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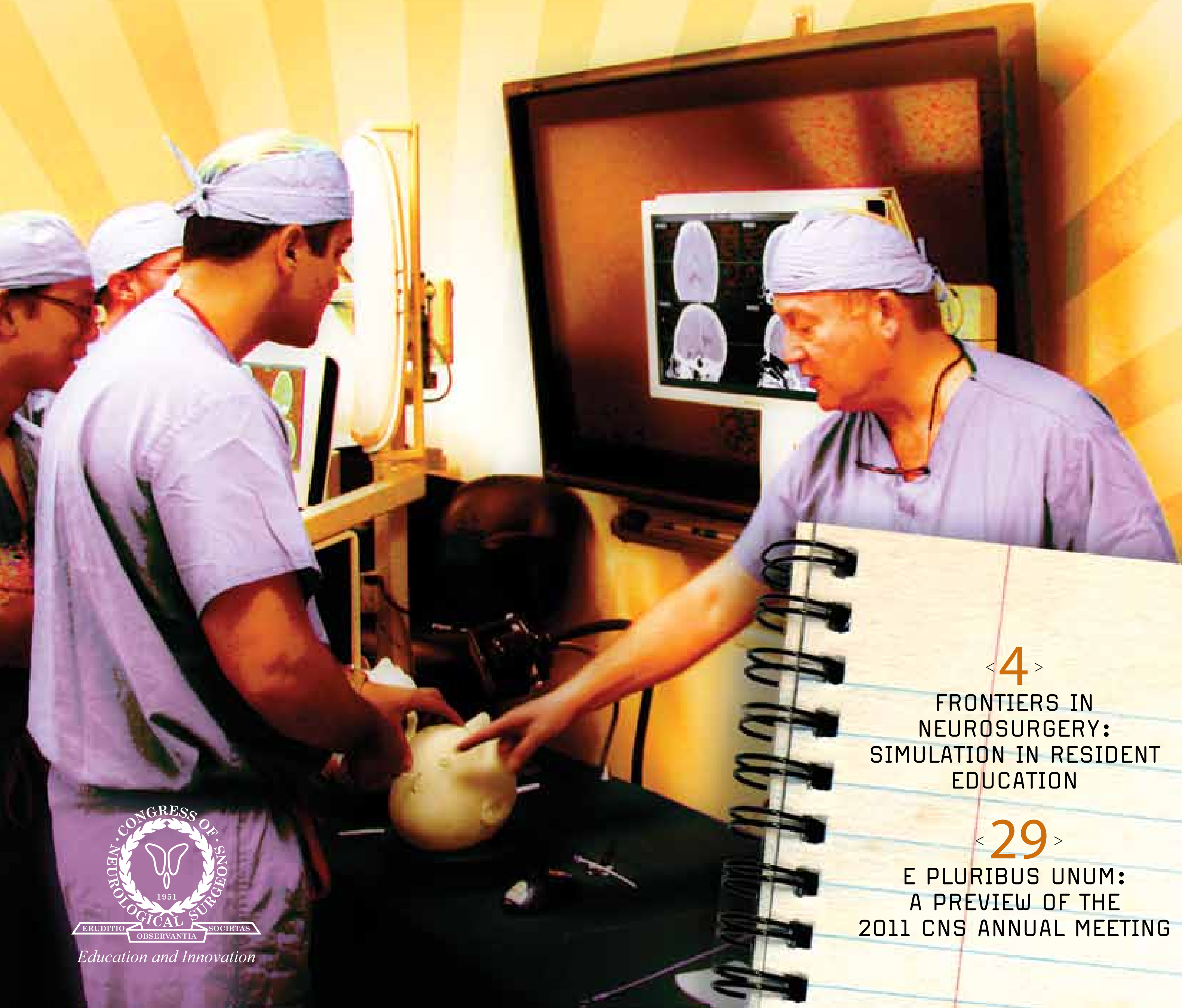
SUMMER 2011

THE FUTURE OF NEUROSURGICAL EDUCATION



4

FRONTIERS IN NEUROSURGERY: SIMULATION IN RESIDENT EDUCATION

29

E PLURIBUS UNUM: A PREVIEW OF THE 2011 CNS ANNUAL MEETING

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Education and Innovation

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CONGRESS OF NEUROLOGICAL SURGEONS MISSION STATEMENT:
The Congress of Neurological Surgeons exists to enhance health and improve lives worldwide through the advancement of education and scientific exchange.

