Criterion and face validity of the ANGIO Mentor Express for diagnostic cerebral angiography

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Abstract

The objective of this study was to assess the face and criterion validity of a computer-based simulation for diagnostic cerebral angiography using the ANGIO Mentor Express. Participants were divided into two groups: experts (experienced interventional physicians) and novices (residents and fellows). Face validity was addressed by asking experts to rate, on a 5-point Likert scale, the appropriateness of the simulated content as a teaching and training tool. Criterion validity was established by comparing the simulation performance of experts vs. novices. After completing a step-by-step tutorial to become acquainted with the relevant technical features involved in performing a simulated cerebral angiography, all participants practiced performing an angiography of the left internal carotid artery. Subsequently, they completed a simulated angiography of the right middle cerebral artery. The procedure time, fluoroscopy time, amount of contrast, number of fluoroscopic images, and number of roadmaps utilized when performing the right middle cerebral artery were recorded. These allowed us to compute objective measures of performance. Upon completion of the two simulated cases, experts were asked to rate the appropriateness of the simulated content. Experts outperformed novices in nearly all performance variables, but significant differences were found for fluoroscopy time and amount of contrast utilized, p<0.05. Experts reported that the ANGIO Mentor provided content appropriate to the angiography procedure (mean=4.85) and that it is useful as a teaching and training tool (mean=4.71). Preliminary results revealed that the ANGIO Mentor has appropriate face and criterion validity, providing support for the ANGIO Mentor's use as a tool for teaching diagnostic cerebral angiography.
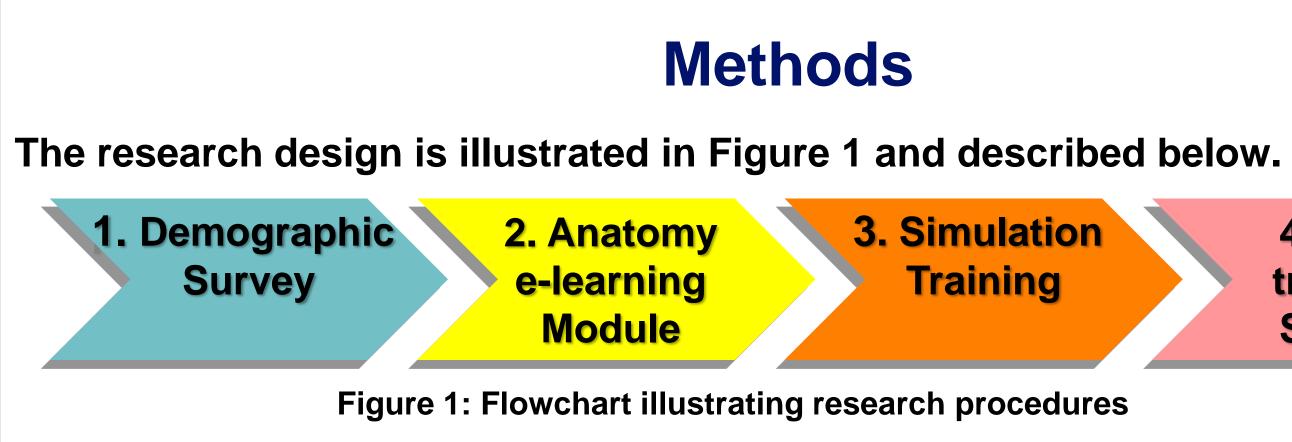
Background

- Desire for patient safety and quality of patient care has led to an emphasis on finding innovative ways in teaching diagnostic catheter-based procedures outside of the catheterization suit [1].
- Computer-based simulation (CBS) training has been proposed as a safe substitute for practicing on real patients [2].
- Unfortunately, the use of CBS for training diagnostic catheter-based procedures has been slow. This may be to the limited number of diagnostic simulators available and the lack of research assessing their validity.
- Establishing the validity of CBS systems and their assessment instruments is important to ensure the simulated scenarios are consistent and reproducible, and that they appropriately simulate the basic skills required to perform the procedure safely [1].

Purpose and Aims

To establish the validity (i.e., face and criterion) of a CBS system (ANGIO Mentor Express, Simbionix, Cleveland, Ohio) for diagnostic cerebral angiography (CA).
- Aim 1: To determine if the ANGIO Mentor provides realistic simulation of diagnostic CA and if the tests appear appropriate to experts (face validity)
- Aim 2: To determine if the ANGIO Mentor can differentiate between individuals' neurointerventional expertise level (criterion *validity*).

Methods

The research design is illustrated in Figure 1 and described below.

