Neurosurgical Education

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This topic is too broad and too subjective to lend itself to a proper scientific presentation. Nevertheless, we have chosen it for discussion because of its importance and because of our passionate interest in education, particularly of neurosurgical residents. Although there are other more specific platforms to discuss neurosurgical education and in spite of the fact that the senior author has alluded to some of the concepts we will discuss in his Presidential Address to the American Association of Neurological Surgeons,[7] it seems most appropriate to discuss education at the annual meeting of the Congress of Neurological Surgeons because this organization was founded for, and its core mission continues to be, neurosurgical education. We will discuss the threats, challenges, and opportunities facing us as neurosurgical educators and mentors at this time. We will add some thoughts about our vision of how our current residency structure could be modified to better cope with current and probable future educational demands on our residents. We will also discuss briefly some thoughts about post-residency continuing education. We will then review some concepts pertaining to the teacher-trainee relationship, and, finally, we will discuss, with a heavy emphasis on the senior author's biases, some "softer," but important and necessary, aspects of neurosurgical education and mentoring, including issues related to today's crisis in neurosurgery brought about by excessive and inappropriate legal and bureaucratic interference in medical affairs.

COULD THE CURRENT RESIDENCY BE IMPROVED?

The answer is obviously "yes." However, we will add the qualifying sentence "but not too much and not too fast." The latter may reflect the authors' aversion to revolutions, which is responsible for their being currently in this great country as opposed to their native land. All of us who have completed or are currently enrolled in a neurosurgical residency feel tremendous pride in the quality of our education. Our residency is long and hard, which is only appropriate for the complexity of our specialty and for the kind of individuals who choose to join our discipline. We have long resisted, and continue to resist, the notion that neurosurgeons who complete their training are incapable of dealing with any of the aspects of neurosurgery that they may choose to master through continuing learning and experience. Ours is the only residency that insists that all neurosurgeons should be not only clinicians, but also scholars. To that effect, we have generally insisted on at least 1 year of research or other electives that would promote such scholarship. The rigor and quality of our residency has given the preeminence to our discipline that makes us so deservedly proud of being in an "elite" specialty. None of this should change. However, we must improve our residency and post-residency training to accommodate some of the challenges and opportunities to be discussed. This we can and must do to ensure that the position of respect earned by our specialty continues to be enhanced and that it continues to be the great source of pride that it is currently to all of us.

DEMANDS, CHALLENGES, AND OPPORTUNITIES AT PRESENT AND IN THE IMMEDIATE FUTURE

Our challenge as educators today could be simply summarized by an equation in which, on the one hand, we have the rapidly increasing expansion both technologically and cognitively that our specialty is experiencing and, on the other, we have the arguably irrational demands from society to lessen the "hours" that our residents work. Resident work hours have been markedly curtailed, out of fear that "tiredness" might affect public safety. Clearly, Winston Churchill's wisdom had no influence on the writers of modern day rules in postgraduate education, when he said:

"The test of the people is what they can do when they are tired." (Winston Churchill, 1874–1965)

Naturally, the expanding nature of our specialty offers us great opportunities in addition to the challenges.

Thanks to a neurosurgical pioneer and a few visionaries who saw the value of these concepts, we have added radiosurgery to our neurosurgery armamentarium. Who could fail to appreciate what radiosurgery has added to the treatment of arteriovenous malformations, deep-seated benign tumors in critical areas, brain metastasis, some localized intrinsic brain tumors, and functional and pain neurosurgery? The question is whether or not we are providing adequate opportunity for

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our residents to master this area of specialization, or to at least develop the requisite knowledge and interest to be able to pursue it after their residency. Like with all opportunities, we are not the only ones who have seen it and we are currently in a pitched battle with radiation oncologists who want to make this area of specialization their own.

Endovascular surgery was also pioneered by neurosurgeons, but initially only a few of our colleagues had the vision to see its importance to the future treatment of vascular and neoplastic neurosurgical conditions. As opposed to the case with radiosurgery, substantial credit is due to another specialty, interventional neuroradiology, for the subsequent refinement and development of this subspecialty. The challenge now is whether or not we should make this technical innovation an integral part of the neurosurgical curriculum, as we have suggested before,[8] so that all our residents are at least exposed to it, understand its principles, become competent in the nuances of the perioperative care of these patients, and, especially, become motivated to possibly pursue further specialization in endovascular surgery. Like in radiosurgery, strong turf challenges from interventional neuroradiology, interventional cardiology, neurology, and possibly even vascular surgery exists in this area. We do have a window of opportunity in that, like in radiosurgery, with the possible exception of neurology, we are the only specialty that is generally in control of the clinical care of these patients at the present time. However, even this is currently being challenged, particularly by interventional neuroradiologists who are increasingly considering themselves neuroclinicians.

Functional neurosurgery is another significant area of our specialty that is in constant evolution and, having gone through relatively dormant periods, is experiencing a rebirth based on technological developments. Few would argue, for example, with the philosophical concept that neurostimulation is more attractive than neuroablation. The possibilities brought about by improvements in neurostimulation are beyond the scope of vision of these authors. If we add to that the possibilities brought about by the revolution in molecular biology that has made gene therapy a probable reality, we can readily foresee that this will be one of the most promising areas of expansion for our specialty. Neurosurgery must be at the leading edge of these developments if we are going to benefit from them as opportunities rather than fear them as threats to our current therapeutic armamentarium.

One of the greatest success stories of modern neurosurgery is the mastering of techniques for fusion and stabilization of the spine that were previously within the exclusive domain of orthopedic surgery. This we did, again with the help of a few visionaries, by the realization that neurosurgeons were, by definition, spine surgeons and that we could not forsake this field to another specialty. A great national effort by organized neurosurgery, by every residency training program, and by private neurosurgical groups resulted in our having retained this field in our specialty The opportunities in this field are already being realized; the challenge is to ensure that we continue to train neurosurgeons who are complete spinal surgeons and whether we can do so within the confines of our traditional residency or whether further subspecialization is necessary in this field. This is not a simple topic because spinal surgery is so crucial to neurosurgery, accounting for more than half of our total practice. Should "spine surgery" be performed exclusively by those who have had subspecialized training in this area or should, at least to a variable degree, spine surgery be performed by all, or at least the great majority of, fully trained neurosurgeons? Is there a clear line of separation between "simple" spine surgery that all neurosurgeons should be competent to perform and "complex" spinal surgery that should only be performed by fellowship-trained spinal surgeons? Of all challenges to our specialty, the one we consider the most serious is a subtle, but determined, effort to splinter spine from the general neurosurgical domain and create "spine services" or independent "spine institutes," separate from neurosurgery, together with orthopedic surgeons, physiatrists, etc. Our strong personal opinion is that every neurosurgeon should be well trained in spinal surgery, whether or not they chose to specialize in other areas or have a "general" neurosurgical practice. This is not to deny that complex spinal surgery, such as complex cerebrovascular surgery, complex pediatric neurosurgery, etc., should best be performed only by neurosurgeons with dedicated specialization or significant experience in these areas.

