University of Pittsburgh
NEUROSURGERY NEWS
Spring 2015, Volume 16, Number 2

Cervical Spine Alignment: Neck and Back Pain

by D. Kojo Hamilton, MD

The maintenance of the level of horizontal gaze, as well as localizing the head over the shoulders and body, represents the main alignment function of the cervical spine. Any deviations from the center of mass of the head, primarily in the sagittal plane, results in an increase in cantilever loads and an exponential increase in work required by muscles to support the head. The optimal curvature for minimizing muscular energy expenditure is continued preservation of lordosis in the cervical spine.

Loss of the ability of the cervical spine to maintain its lordotic alignment may be caused by advanced degenerative disc and facet disease; congenital disorders; trauma; iatrogenic consequences; and neoplasms. The lateral radiographic image seen in Figure 1 shows the effect of loss of cervical lordosis over time, following surgery to alleviate disabling myeloradiculopathy from degenerative disc disease. The patient in this figure lost the ability to maintain cervical lordosis, following anterior cervical discectomy and fusion surgery. This is due to progression of disease, and concomitant failure of the implants. He presented with severe pain in the neck, shoulder, and C8 radiculopathy. Notably, he also had progressively severe back pain in the thoracic and lumbar spine over the course of the day while working. The patient's lower spine discomfort was alleviated with sitting and ceased while supine. He had no leg symptoms.

Figure 2 shows a lateral postoperative radiographic image following surgical correction of cervical alignment. Patient had complete resolution of his cervical and lower spine symptoms, reporting no thoracic or lumbar spine pain. Current studies in spinal alignment and dynamics[1,2] indicate that all sections of the spine are more interconnected, in terms of curvature, than previously known. As such, lumber lordotic curve correlates with thoracic kyphosis, and thoracic kyphosis correlates with cervical lordosis. Thus, a loss of cervical lordosis causes significant alterations in thoracic and lumbar curves, with associated pain and discomfort in the mid and lower back as the patient tries to compensate.

Figure 1. Preoperative scan. Progression of disease and failure of earlier surgical implants resulted in severe pain.

Figure 2. Postoperative scan. Surgical correction of cervical alignment resolved patient's back and neck pain.

The above concept regarding spinal alignment is further tangled by the fact that the degenerative process occurring in the cervical spine may also be present in the lumbar spine, and the clinical diagnosis may be obfuscated by the lack of understanding of the contribution of global spine alignment to the continued degenerative process.

(Continued on Page 8)

Affiliated with the University of Pittsburgh School of Medicine, UPMC is ranked among the nation's best hospitals by *U.S. News & World Report*.

UPMC LIFE CHANGING MEDICINE

Chairman's Message

The Making of an Academic Neurosurgical Leader

Over the years, I have put quite a bit of thought into what leads a person to become a transformative neurosurgical academic leader. Clearly it begins with top-quality students. The application process has become increasingly competitive. Applicants reach us with stellar records, already possessing a deep publication record, from basic science to clinical work. We are selecting elite residents, and this is the beginning of the climb to the pinnacle. But how does the training process maximize opportunities so trainees will realize their potential?

We have structured our residency program to provide the very best resources and individually tailored training. I always ask our residents (and our faculty), how are you going to change neurosurgery? This must be the guiding principle for all residents aspiring to make an impact. There are several components needed to achieve leadership capabilities.

Clinical training: Residents need to be exposed to a varied and large case load, to learn how to quickly and efficiently evaluate a patient's condition and decide on the best course of action. As the largest clinical department in the nation — and one of the largest referral centers — our residents see a large number of patients and also observe a wide variety of procedures, including the rare and extremely complex. If surgery is recommended, our residents are afforded fantastic clinical opportunities to experience almost every facet of neurosurgical work.

Research: Scientific pursuit is the tool that implements change. Research must be tailored to the interests and training of each resident, whether through basic science or clinical research, and most of our residents participate from their very first year. Internal funding through The Copeland Fund supports pilot projects up to $200,000 per year, so researchers can develop ideas not yet ready for external funding. The Copeland Fund has allowed many of our residents and faculty to develop preliminary data before pursuing larger projects. This extensive research involvement leads to a substantial research portfolio, positioning our residents for a productive academic career.

Mentor/role model: This is the most critical component to ensure future success. In our department, we pride ourselves on the diverse nature of our academic role models, from basic scientists, to clinical trialists, to leaders in technological development. In addition, our innovative and highly subspecialized neurosurgeons provide clinical leadership and mentorship.

As chair of the Department of Neurological Surgery, I pride myself on our ability to provide our residents with the resources and opportunities necessary to maximize their potential, helping them become highly accomplished — and transformative — academic neurosurgical leaders.

It is our desire, and indeed our mission, to provide the best possible environment to reach this critical goal. The future of neurosurgery depends on the training of the next generation.