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Education and Innovation

EDITOR'S NOTE

James S. Harrop, MD, FACS

In this issue of the cnsq, we explore the **Future of Neurosurgical Education**. Specifically this issue reviews the present interest and expansion of utilizing simulators for education purposes in neurosurgery. Through advances in technology and material properties this field is rapidly expanding, such that training on cadavers may be obsolete in the future.

The CNS is dedicated to neurosurgical education and has made a significant commitment to develop the field of simulation in neurosurgery. One recent addition is by sponsoring a whole day practical course for residents at the CNS Annual Meeting using these sophisticated neurosurgery simulation tools. The lead article in this issue of the cnsq, written by the CNS Simulation Committee's leaders Darlene A. Lobel and Ali Rezai is entitled, *Frontiers in Neurosurgery: Simulation in Resident Education*. The following three articles in subspecialty development are: *Cranial Virtual Simulation Models*, (Ali Rezai), devices in vascular neurosurgery, *(Simulation in Vascular Neurosurgery* – Salah G. Aoun, Bernard R. Bendok, J D. Mocco, and Elad I. Levy) and spinal procedures (*Spine Simulation* – James S. Harrop, Ashwini D. Sharan, and Vincent C. Traynelis). Alejandro M. Spiotta and Richard Schlenk discuss the use of *Simulation in Neurosurgical Residency Training: A New Paradigm* followed by Paul A. Anderson's discussion of *Surgical Simulation: Dural Repair*. Then Nathan R. Selden, Costas G. Hadjipanayis, Thomas C. Origitano, Christopher C. Getch, Kim J. Burchiel, Nicholas M. Barbaro review the present use of simulation in education, *Boot Camp Course for Incoming PGY1 Neurosurgery Residents Utilize Simulation to Improve Training and Safety*. Srinivas Prasad concludes the simulation portion of the issue looking into the future of simulation with the expansion of robotics in *Robotics and Simulation*.

The CNS has several avenues in which to further our educational mission. One such additional Neurosurgery education platform is the internet through the CNS University (CNSU). Jason Sheehan, Nader Pouratian, and Zachary Litvack review the remarkable advances the SANS program has achieved in *SANS: Past, Present and Future*. Additional articles include the *Spine Section Update* by Daniel M. Sciubba, a perspective piece by James I. Ausman analyzing in his opinion, *Why Power Counts in Healthcare* and a look at the Global Vascular Center in Buffalo, NY.

The final focus of this issue is a look at the upcoming CNS Annual Meeting in Washington DC; *E: Pluribus Unum: Preview of 2011 CNS Annual Meeting* by Ganesh Rao, Russell R. Lonser, Alan Scarrow, Christopher C. Getch and H. Hunt Batjer. We hope this issue provides helpful knowledge and we look forward to continuing this discussion of Neurosurgery Education in the Fall issue which is dedicated to the 2011 CNS Annual Meeting taking place October 1-6 in Washington, DC. We are arranging for that issue to be printed and delivered earlier to aid in your choosing the appropriate courses and lectures to maximize your experience.

CONTENTS

PRESIDENT'S MESSAGE

EVOLUTION IN NEUROSURGICAL EDUCATION

Christopher C. Getch, MD
President, Congress of
Neurological Surgeons

The Congress of Neurological Surgeons (CNS) was founded over sixty years ago to enhance health and improve lives worldwide through the advancement of education and scientific exchange. Because of the Organization's unwavering commitment to this mission, its willingness to invest substantially in the science and process of education, combined with the creativity and dedication of its members and their diligence this has resulted in a varied array of novel and effective educational products. The last ten years, for example, has seen the expansion of SANS (self assessment in neurological surgery) to a dynamic, interactive online format, the introduction of Integrated Medical Learning (IML) and the CNS University, and the evolution of the CNS Annual Meeting to include innovative educational formats such as the Neurosurgical Forum, Consensus Sessions and Masters 3D Cadaveric Surgical Dissection, to name just a few.

With the growth and interconnectivity of the World Wide Web, medical education has evolved utilizing internet based methods and products that can more easily reach all neurosurgeons worldwide. The CNS has recognized the increasing challenge to deliver an efficient, high quality, cost effective educational experience for our members, which has resulted in the dedication of significant resources to exploring and developing internet based products such as SANS. The commitment to and investment in this area is clearly visible as well on our society's website www.CNS.org, which has evolved and expanded rapidly, serving as a portal to all that the CNS offers including the CNS University, our platform for the many new opportunities available for online neurosurgical education. In addition, the site contains the NeuroWiki which is a resource not only for neurosurgeons but also the public seeking specific neurosurgical information.