The introduction of the microscope to neurosurgery has become part of history, even though it dates back to only a few decades. Many of us thought then that we were at the zenith of technological achievement in neurosurgery. Yet, who could deny the enhancement of our technical frontiers brought about by the development of cranial base techniques, endoscopy, intraoperative mapping, frameless stereotactic guidance, and the constant attempts to develop less invasive surgical approaches. The opportunities brought about by these technological developments are obvious to all. The challenge is to provide adequate exposure to these techniques during our residency and beyond.

Predicting the future is difficult for us, but of one thing we can be sure and that is that the future will belong to us only to the degree that we continue to emphasize neurosurgical research and, to that effect, expose all of our residents, to the highest degree possible, to the challengers and opportunities in investigational neuroscience. We have commented before on the importance of research to our future in particular reference to cerebrovascular surgery.[9] Few will argue that the future of glioma treatment lies in improved operative technological advancements. Unless neurosurgeons continue to be at the forefront of brain tumor research, it is doubtful that they could continue to claim leadership in the treatment

of primary brain tumors in the future. We have made great advances with endovascular therapy in the mechanical treatment of vasospasm. Would any rational neurosurgeon disagree with the notion that the ultimate solution to the problem of vasospasm is not mechanical, but rather will emerge from continuing intense investigation in the laboratory of the molecular and pathophysiological genesis of vasospasm? With the vast possibilities brought about by molecular engineering and gene therapy in the treatment of degenerative diseases, is it not reasonable for neurosurgeons to be heavily invested in research in this area so that they can claim therapeutic leadership for these common diseases in the future? We have learned that much of the damage that occurs after an ischemic or traumatic injury to the brain is secondary and occurs after the initial event. Shouldn't we continue to be at the forefront of research in neuroprotective maneuvers to prevent such secondary injury after trauma or stroke? Should we let embryologists, neonatologists, and geneticists lead the field of research into the etiology and prevention of congenital and in utero acquired conditions to which the neurosurgeon is exposed? Should the continuing investigation of neurocircuitry, neurotransmitters, and molecular alterations involved in some of the conditions currently within the scope of the functional neurosurgeon be left to neurologists, neurophysiologists, and other neuroscientists? If we do, we would be relegated to the technical role of the technician that needs to be guided to the target by a neurologist or neurophysiologist. In brief, the need for neurosurgeons to continue to support research and to be heavily invested personally in neuroscience research is undeniable. The challenge is whether, with all the other demands, we can continue to provide research opportunities to all of our residents during their training.

POSSIBLE CHANGES IN OUR RESIDENCY

Beginning with the axiom that our residency can be improved and having argued that we must be cautious not to "throw the baby out with the bathwater" simply because some aspects of our residency are not ideal to meet current demands, challenges, and opportunities, we will elaborate our thoughts on how we can improve our residency. We will begin by acknowledging that our thoughts are not original and that, in one way or another, we have heard and have been influenced by similar thoughts expressed by a variety of thoughtful individuals with a major interest in neurosurgical education.

One thought that we hear more and more often is to move towards a curriculum-based system. This could mean different things to different people. The common theme is that we should develop a curriculum to indicate what a resident should know and what he/she should be able to do technically at different stages of his residency. There is much thought given to moving towards a curriculum-based residency at the level of the ACGME. Of course, this would sound ideal to all. The crux of the challenge here is what to do if the resident does not meet expectations at different levels in the curriculum. Do we fire the resident? Do we make him/her "repeat" the year? Under this scheme, should some residents finish their "curriculum" in 3 years, whereas others may require 12 years? What would this do to our current resident structure? Who would pay for the extra years required by "slower" residents? It is also likely that some residents will accomplish in less than average time parts of the curriculum, but would be far behind the average in other aspects, depending on his/her interests and capabilities. Clearly, if we were to design an infernal nightmare for every program director, we could not come up with a better idea than this. Not many of us would last as program directors under such a scheme. Obviously, there is nothing wrong and there is much to be gained by our developing an idealized neurosurgical curriculum that would serve as a guide for program directors to structure their programs, monitor the progress of residents through the program, and make the necessary changes if it seems that the residents in their program are consistently falling behind in some aspects of the curriculum. However, in the spirit of evolution rather than revolution, we would argue strongly that our current system of most residents finishing their training at a specified and pre-determined period of time is desirable. This implies that there could not be a "standard" product from our residency training programs; some residents will be better or know more and be more technically capable than others and, more frequently, one resident will excel in areas and be deficient in others. Additionally, there will continue to be the exception, which will continue to give program directors a great headache, in which a particular resident simply cannot achieve the expected minimum level of competence in the prescribed time and may need 1 or 2 years of additional residency experience. Whether or not this is more disruptive for the resident and for the program than firing such a resident is something that each program director needs to tackle on a case by case basis. Incidentally, these exceptions can also occur in the reverse direction with particularly gifted residents who clearly do not "need" the extra years of training. At times, doing what is best for these individuals can also be a challenge.

Another paradigm that we have heard discussed with some frequency is whether or not we should return to the way we started training neurosurgeons and to the way neurosurgeons are still trained in several areas of the world and that is a "preceptorship." In this system, the resident remains a resident until the preceptor feels that he has become competent enough to start his neurosurgical practice independently. In addition to the problems outlined above for a curriculum-based residency without a specified number of years, the preceptorship lends itself to obvious abuses, inconsistencies,

and lack of accountability. The senior author has been exposed to this system in his travels and the only consistency he has found is that, if the trainee is the son or the nephew of the "preceptor," he generally does well, whereas the rest of the trainees are frequently used as "assistants" for an indefinite period of time, frequently taking them into middle age before they become independent. There does not seem to be any need to further discuss this system.

