The Making of a Neurosurgeon: From Your Hands to Theirs

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J Neurol Surg B 2018;79:415–418.

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I had the great privilege of speaking about Neurosurgical Resident training at the Annual Meeting of the North American Skull Base Society 2018 and I was invited to share my comments with you in this brief manuscript. One of the most arduous and sacred tasks in surgery is teaching surgery and the art and science of “handing off the scalpel” to your resident (→**Fig. 1**). By my rough calculations, nearly 2,700 times per day somewhere in the United States, a patient awaiting surgery in pre-op hold hears something similar to the following, “Good morning Mrs. Smith, I’m the PGY 5 in Neurosurgery and I’ll be assisting Dr. van Loveren in your surgery today” (→**Fig. 2**).

So the conundrum is crystallized, no one wants to have a resident practicing on them, yet everyone wants a well-trained surgeon. How does the teaching surgeon navigate these waters? It will be different for every teacher and every student, but here I give you *Ten Rules for Those Who Teach Surgery*.

Rule #1: Become a master surgeon. As we learn from the military instructor who teaches the art and science of bomb disposal, “We can’t both be learning at the same time. One of you actually needs to know which wire to cut.” So it is in teaching surgery, one of you actually needs to know exactly

what should be done next. You can’t both be learning at the same time. As has been said, it takes 10,000 hours to become an expert. Well it takes 28,000 hours to train a neurosurgeon and it will take countless more hours to be ready to teach neurosurgery to others. If you had a time machine and went back in time to find your great surgical teachers I hesitate to tell you that you will not find them on the playground, on the golf course, or at the theater. Look for them in the laboratory, in the operating room, or in the library. If you are a millennial, a library is where we used to keep books. You have to do the work. Go to the cadaver laboratory after hours and on weekends. Learn the anatomy better than the average

Fig. 1 The hand off.

Fig. 2 Good morning Mrs. Smith.

surgeon. Hone your skills. The vascular laboratory for by-pass techniques is the best model to develop exquisite hand coordination skills for microsurgery. Film yourself and let others watch. Teaching is a performance and an anxiety to be overcome. Study the case tirelessly before arriving in the operating room. Choreograph every step, anticipate every pitfall, have a plan for every potential complication. Know the case so well that you can guide the resident's hands by narrative alone. I recall the joke about the pedestrian with a violin case asking a New York cab driver "How do you get to Carnegie Hall? Practice, practice, practice." I know so many great surgeons, and yet only a few great teachers.

Rule #2: Become a fortune teller. At various times you can enter my operating room and you will find me, gowned and gloved, watching the television monitor. I'm in teaching mode, meaning fortune telling mode. What is this resident thinking? What will he do next? If he makes a mistake, can I correct it, or should I intervene now with my classic phrase "Do you mind if I take a look?" Long before entering the operating room for this case, I was analyzing the resident. How do they think? How do they respond to questions at conference? How do they behave at dinner? How do they move physically? How do they move when playing sports or playing the piano? How do they respond to criticism? (→Fig. 3).

How do they react to stress or sudden threatening events? Many of us do this subconsciously. It's why we can't operate with a stranger. Start doing it consciously. This is not a new teaching methodology. When I was a chief resident, I was walking through the parking garage with my senior mentor Dr. Frank Mayfield. We walked by a car littered with food wrappers, some clothes, a few books, and the Journal of Neurosurgery. He asked whose care this was and I told him it belonged to the new neurosurgery fellow. He told me the fellow was not to be allowed in the operating room by themselves until I could assure him that the way they kept their car was not a reflection of how they would operate. Dr. Mayfield was always watching and always judging what kind of a neurosurgeon you would be.

Rule #3: Teach the resident to telegraph their moves. These are students and they don't know what you need as a

Fig. 3 How do they move. How do they respond to criticism.

teacher if you don't tell them. For you to function as a great teacher, they have to know what it takes to be a great surgical learner. They should say things like, I'm going to cut this adhesion, or I'm going to take this vein. They should let you know that they are aware of their location by saying, I believe the basilar artery will be right behind this piece of tumor here and I'm going to dissect a bit more cautiously. They should learn to let their instrument hover for a moment or two in a certain location so that the teacher sees it and gives silent approval by having seen it. I keep an anecdote in the back of my memory to remind me that silent approval can occasionally fail and it's appropriate to sometimes just ask, what are you thinking, especially if the resident's movements become tenuous, moving not with caution but with fear, hovering so long that you wonder if they're guessing. My mentor and a great teacher, Dr. John Tew, and I were staring intently at the monitor while the chief resident opened the Sylvian fissure under the microscope to expose a middle cerebral artery (MCA) aneurysm. His microscissors hovered over an arachnoid adhesion between a branch of the MCA and the brain. Suddenly, the scissors shifted just a millimeter or two and he cut the arterial branch. As blood filled the field Dr. Tew turned to me and said quite calmly, "honestly Harry, you thought he was going to cut the adhesion too didn't you." Work on those fortune telling skills, teach the residents telegraphy, and by the way, work on those skills for repairing arteries. One of the most skilled residents I have ever seen was a poor learner in the operating room in part because he was so skilled. He moved through the case faster than I or any other faculty member could predict his next move. We were following the case, not leading it. We all became uncomfortable with him in the operating room but many of the faculty couldn't pinpoint the source of their discomfort. After all, he was clearly our most talented resident. Eventually, I pulled him aside and shared my observation. I can't teach you at your current pace of operating, can't predict your moves. Slow down, telegraph your moves, talk your way through the case so your faculty knows what you're thinking. You're an exceptional surgeon, but a lousy student.

