THE USE OF VIRTUAL HUMANS TO ASSESS SURGEON COMMUNICATION SKILLS IN A SIMULATED LAPAROTOMY


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We have previously validated a checklist for performing a laparotomy in a simulated model.

In this study, we have integrated virtual humans (VHs) into this simulated laparotomy scenario to assess surgeon response to VH communication challenges.
METHODS

- Three interactive VH teammates (anesthesiologist, circulating nurse and surgical technologist) were projected on a 40-inch monitor mounted on a rolling stand.

- Nineteen surgeons (6 faculty and 13 residents) videotaped interacting with VHs while performing a surgical time out and laparotomy on a simulated model.

- Outpatient surgical center (OSC) at the University of Florida – Jacksonville.
Communication Elements
1. Leading a surgical timeout.
2. Addressing a timeout interruption.
   ✓ Raters (N=5) reviewed videotapes.

Psychomotor Elements
1. Performing a laparotomy.
   ✓ Raters (N=6) examined simulated laparotomy pads.
METHODS

LAPAROTOMY CLOSURE RATING FORM

1. Bites are between 5 mm to 10 mm wide with 5 mm to 10 mm advancement.
   - 1
   - 2
   - 3
   - 4
   - 5

   Bites and advancement too large/small with no consistency
   Most bites are between 5-10 mm and consistent with regular spacing
   All bites are between 5-10 mm and consistent with regular spacing

2. Running closure started 1 cm above and below the apices of the fascial incision.
   - 1
   - 2
   - 3
   - 4
   - 5

   Neither superior/inferior running suture started 1 cm above/below apex
   Either superior or inferior running suture started 1 cm above/below apex but not the other
   Both superior and inferior running sutures started 1 cm above and below apex

3. Knots are square without “air knots” and have an adequate number of throws (6 to 8).
   - 1
   - 2
   - 3
   - 4
   - 5

   Knots are not square
   Multiple air knots
   Inadequate number of throws
   Knots are for the most part square
   Some air knots present
   Most knots have adequate 8 of throws
   Knots are square
   No air knots
   All knots adequate number of throws

4. No obvious defects in the incision when placed under tension.
   - 1
   - 2
   - 3
   - 4
   - 5

   Large defects in the closure when placed under tension
   Some/smaller defects in the closure when placed under tension
   There are no defects in the closure when placed under tension
RESULTS

Participant Level (N=19)

- Faculty: 6
- PGY5: 1
- PGY4: 3
- PGY3: 1
- PGY2: 4
- PGY1: 4
RESULTS

Participant Experience

- >20
- 11-20
- 6-10
- 1-5
- 0

Laparotomy
Time Out
## RESULTS

### Post Interaction Survey

<table>
<thead>
<tr>
<th>Immersion Level</th>
<th>STRONGLY DISAGREE</th>
<th>DISAGREE</th>
<th>NEUTRAL</th>
<th>AGREE</th>
<th>STRONGLY AGREE</th>
<th>WEIGHTED AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I felt as though I was in a real operating room.</td>
<td>0.00%</td>
<td>15.79%</td>
<td>15.79%</td>
<td>63.16%</td>
<td>5.26%</td>
<td>3.58</td>
</tr>
<tr>
<td>The setup of the virtual OR enhanced the immersiveness of the overall simulation.</td>
<td>0.00%</td>
<td>0.00%</td>
<td>15.79%</td>
<td>57.89%</td>
<td>26.32%</td>
<td><strong>4.11</strong></td>
</tr>
<tr>
<td>The presence of the virtual characters enhanced the scenario and made it</td>
<td>0.00%</td>
<td>10.53%</td>
<td>5.26%</td>
<td>63.16%</td>
<td>21.05%</td>
<td>3.95</td>
</tr>
<tr>
<td>aware the scenario and made it seem more realistic.</td>
<td>0.00%</td>
<td>5.26%</td>
<td>15.79%</td>
<td>73.68%</td>
<td>5.26%</td>
<td>3.79</td>
</tr>
<tr>
<td>I felt like the virtual characters were aware of my presence.</td>
<td>0.00%</td>
<td>10.53%</td>
<td>36.84%</td>
<td>47.37%</td>
<td>5.26%</td>
<td>3.47</td>
</tr>
<tr>
<td>I perceived the virtual characters as being only computerized images not as</td>
<td>0.00%</td>
<td>10.53%</td>
<td>36.84%</td>
<td>31.58%</td>
<td>0.00%</td>
<td>0.00</td>
</tr>
<tr>
<td>real people.</td>
<td>0.00%</td>
<td>5.26%</td>
<td>15.79%</td>
<td>31.58%</td>
<td>0.00%</td>
<td>0.00</td>
</tr>
<tr>
<td>The virtual characters seemed conscious and sentient.</td>
<td>0.00%</td>
<td>10.53%</td>
<td>57.89%</td>
<td>31.58%</td>
<td>0.00%</td>
<td>0.00</td>
</tr>
<tr>
<td>The mock abdomen adequately simulated the real abdominal wall (skin, subcutaneous tissue, fascia).</td>
<td>5.26%</td>
<td>26.32%</td>
<td>36.84%</td>
<td>31.58%</td>
<td>0.00%</td>
<td>2.95</td>
</tr>
<tr>
<td>The feeling of closing the fascia of the mock abdomen was similar to in vivo</td>
<td>15.79%</td>
<td>21.05%</td>
<td>31.58%</td>
<td>31.58%</td>
<td>0.00%</td>
<td><strong>2.79</strong></td>
</tr>
<tr>
<td>closure of the abdomen.</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
## Post Interaction Survey

