Criterion and face validity of the ANGIO Mentor Express for diagnostic cerebral angiography
Ngan Nguyen, PhD¹, Roy Eagleson, PhD¹, Mel Boulton, PhD, MD², Sandrine deRibaupierre, MD¹,²
¹Department of Electrical and Computer Engineering, Western University, London, ON, Canada
²Department of Clinical Neurological Sciences, Western University, London, ON, Canada

Abstract

The objective of this study was to assess the face and criterion validity of a computer-based simulation for diagnostic cerebral angiography with the ANGIO Mentor Express. Participants were divided into three groups: experts (neurointerventional physicians), intermediates (neurology residents and neurosurgery fellows), and novices (residents and fellows). Each group consisted of 12 participants. The procedure was simulated and recorded. Simulated angiography of the right middle cerebral artery was performed, and the procedure time, fluoroscopy time, amount of contrast, movement of the catheter, and roadmaps 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 recorded cases. These results indicate that the ANGIO Mentor has 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 suite.
- Computer-based simulation (CBS) training has been proposed as a safe substitute for practicing on real patients.

- Unfortunately, the use of CBS for training diagnostic catheter-based procedures has been slow. This may be due 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.

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’.

Aim

- To determine if the ANGIO Mentor can differentiate between individuals’ neurointerventional expertise level (criterion validity).

Real CA Environment

Simulated CA Environment

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

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).

Table 1: Descriptive statistics

<table>
<thead>
<tr>
<th>Participants (n = 36)</th>
<th>Level of training</th>
<th>Mean ± SD</th>
<th>Male: Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experts (n = 3)</td>
<td>1 neuroradiologist</td>
<td>51.33 ± 7.37</td>
<td>3:0</td>
</tr>
<tr>
<td>Intermediates (n = 2)</td>
<td>2 neurosurgery fellows</td>
<td>36.50 ± 6.36</td>
<td>2:0</td>
</tr>
<tr>
<td>Novices (n = 3)</td>
<td>2 neurosurgery residents (PGY-2; PGY3)</td>
<td>30.33 ± 3.06</td>
<td>2:1</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Appearance &amp; handling characteristics</th>
<th>Score ± SD</th>
<th>Usefulness as a teaching and training tool</th>
<th>Score ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance of vascular anatomy</td>
<td>5.00 ± 0.00</td>
<td>Teaching vascular anatomy</td>
<td>5.00 ± 0.00</td>
</tr>
<tr>
<td>Appearance of guidewire</td>
<td>5.00 ± 0.00</td>
<td>Teaching surgical planning</td>
<td>5.00 ± 0.00</td>
</tr>
<tr>
<td>Appearance of catheter</td>
<td>5.00 ± 0.00</td>
<td>Teaching handling of catheter</td>
<td>3.00 ± 1.73</td>
</tr>
<tr>
<td>Appearance of fluoroscopic images</td>
<td>4.33 ± 0.59</td>
<td>Training navigational skills</td>
<td>5.00 ± 0.00</td>
</tr>
<tr>
<td>Appearance of DSA</td>
<td>4.33 ± 0.58</td>
<td>Training injection of contrast</td>
<td>4.33 ± 0.58</td>
</tr>
<tr>
<td>Movement of catheter</td>
<td>4.66 ± 0.58</td>
<td>Training eye-hand coordination</td>
<td>4.66 ± 0.58</td>
</tr>
<tr>
<td>Movement of guidewire</td>
<td>4.66 ± 0.58</td>
<td>Overall Usefulness</td>
<td>4.49 ± 0.48</td>
</tr>
</tbody>
</table>

Figure 4: Table showing the mean comparison of the ANGIO Mentor Express' performance with real cases.