistent PI-LL mismatch of 14 degrees. She re-presented with recurrent back and leg pain 22 months later and was found to have adjacent level disc herniation (C) with migration and instability at L3/4. She underwent further surgery for decompression and fusion extension to L3. She had immediate pain relief. Final postoperative x-rays (D) revealed correction of her spinal alignment with a PI-LL of only 2 degrees. She remains pain-free four years after surgery.
Amanda Tocci has always been a fierce competitor. At age 22, she’s a fitness fanatic and has competed in numerous sports, including track, golf, and basketball. While starring for her high school basketball team in Hopewell, Pa., she set the school record for the most three-point field goals in a game.

In the fall of her senior year at Penn State University, a sudden dizzy spell triggered an unexpected visit to the hospital. Tocci didn’t realize at first that she was in for the battle of her life — one that may have changed her ultimate career path.

Tocci learned from doctors that her dizziness was caused by a cerebral aneurysm. “My heart basically stopped,” she recalls. “I said, ‘I’m 21 years old. I’m healthy. What do you mean I have a brain aneurysm?’”

Doctors immediately referred her to Daniel Wecht, MD, clinical professor of neurological surgery and an expert in brain aneurysm management.

“Amanda had a 12 to 15 millimeter right middle cerebral artery aneurysm,” Wecht says. “What made her situation unusual was, primarily, her young age. While not unheard of, brain aneurysms in a 22-year-old are quite rare. Also, her aneurysm was twice the ‘average’ size of 6 to 7 millimeters.” Wecht subsequently performed a craniotomy under microscope, successfully clipping the aneurysm.

Following surgery, Amanda’s family, friends, and professors recommended that she focus on her recovery and take time off from school. Instead, she was determined to follow her passion for physical fitness, and was resolved to graduate on time and pursue her dream career as a physical therapist.

“I remember waking up from surgery and asking when I would be able to run again,” Amanda recalls. “They looked at me like I had three heads.” Patients in similar situations typically require one month of recuperation and another month of rehab. Amanda would go on to cut that recovery period in half.

“I think her fitness, young age, and individual determination all served Amanda well in her recovery,” Wecht points out.

Brain Aneurysm Awareness 5K Walk/Run

On July 12, 2014, the first Pittsburgh-area Brain Aneurysm Awareness 5K Walk/Run was held. The event, co-sponsored by the National Brain Aneurysm Foundation and the Western Pennsylvania Brain Aneurysm and AVM Support Group (hosted by the UPMC Department of Neurological Surgery), attracted more than 350 participants and helped raise more than $25,000 for the Foundation.

The event was held to help provide awareness and public education about the disorder, as well as support for the local people affected directly and indirectly by brain aneurysms.

“It was humbling and encouraging to hear stories from patients and their families,” says Emily Guerriero, PA-C, Department of Neurological Surgery, who organized the event and coordinates the support group.

“Some shared their losses while others shared their stories of surviving a ruptured aneurysm,” Guerriero says. “The overall sense of community, and the determination among the participants to bring the importance of aneurysm detection to the forefront in Pittsburgh, were overwhelming.”

State Senator John H. Eichelberger Jr. (R-Blair) presented Guerriero and Robert Friedlander, MD, chairman of the

(Continued on Page 8)
Neurosurgery Spine Fellowship Attracts Top Applicants

The University of Pittsburgh Neurosurgery Spine Fellowship, directed by Adam S. Kanter, MD, and now in its third year, has already gained national recognition and is attracting applicants from across the globe.

The spine fellowship began in July 2012, following a mentorship tradition that permeates the neurosurgical subspecialties. Fellows are paired with faculty spine specialists for three-month intervals throughout the one-year program. During each rotation, fellows are exposed to distinctively focused treatment paradigms for an array of spinal conditions.

Fellows spend time with several experienced members of the spinal neurosurgery faculty, receiving a well-rounded and thorough training. Dr. Kanter teaches the intricacies of minimally invasive techniques designed to mitigate the morbidity associated with traditional surgical approaches. Fellows learn from David O. Okonkwo, MD, PhD, how to methodically evaluate patients with complex spinal deformity, and when and how to perform interventions that maximize surgical correction and minimize rehabilitative restraints. Rotating with Peter Gerszten, MD, affords fellows the opportunity to implement spinal radiosurgery techniques that have revolutionized spinal tumor control and pain relief, as well as percutaneous cement augmentation and dynamic stabilization techniques. Nduka Amankulor, MD, demonstrates state-of-the-art surgical approaches in the treatment of spinal tumors at UPMC’s Hillman Cancer Center. Kojo Hamilton, MD, edifies fellows about the contemporary treatment of spinal trauma utilizing evidence-based practice and techniques at UPMC’s trauma centers. John J. Moossy, MD, provides essential training on the application of neuromodulation and functional remedies when anatomic and mechanical interventions cannot suffice.