With the rapid growth of science and understanding of the potential for new treatments, the current challenge to neurosurgical education is not just limited to the acquisition and delivery of the substantial and rapidly expanding knowledge base that can be addressed only in part by internet based resources, annual meetings, journals etc. What may be as important is keeping abreast of new procedural technologies and the acquisition and maintenance of practical surgical skills. The CNS is always exploring opportunities to provide newer and more advanced ways to meet the variable educational demands placed on all levels of neurosurgeons, from the early residency through the senior practicing neurosurgeon. It is this challenge of the varying levels of proficiency, knowledge base, and needs particularly across continents that the CNS has continued to grapple with. This issue is perhaps best illustrated by the declining surgical experience of surgeons in training, as a result of work hour restrictions, who require potentially more time performing repetitive procedures under the microscope to achieve proficiency. For the practicing neurosurgeons the challenges are different. There is an ever increasing demand to acquire surgical proficiency in new techniques that are rapidly being added to the armentarium of the practicing physician, technologies not even thought of during one's residency. As well, there is increasing demand to continually meet ever changing certification requirements and CME methodology while increasing productivity and preserving income.

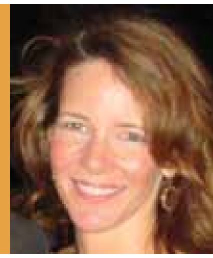
Education and Innovation

At present the CNS is strongly supporting the research and development of "Simulation" for neurosurgical education. As the articles in this issue of the CNSQ clearly illustrate, there are numerous adaptations for simulation in neurosurgery from developing basic practical neurosurgical skills training in a repetitive "no risk" educational experience, to reducing risk of infectious disease transmission as cadaver tissues are not employed, to lower training costs. There is the potential for consecutiveness and portability to where neurosurgeons practice either here or abroad, the cost effective training in new technologies and techniques such as new coiling techniques or new spinal procedures and the ability to personalize the educational experience to the level and proficiency of the surgeon from in training to the practicing neurosurgeon. The CNS in conjunction with both institutional and industry partners is actively expanding our development and application of simulators and presently this effort is being coordinated through the CNS Simulation Committee headed by Drs. Ali Rezai and Darlene Lobel. At this year's Annual Meeting in Washington, DC the CNS is dedicating one afternoon of the practical sessions to a resident course on simulation. There will be 40 residents who will rotate through four stations (spine, trauma, vascular and cranial) with various existing and new simulation devices, providing a unique and challenging experience. The technology of these simulations include basic computer based simulations to more advanced simulation incorporating physical models. The course will serve several purposes. It will bring together a number of devices that represent the current state of technology such that they can be compared and contrasted for the quality of the simulated operative experience. Furthermore, through the evaluation of each of these technologies, it is essential to develop and validate methodology to assess the effectiveness of simulation as a teaching method as well as improve on the experience going forward.

Despite the promise of simulation, there are clear obstacles that need to be overcome in order to make a simulated experience optimal. For example there have been several cerebral aneurysm clipping simulation models developed, but as yet, the technology that currently exists is limited by both imaging resolution and materials science. The virtual environment cannot at present reproduce the clinical detail such as variable wall thickness or perforator anatomy. Furthermore, the current models of simulation cannot reproduce the unpredictable nature of surgery, the tactile sensation or haptic experience when applying a clip to the aneurysm neck or the "emotional training" such as occurs with intraoperative rupture. Maybe not available now, but it is likely this will be the wave of the future as the technologies and science develop.

The relevance and value of internet based education and of neurosurgical simulation is increasing rapidly. Presently, through the advances in technology, the now reasonable costs of producing and deploying these new methods of education and a willingness of surgeons to embrace new ways of learning are all positive factors in the evolution of neurosurgical education. Recognizing these factors, the CNS has and will continue to make a significant investment in the future of virtual surgical education for the benefit of its members as part of it commitment and mission.

> BECAUSE OF THE ORGANIZATION'S UNWAVERING COMMITMENT TO THIS MISSION, ITS WILLINGNESS TO INVEST SUBSTANTIALLY IN THE SCIENCE AND PROCESS OF EDUCATION, COMBINED WITH THE CREATIVITY AND DEDICATION OF ITS MEMBERS AND THEIR DILIGENCE THIS HAS RESULTED IN A VARIED ARRAY OF NOVEL AND EFFECTIVE EDUCATIONAL PRODUCTS. <



Darlene A. Lobel, MD
CNS Simulation Committee

Ali R. Rezai, MD
CNS Simulation Committee

FRONTIERS IN NEUROSURGERY: SIMULATION IN RESIDENT EDUCATION

Simulation in medicine evokes images of a fantastical world of virtual reality (VR). The intrigue associated with the concept of performing a virtual brain surgery in a virtual OR, similar to the immersive flight simulation experience that pilots and astronauts have implemented as an essential part of their training, certainly piques the interest of both residents and neurosurgical educators alike. With recent quips in the news and on the internet about Canada's VR based Neurotouch simulator (Figure 1), YouTube video examples of medical applications of augmented reality, and virtual hospitals and medical environments in web-based programs such as Second Life (Figure 2), it is no wonder that we as neurosurgeons, as innovators in the field of medicine, are attracted to this visionary concept of integrating simulation technology into our current practice and into the educational experience for our residents.