Another scenario, about which the senior author has frequently speculated with variable degrees of enthusiasm, is one that would require us to renounce our current perception that the neurosurgeon that completes his residency and becomes Board certified is capable, according to his own judgment, of taking care of all types of neurosurgical problems. Departing from this tenet would indeed be a revolutionary concept, but it is one that cannot be discarded so easily. Should we have a basic curriculum of, perhaps, 2 or 3 years during which the resident is exposed, in at least a superficial manner, to all aspects of neurosurgery and during which he/she becomes proficient in performing some of the less demanding forms of neurosurgery, such as trauma, simple spine surgery, surgery of some intrinsic brain tumors and convexity meningiomas, etc.? Under this scheme, the second part of the residency, again 2 or 3 years, could be spent by the resident developing deep expertise in one or two specialized areas of neurosurgery, such as complex spinal surgery, neurovascular and cranial base surgery, functional neurosurgery and epilepsy, pediatric neurosurgery, etc. This, of course, brings up the issue of certification and what kind of certificates should such residents have. Obviously, we would then have to have a "general" certification and go into the Pandora's box of sub-certification or certificates of special competence to indicate that particular individual's training and capabilities. One could easily see the chaos and attending headaches that such a system would bring to faculty and program directors, not to speak of patient care within the context of the residency training program. Such headaches may not be of the magnitude we would experience under a curriculum-based, unlimited-time residency, but would still be major. One could foresee that in one program, most residents would "choose" (clearly, we would not think of dictating their choice for our convenience) to subspecialize in vascular or spine surgery. There is no need to discuss the potential problems with this for this program. I would argue that this system would also present major problems for the trainee. It is an every day occurrence that a particular resident that may be committed to a particular area of subspecialization gets fascinated by a different area during his last years of residency. It is also a frequent occurrence that, upon starting practice, the resident who was clearly interested and committed to a particular area of neurosurgery finds himself, for practical reasons, focusing his practice on a completely different area. This may relate to the particular faculty or group he joins, to financial and lifestyle issues, or simply to changing interests. Would the scheme of a general basic neurosurgical curriculum followed by more intensive training in one or two areas meet the needs of such a neurosurgeon? What would the medicolegal implications be for the neurosurgeon who, even though he/she has gained experience, ends up with a bad result while practicing in a subspecialty area different from that in which his special training was? One could go on and on finding potential pitfalls with this system, but, as stated above, this issue of whether or not a neurosurgeon is competent to engage in all forms of neurosurgery when he/she finishes his/her residency and/or becomes certified will not leave us particularly as neurosurgery becomes more and more complex.

A PROPOSED SCHEME FOR A LONGER RESIDENCY

Without dismissing the last outlined scheme altogether, which may become necessary as neurosurgery becomes even more complex in the future, we would like to offer our thoughts on how we can improve, without too much disruption, our current neurosurgical residency. Basically, we will argue for a longer residency. Few would deny that, to cope with most of the demands and challenges outlined above, a longer residency would be needed if we continue to hold to the concept that, when our trainees finish their residency, they are capable, depending on further interest and experience, of engaging in any area of neurosurgery that they choose. Clearly, the current demands on fewer work hours make it even more imperative to consider lengthening the period of our residency. In fact, at least half of our programs now exceed the number of years required by the Board and several programs have lengthened their residency to a total of 7 or 8 years. The question is whether or not neurosurgery can do this and still remain attractive and competitive for the best candidates for postgraduate training who may be pressured, by lifestyle concerns and/or family demands, to choose a shorter residency. The staggering debt with which most of our trainees start their residency, and frequently their practice, is well known. It is also clear that an increasing number of our residents are already married and many have families by the time they start a residency or sometime during their residency. Many of them may look with some envy towards their frequently less bright colleagues in medical school who are now reaping the social and financial rewards of a successful professional career in a less demanding specialty that requires a shorter period of training. There would also likely be major financial barriers to a longer residency from the entities now involved in the funding of graduate medical education. How could we come at least halfway in addressing some of these challenges?

We would suggest dividing our residency into two clearly defined periods, one of which would be a "junior," or

basic, residency, which would consist of a 3 to 4 year period of time. We would favor 4 years, including the first year of general competence. Incidentally, we would argue strongly for a major effort by organized neurosurgery to gain complete control of the PGY-1 year, as orthopedics; ear, nose, and throat; and other specialties have. Only in this manner can we assure that our residents are not "used" by general surgical programs to fill the quota in the rotations that are less desirable to their "categorical" residents who plan to stay on the general surgical program. Things were different when the senior author was an intern. At that time, a general surgical internship, at least at the Massachusetts General Hospital where he trained, was pure joy. The interns worked very hard, in fact, every other night, but there was in every rotation much surgery to be done and at that level of surgical training, a trainee can take all the punishment in the world provided that he is rewarded with "surgical cases". Nowadays, when our PGY-2's come to us after their first year of general competence, under the aegis of the general surgical program, they have performed practically no surgery at all and have spent their time in the emergency room, perhaps closing some lacerations, or in the transplant service and in a variety of "private" surgical rotations where they serve as second or third assistants or do not come to the operating room at all. It is up to us when they begin in neurosurgery to take them through their very earliest surgical steps, including the techniques of wound closure and wound care. If we have to do that, why not give us that responsibility from the beginning? We could then design a wonderful year for our trainees that may include a heavy emphasis on intensive care, particularly neurological intensive care, and rotations such as plastic surgery; orthopedic surgery; ear, nose, and throat; and one or two well chosen general surgical rotations, depending on which are most likely to be beneficial for our residents in our particular institution. Obviously, this would also be the time to have the 3 months exposure to neurology and, perhaps, another elective such as neuroradiology or neuropathology.