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

Faculty

Chairman
Robert M. Friedlander, MD, MA

Professors
C. Edward Dixon, PhD
Peter C. Gerszten, MD, MPH
L. Dade Lunsford, MD
John J. Moossy, MD
David O. Okonkwo, MD, PhD
Ian F. Pollack, MD
Mingui Sun, PhD

Associate Professors
Jeffrey Balzer, PhD
Johnathan Engh, MD
Juan C. Fernandez-Miranda, MD
Paul A. Gardner, MD
D. Kojo Hamilton, MD
Adam S. Kanter, MD
Ajay Niranjan, MD, MBA
Raymond F. Sekula Jr., MD, MBA
Parthasarathy D. Thirumala, MD
Elizabeth C. Tyler-Kabara, MD, PhD

Assistant Professors
Nduka Amankulor, MD
David J. Bissonette, PA-C, MBA
(Executive Administrator)
Diane L. Carlisle, PhD
Donald J. Crammond, PhD
Andrew F. Ducruet, MD
Avniel Ghuman, PhD
Paola Grandi, PhD
Stephanie Greene, MD
Miguel Habeych, MD, MPH
Brian Jankowitz, MD
Edward A. Monaco III, MD, PhD
Jamie Pardini, PhD
Ava Puccio, PhD, RN
R. Mark Richardson, MD, PhD
Mandeep Tamber, MD, PhD

Clinical Professors
Adnan A. Abla, MD
Matt El-Kadi, MD, PhD
Joseph C. Maroon, MD
Daniel A. Wecht, MD, MSc

Clinical Associate Professors
Michael J. Rutigliano, MD, MBA
David S. Zorub, MD

Clinical Assistant Professors
J. Brad Bellotte, MD
Daniel M. Bursick, MD
David L. Kaufmann, MD
Vincent J. Miele, MD
Monte B. Weinberger, MD

Research Associate Professor
Hideyuki Kano, MD, PhD

Research Assistant Professors
Yue-Fang Chang, PhD
Wendy Fellows-Mayle, PhD
Esther Jane, PhD
Wenyan Jia, PhD
Daniel Premkumar, PhD
Hong Qu Yan, MD, PhD

Clinical Instructors
Jeff Bost, PA-C
Erin Paschel, PA-C

Chief Residents
Kimberly A. Foster, MD
Phillip Vaughan Parry, MD
Paul S. Richard, MD

Contact Us

Brain Function & Behavior
412-647-7744

Brain Tumors
412-647-2827

Carotid Disease
412-647-2827

Cerebrovascular
412-647-2827

Clinical Neurophysiology
412-647-3450

Cranial Nerve Disorders
412-647-3920

Donations
412-647-7781

Endonasal Surgery
412-647-6778

Endovascular
412-647-7768

Gamma Knife®
412-647-7744

MEG Brain Mapping Center
412-648-6425

Movement Disorders
412-647-7744

Neurosurgical Oncology
412-647-8312

Pediatric Neurosurgery
412-692-5090

Referrals
412-647-3685

Residency Program
412-647-6777

Spine
412-802-8199

Spine Radiosurgery
412-647-9786

UPMC Mercy Neurosurgery
412-471-4772

Department of Neurological Surgery
UPMC Presbyterian
Suite B-400
200 Lothrop St.
Pittsburgh, PA 15213

Editor: Peter C. Gerszten, MD, MPH

Website: neurosurgery.pitt.edu

Email: neuroinfo@upmc.edu

Hard Search for Less Invasive Brain Surgery Leads to Eyelid

[Reprinted with Permission of the Associated Press]

Doctor after doctor said removing the tumor causing Pamela Shavaun Scott's unrelenting headaches would require cutting open the top of her skull and pushing aside her brain. Then one offered a startling shortcut — operating through her eyelid.

The idea: Make a small incision right in the crease and sneak past the eyeball into the hard-to-reach center of the head.

"The nice thing about it is, we have to saw off much less of your head," is how Dr. S. Tonya Stefko of the University of Pittsburgh Medical Center explains it.

Less invasive brain surgery isn't common but surgeons are working out different ways to get to tumors, aneurysms and other problems without as much trauma in hopes that patients recover faster. But Scott's experience shows how difficult it can be for patients to learn about alternative options like the eyelid approach — performed by a small number of highly specialized surgical teams — or even to know what to ask.

Scott knew that major medical centers often offer second-opinion consultations for long-distance patients, and started hunting — aided when her husband used a 3D printer to create a life-size model of her skull with her tumor, a meningioma growing behind her left eye, for surgeons to examine.

"The sad thing is that people don't know there are other options than what their small-town doctor is telling them," said Scott, 56, who traveled from her home in Morro Bay, California, to Pittsburgh for the surgery. "I feel like a walking miracle."

Reaching that spot above and behind the eyes, the underside of the brain, is a challenge. Traditional surgery means a large opening in the skull to give doctors plenty of room to maneuver. But they must move painstakingly past sections of healthy brain, and Scott was warned that because her tumor was in such a tough location, vision or even cognitive damage was a risk of that top-down surgery.

Sometimes, surgeons can snake their tools through the nasal passages instead, a straighter shot through a natural opening.