While clearly intriguing, we must ask whether VR is truly the best method to enhance technical skills of trained surgeons and to teach clinical skills to our young residents. We must also understand that simulation, in medicine in particular, involves much more than the flash and glamour of VR. Simulation encompasses any technique designed to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion.[1] So, in addition to VR experiences, simulators may include physical models, web-based programs, and live role playing interactions. According to this broad definition, simulation techniques can be used not only to teach surgical skills, but also patient and family interactions, professionalism, and many of the core competencies that the ACGME emphasizes as critical to resident education.

Simulation as a training tool has been integrated over the last several years into many medical residency programs, most notably emergency medicine, ob/gyn, ENT, and general surgery. In fact, the ACGME now requires general surgery residency programs to incorporate simulation as a component of the training program. While validity studies, which assess efficacy of simulation techniques are limited at the present time, there is some evidence to support improvement in surgical skills after training using simulators. The results of two studies demonstrated improvement in laparoscopic techniques after surgical residents trained on VR simulators.[2,3] The study by Seymour revealed that simulator trained residents were almost 30% faster in surgical dissection and made 1/6 of the errors of their non-simulator trained counterparts. Dayal et al. published a study which evaluated the benefit of training both novice and expert surgeons on a VIST endovascular simulator. There was significant reduction in the time for stent placement, use of fluoroscopy, and reduction of errors in carotid stent placement by novices who trained using the VIST device.[4] Furthermore, after only two hours of training, novices felt increased confidence in performing endovascular procedures. While the evidence in these studies supports improvement in technical skills training using simulation techniques, there are also studies to support improvement in non-technical skills, such as teamwork and leadership ability, which

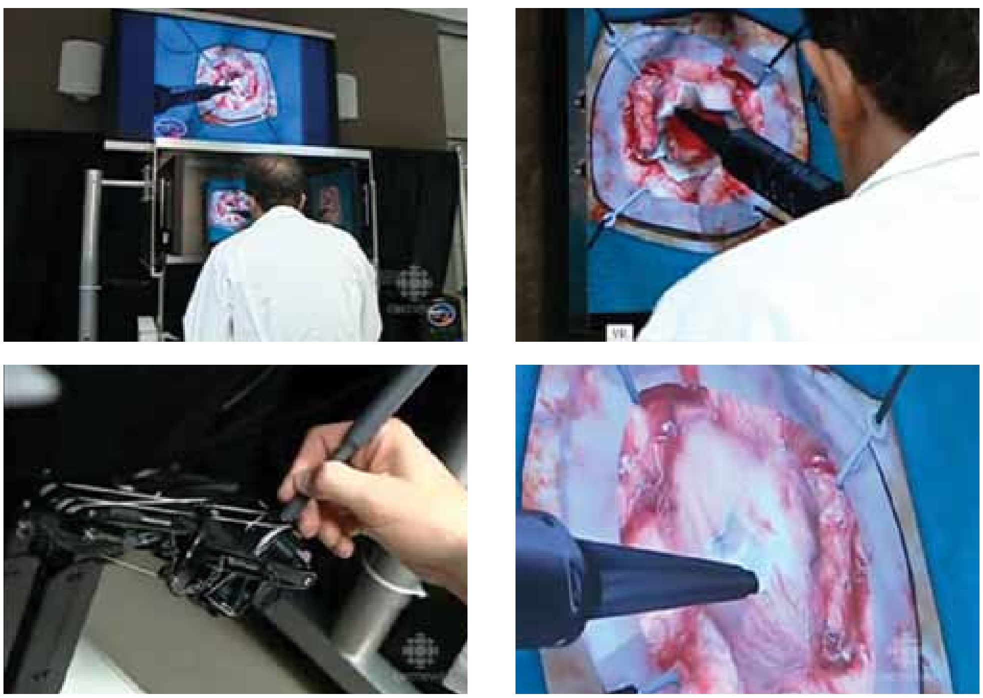


Figure 1. Neurotouch brain tumor resection simulator. Courtesy of CTV news

Figure 2: Second Life image of operating room. Courtesy of the Imperial College of London.