The junior residency we have just alluded to would be the "grunt" time when the residents take night call in the hospital, do the scut work that needs to be done, get exposure to all areas of neurosurgery and, given the fact that we would have more flexibility because of the length of the residency, get a significant operative exposure. Depending on the different programs, we may develop schedules where one or two residents stay out of the operating room in charge of the intensive care unit and general floor care, coverage of the emergency room, etc., whereas the other junior residents come down to the operating room to serve as first assistants, learn how to open and close independently, perform some of the simpler cases and be exposed to the critical aspects of some of the more challenging neurosurgical operations so as to be stimulated to look forward to their "senior years." I would consider making a substantial exposure to radiosurgery and endovascular surgery a requisite during these years. Although encouraged to routinely keep up with the main neurosurgical journals, cognitive learning during these years would come mostly from daily exposure to the faculty, mandatory attendance to a carefully planned schedule of didactic and interactive conferences, and "case reading" based on the patients on the service at that time and the need to look up the answers to questions posed by the faculty. We envision this "junior" period to last 4 years, including the year of general competency.

We would insist in maintaining at least 1 year, and preferably 2 years, of research and/or elective rotations between the "junior" and "senior" years. As argued above, we would hope that it would be possible for us to continue to insist on at least 1 year of research exposure to all of our residents. At some programs, that may presently be impossible and this year may need to be a year of clinical research or electives depending on the resources of the program and the interests of the residents. The second year in those programs that chose it, could be a continuation of the research experience or a year of electives or possible special competence in a particular area of neurosurgery, such as functional neurosurgery, spine, endovascular surgery, etc. Whether or not this year can be considered a year of "in-folded" fellowship or not would depend on the particular area. But, generally, this should not be the intention of that particular year in our opinion. This 1 or 2-year period of time would be the time for systematic categorical reading in preparation for the written Boards and the resident would be expected to pass for credit the written examination in the spring of either the first or second elective year.

So far, we haven't proposed anything very different than what we already have in many, if not most, of our programs. The major difference we propose is to make the second part of the residency, the "senior" years, a very special and different time for the residents. Our feeling is that, given the demands of the field today, this period should preferably be 3 years, including the last year of Chief Residency. How could we make this second part of the residency attractive enough not to be seen as a time of sacrifice to go through before beginning to enjoy the rewards of our profession? First and foremost, we need to emphasize firsthand surgical experience during these years. Likewise, these years should be free of "scut work" to the best feasible degree. Clearly, the resident should have no night calls in the hospital during these years. This will ensure that they can stay in the hospital in the evenings as long as necessary to complete the surgeries in which they are involved without fear of exceeding the "work hours." Additionally, this would ensure that they are fresh the next day to engage in surgery. This would obviously enhance the appeal of those years very significantly. The second, and revolutionary, concept is to pay these senior residents not as residents or even fellows, but at a level that

would allow them to live a comfortable life with their families, not yet with a Lexus and a summer home, but perhaps with their own modest house and with the ability to send their younger kids, which by this time many of them will have, to a private school if they so choose. This particular change would be of special appeal to the spouses of the senior residents who may be enticed to look upon those senior years as something different than just "sacrifice" years. Where would the funds come from to pay these senior residents at a level of double what we currently do? We have no specific magical suggestions on this, but we trust that the ingenuity and entrepreneurial spirit of our faculties and program directors will be able to cope with this problem. If worse comes to worse, we, the faculty of the residency training program, need only to step back and realize what our residents do for us day in and day out to make our lives more comfortable and our work more enjoyable. Would our faculty members have to take their kids out of college or sell their boat if everything else fails and we had to contribute some of our clinical income towards supplementing the salaries of these senior residents? Yes, we are well aware of the problems with decreased reimbursement, increased malpractice premiums, the cost of coping with regulations, bureaucracy, compliance, etc., but, in spite of this, we are unaware of a substantial decrease in the average income of our faculty members. Clearly, we are maintaining our incomes by working harder and taking care of a larger number of patients but, how much of this could we do without the help of our residents?

The senior years that we envision in this scheme would be years to look forward to. We can contribute to this feeling not only through the objective means discussed above, but also through the way in which we think of and treat the residents during this period of time. These residents will no longer be "kids" and we may begin to think of them more as colleagues than as slaves. We could plan and discuss cases with them. We could ask them their opinion and change ours not infrequently when their ideas are better. We could make them partners in the operating room whether they are performing the surgery under our supervision or assisting us. We should treat them differently in conferences and daily rounds than we do the junior residents. We should get to know their families better and include them in our social life. In brief, we should make them feel as the professional practitioners that they already are rather than the students they were. These senior years we propose may remind some of the Senior Registrar years in the British system. However, a very important difference is that, whereas in England, at least in the past, the duration of these years was open ended, the scheme we propose calls for a limited and predetermined period of Senior Residency.

We feel that with the enhancements and modifications proposed above, we could sufficiently expose our residents to the multiple areas of expansion of our discipline previously discussed and others to come in the near future. In our opinion, this expanded residency would add legitimacy to our current claim that our residents are fully trained and capable of engaging in any neurosurgical area of their choice upon completion of their residency. This is not to say that in certain subspecialized areas, neurosurgical residents will not continue to choose to have a fellowship at the completion of even this lengthy period of residency. We would then have to decide issues of compensation and lifestyle for those who choose a fellowship at that time. One obvious scheme already used frequently is to make these fellows temporary junior partners or junior faculty (instructors) with the ability to bill on their own. We continue to envision the need for fellowships for such very specialized areas as endovascular surgery, complex vascular and cranial base surgery, complex spinal surgery, pediatrics and, functional neurosurgery and peripheral nerve surgery. Yet, this expanded residency scheme would make it legitimately possible for a practitioner who has completed the residency to engage in one of these very subspecialized areas without a fellowship through gradual exposure under more senior colleagues in either an academic or a private practice setting.

Any of the changes discussed above has very significant implications for the Residency Review Committee and the American Board of Neurological Surgeons, and their details and refinements would be most appropriately developed by our Senior Society which brings together Program Directors and senior academic faculty. We would prefer not to enter into speculation about the detailed changes that a scheme similar to the one we propose would require, except to suggest that, under this expanded residency scheme, it would be very logical to forego the 2-year practice requirement and make the residents eligible to sit for their oral Boards and obtain full certification at the completion of the residency. This may facilitate hiring of "fellows" as temporary junior faculty with obvious implications for ability to bill and to earn a reasonable salary.