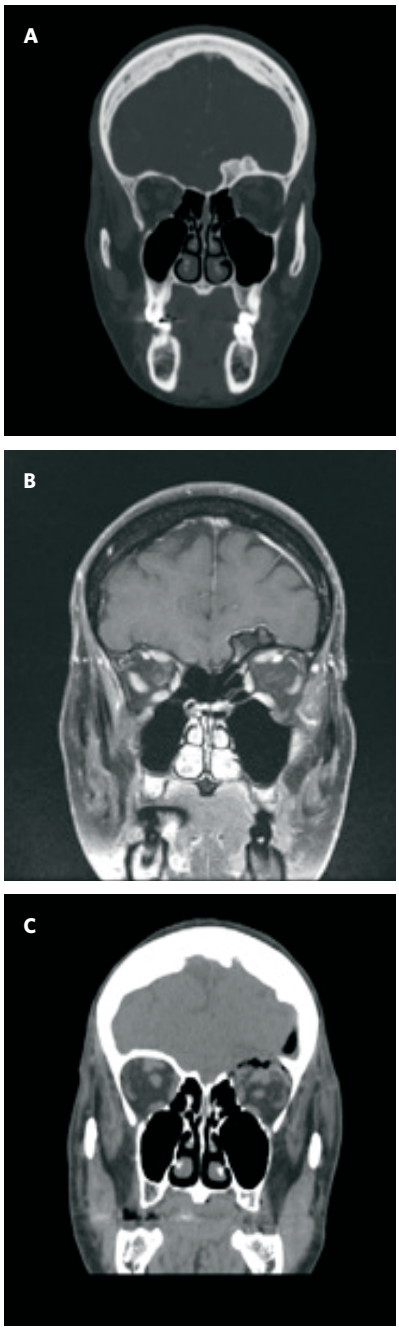


Figure 1. (A) Preoperative coronal CT shows the tumor growing in the bone of the roof of the orbit. (B) Preoperative coronal MRI with contrast shows the tumor (dark) with surrounding dural involvement, typical for a meningioma. (C) Postoperative coronal CT shows complete removal of the bony tumor and surrounding involved dura.

Now the eye is offering some paths into this difficult region, too.

Think of the eye socket like an ice cream cone, with the tip pointing back toward the brain's center, said Dr. Paul Gardner, director of UPMC's Center for Skull Base Surgery. Entering through the eyelid crease, surgeons can follow that cone to just the right spot to access the brain — removing a bit of bone about the size of two postage stamps from the inside.

Entering the socket at a different angle, doctors also can make a cut in the crow's feet at the corner of the eye. Or they can hide an incision in the eyebrow, making a small hole in the skull just above the eye.

Dr. Robert Harbaugh, president of the American Association of Neurological Surgeons, cautioned that transorbital approaches haven't been formally studied to compare ultimate outcomes, including safety, to traditional open surgery.

"This is worth exploring," he said. But, "because it's new doesn't mean it's necessarily better."

The surgery is only for carefully selected patients, stressed Dr. Alfredo Quinones-Hinojosa, a Johns Hopkins University neurosurgeon who co-authored one of the first medical journal reports on the eyelid method a few years ago.

Tumors can't be too big. No important nerves can be in the way; he also turns away people with large sinuses, to be sure there's room to get by. He calls infection the main risk.

And it can only be done by a specialized team with experience in both the eye and the brain, added Gardner, who will present some of Pittsburgh's cases at a medical meeting next month. Stefko, UPMC's director of orbital and oculoplastic surgery,

(Continued on Page 7)

2015 AANS Annual Meeting Presentations

The UPMC Department of Neurological Surgery will be involved in a number of practical clinics, seminars, and other events at the American Association of Neurological Surgeons Annual Meeting, May 2-6, in Washington, D.C. For dates and times of the events, please visit neurosurgery.pitt.edu or aans.org.

Practical Clinics

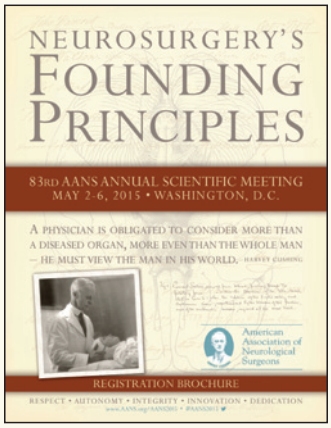
Introduction to Cerebrovascular Neurosurgery for Residents. Co-Directors: Mocco J, Veznedaroglu E. Faculty: Arthur AS, Bendok BR, Binning MJ, Cockroft KM, **Ducruet AF,** Howington JU, Khalessi AA, Levy EI, Mack WJ, Ogilvy CS, Riina HA, Turner IV RD, Woo HW.

Current Treatments and Controversies in Traumatic Brain Injury. Co-Directors: **Okonkwo DO**, Timmons SD. Faculty: Bullock MR, Gibbons KJ, Hawryluk GWJ, Jallo JI, Kitagawa R, Medow JE, Pilitsis JG, Slotkin JR, Stippler M, Zacko JC.

