Neurosurgical Skills Assessment: Measuring Technical Proficiency in Neurosurgery Residents Through Intraoperative Video Evaluations

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■ OBJECTIVES: Although technical skills are fundamental in neurosurgery, there is little agreement on how to describe, measure, or compare skills among surgeons. The primary goal of this study was to develop a quantitative grading scale for technical surgical performance that distinguishes operator skill when graded by domain experts (residents, attendings, and nonsurgeons). Scores provided by raters should be highly reliable with respect to scores from other observers.

■ METHODS: Neurosurgery residents were fitted with a head-mounted video camera while performing craniotomies under attending supervision. Seven videos, 1 from each postgraduate year (PGY) level (1–7), were anonymized and scored by 16 attendings, 8 residents, and 7 nonsurgeons using a grading scale. Seven skills were graded: incision, efficiency of instrument use, cauterization, tissue handling, drilling/craniotomy, confidence, and training level.

■ RESULTS: A strong correlation was found between skills score and PGY year ($P < 0.001$, analysis of variance). Junior residents (PGY 1–3) had significantly lower scores than did senior residents (PGY 4–7, $P < 0.001$, t test). Significant variation among junior residents was observed, and senior residents' scores were not significantly different from one another. Interrater reliability, measured against other observers, was high ($r = 0.581 \pm 0.245$, Spearman), as was assessment of resident training level ($r = 0.583 \pm 0.278$, Spearman). Both variables were strongly correlated ($r = 0.90$, Pearson). Attendings, residents, and nonsurgeons did not score differently ($P = 0.46$, analysis of variance).

■ CONCLUSIONS: Technical skills of neurosurgery residents recorded during craniotomy can be measured with high interrater reliability. Surgeons and nonsurgeons alike readily distinguish different skill levels. This type of assessment could be used to coach residents, to track performance over time, and potentially to compare skill levels. Developing an objective tool to evaluate surgical performance would be useful in several areas of neurosurgery education.

INTRODUCTION

Since the implementation of the resident work hour restrictions in 2003, there has been a growing need to properly train residents in less time to safely practice Neurosurgery Much debate exists on whether there have been increased neurosurgical complications or changes in outcome since the implementation of the duty-hour restrictions.[1-4] A recent survey demonstrated that most chief residents believe that there has been an increase in on-call duty hours and a decrease in operating room time with new work hour restrictions.[5] As resident work hours have decreased, resident exposure to the experience and guidance of an attending physician has decreased. Years of residency have increased, highlighting the need for improved surgical proficiency.

Novel training methods to augment the residency curriculum and complement the operating room experience would be useful. The use of simulation in residency training can serve such a purpose. Simulation has been highly validated in such fields as aviation and the military, but its use in surgical training curricula has been limited, and recognition of its value has increased over the past decade.[6,7] A recent survey of neurosurgery program directors[8] demonstrated their belief that simulation training could serve as a major supplement to training and improve patient

Key words
- Intraoperative evaluations
- Neurosurgery simulation
- Surgical skills
- Video-based resident training

Abbreviations and Acronyms
ANOVA: Analysis of variance
OSATS: Objective Structured Assessment of Technical Skill
PGY: Postgraduate year

outcomes. Studies have demonstrated the successful implementation of simulation programs into existing medical curricula and found significant educational benefits, with 1 study reporting an 82% perceived proficiency improvement after simulator use among junior neurosurgery residents.[9,10]

The surgical literature has commonly demonstrated wide variation among patient outcomes across different surgeons for a given procedure.[11] A recent study among practicing bariatric surgeons linked differences in patient outcome and postoperative complications to the technical skill of the surgeon, using a peer-based video scoring of the surgery using a variant of the commonly used Objective Structured Assessment of Technical Skill (OSATS) method in general surgery training.[12,13] A direct link to patient outcomes and a validated scoring system such as the OSATS are the key prerequisites to gauge the progress of resident and practicing surgeon proficiency given external factors such as coaching and simulation-based training.[14,15]

Our institution opened a neurosurgery simulation program in 2012 to strengthen resident education. Although technical skills are fundamental in neurosurgery, there is little agreement on how to describe, measure, or compare skills among surgeons. Before

Evaluation of Operative Skill

Title: (Place a Check Mark)

☐ Attending Surgeon
 Specialty Interest
 (Choose One)
  ○ Brain
  ○ Spine
  ○ Other

☐ Attending Physician
☐ Neurosurgery Resident
☐ Resident (Other)
☐ Nurse
☐ Nurse Practitioner
☐ P.A.
☐ Surgical Tech
☐ Administrator
☐ Other_____

Years of Experience in Role:

(Fill in the Blank)_____

Highest Degree Received:

(Fill in the Blank)_____

Work Site: (Place Check Mark(s))

☐ Operating Room
☐ N.S.I.C.U.
☐ Floor
☐ Other_____

Resident Performance

1 = intern

3 = mid-level resident

5 = chief resident

(Place a Check Mark for Each Section)

Performance Categories	1	2	3	4	5
1. Incision					
2. Efficiency of Instrument Use					
3. Bleeding Control/Cauterization					
4. Tissue Handling					
5. Drilling/Craniotomy					
6. Confidence Level					
Overall Assessment					

Guess PGY Level of Resident _____

Figure 1. Scoring sheet for evaluation of operative skill.