

Surgical Theater's Selman Surgical Rehearsal Platform (SRP) : Potential Uses in Microsurgery Andrew E. Sloan MD; Nicholas C. Bambakidis MD; Warren R. Selman MD The Neurological Institute University Hospitals-Case Medical Center Case Western Reserve Univesity School of Medicine



Introduction: Abstract: Surgical training has remained remarkably similar in many respects since the early days of Halstedian training. Neurosurgery is a demanding field that requires extensive cognitive, perceptive, and technical training. Surgical simulation is a promising approach to facilitate acquiring proficiency in neurosurgical procedures. Simulation can permit mentoring trainees in a "safe" environment. By incorporating images that depict specific abnormalities in actual patients, simulation can provide realistic rehearsal for any given case for both novice and experienced surgeons in much the same way that data acquired from drones can be used to allow pilots to rehearse mission-critical maneuvers in a simulator prior to taking flight. Most neurosurgical simulators to date have focused on endovascular procedures, spinal procedures, temporal bone dissection, and stereotactic procedures. This article describes a novel simulator called the Selman Surgical Rehearsal Platform. The platform shows promise in use for microsurgery which requires repititition that is becoming increasingly limited for trainees who have to learn more procedures in much less time than even a decade ago.

Methods: In order to develop a more robust surgical simulator, the authors have collaborated with Surgical Theater LLC (http://www.surgicaltheater.net/home.htm ) to develop a technique for reconstruction of medical images (e.g., CT and MRI) into realistic, interactive, patient-specific 3-D virtual surgeries (Figures 1-5, and Video 1), allowing neurosurgeons to plan, rehearse, and perform aneurysm clipping with the interactive tools in a 3-D environment and haptic feedback. Stereoscopic visuals give the surgeon utilizing Selman Sergical Researsal Platform (SRP) a realistic 3-D experience. Because the anatomy of the pathology is derived from patient-specific images, the SSRP allows for interactions between the surgeon's instruments in 3-D and provides

## Figure 1: SRP Platform with 3D glasses and Monitor





the opportunity for neurosurgeons to rehearse techniques specific to each individual surgical procedure. While this technology can be used for any intracranial application, the first application being developed focuses on aneurims clipping.

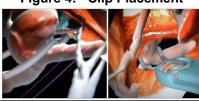
Retrospective analysis of 30 consecutive cases at our institution revealed a mean of mean of 5.4 and median of 6 clips/aneurism.

We *hypothesized* that rehearsal of aneurysm clipping utilizing Surgical Rehearsal Platform (SRP) would: 1). facilitate clip selection, 2). minimize "trial" clip placement and 3). decrease OR time.

*Prospective Cohort Study:* A two-armed randomized controlled prospective study of clipping supratentorial aneurisms in the circle of Willis was designed to test this hypothesis. In the SRP arm, simulated clip placement using SRP precedes the operative procedure; the control arm does not use simulator.



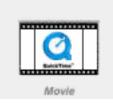
## Figure 4: Clip Placement



Design of Prospective Study: With 20 pts/group, and two-sided Type I error of 0.05, the study power is 0.714 with assumption that number of clipping attempts can be reduced to 2, on average, with a standard deviation of 3.0. During clipping, the surgeon may adjust and replace clips during the surgery and try several different clips and configurations in order to achieve optimal placement of the clip(s) to secure the aneurysm and maintain patency of the parent and branch vessels. Independent observer review of operative recordings will be used to determine operative time and number of clipping attempts. Parameters to be evaluated include:1). number of clipping attempts; 2). total clips utilized; 3). operative time; 4). confirmation of aneurysm obliteration and patency of parent vessels.

<u>Results:</u> A control sample of recent historical cases (N=20) was analyzed: 30% of the aneurysms (N=6) were clipped in one attempt, 20% (N=4) in 2 or 3 attempts, and 50% (N=10) in 6 or more attempts. Mean number of clipping/aneurism was 5.4 +/- 5.38.

## **VIDEO:** DEMONSTRATION OF ANEURISM CLIPPING SIMULATION ON SSRP PLATFORM



**Conclusions:** Current analysis of ongoing data suggests that rehearsal of aneurism clipping using SRP miniumizes unused clips as well as operative time. Trial is still ongoing Successful application of this technology may allow for a change in the manner in which neurosurgeons are trained and the way they prepare themselves for surgery. Haptic feedback elements are being incorporated into new designs. Extension of surgical rehearsal technology may also allow pre-operative training for other neurosurgical conditions, such as complicated neoplastic and skull base cases, as well as in other surgical disciplines. Telepresenence mentoring and consultation may also be possible.