Nuts and Bolts of Posterior Fossa Surgery: How I Do It. Co-Directors: Couldwell WT, Nanda A. Faculty: **Fernandez-Miranda JC**, Link MJ, Michael LM II, Misra BK, Prevedello DM, Seifert V.

3D Anatomy and Approaches to the Supratentorial Area and Anterior Skull Base. Co-Directors: da Luz de Oliveira EP, Sorenson JM; **Fernandez-Miranda JC**. Faculty: Gardner PK, Knuckey N, Lee KS.

Advanced MIS: Lateral Transpsoas Reconstruction. Co-Directors: **Kanter AS**, Uribe JS. Faculty: Khoo LT, O'Toole JE, Pimenta L, Taylor WR.



Neurosurgeon Team Physician. Co-Directors: Rosseau GL, Sills AK. Faculty: Allen J, Bernhardt DT, Curl LA, Guskiewicz K, Hughan B, Johnston KM, Kaplen M, Kaye AH, Manley GT, **Maroon JC**, Putukian M, Samson DS, Spinner RJ, Solomon G, Theodore N.

Update on Spinal Radiosurgery. Co-Directors: **Gerszten PC**, Bilsky, MH. Faculty: Angelov L, Chang SD, Sheehan JP, Weaver JA, Yao KC.

Applications of Video and 3D Technology in Neurosurgery. Co-Directors: Grande AW, Sorenson JM. Faculty: **Fernandez-Miranda JC**, Hines T, Liu JK, Tew JM.

How to Tackle Difficult Cranial Cases: A Step-by-Step 3D Case-Based Presentation. Co-Directors: Cohen-Gadol AA, **Fernandez-Miranda JC**. Faculty: Lawton MT, Thompson Jr. BG, van Loveren HR.

State-of-the-Art: Cranial Endoscopy. Co-Directors: Cohen AR, Souweidane MM. Faculty: **Engh JA**, Gaab MR, Grotenhuis JA, Guillaume DJ, Heilman CB, Herrada-Pineda, Jeelani Y, Lin N, Rehder R, Schroeder HWS.

Neurotrauma Critical Care Review and Update for the Practicing Neurosurgeon. Co-Directors: Raksin PB, Villanueva PA. Faculty: Ball PA, Bullock MR, Coplin WM, Gibbons KJ, Hutchinson PJ, Medow JE, **Okonkwo DO**, Rubiano AM, Servadei F, Taylor SL, Unterberg AW, Valadka AB.

3D Anatomy and Approaches to the Posterior Fossa and Posterior Skull Base. Co-Directors: da Luz de Oliveira EP, **Fernandez-Miranda JC**, Sorenson JM.

Presentations

Outcomes After Stereotactic Radiosurgery for Residual or Recurrent Vestibular Schwannomas. AANS/CNS 11th Biennial Satellite Tumor Symposium. **Huang MJ, Kano H**, Mousavi H, **Niranjan A, Monaco E**, Arai Y, **Flickinger J, Lunsford LD.**

Pre- and Postoperative Skin Preparation Using Chlorhexidine-Alcohol in Patients Undergoing Lumbar Instrumented Fusion: Results of a Novel Antisepsis Protocol. Advanced Practice Providers Plenary Session 2. **Paschel EE**, Grandhi R, **Gerszten PC, Kanter AS, Okonkwo DO**, Fang YL.

A Prospective, Multi-center Clinical and Radiographic Outcomes Evaluation of ChronOS Strip for Lumbar Spine Fusion. Young Neurosurgeons Research Forum. **Kanter AS, Gandhoke GS**, Welch WC, Arnold PM, Cheng JS, **Okonkwo DO**.

Venous Thrombo-embolism Prophylaxis in Neurosurgical Procedures — Experience from the UPMC Presbyterian Hospital. Young Neurosurgeons Research Forum. **Zenonos GA**, Walch FJ, Roach E, Stokes S, **Friedlander RM, Gerszten PC**.

The Influence of Spinopelvic Alignment on Development of Symptomatic Adjacent Level Disease Following Single Level Lumbar Fusion. AANS/CNS Section on Disorders of the Spine and Peripheral Nerves. **Tempel ZJ**, Bolinger BD, **Gandhoke GS, Parry PV**, Khattar N, **Okonkwo DO, Kanter AS.**

When Trigeminal Neuralgia Is Associated with Skull Base Meningiomas. AANS/CNS Section on Pain. **Kano H**, Mousavi S, **Niranjan A, Monaco E**, Arai Y, **Flickinger J, Lunsford LD.**

Evolution of T2 Hyperintensity on MRI Following Spinal Cord Injury in Professional Athletes. AANS/CNS Section on Neurotrauma and Critical Care. **Maroon JC, Tempel ZJ, Bost J.**

Cost-effectiveness Comparison Between Transforaminal and Lateral Lumbar Interbody Fusions Using the Incremental Cost-Effectiveness Ratio. AANS/CSNS Socioeconomic Section. **Gandhoke GS, Kanter AS, Okonkwo DO, Gerszten PC.**

Seminars

Lumbar Interbody Fusion: Direct Lateral Retroperitoneal Transpsoas Fusion. Moderator: **Kanter AS**. Panelists: Liu JC, O'Toole JE, Prusmack CJ, Uribe JS.