can play an integral role in improving patient care and outcomes.[5,6]

As stated above, there is evidence that training using a variety of simulation techniques can improve both technical and non-technical skills. And, simulation training carries an innate intrigue that should engage both learners and educators in the medical field, and in neurosurgery, in particular. Furthermore, there is clearly a need to integrate such technologies into the residency programs, given the perceived limitations in surgical training due to resident work hour restrictions. Residents are spending approximately 35% less time in the operating room than before the new work hours were established. Many educators have cited the need to effect a paradigm shift in our training processes in order to deliver the same level of training to our residents. Furthermore, with ever increasing emphasis on patient care and safety; it is becoming less acceptable to have residents “practice” procedures for the first time on actual patients.

So, what is the current status of simulation use in neurosurgical residency training programs today? Our residents have some exposure to simulation during their “boot camp” experience as they commence residency. There are some programs in the country that promote residents use of cadaver labs, and

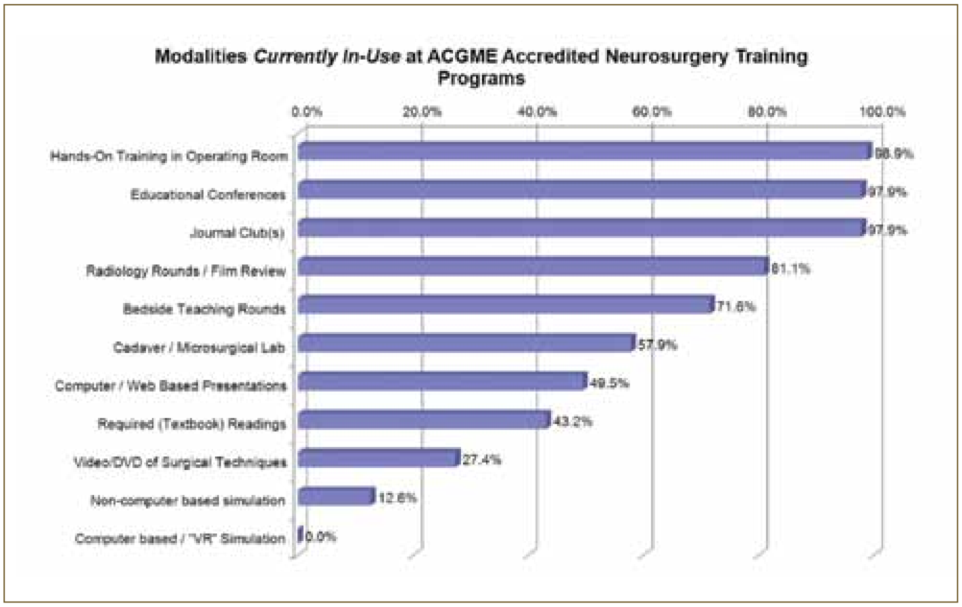


Figure 3: CSNS survey results to assess current use of simulation in NS residency programs. Litvack ZN and Lobel DA. State of the Art: Use of Simulation in Neurosurgery Residency Programs. AANS Abstract 2010.

a select few programs permit resident use of endovascular, temporal bone dissection, or other advanced simulators. There are some courses and exhibits at the national meetings that allow exposure in a limited fashion to VR based techniques as well.

In order to fully assess the use of simulation in neurosurgical residency programs, the Council of State Neurosurgical Societies (CSNS) recently conducted a survey which was sent out to all NS residency programs in the US Responses were gathered from 42% of these programs. These results suggest there is minimal to no use of simulation, including virtual reality techniques, physical simulators, and task trainers in current neurosurgical residency programs (Figure 3). And, those few programs that do provide simulators have not formally integrated them into their training curriculum. As expected, most residents welcome the opportunity to incorporate simulation into their training experience (Figure 4).