<table>
<thead>
<tr>
<th>Skill Confidence/Improve</th>
<th>STRONGLY DISAGREE</th>
<th>DISAGREE</th>
<th>NEUTRAL</th>
<th>AGREE</th>
<th>STRONGLY AGREE</th>
<th>WEIGHTED AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am confident in my ability to perform laparotomy.</td>
<td>0.00%</td>
<td>5.26%</td>
<td>21.05%</td>
<td>42.11%</td>
<td>31.58%</td>
<td>4.00</td>
</tr>
<tr>
<td>I am confident in my ability to perform abdominal wall closure.</td>
<td>0.00%</td>
<td>11.11%</td>
<td>5.56%</td>
<td>50.00%</td>
<td>33.33%</td>
<td>4.06</td>
</tr>
<tr>
<td>I am confident in my ability to perform a complete and appropriate time out.</td>
<td>0.00%</td>
<td>0.00%</td>
<td>5.26%</td>
<td>42.11%</td>
<td>52.63%</td>
<td>4.47</td>
</tr>
<tr>
<td>I am confident in my ability to manage a possible retained surgical item in the abdomen.</td>
<td>0.00%</td>
<td>5.26%</td>
<td>0.00%</td>
<td>52.63%</td>
<td>42.11%</td>
<td>4.32</td>
</tr>
<tr>
<td>Today's simulation has improved my ability to perform laparotomy.</td>
<td>0.00%</td>
<td>15.79%</td>
<td>31.58%</td>
<td>31.58%</td>
<td>21.05%</td>
<td>3.58</td>
</tr>
<tr>
<td>Today's simulation has improved my ability to perform abdominal wall closure.</td>
<td>0.00%</td>
<td>15.79%</td>
<td>31.58%</td>
<td>26.32%</td>
<td>26.32%</td>
<td>3.63</td>
</tr>
<tr>
<td>Today's simulation has improved my ability to perform a complete and appropriate time out.</td>
<td>0.00%</td>
<td>5.26%</td>
<td>31.58%</td>
<td>36.84%</td>
<td>26.32%</td>
<td>3.84</td>
</tr>
<tr>
<td>Today's simulation has improved my ability to manage a possible retained surgical item in the abdomen.</td>
<td>0.00%</td>
<td>5.26%</td>
<td>36.84%</td>
<td>31.58%</td>
<td>26.32%</td>
<td>3.79</td>
</tr>
</tbody>
</table>

Pre Survey
- **3.70**
- **3.25**
RESULTS

Communication Elements

<table>
<thead>
<tr>
<th>Surgical Time Out</th>
<th>Residents N (%)</th>
<th>Faculty N (%)</th>
<th>p Value (α=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiated</td>
<td>11 (84.6)</td>
<td>5 (83.3)</td>
<td>NS</td>
</tr>
<tr>
<td>Interruption Addressed</td>
<td>7 (53.8)</td>
<td>6 (100)</td>
<td>NS</td>
</tr>
<tr>
<td>Time Out Resumed</td>
<td>2 (15.4)</td>
<td>4 (66.7)</td>
<td>NS</td>
</tr>
<tr>
<td>Time Out Restarted</td>
<td>5 (38.4)</td>
<td>2 (33.3)</td>
<td>NS</td>
</tr>
</tbody>
</table>
## Communication Elements

<table>
<thead>
<tr>
<th>Response to Incorrect Count</th>
<th>Residents N (%)</th>
<th>Faculty N* (%)</th>
<th>P Value (α=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopped Operating</td>
<td>7 (53.87)</td>
<td>5 (100)</td>
<td>NS</td>
</tr>
<tr>
<td>Asked for Recount</td>
<td>7 (53.8)</td>
<td>3 (60.0)</td>
<td>NS</td>
</tr>
<tr>
<td>Asked for X-ray</td>
<td>6 (46.1)</td>
<td>2 (40.0)</td>
<td>NS</td>
</tr>
<tr>
<td>Searched Abdomen</td>
<td>10 (76.9)</td>
<td>5 (100)</td>
<td>NS</td>
</tr>
</tbody>
</table>

*One faculty did not receive incorrect count challenge.*
RESULTS

Psychomotor Elements
## RESULTS

### Psychomotor Elements

<table>
<thead>
<tr>
<th>Closure Item*</th>
<th>Residents Mean (95% C.I.)</th>
<th>Faculty Mean (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bites (Distance/Spacing)</td>
<td>2.61 (1.97, 4.28)</td>
<td>1.97 (1.05, 2.89)</td>
</tr>
<tr>
<td>Running Closure (Start/Finish)</td>
<td>1.88 (1.25, 2.51)</td>
<td>1.50 (0.95, 2.01)</td>
</tr>
<tr>
<td>Knots (Square/# Throws)</td>
<td>3.51 (2.88, 4.14)</td>
<td>2.89 (1.70, 4.08)</td>
</tr>
<tr>
<td>Defects (With Tension)</td>
<td>3.88 (3.22, 4.54)</td>
<td>2.67 (1.42, 3.92)</td>
</tr>
<tr>
<td>Overall</td>
<td>11.88 (9.77, 13.99)</td>
<td>9.02 (5.51, 12.53)</td>
</tr>
</tbody>
</table>

*Likert scale 1-5 (1=worst, 5=best).
Participant Comments

“Phenomenal opportunity to practice surgical and verbal skills as a solo surgeon.”

“This was very helpful. I think that having a perfect performance to watch would be great in knowing how to improve.”

“It strengthened my ability to communicate with my team in the OR.”

“The tissue planes were strange at first, having never operated on simulated humans. Still, once I got the hang of it, I was fine.”
• We have successfully integrated VHs with a simulated laparotomy model to teach/assess communication/teamwork and psychomotor skills.

• Participant performance demonstrates a need for deliberate practice with feedback in correctly performing a surgical time out and a laparotomy with an incorrect sponge count for surgical residents and faculty.