Operative Nuances I: Tackling Challenging Cases 3D Video Presentation. Moderator: Cohen-Gadol AA. Panelists: Boop FA. Couldwell WT, Dumont AS, **Fernandez-Miranda JC**, Spetzler RF.

Radiosurgery and Separation Surgery for Spinal Metastases. **Gerszten PC**.

(Continued on Page 6)

Select AANS Meeting Abstracts

Cost-Effectiveness Comparison Between Transforaminal and Lateral Lumbar Interbody Fusions Using the Incremental Cost-Effectiveness Ratio

Gandhoke GS, Kanter AS, Okonkwo DO, Gerszten PC

Introduction: Both transforaminal lumbar interbody fusion (TLIF) and lateral lumbar interbody fusion (LLIF) are effective surgical interventions for appropriately selected patients with degenerative lumbar spondylosis. This study sought to compare health care costs associated with these procedures by calculating the incremental cost-effectiveness ratio (ICER) and, thereby, the difference in the total cost per quality adjusted life year (QALY) gained for TLIF versus LLIF for the treatment of degenerative spondylosis. We further calculated the thresholds for Minimum Clinically Important Difference and Minimum Cost Effective Difference for patient-reported outcome measures at two-year followup.

Methods: Forty-five patients who underwent single level TLIF and 29 patients who underwent single level stand-alone LLIF for degenerative spondylosis with low back and leg pain were included. All costs from diagnosis through two-year postsurgical follow up were available from a comprehensive single center data bank within a unified hospital system. Total cost to the third-party payor for all spine-related medical resource use from the time of diagnosis through two years was recorded. QALYs were calculated from EQ5D collected in an unbiased manner by a non-clinical staff member. Difference in total cost per QALY gained for LLIF minus that for TLIF was assessed as the incremental cost-effectiveness ratio ICER: (Cost LLIF- Cost TLIF)/(QALY LLIF- QALY TLIF).

Results: Significant improvements were observed at two-year follow up for both TLIF and LLIF utilizing SF36PCS, ODI, VAS BP, VAS LP and EQ5D. ICER calculations revealed similar mean cumulative QALYs gained at the two-year interval (0.67 for TLIF and 0.60 for LLIF; p=0.331). Median total cost of care following TLIF and LLIF were $44,068 and $45,574, respectively; (p=0.960). MCED thresholds with an anchor of <$50,000/QALY were higher than MCID thresholds (calculated using the Health Transition Index anchor) for all patient-reported outcome measures. Total mean cost and EQ5D were statistically equivalent between the two treatment groups.

Conclusions: Transforaminal lumbar interbody fusion (TLIF) and lateral lumbar interbody fusion (LLIF) produced equivalent two-year patient outcomes at an equivalent cost effectiveness profile.

• • •

The Influence of Spinopelvic Alignment on Development of Symptomatic Adjacent Level Disease Following Single Level Lumbar Fusion

Tempel ZJ, Bolinger BD, Gandhoke GS, Parry PV, Khattar N, Okonkwo DO, Kanter AS

Introduction: The annual incidence rate for the development of symptomatic adjacent level disease (ALD) following lumbar fusion surgery ranges from 0.6 to 3.9%. It has been suggested that sagittal malalignment may contribute to the development of ALD. In this report, we describe the relationship between spinopelvic parameters and the development of symptomatic ALD requiring revision surgery following single-level transforaminal lumbar interbody fusion (TLIF) for degenerative lumbar spondylosis and/or low-grade spondylolisthesis.

Methods: All patients who underwent a single-level LIF at either L4/5 or L5/S1 at our institution for degenerative lumbar spondylosis and/or low-grade spondylolisthesis between July 2006 and December 2012 were analyzed for pre- and postoperative spinopelvic parameters: pelvic tilt (PT), sacral slope (SS), pelvic index (PI), lumbar lordosis (LL), and pelvic incidence-lumbar lordosis mismatch (PI-LL). Using univariate and multivariate logistic regression analysis, we compared the spinopelvic parameters of those patients who required revision surgery against those patients who did not require revision surgery for symptomatic ALD during the study period. The sensitivities and specificities for development of symptomatic ALD requiring revision surgery were also calculated based upon preoperative values of PT ≥ 24° and pelvic mismatch ≥ 12°.

