The Cognitive and Technical Skills Impact of the Congress of Neurological Surgeons Simulation Curriculum on Neurosurgical Trainees at the 2013 Neurological Society of India Meeting

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OBJECTIVE: **To assess the impact of a simulation-based educational curriculum of 4 modules on neurosurgical trainees at the Neurological Societies of India annual meeting, which was held in Mumbai, India, in December 2013.**

METHODS: **We developed a microanastomosis, anterior cervical discectomy and fusion (ACDF), posterior cervical fusion (PCF), and durotomy repair and their corresponding objective assessment scales. Each module was divided into 3 components: 1) a before didactic cognitive knowledge and technical skills testing, 2) a didactic lecture, and 3) an after didactic cognitive knowledge and technical skills testing. We compared the trainees' cognitive and technical scores from the before and after testing phases. Wilcoxon sum rank test was used to test statistical significance. The incorporation of a simulation-based educational program into neurosurgical education curriculum has faced a number of barriers. It is essential to develop and assess the success and feasibility of simulation-based modules on neurosurgical residents.**

RESULTS: **The knowledge test median scores increased from 60%, 69% to 72%, and 60% to 80%, 85%, 90%, and 75% on the microanastomosis, ACDF, PCF, and durotomy modules, respectively ($P < 0.05$). The practical hands-on scores increased from 45%, 45% to 60%, and 65% to 62%, 68%, 81%, and 70% on the microanastomosis, ACDF, PCF, and durotomy modules, respectively ($P < 0.05$).**

CONCLUSIONS: **Our course suggests that a simulation-based neurosurgery curriculum has the potential to enhance resident knowledge and technical proficiency.**

INTRODUCTION

Simulation has proven to be a cornerstone of education for various domains including aerospace, airline, and the military (27). In health care, through the use of cadaver dissection, simulation has been used for centuries as a physical model. As educational theories and understanding of teaching philosophies matured, the concept of modern simulation has also evolved. With the introduction of laparoscopic techniques, an education gap was noted when using only simulation models.

Key words
- ACDF
- Durotomy
- Education
- Microanastomosis
- PCF
- Resident
- Simulation
- Spine
- Vascular

Abbreviations and Acronyms
ACDF: Anterior cervical discectomy and fusion
CNS: Congress of Neurological Surgeons
NOMAT: Northwestern Objective Microanastomosis Assessment Tool
OSATS: Objective Structured Assessment of Technical Skill
PCF: Posterior cervical fusion

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*Citation: World Neurosurg. (2015) 83, 4:419-423.
http://dx.doi.org/10.1016/j.wneu.2014.12.006*

Supplementary digital content available online.

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

Thus, present day simulation models are linked to the educational needs such as predefined curriculums. Experienced surgeons quickly identify the assets of learning new techniques in a simulated environment, proving this approach to be highly successful (10, 19, 22, 25).

Incorporation of a simulation-based educational program into a neurosurgical education curriculum has faced a number of barriers including time constraints, funding limitations, technical limits of the current simulators, and the absence of validated objective assessment tools and curricula (13, 27). Recognizing the educational value of this modality. the Congress of Neurological Surgeons (CNS) has incorporated simulation approaches into their national and international educational curricula. Standard neurosurgical microsurgical and operative techniques are essential skills in which every neurosurgical resident should achieve competency. With changes in medical education, adequate access to these techniques can be challenging. To assess the potential impact of a simulation-based educational curriculum on neurosurgical residents, we introduced 4 simulation modules: microanastomosis, anterior cervical discectomy and fusion (ACDF), posterior cervical fusion (PCF), and durotomy repair and their corresponding objective assessment scales to the Neurological Societies of India annual meeting, which was held in Mumbai, India, in December 2013.

METHODS

Twenty neurosurgery residents from India participated in a structured simulation-based didactic and technical course. This consisted of simulation curriculums with a microanastomosis module, an ACDF module, a PCF module, and a spinal durotomy repair module.

Microanastomosis Module

Four surgical microscopes were used for the microanastomosis session. One 3-mm silicone-based artificial vessel was provided for each resident. The vessel was placed on a wetted filter paper in a petri dish, which was fixed under the microscope (**Figure 1**). One scissor, 1 jeweler, 1 needle holder, and one 8-0 suture per trial were provided for each resident to perform an end-to-end anastomosis with interrupted stitches.

ACDF Module

Six simulator models (Medtronic, Minneapolis, Minnesota, USA) were available for the ACDF module. A kerrison rongeur, a nerve hook "micro dissector," an anterior cervical plate and screws, interbody cages and insertion tools, Kaspar distraction posts and

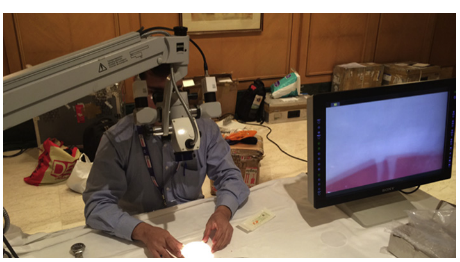

Figure 1. Microanastomosis setting.

Figure 2. Anterior cervical discectomy and fusion setting.

retractor sets, and anterior cervical retractors were provided for the residents to perform an ACDF (**Figure 2**).

PCF Module

Three simulator models from the CNScreated by Phacon (Leipzig, Germany) along with the drill, suction, nerve hooks, and cerebellar retractors were available for the PCF module. Using these instruments, the residents had to perform a posterior cervical laminectomy and foraminotomy (**Figure 3**).

Durotomy Repair Module

Three simulator models (Pacific research Laboratories, Vashon Island, Washington, USA) along with the suture (4-0), needle holder, tubing, latex tubes, forceps, and intravenous bag were provided for the durotomy repair module. The neurosurgical trainees were asked to repair a spinal durotomy with these available tools (**Figure 4**).

Course Design

The overall course began with a 30-minute introductory lecture on simulation after which 4 rotations were created: microanastomosis, ACDF, PCF, and durotomy repair. Each session was scheduled for 2 hours. Four faculty members from the CNS proctored the residents during the sessions. The residents were given 15 minutes to complete a multiple choice test to assess their baseline knowledge on cerebral microanastomosis, ACDF, PCF, and durotomy repair (depending on which session they were in). Afterward, the residents were given 20 minutes to perform the specified task in each session. The residents' performance was graded based on each module's respective Objective Structured Assessment of Technical Skill (OSATS) scale (**Supplementary Materials 1–4**).

Figure 3. Pposterior cervical fusion setting.