CONTINUING POSTRESIDENCY EDUCATION

We will limit our comments in this respect to a minimum because there is currently a major emphasis in this area in organized neurosurgery, particularly within the ABNS. Suffice it to say that it is imperative that, like in so many other respects, our specialty takes a leadership role in this endeavor. Grudgingly, we would have to admit that, at least in the area of recertification, we have been, until recently, followers rather than leaders, which is not typical of our discipline. I do not feel that we need to apologize for the important role that postresidency education has always played in our profession. The quality of our two large national meetings, our subspecialty meetings, our postgraduate courses, our journals, and our specialty publications is a source of great pride for neurosurgery. However, by and large, although most neurosurgeons have

participated and benefited tremendously from these postgraduate educational efforts throughout the years, it has mostly been on a voluntary basis. Because of the caliber of the individuals who choose to join our specialty, this has been sufficient in the past. However, society and organized medicine will not tolerate this much longer and the need for recertification, to make these efforts mandatory rather than optional, is undeniable at the present time. We have nothing but praise for the way our leaders have approached this problem and for the very specific steps in this direction being taken by our ABNS with the help of our two major national organizations, the AANS and the CNS.

WHAT MAKES A GOOD TEACHER?

"Education should be constructed on two bases: Morality and prudence. Morality in order to assist virtue, and prudence in order to defend you against the vices of others. In tipping the scales toward morality, you merely produce dupes and martyrs. In tipping it the other way, you produce egotistical schemers." (Chamfort (1741–1794), Maxims and Thoughts, 1796)

In studies attempting to define the criteria of effective clinical teaching, residents identified six dimensions as the most important.[5] Interestingly, the first four focus on the interpersonal environment.

1. Establishment of a personal environment in which the resident is an active participant.
2. Positive preceptor attitude towards teaching and residents.
3. Humanistic orientation by the preceptor.
4. Residents' centered approach to instruction.
5. Preceptor's emphasis on the clinical problem-solving process.
6. Emphasis on references and research.

It is disconcerting to note that several current studies looking specifically at stress in surgical residents found that the trainees did not have close enough relationships with staff or mentors in their programs to feel they could approach them with stressful issues.[5]

If we value our educational role, we must take in consideration all of the above. "Role models" need to earn, not demand, the respect of the trainee, and, in the process, become worthy of emulating. If we wish to "teach by example," we'd better make, or become, a very good example! This having been accomplished, we can then be ready to rise to true "mentorship," which includes "role modeling," but goes beyond it.[11] We now need to explore and understand the qualifications, aspirations, and, more importantly, the shortcomings and inner threats of our "mentees" before we can claim to designate ourselves shepherds of their budding careers or advocates of their minds.

It is no coincidence that good mentors, beloved by their students, are also generally good physicians, beloved by their patients. In both sets of relationships, the needs of the other are placed before self, and, through this, to quote Mayeroff, "self-growth is actualized." Ironically then, teachers need students just as students need teachers, and physicians need patients just as patients need physicians!

THE TEACHER-TRAINEE RELATIONSHIP IN MEDICAL EDUCATION

Interestingly, there has been very little scholarly work addressing the influence the very nature of the teacher-trainee relationship imparts on the outcome of the training process. One may start by acknowledging, as do Tiberius et al.,[12] that a working definition of an interpersonal relationship between any two people in general consists of: 1) a series of interpersonal interactions that result in the development of, 2) cognitive and affective components, and 3) mutual awareness.

In the case of the teacher-trainee relationship, special characteristics also apply. First, the relationship is formal and, therefore, constrained by social and institutional roles. We are all too familiar with the currently reinforced and hyper-legalized layers of formality imposed on our educational process, and do not need to illustrate those here.

Secondly, there is an obvious imbalance of power between the two individuals, teacher and trainee. Indeed this inequality acts as a double-edged sword. This is because the teacher "experiences the pupil being educated, but the pupil cannot experience the educating of the educator." When a sculpture, while being created, realizes the mechanistic details involved in its own creation, it will lose the magic of the artistic experience. Similarly, as Buber[1] eloquently states, at the moment when the learner is able to jump across the gap separating him or her from the teacher, and experiences the world from the teacher's perspective, "the educative relation will burst asunder, or change into friendship."

The third special feature of a teacher-trainee relationship is a relative vulnerability and discomfort of the trainee. The acquisition of new knowledge never comes without a degree of un-learning of previous concepts. It is as if the teacher engages the learner in a period of cognitive uncertainty before a new tabula rasa can be created and written upon. This process is bound to be emotionally unsettling for the trainee, may engender a love-hate relationship with the teacher, and give a brand new meaning to the cliché "no pain, no gain."

A simple awareness on the part of both, teacher and trainee, of the special nature of their relationship, will go a long way towards improving the content of their educational exchange. Historically, teacher-student relationships have followed one of three different models[12]:

1. Model 1: Objectivistic: Transfer and shaping
2. Model 2: Interactionistic: Growth and conversation
3. Model 3: Relational: Inclusion and transformation

Model 1: "Just Listen!"

In this model, "transfer" refers to the transfer of information from the teacher to the learner as if the learner were a vessel to be filled. "Shaping" refers to the molding and shaping of the learner as if the learner were clay. The goal is factual mastery of content, and there is very little role for the interpersonal interaction between the teacher and the student. In neurosurgery, as in all medical disciplines, there is an inescapable curriculum of factual information that a trainee is bound to have to learn and assimilate. The question is not what to impart, but how to impart it.

Model 2: "Let's Talk About It!"

In this subsequent model, the concept of feedback and two-way communication becomes center stage. "Growth" and "conversation" metaphors are now more apt to use: "gardening" and "dialogue," respectively, rather than "transfer" and "shaping." In this model, social interaction becomes a fundamental step in understanding and learning. The teacher changes from being "the sage on the stage" to becoming the "guide on the side."

One may wish to draw an analogy between these concepts and the debate of whether or not one should use the microscope or the endoscope during surgery. While the microscope "delivers" it's bright light and passively reflects to the surgeon the factual reality beneath (Model 1), the endoscope actively "interacts" with the tissue being studied through dynamic feedback and engagement (Model 2). It escapes no one that, as the microscope and endoscope will both survive controversy and be around for decades to come, so too will the validity of both educational models we have just discussed.

Model 3: "Let's Become in tune!"

In this most recent trend in education, the teacher-learner relationship acquires even more importance than in the interaction model. The relationship becomes the very vehicle of learning by relying on a heightened awareness of the interaction. This model is best described by the metaphors of "inclusion" and "transformation." It relies on active listening and building a relationship of trust.