1. Demographic Survey → 2. Anatomy e-learning Module → 3. Simulation Training → 4. Post-training Survey

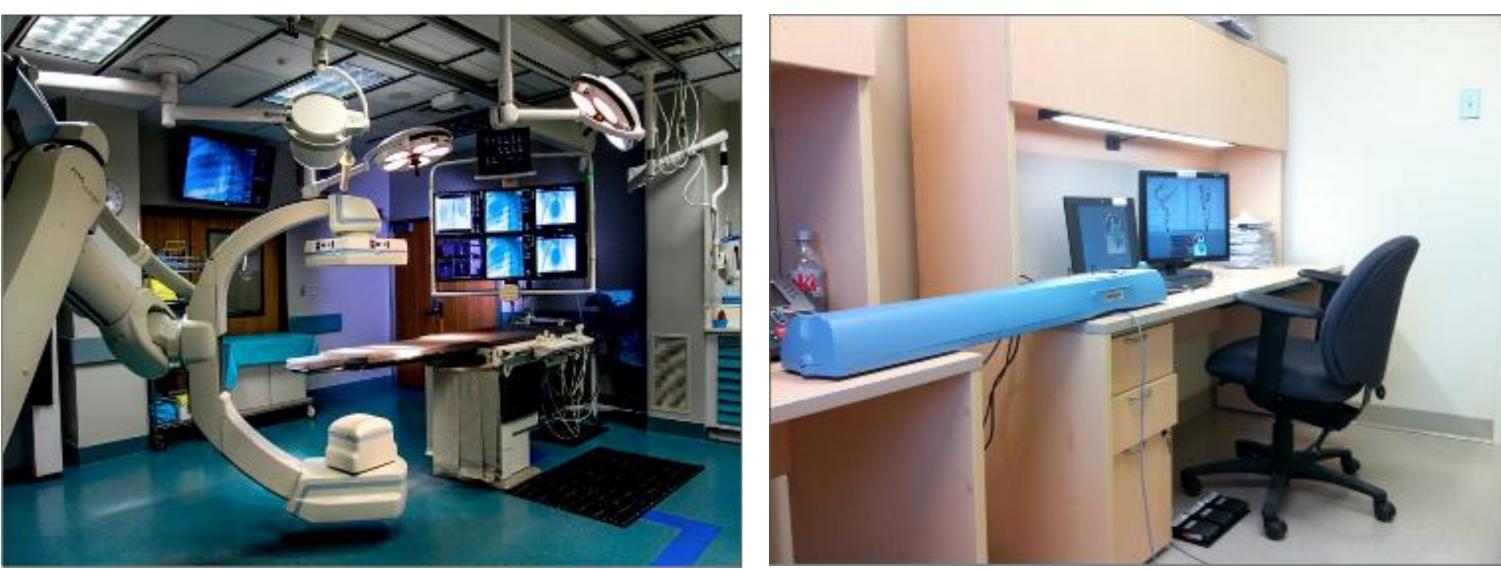Figure 1: Flowchart illustrating research procedures

- Survey collects information about participants sex, age, handedness, professional level, prior use of simulator, videogame experience, neurointerventional experience, and experience performing cerebral angiography.

  Based on their reported level of interventional experience and experience performing CA, participants will be categorized as either a 'novice', 'intermediate', or 'expert.'

- The anatomy module and subsequent knowledge test are used to ensure that novices and intermediates have adequate knowledge of vascular anatomy and CA technique.

- Baseline: 1. All participants receive information about the simulator and relevant technical features involved in performing a CA procedure. 2. Participants have up to 45 minutes to familiarize themselves with the system. 3. They complete a simulation case scenario and task performance (i.e. procedure time, fluoroscopy time, contrast, roadmaps, and DSA utilized) is automatically recorded.
- Subsequent sessions: Novices and intermediates will return and complete the same simulation scenario once a week for 2 months.
- Experts are asked to rate their simulation experience on a 5 point Likert scale.

Real CA Environment   Simulated CA Environment

http://www.meri.org/meri-services/angiography/

Badruddin et al., 2010

Figure 2: Representative images from the ANGIO Mentor Express as compared with images from a real angiography suit.

References:
1.Nicholson WJ, Cates CU, Patel AD, Niazi K, Palmer S, Helmy T, Gallagher AG. Face and content validation of virtual reality simulation for carotid angiography: Results from the first 100 physicians attending the emory neuroanatomy carotid training (enact) program. *Simulation in Healthcare*. 2006;1:147-150
2.Kneebone R. Simulation in surgical training: Educational issues and practical implications. *Med Educ*. 2003;37:267-277
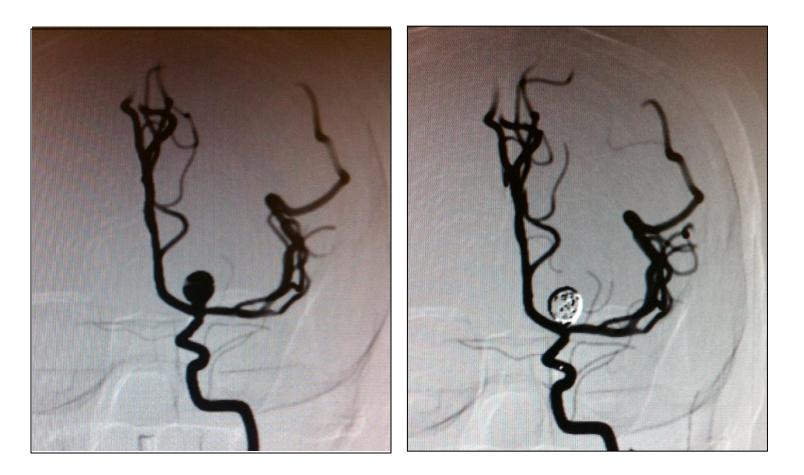
Preliminary Results