The need to integrate simulation into our training process is there, along with the desire to do so. How do we now create and implement an effective simulation training platform? In order to achieve the greatest benefit from simulation techniques, two requirements must be met. First, simulation as a training modality must be integrated formally into the curriculum. The concept of a curriculum which teaches defined fundamental skills is essential to graduate medical education.[7,8] Simulators should not be simply purchased as an additional learning experience for residents to use at will, but their use must be matched to a core curriculum goal

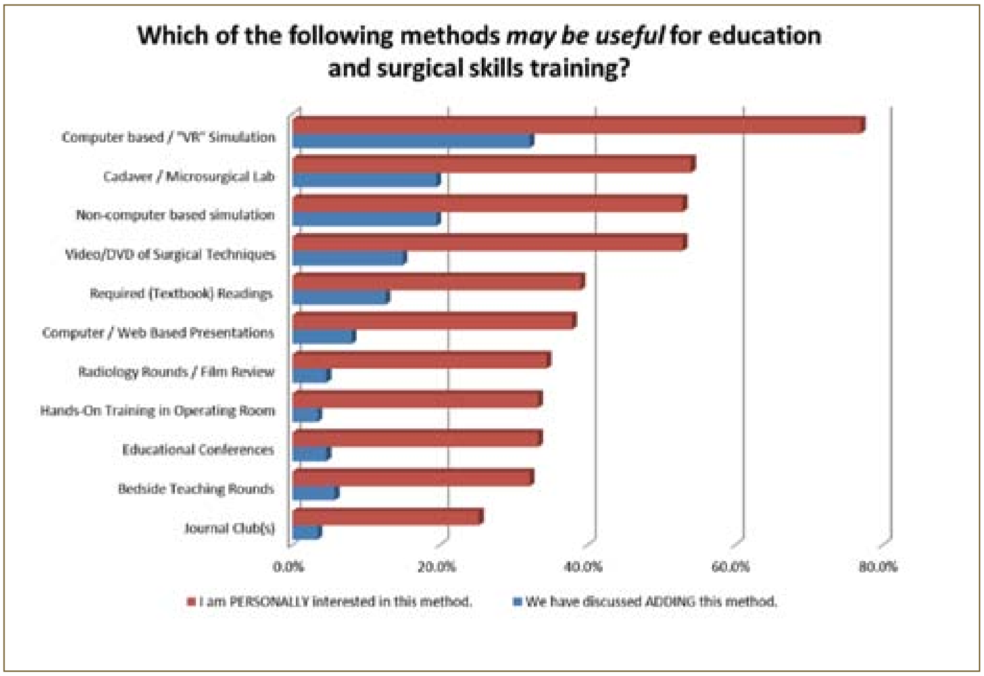


Figure 4: CSNS survey results to assess desired use of simulation by NS residents and educators. Litvack ZN and Lobel DA. State of the Art: Use of Simulation in Neurosurgery Residency Programs. AANS Abstract 2010.

and incorporated in a defined way into the training program. In this way, it will be possible to meet the second requirement, namely testing the validity of the simulators, or their ability to meet the educational goals. Very few validity studies have been conducted or published to date, particularly in the neurosurgical arena. Therefore we find ourselves in an opportune moment to begin to define not only a simulation-based curriculum, but also a program which will lend itself to validity testing.

In developing this curriculum, we will meet a few challenges. First, we may find that while the intrigue of VR simulation techniques first draws residents' and educators' interest into the field, that more of a multi-modality approach, using different simulation techniques may prove more useful and effective to teach the technical and non-technical skills necessary to optimally train our residents. Second, in choosing the simulators to become part of the curriculum, we must proceed with caution. The options are to adopt simulators that are currently available, or to partner with companies to create novel simulators. In simulator development, it is important to include the end user, namely the neurosurgeon, as a key component in product creation. Many simulators, including the physical, VR, and web-based programs that are currently available, were created by companies that did not utilize the expertise of neurosurgeons. There are technical gaps and limitations in many such products. The use of such simulators must be weighed against the cost and time for developing new simulators.

Another important consideration in developing a simulation curriculum is cost. While some of the lower fidelity simulators are reasonably priced, many of the VR components can cost several hundred thousand dollars, or more, to purchase a single unit. There is government funding available for grants to fund creation of simulation curricula through AHRQ and other venues. There are bills in both the House and Senate which will potentially offer $50 million in funding for simulation over the next several years. However, it is daunting to consider the possibility that residency programs may be left to their individual university resources to fund development a strong simulation curriculum.

Funding challenges, combined with the necessity to develop a validation proven simulation curriculum, speak to the need for the creation of a unified program that can be instituted on a national level. A single simulation based curriculum, developed by leaders in the organization, with the assistance of subject matter experts, would allow consolidation of efforts and funding to create a neurosurgical simulation platform that can serve to refine and cultivate the optimal resident training experience for the future.

The CNS Simulation Committee is developing several simulation approaches for neurosurgical education that will employ curriculum-based teaching in conjunction with validation and testing methods. These simulation initiatives include physical models, VR- and web-based modules for general neurosurgery, spine, trauma, vascular and skull base.