The evolution of teaching through these models has probably not been summarized more succinctly and aptly than in the words of William Arthur Ward:

"The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires." (William Arthur Ward, Professionalism, 1921)

I would venture to say that most neurosurgical educators espouse various facets of each of the three teaching models described above, and amalgamate different portions in different residents. We are all aware that our discipline is both a science and an art, rational and emotional. And, interestingly, there is neurophysiological research indicating that teachers who firmly believe in tapping the emotional, as well as the rational, mind of their students may indeed be on the right track. Students must "feel something" in order to learn. More importantly, they must care. This is why it is infinitely easier for our residents to acquire, retain, and reuse knowledge when the process is purposeful, goal-oriented, and revolves around patients currently being cared for. The medical mystery becomes their challenge and relief of suffering their homework. Whether the outcome of the battle is triumph or disappointment, they are unlikely to forget the struggle or its epilogue.

PROFESSIONALISM AND OTHER ASPECTS OF NEUROSURGICAL EDUCATION

In his AANS Presidential Address, the senior author commented on some of the "softer" aspects of neurosurgical education that, in his opinion, should be an integral part of the education of a neurosurgeon, but do not fall within the context of a prescribed curriculum.[7] In his Presidential Address to the North American Spine Society, Volker Sonntag delivered a very elegant and scholarly discussion of the significance of "mentorship".[11] We think that a commitment to these more subtle aspects of education that we will briefly touch upon is required of those of us who choose to go beyond being teachers and aspire to be true mentors. We should add that this mentorship function does not need to be confined to academic environments or to residency training programs. Wonderful neurosurgical mentors can be found in all settings in which our specialty is practiced, including many of our outstanding private practice groups where the more senior members of the group take this function very seriously as they recruit and work with younger colleagues. Because the senior author has had particular interest in these aspects of education and made them the subject matter of his previously cited Presidential Address, as well as several other talks in different settings, we will not do more than allude to some of these issues. But first let's reexamine what "professionalism" might mean.

It has long been accepted that neurosurgeons and physicians in general are "professionals." But what is a profession exactly? The educationist Mike Golby defines professionals as "persons who seek a broad understanding of their practice, paying attention not only to their developing competence, but also to the fundamental purposes and values that underpin their work".[6]

Fish and Coles,[3] as reported by Linda De Cossart in her Moynihan lecture,[2] state that a profession:

1. Is an occupation exercising "good" in the service of another.
2. Is specialized work in that it cannot entirely be understood by the layman.
3. Is not measured by financial reward only.
4. Is ethically and morally based.

5. Has an esoteric and complex knowledge base.
6. Exercises discretion.
7. Depends upon professional judgment.

Schon[10] beautifully captured the two prevailing views of "professionalism." He describes those as the Technical Rational (TR) and the Professional Artistry (PA) views. His TR view represents professional activities as skills that can be defined, described, and finally mastered. The PA view, on the other hand, defines professionals as being concerned with both means and ends, i.e., concerned with conduct rather than mere behavior. Fish and Twinn[4] extended Schon's work and summarized the two versions of "professionalism" (*Table. 4.1*).

It is clearly evident that our profession has a dual nature. It is highly technical in the operating room, the practical courses, and the surgical mastery showcases. It is highly artistic at the bedside, in the research think-tanks, and on the sociopolitical scene. Espousing only one view of it is short-sighted and indignant. It is saying that a penny has one side, that one hand can clap, and that there is an up but no down.

So what are we the educators to do with these "professional values?" How do we impart them on our trainees? Should we impart our personal values onto the young minds depending on us? The cynic would say no and would cite Arthur Dano:

"When I transfer my knowledge, I teach. But when I transfer my beliefs, I indoctrinate." (Arthur C. Danto, An Analytical Philosophy of Knowledge, 1968)

But, of course, all depends on the fabric of what is being taught. At the risk of offending the purists, we submit that what must be taught is the "whole package," an "all-or-none" process. In order to teach with conscience, the educator must commit his inner struggles along with his certainties, his emotional investments along with his calculated reasonings, and his heart along with his mind. In order to inspire, he must teach part of himself. Let us arm our trainees first with knowledge, then with the tools to analyze it, but lastly and mostly with the tools to discriminate what they need to retain from what is being taught. From pupils, let us make them apprentices, then practitioners and lastly judges. Theodore Roosevelt (1858–1919) said, "To educate the person in mind and not in morals is to educate a menace to society."

It is politically correct to emphasize the teaching of "ethics" and "professionalism" to our trainees. But, do we need formal lectures and training by ethicists and other professionals in our programs? A lecture along these lines every now and then would dress up our Grand Rounds schedule and may actually keep some of us awake for an hour. However, it is our opinion that ethics and professionalism (are they different?) are an integral part of every aspect of our practice, that this is best taught to a neurosurgical trainee by his/her neurosurgical mentors, and that this teaching should be part of our daily work with the residents, as opposed to being structured in formal didactic lectures. Our daily professional interactions with patients, with other col-

TABLE 4.1. The Technical rational and Professional Artistry views of professionalism

Technical Rational View (TR)	Professional Artistry View (PA)
Follows rule, laws, and prescriptions	Starts where rules fade, sees pattern and frameworks
Uses diagnosis and analysis	Calls on interpretation and appreciation
Wants efficient systems	Wants creativity and room to be wrong
Sees knowledge as graspable and permanent	Sees knowledge as temporary, dynamic and problematic
Applies theory to practice	Allows theory to emerge from practice
Regards a visible performance as central	Sees more to practice than surface features
Regards as vital the setting out and testing for basic competency	Sees more to the practitioner than the sum of the parts
Sees technical expertise as all	Values professional judgment
Sees professional activities as masterable	Sees mystery at the heart of professional activity
Emphasizes the known	Embraces uncertainty
Requires standards to be fixed, measurable, and controlled	Warns that which is fixed is usually trivial and argues that professionals should be trusted
Emphasizes assessment, appraisal, inspection, and accreditation	Emphasizes investigation, reflection, and deliberation
Thinks change must be made from outside	Believes professions can and should develop from inside
Believes that quality is really about quantity which is easily measurable	Believes quality comes from deepening insights into one's values, priorities, and actions
Requires technical accountability	Requires professional answerability
Requires training	Needs education
Takes the limited instrumental view of the professional	Sees education as necessary for developing the whole professional