Results: 159 patients (85 females and 74 males) met inclusion criteria during the study period. The results of multivariate logistic regression analysis noted preoperative PI-LL mismatch (OR: 1.25 CI: 95% (1.16, 1.33) $p < 0.0001$), postoperative PI-LL mismatch (OR: 1.40 CR: 95% (1.27, 1.54) $p < 0.0001$), and postoperative change in LL (OR: 0.96, CI: 95% (0.92, 1.0) $p = 0.39$) to be statistically significant independent predictors for the development of symptomatic ALD requiring revision surgery following a single-level LIF. Based upon threshold preoperative values of a PI-LL mismatch > 12°, the sensitivity and specificity for the development of symptomatic ALD requiring revision surgery following a single-level LIF were 81.82% and 86.54%, respectively. The positive predictive value for a postoperative PI-LL mismatch ≥ 12° leading to need for revision surgery was 79.0%; the area under the receiver operating characteristic curve was 0.92.

Conclusions: Abnormal preoperative spinopelvic parameters and failure to correct pelvic mismatch with surgery are associated with higher rates of developing symptomatic adjacent level disease requiring revision surgery following a single-level transforaminal lumbar interbody fusion. In our analysis, postoperative pelvic mismatch (PI-LL) was the strongest predictor of development of adjacent level disease requiring revision surgery. Assessing and correcting spinopelvic parameters is an important factor for maximizing long-term outcomes in single-level transforaminal lumbar interbody fusion.

• • •

IDH Mutant Gliomas Escape Natural Killer Cell-Mediated Death by Entering Autophagy

Deibert CP, Kim WJ, Brancho M, Amankulor N

Introduction: Studies have shown that IDH mutant gliomas avoid natural killer cell-mediated death, unlike IDH wild-type counterparts. However, the basis for NK cell resistance in IDH mutants remains unknown. Autophagy has been described as a mechanism for NK cell resistance in various cancers. Therefore, we explored whether IDH mutations induce autophagy as survival mechanism following NK cell-induced stress.

Methods: To determine whether astrocytes entered autophagy, we utilized immunocytochemistry to identify LC3 puncta, a marker for autophagosome formation during autophagy. We cultured IDH mutant and wild-type astrocytes with NK cells for 48 hours at a 20:1 effector:target ratio. Astrocytes were fixed on microscope slides and stained using anti-LC3 antibodies. Slides were finalized and imaged at 1000x using an oil-emersion fluorescent microscope to determine the number, average area and fluorescence intensities of the LC3 puncta.

Results: Co-culturing IDHmut with NK cells showed 97%, 113%, and 104% increase in puncta area in early, middle, and late passage astrocytes

(Continued on Page 6)

AANS Presentations (Continued from Page 4)

The Evolving Role of Molecular Classification in Treatment Planning for Childhood Brain Tumors. Moderator: **Pollack IF**. Panelists: Greenfield JP, Taylor MD, Storm PB.

Vertebral Column Tumors: Radiosurgery and Percutaneous Cement Augmentation for Spine Tumors. Moderator: Bilsky, MH. Panelists: **Gerszten PC**, Mendel E, Rhines LD, Sciubba DM.

Intracranial Endoscopy. Moderator: Cohen AR. Panelists: Drake JM, **Engh JA**, Jimenez DF, Schroeder HWS, Sekhar LN.

How I Do It: Acoustic Tumors. Moderator: Barker II FG. Panelists: Link MJ, **Lunsford LD**, Parsa AT, Pieper DR, Schwartz MS.

Posters

Prospective Outcomes Evaluation of a Novel Zero-Profile Device for Single and Multi-Level Anterior Cervical Discectomy and Fusion. **Mashaly H, Paschel EE, Gerszten PC.**

Surgery after Radiosurgery for Spine Metastases: Results from an International Research Consortium. **Gerszten PC**, Guckenberger M, Saghal A, Grills IS, Shin JH, Oh K, **Flickinger JC**, Sheehan JP, Kersh R, Fahim DK.

Posterior Dynamic Stabilization of the Lumbar Spine: Results of a 10-Year Clinical Cohort Investigation. **Paschel EE**, **Khattar NK, Gerszten PC**.

Stereotactic Radiosurgery for Jugular Foramen Schwannomas. **Meola A, Kano H**, **Mousavi S, Niranjan A, Monaco E, Arai Y, Flickinger J, Lunsford LD**.

Gamma Knife Radiosurgery as the Initial Surgical Management for Trigeminal Neuralgia. **Mousavi H, Kano H, Niranjan A, Monaco E, Lunsford LD**.

Klippel-Trenaunay Syndrome and Cavernous Malformations. **Ricks CB, Ducruet AF**.

IDH Mutant Gliomas Escape Natural Killer Cell-Mediated Death by Entering Autophagy. **Deibert CP**, Kim WJ, Brancho M, **Amankulor N**.