Table 1: Descriptive statistics

Participants (n =8)	Level of training	Mean age ± SD	Male: Female
Experts (n = 3)	1 neurosurgeon, 2 interventional radiologists	51.33 ± 7.37	3:0
Intermediates (n = 2)	2 neurosurgery fellows	36.50 ± 6.36	2:0
Novices (n = 3)	2 neurosurgery residents (PGY-2, PGY3), 1 neurology resident (PGY-3)	30.33 ± 3.06	2:1

Table 2: Expert assessment of individual qualities of the simulated CA procedure

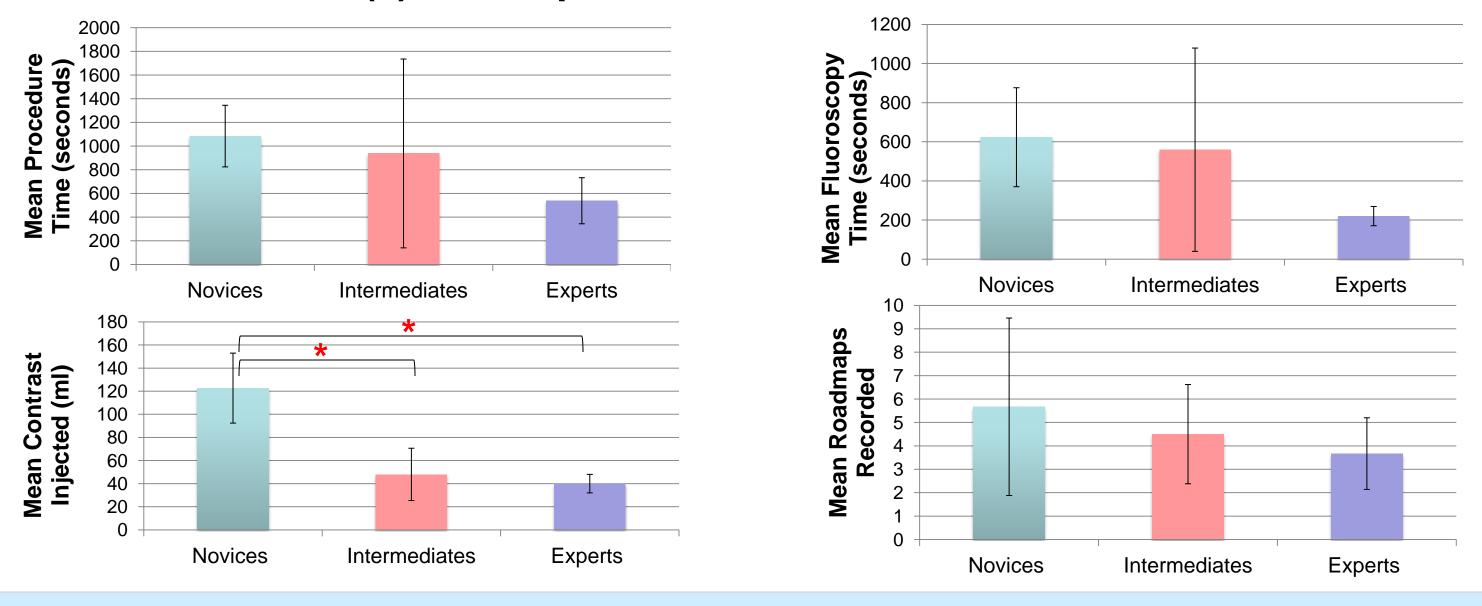| Appearance & handling characteristics (1 = not realistic, 3 = undecided, 5 = realistic)	Score ± SD (N = 3)	Usefulness as a teaching and training tool (1 = disagree, 3 = undecided, 5= agree)	Score ± SD (N = 3)
Appearance of vascular anatomy	5.00±0.00	Teaching vascular anatomy	5.00±0.00
Appearance of guidewire	5.00±0.00	Teaching surgical planning	5.00±0.00
Appearance of catheter	5.00±0.00	Training handling of catheter	3.00±1.73
Appearance of fluoroscopic images	4.33±0.58	Training navigational skills	5.00±0.00
Appearance of DSA	4.33±0.58	Training injection of contrast	4.33±0.58
Movement of catheter	4.66.±0.58	Training hand-eye coordination	4.66±0.58
Movement of guidewire	4.66±0.58		
Overall Realism	4.71±0.33	Overall Usefulness	4.49±0.48

Figure 3: Histogram comparing mean procedural time (secs), fluoroscopy time (secs), amount of contrast (ml), and number of roadmaps utilized for experts, intermediates, and novices. Significant differences were found for amount of contrast utilized, $F_{(2)}=12.04$, $p<0.05$

Conclusions

Preliminary results suggest the ANGIO Mentor:
1. Provides realistic simulation of diagnostic CA and is useful as a teaching and training tool (face validity),
2. Can differentiate between individuals processing different levels of neurointerventional expertise level (criterion validity).