Exercises, scenarios and metrics for neurosurgical training on a virtual reality simulator

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This study is part of a program aiming to develop a simulator for training neurosurgeons to perform brain tumour resections. Such simulators allow trainees to develop surgical skills and rehearse difficult cases without any risk to the patient. Therefore, surgical simulators could reduce the number of medical errors, the same way flight simulators have reduced human errors in the aviation industry.

Virtual reality (VR) simulation has been used as a teaching tool in the military as well as in aviation, marine and power plant industries. However its introduction to medicine is relatively new. In order for the trainee to use the simulator autonomously, metrics have been developed to provide user feedback on errors and proficiency in performing the simulated task. Metrics can also be used for certification and re-certification of trained professionals.

This particular simulator will be designed to teach neurosurgery residents skills ranging from basic motor skills to decision making, for both open and endoscopic neurosurgery. The focus of this study is to define simulation scenarios and appropriate metrics to help the trainee achieve the learning objectives.

Simulation modules will include a set of 5 exercises to learn fundamental skills specific to neurosurgery (Fundamentals of Neurosurgery), ranging from anatomical navigation to micro-dissection, and 10 brain tumour resection procedures of increasing difficulty from convexity meningiomas to high grade gliomas.

Emphasis will be placed on the development of suitable simulator metrics. In particular, metrics will be implemented to provide the trainee with immediate feedback identifying parts of the performance that were satisfactory and areas that need improvement. This type of feedback is critical to the learning process [1]. The proposed metrics, inspired from a global rating scale developed for general surgery [2], will focus on 1) respect for tissue, 2) time and motion, 3) breaching of no-go zones, 4) hemostasis, 5) depth perception, and 6) autonomy. The metrics will be implemented in the simulator such that a score will be feedback in real-time during training. To ensure their relevance, these metrics will be validated against expert evaluations of performance of trainees in the operating room.

1. Dankelmann J. Surgical simulator design and development, *World J Surg,* 2008; 32:149–155.

2. Reznick R, et al. Testing technical skill via an innovative bench station examination. *Am J of Surg,* 1997; 173;226-230.