Cost-Efficient Laparoscopic Haptic Trainer Based on Affine Velocity Analysis
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Introduction

- Learning minimal invasive surgery (MIS) skills is young surgeons’ major concern.
- Cognitive load elicited by simulators’ use and trainees’ spatial abilities seem to impact efficient learning process\(^1\).
- Objectives: design a basic skill training simulator which objectively evaluate trainees’ level.
- Use of Affine velocity\(^2-3\) as assessment variable.

Methods

Step 1 - Cognitive conception

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

Step 2 - Simulator conception

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

Step 3 - Simulator validation

Define assessment variables to evaluate the trajectory:
- Time taken to complete the level
- Number of errors (collisions)
- Affine Velocity

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>
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<th>Expert</th>
<th>Intermediate</th>
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Statistical test Kruskal and Wallis on affine velocity (above) can separate every groups but Experts and Intermediates, whereas collision alone could also not separate Novices from Unexperience Interns.

Concentration

- 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