Bevacizumab for Symptomatic Radiation-induced Tumor Enlargement in Pediatric Low Grade Gliomas. **Foster KA, Ares WJ**, Jakacki RI, **Pollack IF.**

Short Term Neurocognitive Outcome Following Anterior Temporal Lobectomy. **Lee P,** DeStefino V, **Pardini J, Richardson RM.**

The Pathological Response of Cavernous Malformations Following Radiosurgery. **Shin SS**, Murdoch G, Hamilton RL, **Faraji AH, Kano H, Zwagerman NT, Gardner PA, Lunsford LD, Friedlander RM.**

Endoscopic Endonasal Approach for ACTH Secreting Pituitary Adenomas: Outcomes and Analysis of Long and Short Term Remission Rates and Tumor Biochemical Activity with Respect to Tumor Invasiveness. **Shin SS, Gardner PA**, Ng J, **Faraji AH, Agarwal N,** Chivukula S, **Fernandez-Miranda JC**, Snyderman CH, Challinor SM.

A Morphologically-Based Statistical Model Predicting Rupture of Intracranial Bifurcation Aneurysms. Zhao Y, Khattar N, **Parry PV, Ducruet AF, Friedlander RM.**

Effect of Intracranial Aneurysm Location on Accuracy of Diagnostic Subtraction Angiography. **Ares WJ, Ducruet AF.**

The Effect of AGA, Age and Obesity on Hospital State in Lumbar Pedicle Screw Fixation. **El-Kadi M, Maroon JC.**

AANS Meeting Abstracts (Continued from Page 5)

respectively; 138% and 40% increase in puncta intensity in early and middle passages respectively; and 104% increase in the number of puncta/cell in late passages compared to controls. In contrast, co-culturing IDHwt with NK cells showed a 14% decrease and 53% increase in puncta intensity in middle and late passages respectively when compared to controls. All other values were statistically insignificant.

Conclusion: These results indicate significant increases in autophagy in IDH mutant cells compared to IDH wild-type cells when stressed by NK cells. These findings suggest autophagy inhibitors may be an effective means of treatment in various IDH mutant cancers including astrocytomas.

• • •

Venous Thrombo-embolism Prophylaxis in Neurosurgical Procedures — Experience from the UPMC Presbyterian Hospital

Zenonos GA, Walch FJ, Roach E, Stokes S, Friedlander RM, Gerszten PC

Introduction: Pharmacological prophylaxis for venous thromboembolism (VTE) in the neurosurgical population is still a matter of debate, as the risk/benefit ratio is not well defined.

Methods: We evaluated our general protocol for VTE prophylaxis (VTEP) in 11,436 neurosurgical procedures performed from July 2011 to December 2013 at the UPMC Presbyterian hospital. Every patient was immediately ordered intermittent compression devices and out-of-bed orders. Unless a bleeding complication was present, 5,000 units of subcutaneous heparin q8 hours was ordered on postoperative day (POD) 1 for all spine procedures, on POD2 for cervical spine and cranial procedures, and by POD4 for cranial subdural, intracerebral, and epidural hematomas (SDHs/ICHs/EDHs).

Results: A total of 70 VTEs (0.61% of all procedures) were recorded (28 deep-venous thrombosis (DVTs), and 42 pulmonary embolisms (PEs)), resulting in one fatality. The highest rates of VTE involved open-cerebrovascular (8.06%), deformity (6.16%), SDH/ICH/EDH (3.24%), spine trauma (2.42%) and craniotomy for tumor (1.63%) cases. The majority of patients with VTE had a body mass index over 30 (62%), were over 60 years old (63%), and had operative times over three hours (84%). Notably, seven DVTs progressed to PEs, and 66/70 VTEs occurred while on pharmacologic VTEP. A total of 48 (0.42%) delayed bleeding complications (six remote from operative sites) occurred on/after POD2, resulting in 28 interventions and one fatality. Twenty-five patients were on prophylactic and 12 on therapeutic anticoagulation when the bleeding occurred. Highest bleeding rates were amongst SDH/ICH/EDH (3.7%), CSF- diversion (2.23%), and open-cerebrovascular procedures (1.61%).

Conclusion: The proposed VTEP protocol seems to afford a good risk/benefit ratio for most procedures, but may be overly aggressive for SDH/ICH/EDH and CSF-diversion procedures, in which a more conservative approach may be warranted.

News & Notes

Maroon Partners With Senior Health Center to Develop Community-Based Health Initiative

Joseph Maroon, MD, is partnering with local senior retirement community St. Barnabas Health System to develop a community-based brain health initiative called the Cognitive Brain Health Program. Maroon — an expert on dietary supplements and author of two books on dietary health — said the initiative will use interventions to "aid in preserving brain health." The program will focus on changes in diet and the proper use of dietary supplements, brain-specific physical activity, elimination of environmental pollutants that target the brain, and improved stress management.

Awards

Ian Pollack, MD, was awarded the 2015 H. Richard Winn, MD, Prize of the Society of Neurological Surgeons. The prize recognizes a neurological surgeon who has made — and continues to make — substantial contributions to clinical or basic neuroscience.

Special Lectures & Appearances

Ian Pollack, MD, was an invited speaker at the International Brainstem Glioma Workshop in Barcelona, Spain, on February 26. He was also an invited speaker at the Society for Brain Mapping and Therapeutics in Los Angeles on March 7.

