Cost-Efficient Laparoscopic Haptic Trainer based on Affine Velocity Analysis.

Charles Barnouin, Benjamin de Witte, Richard Moreau, Arnaud Lelevé, Xavier Martin

To cite this version:
Charles Barnouin, Benjamin de Witte, Richard Moreau, Arnaud Lelevé, Xavier Martin. Cost-Efficient Laparoscopic Haptic Trainer based on Affine Velocity Analysis.. Surgetica 2017, Nov 2017, Strasbourg, France. hal-01563262

HAL Id: hal-01563262
https://hal.archives-ouvertes.fr/hal-01563262
Submitted on 4 Feb 2019

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Learning minimal invasive surgery (MIS) skills is young surgeons' major concern.

Objective: design a basic skill training simulator which objectively evaluate trainees' level.

Use of Affine velocity as an assessment variable.

**INTRODUCTION**

- Observation and analyses of surgeons in situ
- Inclusion of literatures’ recommendations

**Step 1 - Cognitive conception**

**Step 2 - Simulator conception**

**Step 3 - Simulator validation**

**METHODS**

- Use of materials enabling haptic feedback and developing a VR environment (Phantom Omni, CHAISD, laparoscopic devices...)

**WHAT IS AFFINE VELOCITY**

Relationship between geometry and kinematic first shown in 2D drawing:

\[ v = v_0 K^{1/3} \]

- With the curvature \( K \)

**RESULTS**

Panel of 77 subjects separated initially into 4 groups:

- Expert surgeon: more than 100 interventions
- Intermediate: between 5 and 20
- Unexperienced intern (BSS): witnessed but never performed
- Novice

<table>
<thead>
<tr>
<th>Groups</th>
<th>Intern</th>
<th>Expert</th>
<th>Intermediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>P&lt;0.05</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>P&lt;0.05</td>
<td>0.43</td>
<td>P&lt;0.05</td>
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<tr>
<td>Novice</td>
<td>P&lt;0.05</td>
<td>P&lt;0.05</td>
<td>P&lt;0.05</td>
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</table>

Statistical test Kruskal and Wallis on affine velocity (above) can separate every group but Experts and Intermediates, whereas collision alone could also not separate Novices from Unexperience Interns.

**CONCLUSION**

- A cognitive analysis of MIS enables to design a reliable and valid simulator.
- Affine velocity is a valid tool and another objective variable to evaluate a trainee skill on his trajectory.
- Once a certain level of skill is reached, it becomes harder to differentiate individuals.
- As feedback about skill level is displayed, the simulator should be effective in learning, this needs however to be confirmed by future investigations.

**REFERENCES**