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Daniel M. Prevedello, MD **Don Stredney** **Ali R. Rezai, MD**

SKULL BASE SIMULATORS: THE EVOLUTION OF NEUROSURGICAL TRAINING

The surgical profession's training has traditionally employed cadaveric specimens. Although an elegant way to learn surgical principles, it has become increasingly difficult and less practical to obtain access to cadaveric specimens. Furthermore, exposure to hazardous chemicals such as formalin, as well as the increasing cost related to the preparation and maintenance of specimens makes the use of specimens continuingly problematic.

To overcome the limitations of cadaveric specimens use, many have pursued the use of physical correlates. However, these models are also limited by cost, biofidelity, and basic limitations in physical wear and breakdown.

Over the past decade, advances in computer technology and haptic feedback have facilitated the development of medical virtual reality simulators as growing and increasingly utilized training tool. Virtual simulators have been used in many other industries for decades. For example, through virtual simulation, pilots are required to train for many hours in simulators before actual flight. We have begun seeing this trend in medical training, where society is expecting a commensurate level of training, particularly from surgeons. Many surgical specialties are adopting simulation technologies to circumvent the limitations of traditional approaches, and neurosurgery is no exception.

It is now technologically feasible to create a multifaceted virtual reality approach that simulates the visual, aural, and forces encountered in surgery.[1] Recently, the CNS has initiated a multidisciplinary collaboration and partnership between neurosurgery, otolaryngology and modeling and simulation experts from the Ohio Supercomputer Center to establish a working group with a focus on skull base surgery simulation. The group builds on existing expertise that have resulted in skull base visualization[2], functional endoscopic sinus surgery (FESS)[3] and temporal bone surgical simulation, more specifically, a complete mastoidectomy with facial recess approach.[4] The OSU/OSC group

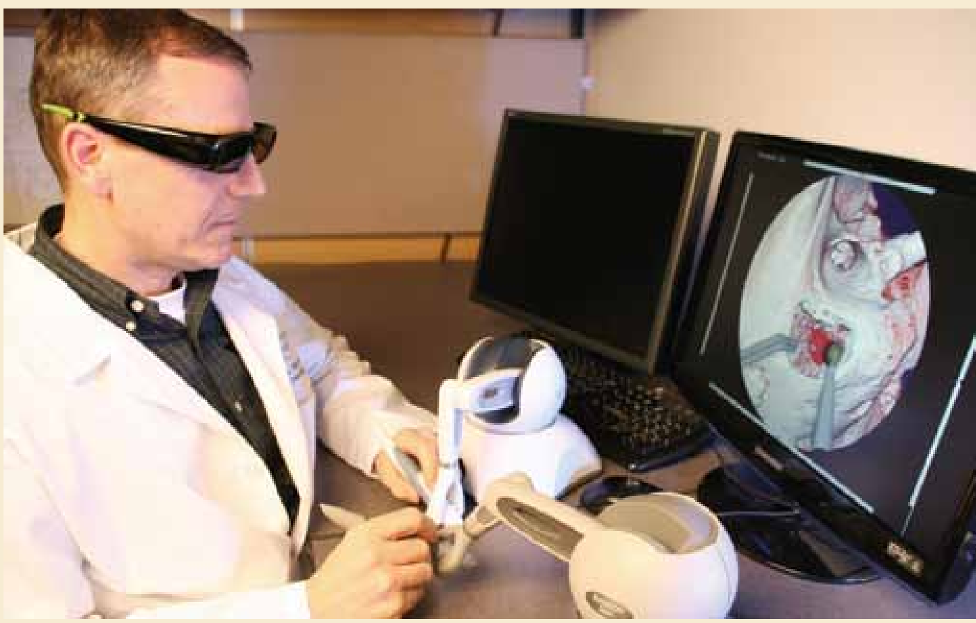


Figure 1: Left - User in system w/stereo glasses and two haptic interfaces. Above - Surgical view w/bleeding/irrigation.

is renowned for its work in emphasizing virtual simulation over physical models. Recent developments have been funded under R21 DC004515-01 and R01 DC011321-01A1 from the National Institute on Deafness and other Communications Disorders (NIDCD), and ARRA funding from the National Center for Research Resources (NCRR - UL1RR025755), of the National Institutes of Health.