leagues, and with the world at large are driven by our personal code of ethics and we cannot teach this to our trainees by better means than example. Clearly, the example they will get from different mentors will be different, which is good because, ultimately, it would be best and necessary for each of us to develop our own code of ethics and professional conduct. Can anybody teach a neurosurgical trainee how to deal with an end of life decision better than an experienced neurosurgical mentor who deals with these issues on a daily basis? Can that trainee learn in a better way than to be brought into such discussions when these cases present in our practices? Can an ethicist instruct a young neurosurgeon about when it is ethical to tackle, for example, a particular operation when he has a reasonable belief, based on his training and experience, that he can perform it successfully, but yet there may be another neurosurgeon nearby who has a substantially larger experience and a more established track record of good results with that particular operation? All of us, no matter how old we get, deal with these situations on a daily basis and there is no better way to mentor our trainees or younger colleagues than to openly discuss with them what is involved in our decisions to go ahead and operate on that particular patient ourselves or, on the other hand, to refer the patient to a more experienced or more capable colleague. What is the proper way of obtaining informed consent? Should we have lectures by ethicists, lawyers, compliance officers, etc. on this issue or should our trainees and younger colleagues develop their own guidelines in this respect by watching and being part of the way in which each of their mentors deals with this issue? In brief, we think that ethics, being a fundamental driving force of our daily professional life, cannot be taught other than through constant exposure and interaction of the trainee with his mentors.

"All ethics begins when the individual is taken to be of infinite importance – in contrast to nature, which behaves cruelly and playfully towards the individual." (Friedrich Nietzsche, 1844–1900, Philosophy and Truth: Selections from Nietzsche's Notebooks of the Early 1870's).

If there is an area that we absolutely cannot teach other than by example is that of the complex interaction between the physician and the patient. We could make everyday statements such as "The patient comes first" or "Always do what is right for the patient." However, this will not mean anything if not accompanied by the daily example of how we live by that principle. Just as clearly, what we teach by example will not be as effective if we do not have the intellectual honesty to openly admit the real reasons for which we, not infrequently, deviate, at least to some degree, from these sacred principles.

Within this general topic, we will digress a bit into two areas of professional ethics that have bothered us significantly through our career and that we endeavor to present to our trainees as what not to do later on in their professional lives. One of these concerns refers to the not infrequent, but, in our opinion, unfortunate practice of referring patients away from their home to a different city, and frequently to a different state, for treatment that could perfectly adequately be carried out at home. The senior author well remembers when he was in Boston having several patients over the years with difficult cerebral arteriovenous malformations referred from New York after being told that there was nobody in New York who could do such an operation. They appeared surprised when told that, in fact, there were several neurosurgeons in New York who could perform such operations at least as well and that they should stay at home for this difficult treatment that may require weeks in the hospital if things did not go well. Needless to say, it is hard to escape the conclusion that such referrals out of town are motivated by fear of promoting competition in one's hometown. The converse is, in my opinion, just as bad, and that is accepting for treatment of sometimes a relatively simple problem, patients from out of town who the accepting neurosurgeon knows perfectly well can be treated just as adequately by a colleague in the hometown of the patient. Not infrequently, these patients who were greatly inconvenienced by going out of town for their treatment end up having their aftercare by the local neurosurgeon who could have taken care of the patient just as competently from the beginning

The second issue is a bit more complicated and may be thought of as being a "politically sensitive" topic. That is the issue of promoting ourselves professionally directly to the public through a variety of means including the press, television interviews, appearances for purposes of personal promotion at meetings of patient support groups, etc. This practice has been greatly facilitated by the Internet. How many hours have we had to spend in our offices and clinics dispelling false impressions that patients have acquired from "browsing" the Internet about whatever diagnosis they have been given? Frequently, trying to dispel, in a professional and sensitive way, outrageous and false claims made by some of our colleagues in the Internet takes longer than the actual discussion of the patient's real problem and what a realistic approach to the problem should be. These practices would be, if not admirable, at least acceptable, if statements made in these different settings were accurate, professional, and in keeping with the kind of statements we would be proud to make in front of our own professional neurosurgical colleagues. Frequently, however, this is not the case and statements, implications, and insinuations are made that most respectable neurosurgeons would be embarrassed to have their colleagues hear. Implications to the effect that, for example, patients can be cured of their glioblastoma if they went to see that particular surgeon because of the special technology that he uses, an experimental form of treatment, or a special kind of radiation therapy that is "only" available at that institution are typical examples. Claims of cures with operations for chronic fatigue syndrome and/or fibromyalgia are other good examples

of this practice. Although these claims are frequently made in a somewhat indirect and veiled fashion, they certainly are effective in attracting patients and, in some instances, have resulted in the building of huge practices for those particular physicians or institutions. I feel strongly that our trainees should repeatedly hear from us exactly how we feel about these practices. If they respect us enough, they will think about it before engaging in this kind of activity. Traditionally, we have earned our reputations through the respect that we have gained from our colleagues by their reading our publications, listening to our scientific presentations, and observing our operations, and through interaction with patients who have frequently heard about us from other colleagues and patients. I hope that this will remain the means by which we stimulate our trainees to seek recognition in the future, rather than appealing to the public directly through false claims or thinly veiled half-truths. With the rapid spread of different media of communications today, this latter practice can clearly be very effective and successful in rapidly building a large and lucrative practice, but I hope we can convince our trainees that the respect of our colleagues is much more important than that.

Our trainees need to learn from us not only the science of medicine, but, just as importantly, that medicine is an art where we use the science as the pedestal upon which we build with experience, humanity, and emotional considerations to reach the ultimate decision of what is best for each of our patients. With the current emphasis on "evidence-based" medicine, another politically correct trend, it is not easy for our residents to realize that much of what we do and how we do it does not have a solid scientific basis and is shaped by personal experience, anecdotal evidence and frequently our mood at the time. We should share openly with our trainees and younger colleagues the complexity of our decision making processes and the agony sometimes involved in such decisions. This will certainly increase their respect for us and will reassure them that it is alright for them to go through such complex and, at times, painful exercises in introspection.

