

Automated motion analysis on Cyrano simulator for assessment of technical skills in endoscopic endonasal surgery

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Introduction

Simulation-based training has become a cornerstone of modern surgical teaching, allowing skill acquisition in a controlled and safe environment. Beyond visual and haptic realism, objective and meaningful feedback is essential for effective learning.

Simulators must be able to discriminate levels of technical expertise, which requires validated performance metrics. The Objective Structured Assessment of Technical Skills (OSATS) is widely accepted as a reference standard for evaluating surgical performance.



Figure 1. 3D-print artificial head, container for different removable pedagogical modules.

Methods and Materials

➤ Simulator & Tasks :
Four standardized endoscopic endonasal exercises on simulator Cyrano (Fig 1 & 2)

➤ Data acquisition :
• Triaxial inertial sensors
• Recording of time, errors, instrument openings
• Video recording for OSATS-v assessment

➤ Motion analysis
Using these data, we computed :
• A global performance score
• Several subscores such as :
Tremor, motion amplitude, Smoothness, precision, safety .

➤ Expert assessment :
By two blinded experts using OSATS-v (Fig 3)

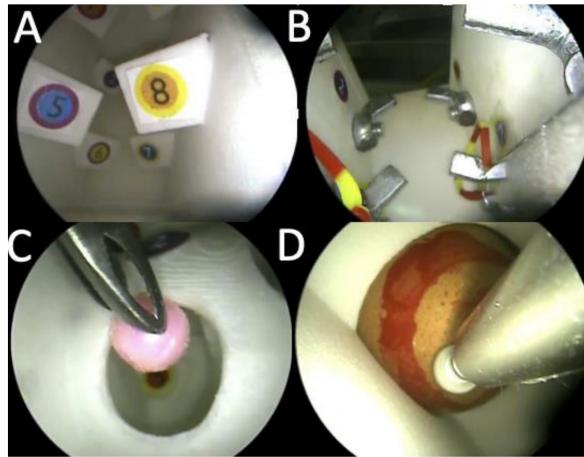


Figure 2. A : Target the target B : Captain Hook C : Drag'n Drop D : Chicken Run

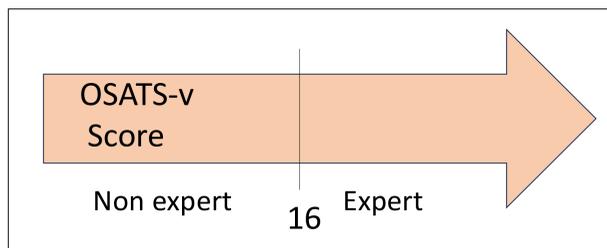
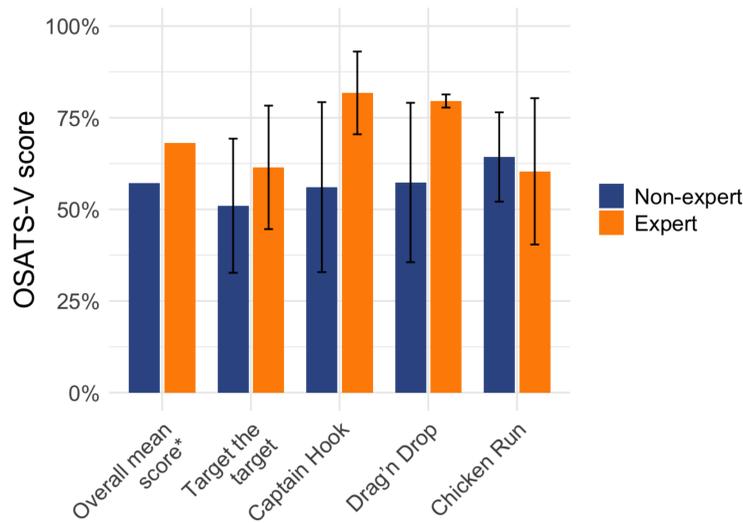


Figure 3. Stratification by OSATS-v score.

Results

Across the 29 ENT surgeons and neurosurgeons (residents to expert rhinologists), expert group demonstrated a mean global score of 61,46% for Target the target, of 81,78% for Captain Hook, of 79,57% for Drag'n Drop, of 60,37% for Chicken Run.

Non expert group demonstrated a mean global score of 50,99% for Target the target, of 56,07% for Captain Hook, of 57,33% for Drag'n Drop, of 64,29% for Chicken Run.



*Overall mean score cannot be computed for all trainees (no SD).

Figure 4. Overall score of the two groups according to the OSATS-V scale.

Captain Hook had the ability to discriminate expert and non expert performance ($p < 0.05$).

Discussion

This pilot study demonstrates that automated motion analysis integrated into the Cyrano simulator can discriminate levels of surgical expertise. While the global score differs according to expertise, it provides limited insight into which aspects of surgical technique require improvement.

Relying on a single global metric is therefore reductive. A weighted combination of subscores would likely provide a more accurate representation of competence.

Conclusions

Automated performance analysis on the Cyrano simulator, combining global scores and targeted motion subscores, appears to be a promising tool for objective assessment of technical skills in endoscopic endonasal surgery, complementary to expert evaluation.



Scan for supplementary data

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