The CNS skull base simulation collaborative effort will create a simulation environment that integrates stereo graphics, audio, and force-feedback (haptics) for emulation of manual instrumentation (See Figure 1).The development of neurosurgical skull base simulators is a multi-step effort. The current system that is being developed will provide the surgeon a haptic feedback during tissue manipulation. This system is ideal for bone as the surgeon is able to perform drilling of the skull base and understanding the anatomy in a multi-dimensional platform where one can also see the internal structures through the skull bone if desired. The student is able to drill the bone with a "probe" that is connected to a haptic device that gives feedback to the surgeon in terms of the hardness of the tissue and the sensation of drilling of the structures as if they were real. This haptic feedback is so sensitive that it can differentiate the sensation of drilling in between the cortical and cancellous bone, which is essential in skull base work.

The Congress of Neurological Surgeons' skull base translational simulation program will develop multiple modules for emulating neurosurgical approaches. At this fall's CNS Annual meeting in Washington, D.C., the team will demonstrate skull base surgery simulations including pterional, pre- and retrosigmoid approaches. Future developments will include the emulation of additional neurosurgical procedure from a simple craniotomy to the performance of complex orbitozygomatic and far lateral approaches. The eventual inclusion of soft tissue with haptic feedback will require continuous development that will expand the number of approaches to include endoscopic skull base procedures and fine microscopic dissections.

Our goal is to leverage collaborative efforts in training, research and clinical applications, including pre-surgical assessment, planning, testing and validation, and extensions to robotics. This effort will be supported through the establishment of a digital data repository that includes multi-scale and multi-modal 3D acquisitions of various regions of the skull (See Figure 2). We will promote and lead a national effort to develop standards and the exchange of techniques to provide for wider extensibility and dissemination.

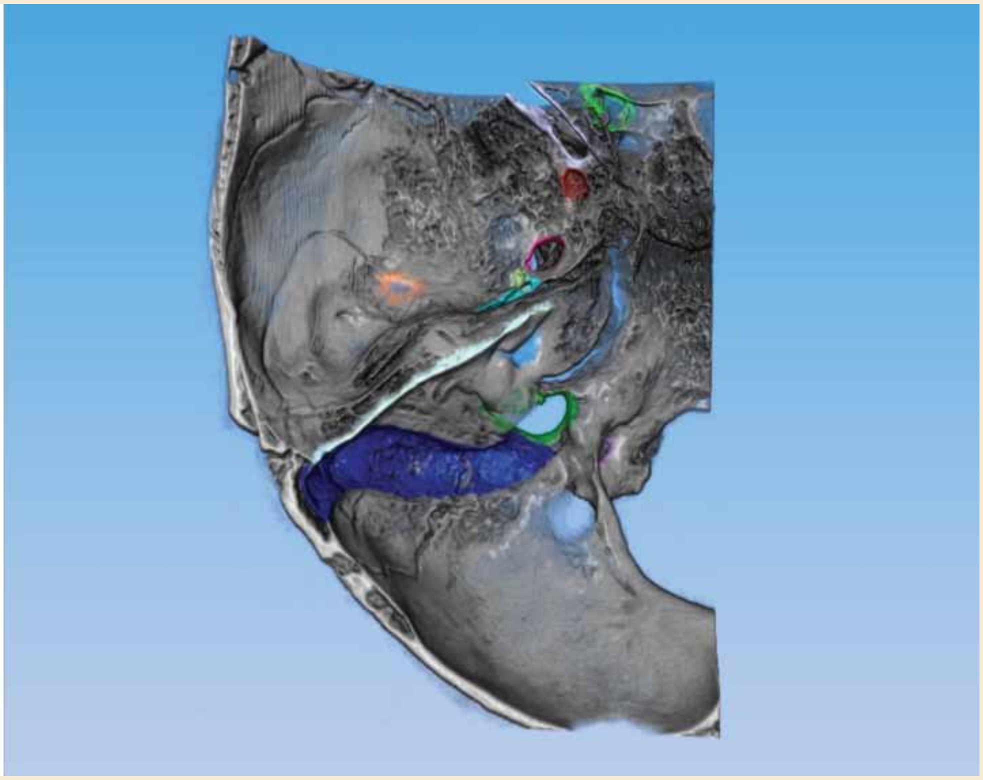

Figure 2: SUPERIOR view of cranial vault with segmented structures.

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IMAGES IN NEUROSURGERY

Figure 1

Figure 2

A 26 yo patient with Sickle Cell presented with progressive HAs after a syncopal episode. He underwent a far lateral approach for resection of an epidermoid tumor that contrast enhanced (they never contrast enhance…) and wrapped his basilar and vertebral arteries as well as cranial nerves IX, X, XI, and XII.

Submitted by:
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Emory University School of Medicine

CONGRESS OF NEUROLOGICAL SURGEONS
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The 2011 CNS Annual Meeting is a Joint Meeting with the Spanish Society of Neurosurgery!