The spine fellowship is honored to be accredited by the Committee on Advanced Subspecialty Training with oversight from the Society of Neurological Surgeons (SNS), the oldest neurosurgical society in the world. Past fellows have performed in exemplary fashion, having been awarded grant and research honors during their time in Pittsburgh by the Spine Section of the AANS and CNS totaling $60,000 in clinical research funding. Their research has also been presented at national conferences and neurosurgical meetings.

It is with great pride and pleasure that the University of Pittsburgh spine faculty continues to enrich the minds of budding neurosurgical colleagues, and to impart the wisdom of experience and the teachings of their mentors, one fellow at a time.

Zero-Profile ACDF System (Continued from Page 3)

load-sharing interface. The variable angle screw option is designed to prevent stress shielding. Included in this device is a large graft surface and three footprints to accommodate different patient anatomy. The cortico-cancellous thread design enhances bone purchase. The modular plate strength is equivalent to a traditional cervical plate.

We are now using the Optio-C zero-profile device for all patients who require an anterior cervical discectomy and fusion procedure instead of placing a traditional cervical plate.

By eliminating the need for a cervical plate, a smaller incision can be used, allowing for less manipulation of the airway, vocal cords, esophagus, and vascular structures. This more minimally invasive approach allows for a decrease in the risk of complications and may shorten the length of hospital stay. A prospective clinical investigation at our center of patients who have undergone ACDF with these new zero-profile devices instead of plate fixation is currently under way.
News & Notes

Study Shows How Huntington’s Disease Protein Could Cause Death of Neurons

Scientists at the University of Pittsburgh School of Medicine have identified a key molecular mechanism by which the abnormal protein found in Huntington’s disease can cause brain cell death. The results of these studies, published in the May 18 issue of Nature Neuroscience, could one day lead to ways to prevent the condition’s progressive neurological deterioration.

Huntington’s disease patients inherit a gene that contains too many repeats of a certain DNA sequence, which results in the production of an abnormal form of a protein called huntingtin (HTT), explains senior investigator Robert Friedlander, MD. But until now, studies have not suggested how HTT could cause disease.

“This study connects the dots for the first time and shows how huntingtin can cause problems for the mitochondria that lead to the death of neurons,” Dr. Friedlander says. “If we can disrupt the pathway, we may be able to identify new treatments for this devastating disease.”

Department Honors Graduating Residents

A special black-tie graduation reception and dinner on Saturday, June 14 honored 2014 chief neurosurgical residents Christopher Bonfield, MD, and Ramesh Grandhi, MD. Dr. Bonfield has joined the University of British Columbia Children’s Hospital in Vancouver as a pediatric neurosurgery fellow, and Dr. Grandhi has accepted a cerebrovascular fellowship with Lyerly Neurosurgery of the Baptist Health System in Jacksonville, Fla.

Annual teaching awards were also announced, with Dr. Grandhi selected as best resident teacher by the staff, and Paul A. Gardner, MD, receiving the best faculty teaching award as selected by the residents.

Special Lectures and Appearances

L. Dade Lunsford, MD, served as the Shelley Chou Visiting Professor and Lecturer at the University of Minnesota from May 2 to 3.

Joseph Maroon, MD, was a visiting professor at the University of Rochester, from June 5 to 6.

Paul Gardner, MD, was co-director of the “Endoscopic Endonasal Surgery of the Cranial Base and Pituitary Fossa” course at the Taipei Veterans General Hospital in Taipei, Taiwan, from August 5 to 7.

Partha Thirumala, MD, was a visiting professor at Madras Medical College in Chennai, India, on June 20, and at Meenakshi Mission Hospital in Madurai, India, on July 2.

Ian Pollack, MD, was the Marion Walker Lecturer at the University of Utah’s Primary Children’s Hospital on April 24; the Van Wagener Lecturer at the American Association of Neurological Surgeons Annual Meeting on April 9; and the keynote speaker in the Marne Rose Brain Tumor Symposium at the MD Anderson Cancer Center in Houston, Texas, from February 28 to March 1.

Congratulations

Department chairman Robert M. Friedlander, MD, was an honored guest of Serbia’s Crown Prince Alexander, Crown Princess Katherine, and U.S. Ambassador to Serbia Michael D. Kirby on April 29, in Belgrade, Serbia, as a tribute to his work in developing collaborative medical partnerships with the eastern European country.

