The Role of Laboratory Dissection Training in Neurosurgical Residency: Results of a National Survey

Varun R. Kshettry, Jeffrey P. Mullin, Richard Schlenk, Pablo F. Recinos, Edward C. Benzel

■ OBJECTIVE: **Work hour restrictions and current quality, financial, and legal concerns have reduced resident operative volume and autonomy. Although laboratory (cadaveric or animal) dissection has a rich history in neurosurgery, its current role in resident training is unclear. Recent literature suggests educators have looked to simulation to accelerate the learning curve of acquiring neurosurgical technical skills. The purpose of this study was to determine the prevalence, characteristics, and extent of laboratory dissection in neurosurgical residency programs in the United States.**

■ METHODS: **A survey was sent to program directors of all 100 neurosurgical residency programs in the United States.**

■ RESULTS: **Response rate was 65%. Most programs (93.8%) incorporate laboratory dissection into resident training. Most programs have 1–3 (36.1%) or 4–6 (39.3%) sessions annually. Residents in postgraduate years 2–6 (85.2%–93.4%) most commonly participate. The most common topics are cranial approaches (100%), spinal approaches (88.5%), spine instrumentation (80.3%), and endoscopy (50.8%). Thirty-one (47.7%) programs use artificial physical model or virtual reality simulators; the most common simulators are endoscopy (15.4%), microvascular anastomosis (13.8%), and endovascular (10.8%). Only 8 programs (13.1%) formally grade dissection skills. Educators (95.4%) believe laboratory dissection is an integral component of training and no respondent believed simulation could currently provide greater educational benefit than laboratory dissection. Most (89.2%) respondents would support a national "suggested" dissection curriculum and manual.**

■ CONCLUSIONS: **In neurosurgical resident education, laboratory dissection is widely used; however, significant variation exists. Nonetheless, program directors believe laboratory dissection plays an integral role in neurosurgical training and is currently associated with greater educational benefit than simulation.**

INTRODUCTION

Resident training is facing a multitude of changes. Duty hour restrictions impose limits on training time and the total number of cases performed by residents while in training (8, 14, 25, 36). In addition, the evolving health care climate has reduced resident autonomy in the operating room. New initiatives, such as outcome-based reimbursement and the reporting of physician-specific outcome data, might further pressure staff surgeons to reduce resident autonomy. In addition, hospitals have an incentive to reduce operating room time to curb costs. These changes adversely affect the opportunities for residents to develop surgical skills. The desire for transparency and the perceived need to develop training standards has led the Accreditation Council for Graduate Medical Education (ACGME), the Society of Neurological Surgeon (SNS), and the American Board of Neurological Surgeons (ABNS) to develop standards for assessing trainee competency and documenting trainee proficiency (4, 18, 37). To incorporate such changes and to maintain a high standard for our graduating trainees, educators are being forced to devise more effective and efficient educational techniques. We can no longer rely on the "sponge" educational concept (i.e., if trainees spend enough time in the hospital and

Key words
- Cadaver
- Education
- Laboratory
- Neurosurgery education
- Residency
- Simulation
- Training

Abbreviations and Acronyms

AANS: American Association of Neurological Surgeons
ABNS: American Board of Neurological Surgeons
ACGME: Accreditation Council for Graduate Medical Education
SNS: Society of Neurological Surgeons
VR: Virtual reality

Neurosurgical Skills and Anatomy Laboratory and Department of Neurosurgery, Neurological Institute, Cleveland Clinic, Cleveland, Ohio, USA

To whom correspondence should be addressed:
Varun R. Kshettry, M.D.
[E-mail: kshettv@ccf.org]

Citation: World Neurosurg. (2014) 82, 5:554-559.
http://dx.doi.org/10.1016/j.wneu.2014.05.028
*Journal homepage: **www.WORLDNEUROSURGERY.org***

*Available online: **www.sciencedirect.com***

operating room, they will absorb enough to reach a critical threshold of knowledge and surgical skills).

Much attention has been given to the role of simulation as a method to supplement neurosurgical training (19, 44, 45, 46). In the literature, much of this has been directed toward computer-based virtual reality (VR) and artificial physical model simulation (2, 3, 5-7, 9, 12, 13, 15, 20, 22, 26-30, 39, 41-43, 48). This is because trainees report greater benefit from cadaveric dissection than from artificial physical models or computer-based VR simulators (19).

Laboratory cadaveric dissection has a rich history in neurosurgical training (1, 10, 11, 17, 23, 32, 34, 35, 51, 53). In the changing landscape of neurosurgical education, the role of laboratory dissection as a training tool in neurosurgical residency programs remains unclear. Therefore, we conducted a study to assess the prevalence, characteristics, and extent of laboratory dissection in neurosurgical residency programs in the United States.