Juan Fernandez-Miranda, MD, served as an invited faculty member at the University of South Florida Skull Base Surgery Course in Tampa on February 5-7, and the AANS/NREF Skull Base Course in Memphis on March 19-20.

Paul Gardner, MD, and **Carl Snyderman, MD**, were invited to perform surgery, teach a cadaver workshop on skull base surgery, and present several keynote lectures at the Asia-Oceanian International Skull Base Surgery Conference held in Mumbai, India, January 5-10. They also participated in a skull base surgery cadaver workshop at the LTM Medical College.

Dr. Gardner was also an invited faculty member at the Hands-On Workshop for Endoscopic Transnasal Approaches to the Skull Base in Trier, Germany, March 4-6; the Brain Tumor and Minimally Invasive Spine Symposium held in Miami on March 19; and, along with Dr. Snyderman, the National University Hospital Endoscopic Sinus & Skull Base Course in Singapore, April 6-8.

L. Dade Lunsford, MD, was an honored guest lecturer at the North American Skull Base Society Annual Meeting in Tampa on February 21.

C. Edward Dixon, PhD, was a visiting professor at University of California-Davis, from March 9-11.

In the News

Robert Friedlander, MD, was featured in a WTAE-TV Action News feature, December 24, discussing the surgery and recovery of a talented wood carver whose brain tumor had threatened his eyesight.

Joseph Maroon, MD, was featured in a USA Football question and answer article, March 6, that discussed his recently published 60-year review of chronic traumatic encephalopathy in athletes and veterans.

Eyelid Surgery (Continued from Page 3)

has the job of protecting the eyeball, making the corridor for the neurosurgeons to work.

Those kinds of multidisciplinary teams are rare, limiting wider adoption of these techniques, said Quinones-Hinojosa.

"You really have to learn how to be co-captains. Medicine and surgery hasn't been, traditionally, like that," he said.

For California's Scott, it took a few hours longer to remove her meningioma — a benign tumor that started in the brain's protective covering and grew into the bone and near her optic nerve — through the small opening. But she awoke with essentially a black eye, and was back at work in her psychotherapy practice in two weeks, wearing sunglasses.

In Indianapolis, dentist Deborah Boyer underwent a similar months-long search to treat a meningioma growing around critical nerves and blood vessels, threatening her vision and motor function. She wanted both a brain and an eye specialist. So she read medical journals online and hunted designated "centers of excellence."

Pittsburgh's Gardner initially planned to cut through the side of her skull, a smaller operation than other doctors offered, but later decided the corner of her eye offered a good path. Boyer said it took twice as long as regular surgery, but she was discharged in four days pain-free.

Figure 2. Resection of tumor through eyelid.

"People need help to try to get connected more quickly, and to know what those options are," she said.

UPMC LIFE CHANGING MEDICINE

UPMC Presbyterian
Department of Neurological Surgery
200 Lothrop St.
Pittsburgh, PA 15213-2582

Nonprofit Org.
U.S. Postage
PAID
Pittsburgh, PA
Permit No. 3834

Cervical Spine Alignment (Continued from Page 1)

Through several recent large database studies,[3,4] patients with loss of cervical lordosis and those with significant kyphosis of the cervical spine after cervical spine surgery suffered worse health-related quality of life metrics over the long term. The concepts behind these findings are explained by the spine "Conus of Economy" theory, which states that the body adapts to changes in balance in order to regulate the center of gravity over as narrow a perimeter as possible. Failure of ability to compensate results in disability.

At the UPMC Department of Neurological Surgery, spine surgeons who treat all spinal disorders continue to study and apply these principles for best patient outcomes. Our continued participation in patient outcome metrics analysis (excellent care with long-term followup expectations), has placed us at the forefront of identifying and embracing proven current concepts in spine care.

It is prudent, prior to any spinal surgery for multilevel degenerative disease of the vertebral body, disc, or facets of all spinal segments, to perform dynamic imaging of the afflicted segments and also upright global spine radiographs, to appreciate the baseline curve characteristics and subsequent changes to the patient's total spine. This will aid in counseling patients regarding long-term expectations prior to any treatment.

References

1 Scheer JK, Tang JA, et al. Cervical spine alignment, sagittal deformity, and clinical implications: a review. *J Neurosurg Spine* 2013 Aug;19(2):141-59.

2 Oh T, Scheer JK, et al. Cervical compensatory alignment changes following correction of adult thoracic deformity: a multicenter experience in 57 patients with a 2-year follow-up. *J Neurosurg Spine* 2015 Mar 20:1-8 [Epub ahead of print].

3 Tang JA, Scheer JK, et al. The impact of standing regional cervical sagittal alignment on outcomes in posterior cervical fusion surgery. *Neurosurgery* 2015 Mar;76 Suppl 1:S14-21.

4 Nolet PS, Côté P, et al. Is neck pain associated with worse health-related quality of life 6 months later? A population-based cohort study. *Spine J.* 2015 Apr 1;15(4):675-84.