How much training should our residents have to help them understand and cope with the increasingly complex bureaucratic and legalistic interferences in our professional lives? Unfortunately, the answer is "more and more." We would be doing them a disservice if we didn't prepare them to deal as successfully as possible with these issues. Much of this will be imposed on us by the environment in which we work. We are constantly annoyed and often respond with a tantrum to the continuing demands to take our educational time, for example, out of our Grand Rounds, by different non-physicians who want to talk to us about compliance issues, privacy regulations, domestic violence, child abuse, integrity in research, etc. We would have little time left for didactic neurosurgical education if we agreed to all these demands on the time of our faculty and residents. We have no answers as to how best to deal with this increasingly serious problem other than to say that we must become our resident's advocates and fight forcefully on their behalf. The challenge to us is how, without blindfolding our residents to these necessary, but onerous, annoyances, to still remind them and hopefully convince them that neurosurgery is not only immensely rewarding, but also great fun. Again, only if they see us having fun will they be able to join us in the enjoyment of neurosurgery.

More importantly, and of tremendous current relevancy, is the issue of how to function in what we have called a "hyperlegalistic society".[7] Here, the constant guiding lantern should be, as much as it may sound like a cliché, to do what is best for the patient and keep the patient foremost in our thoughts. We cannot practice good medicine under the constant fear of legal interference, frequently in the form of malpractice suits. We are not aware of solid evidence indicating that practicing defensive medicine eliminates or even markedly reduces the risk of malpractice suits. Such risks would only be eliminated by our not practicing neurosurgery. Could this risk, if not eliminated, at least be reduced? Surely, this is the case. However, the degree to which we do less or more than is best for the patient for the purpose of lessening this risk is a complex matter of individual ethical behavior which, again, we cannot teach our trainees other than by example. How many and how often should we order unnecessary tests for the sake of avoiding medicolegal risks? How should we modify our informed consent process to minimize such risks? Should we discuss an exhaustive list of all the potential complications of the upcoming surgery with a patient with a recent subarachnoid hemorrhage who is already terrified about "an operation of the brain?" Should we tell the young patient with a new seizure and a normal magnetic resonance imaging scan that he or she may have a brain tumor, or should we simply say that it may be best to repeat the scan periodically to make sure that "nothing turns up" and risk being sued when the tumor shows up for "not having told me I could have a brain tumor?"

Should we educate our residents on how to serve as expert witnesses? First of all, do we need to ever be involved in testifying against another colleague on behalf of a plaintiff? Our answer, which is no, will certainly be perceived as politically incorrect. Yes, we should feel free, but not necessarily compelled, to testify against a colleague when we become aware of a situation in which a patient has been seriously hurt, and, in our opinion, deserves compensation, particularly to cope with his medical expenses and loss of income, because of gross negligence by one of our colleagues. The point here is to be very careful not to confuse our definition of negligence with that of the plaintiff's lawyer's. We are not negligent every time that our patient has a bad result. In our opinion, we are not negligent even when, in good faith and while trying to do our best, we do something that could have been done better and may have ended up with a better result for a patient. Of course, our esteemed legal colleagues will disagree with this opinion. Yet, we are

certainly negligent when we did not get out of bed to take care of a patient with an acute subdural hematoma that night instead of in the morning. We are also negligent when, out of carelessness, we are not sufficiently thorough in our approach to the patient who then experiences a major complication that could have been avoided by a reasonable degree of thoroughness and good judgment. We are certainly negligent when the patient ends up with a bad result because we undertake a procedure for which we do not have appropriate training or experience. In all of these cases, even though for one reason or another we personally have never done it, it is reasonable for a neurosurgeon to testify on behalf of the injured patient. However, we insist that we do not have to do so for the simple reason of preserving our current tort system which demands that the plaintiff has an expert witness. In our opinion, our current tort system is unfair and is driven and distorted by plaintiff attorneys' greed preying upon a society that has been taught to believe that successful, rather than just good, medical care is a patient's right. Frankly, it is a rotten system and we have no obligation to support and perpetuate it! Do we have an obligation to defend our colleagues as expert witnesses when we feel that they are being unfairly accused of malpractice? Again, the answer may not be agreeable to all, but we feel that we have no such obligation beyond that brought about by collegiality and love of our profession and our colleagues. What are our obligations if we agree to testify under either circumstance? We do not have much to add to the clearly spelled out code of ethics published by the AANS to this effect. To simplify it, we should testify objectively, knowledgably, and fairly. We feel strongly that we should not testify about issues outside of the daily scope of our practices in which we are not truly "experts." Even if we feel that we are "experts" in the particular topic at hand, it is our obligation to learn all we can about the particular case, which includes thoroughly reviewing the records available, as well as the literature, current and past, related to the issue at hand. In terms of objectivity and fairness, it is important to remember that, when we agree to testify, we do not become part of the "team" in the context of doing everything we can to have "our team" win, much as in a sports event. We should not avoid making statements that, while truthful, may be prejudicial to either the patient for whom we are testifying or the colleague we are trying to defend. There is no need to follow the lawyer's instructions as to what to say and how to say it. There is only a need, and an obligation, to state the facts as we know them as related to the patient at hand or the topic being discussed. There is certainly no need to "color" our testimony in order to benefit "our team." Yes, we are frequently paid for our time, because it is time away from practice, for testifying. However, it is important to remember that we are being paid for our time as expert witnesses and are not "hired" to become part of the team. Were the latter the case, it would be reasonable to be paid on a contingency basis only if our team "wins."We see no need to reiterate the gross perversity of such an approach.

THE PRIDE OF BEING A NEUROSURGEON

Finally, we want to end with the same thought with which we ended our AANS Presidential Address.[7] We do so because we do feel that this is an integral part of neurosurgical education. We do not see how our residents could endure the hardships of training to become a neurosurgeon without the awareness of the rewards and pride of our profession. Such awareness could not be learned in a better way than through the living example of their mentors. Our trainees must be reminded on a daily basis that there is no profession nobler and more rewarding than ours. Yes, the process to become a neurosurgeon is long and arduous, but it is also rewarding and those rewards begin early during our training and do not necessarily need to wait until we complete our residency. They will enjoy every day of their training with us if we show them our joy in seeing a patient improve, in making the correct judgment, in knowing the answer to even a simple question, in making the "right moves" at surgery, etc. They also will see the pain and suffering of their mentor when things don't go well or when we cannot help, or sometimes hurt, a patient. The realization that the rewards and privileges attending our professional lives are not an entitlement, but rather are earned through pain and sacrifice, will make them able to enjoy such rewards without apology and with great pride.

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