METHODS

An electronic cover letter and survey was constructed and reviewed by all authors (**Table 1**). The cover letter stated that the purpose was to study the role of laboratory dissection in neurosurgical residency programs in the United States. A list of programs in the United States was obtained from the American Association of Neurological Surgeons (AANS) neurosurgical residency directory web database (49). One hundred programs were identified. Contact information for the program director of each program was obtained from the ACGME, the program's website, or by contacting the program coordinator, when necessary. Three attempts were made to contact each program director with approximately 2-week intervals between attempts.

RESULTS

Prevalence of Laboratory Dissection Training

There were 65 respondents (65% response rate). Sixty-one programs (93.8%) currently incorporate cadaveric or animal dissection in their neurosurgical residency program. Of the 4 programs (6.2%) that do not incorporate laboratory dissection, the most commonly cited barriers to implementation are resident time, need for a laboratory director, and specimen acquisition and/or storage (**Figure 1**). Faculty participation and equipment were less common concerns.

Logistics Surrounding Laboratory Dissection

For programs that incorporate laboratory dissection into the training program, specific questions were asked about the nature of the dissection training. Most programs (58.3%) have scheduled sessions with additional laboratory availability for resident independent study. Conversely, 31.7% of programs have only scheduled sessions without the option for independent self-study and 10.0% had no scheduled sessions, but do have a laboratory available for independent self-study. Most programs schedule 1–3 (36.1%), 4–6 (39.3%), or 7–12 (18.0%) sessions per year (**Figure 2**). A very small minority of programs (2, 3.3%) schedule 13–26 sessions per year and 1 program has a separate rotation with time dedicated to laboratory dissection. Of the programs with more than 4 scheduled sessions per year ($n = 40$), 55.0% stated that they had a formal curriculum. The source of funding for the laboratory dissection program is primarily industry in 33.3%, primarily institution in 23.3%, equal industry and institution in 33.3%, and from other sources in 10.0%.

Resident Participation and Curriculum

Laboratory dissection programs most commonly involve residents in the postgraduate year levels 2–6 (range, 85.2%–91.8%), which reduced to 75.4% in postgraduate year level 7 (**Figure 3**). Postgraduate year level 1 trainees participate in laboratory dissection in 77.0% of programs with a laboratory dissection curriculum. Laboratory dissection curricula most commonly include cranial approaches (100%), spinal approaches (88.5%), and spinal instrumentation (80.3%) (**Figure 4**). Endoscopy (50.8%), microvascular anastomosis (50.8%), and peripheral nerve procedures (34.4%) are less often included. Formal grading or evaluation of a trainee's laboratory dissection skills is conducted in only 8 programs (13.1%).

Thirty-one program directors (47.7%) stated that they incorporate simulators in the residency program. Among all responding program directors, the most common types of simulators used are endoscopy (15.4%), microvascular anastomosis (13.8%), and endovascular (13.8%) (**Figure 5**).

Educational Impact

Respondents were asked: "Do you believe that laboratory dissection is an integral component of a neurosurgical residency program," and 95.4% replied affirmatively. Respondents were also asked: "Do you believe the potential impact on resident education is greater from simulators, in the current technological state, or laboratory (cadaveric or animal) dissection?" Most respondents (69.2%) stated the impact on resident education is greater with laboratory dissection and 30.8% stated they were equal (**Figure 6**). No respondent believed simulation, in its current state, could provide greater impact on resident education. Finally, 89.2% of respondents stated that they would be in support of an initiative to develop a suggested universal curriculum and manual for laboratory dissection for residents.

DISCUSSION

The Role of Laboratory Cadaveric Dissection

The potential benefit of laboratory dissection and simulation in neurosurgery is readily apparent. Skills can be developed in a controlled environment with no risk to patients. This type of training can be used to advance residents through the early part of the learning curve of acquiring technical skills. However, the optimal nature of such supplementary training is still under debate. Our study demonstrates that the majority of programs incorporate laboratory dissection into the residency program and about half incorporate some form of simulation (physical model or computer-based VR). The high number of programs incorporating laboratory dissection suggests that the hurdles of implementation (e.g., space, equipment, funding, and time) can be overcome with a combination of institution and industry resources. Interestingly, all four programs without laboratory dissection stated resident time as a barrier to implementation. In the era of duty hour restrictions, one must consider that in-house time dedicated to laboratory dissection or simulation is counted toward duty hours and therefore, any such activity must possess sufficient value to warrant an obligatory reduction in clinical or surgical time. One potential advantage of physical model and