Rule #4: Be an intentional teacher. You must come to the operating room with the intent to teach and you must mean it. It is a slower process than conventional surgery. Like the professional caddy for the new golfer, you have to tell the student everything there is to know about the lie of the green and then have them take the shot. The best way to convey intentional versus incidental teaching is by example. I was taking a resident through the clipping of a slightly complicated MCA aneurysm. They were exposing the aneurysm but I didn't sufficiently understand the anatomy to maintain comfort with the resident as the primary surgeon. I said as usual, "Do you mind if I take a look." Truly a rhetorical question. I isolated the aneurysm between temporary trapping clips and performed a more aggressive dissection and obtained a comprehensive look at all sides of the aneurysm and the location and configuration of branches emerging from the neck. Once I fully understood the exact and best clip placement and configuration, I removed the temporary clips, allowed the Sylvian fissure to close back over the aneurysm,

stood up from the chair and said, “OK, you can proceed now.” That is intentional teaching. Are you really up to that level of patience, diligence, and devotion to make the next generation of neurosurgeons?

Rule #5: Give ‘em a little of the “white tile treatment.” This saying comes from one of my residency training mentors who said that after completion of training you would inevitably encounter the white tile syndrome in which you look up during a particularly stressful or confusing part of the case hoping to see the all-knowing eyes of your mentor bestowing silent approval, giving a verbal cue, or even nodding a willingness to take over. Instead, you see only the white tile wall of the operating room and you realize that you are alone, you are in charge, you are the most knowledgeable and skilled person in the room, and this patient is depending completely upon you, and you alone. On occasion, my partners will see me leaning on the wall just outside the door to my operating room and ask, “Hey van Loveren, what are doing out here in the hall,” and my answer is blunt, “TEACHING.” These white tile moments are carefully selected, carefully orchestrated, and critical for the learner who needs to feel the stress of decision making and continue to progress through the case. When you reenter the room and see a few beads of sweat on the resident’s forehead, something light like “same case?” is always appropriate.

Rule #6: Use accelerators or as we like to say, “Let’s pour a little gas on this fire,” the fire being the learning exercise. Our residents run their own weekend cadaveric dissection club, while the faculty provides cadavers, instruments, and lunch. We have a summer dissection course (► Fig. 4).

We have laboratories for spine instrumentation, endoscopic surgery, interactive endovascular simulators, and a mouse by-pass laboratory where the mice are essentially valet anesthetized for you with a simple phone call. This is all

expensive but worth it. You can clearly tell the difference between a resident in the operating room who has learned everything possible from attending surgical procedures and one who has “blown it out” in the laboratory. The latter is more comfortable in their movements, knows what’s beyond what is in view, and is able to hold the teacher at the observer’s side of the scope for more of the case. As surgical educators, we are late adopters of simulation compared with many industries involved with training critical tasks. When I was a team physician for the Cincinnati Reds baseball team, Pete Rose was their coach and was being heavily criticized for bringing a player up from the minor leagues and letting him go after only one game. The critics said the player deserved more time to learn the game. His response, “you don’t come to the major leagues to learn how to play baseball.” Well to the residents I would say, the operating room is the major leagues, and you best come already knowing how to play.

Rule #7: Mentor aggressively. Real mentoring is not for sissies. You have to address resident shortcomings, errors, and failures immediately, constructively, and privately. I cringe if I hear a faculty member complaining about a resident’s performance to another faculty member rather than speaking to the resident directly. I cringe when a resident gets a poor 6-month evaluation, when for 6 months, the resident was unaware that they were performing poorly. “New Innovations,” the neurosurgery resident performance assessment program is a review format, it is not a format for educating the resident or adjusting performance. Real teachers are experts in “difficult conversations.”

Rule #8: Make them teach. Teaching as a method of learning is not new. The Roman philosopher Seneca in the first century A.D. stated that “while we teach we learn.” In teaching a surgical procedure, we are forced to understand more completely so that we can describe it more simply. The learner who teaches will benefit from “the protégé effect,” in which learners who teach perform at a higher level. Observing a resident teaching a junior resident will also tell you everything you need to know about whether the senior resident really understands a procedure in depth and, equally important, whether they have adapted the procedure to a new personal paradigm of their own invention, documenting that now, they own it.

Rule #9: Put your humanity on display. In deference to some of my training mentors, I was raised in era of the “Gods of Neurosurgery.” In that era, surgeons didn’t make mistakes, residents made mistakes, patients had poor protoplasm that cause surgical failures, poor outcomes were just the natural unfolding of the universe, luck, good and bad, were tangible commodities. Many of us learned to be neurosurgeons in this environment but it is a slower process than just being told the truth and not having to figure it out for ourselves over a longer period of time. It’s alright to tell the resident that your plan was perhaps not the best one, that at some point the complexity of the case exceeded your personal skill set, that at a critical point in the case your ego perhaps drove you further than you should have gone. Then, they will understand what really happened in the case, how it might have been done better, how they should remember this and

Fig. 4 The president dissection club.

handle a similar case in the future. So you can pretend to be a “God-like” surgeon or you can put your own humanity on display and show them a path forward that even an ordinary human being can follow.

Rule #10: Take “Extreme Ownership” of this process. This is a concept crystallized in the New York Times bestseller “Extreme Ownership, How U.S. Navy Seals Lead and Win.” As it is on the battlefield, so it is in the operating room. The Commander owns the battle and any complications reflect

his or her poor planning, poor communication, or poor oversight. So it is in resident training. You cannot come to morbidity and mortality conference and claim that the resident caused your complication any more than a battlefield commander can go to debrief and claim that his/her soldiers failed to take the hill. You planned it, you communicated it, you own it. Teaching surgery is an arduous and sacred task, critical to the survival of our profession. Take extreme ownership of this process.