Georgios Zenonos, MD, PGY-4 resident, received the 2014 Robert J. Dempsey, MD, Cerebrovascular Research Award from the AANS/CNS Section on Cerebrovascular Surgery.

Andrew Ducruet, MD, was a recipient of the NINDS Neurosurgeon Research Career Development Award for 2014-16.

Researcher Don Krieger, PhD, was selected to the Open Science Grid governing council, a consortium of more than 150 laboratories and more than 250,000 computers managed by a group at Fermi National Laboratory in Batavia, Ill.

In the News

Robert Friedlander, MD, and Daniel Wecht, MD, were featured in a July 7 Pittsburgh Post-Gazette article that highlighted the recovery of two brain aneurysm patients. Dr. Friedlander was also quoted in a July 24 New York Times Magazine article discussing a new padded baseball cap for pitchers, the Isoblox, designed to prevent head injuries from line drives. In addition, Dr. Friedlander was interviewed on the August 13 KDKA Radio Morning News Show regarding brain aneurysms’ risk factors, screenings, causes, and treatment options.

Joseph Maroon, MD, was spotlighted in a July 16 Cleveland.com article that detailed 14 people from Cleveland and Pittsburgh who have advanced football-related brain issues.

R. Mark Richardson, MD, PhD, was a guest on the KDKA Radio Morning News Show on April 30, talking about Deep Brain Stimulation and its use in the treatment of symptoms of Parkinson’s disease and other movement disorders. He also was featured in an August 11 Pittsburgh Post-Gazette article about deep brain stimulation for patients suffering from severe obsessive-compulsive disorder.

Don Krieger, PhD, was featured in a June 24 Symmetry Magazine article that discussed the Open Science Grid, a global network of scientists, researchers, and experts in high-throughput computing.
Brain Aneurysm (Continued from Page 5)

Amanda went on to take online classes and finish her studies, graduating with her classmates in the spring of 2014 with a 4.0 GPA. “It’s incredibly impressive that she was able to graduate on time,” Wecht says. “There are many who get well physically in a decent time frame, but it is highly unusual to function intellectually and cognitively so quickly after brain surgery at that level — senior year of college — and do what is necessary to graduate.”

In January 2015, Amanda will attend Elon University in North Carolina to study physical therapy. However, her personal battle with a brain aneurysm has given her pause to also consider a career in neuroscience.

“I’ve always wanted to be a physical therapist because I’m interested in sports and fitness and helping people,” Amanda explains. “But this experience has definitely opened my eyes from a neurological perspective. I want to focus on neuro-rehab now… even brain injury.”

Amanda remembers her own experience in the hospital of having the nurses and physical therapists wake her and help her move around. “I didn’t want to,” she recalls laughing. “I was tired. I had a headache. I didn’t want to get up. Now I see that I would love to be someone like that, to help people in similar situations. It’s kind of changed my outlook on my profession.”

Brain Aneurysm Awareness 5K Walk/Run (Continued from Page 5)

Department of Neurological Surgery, with an official Pennsylvania resolution marking July 12 as Brain Aneurysm Awareness Day in Pittsburgh. The proclamation also named July 6 through 13 as Brain Aneurysm Awareness Week. In addition, Pittsburgh City Councilman Corey O’Connor gave an official welcome on behalf of the city.

The aneurysm and AVM support group at UPMC is open to all patients, family members, and support persons, regardless of hospital affiliation. The final support group meeting of the year will take place on Nov. 19. The meeting will start at 6:30 p.m. in the Department of Neurological Surgery’s main conference room on the fourth floor of UPMC Presbyterian. Light refreshments will be served and discounted parking will be available. For more information, contact Emily Guerriero at 412-864-2294 or guerrieroer@upmc.edu.

Pre- and post-op CT angiogram images show the aneurysm at the middle cerebral artery bifurcation before clipping (left), and the same view after a clip has been applied (right), obliterating the aneurysm but preserving flow in the middle cerebral artery and its branches.

“I am inspired by Amanda’s desire to utilize her experience and hard-earned knowledge toward a career in neuro-rehabilitation,” Wecht says. “For Amanda, the surgery was clearly just a bump in the road that she quickly overcame. In fact, she not only recovered quickly, but she has used her experience to fuel her drive toward her career goals.”

Considering Amanda’s fiercely competitive nature, those goals are well within her grasp.

Free Online CME
We provide numerous free courses for CME credit on our website: UPMCPhysicianResources.com/Neurosurgery.