Assessing Technical Competence in Simulated Colonoscopy Using Joint Motion Analysis

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INTRODUCTION: Colonoscopy is a commonly used image-guided therapy to treat many different types of disease in the colon. Because of the spatial awareness required to perform colonoscopy, it is critical that trainees master basic colonoscope manipulation techniques at an early stage of training [1]. Training on low-fidelity simulators allows trainees to master manipulation technique prior to more complex training scenarios. What remains a challenge, however, is assessing how well a trainee has mastered the manipulation techniques. In this work, we evaluate how well joint motion analysis can be used to determine whether an operator has mastered basic colonoscope manipulation techniques.

METHODS: Twenty-eight novice medical students and nine expert gastroenterologists navigated a previously validated, low-fidelity colon model [2] using a standard colonoscope (Figure 1). Participants' hands, forearms, and upper arms were tracked using position and orientation sensors (Ascension TrakStar, Northern Digital Inc.). Using the trackers and a series of calibration exercises, the angles of each wrist and elbow could be determined. We evaluated whether these angle times series could be used to discriminate colonoscope manipulation skill between novices and experts. Analysis was performed using the Perk Tutor software (www.perktutor.org).

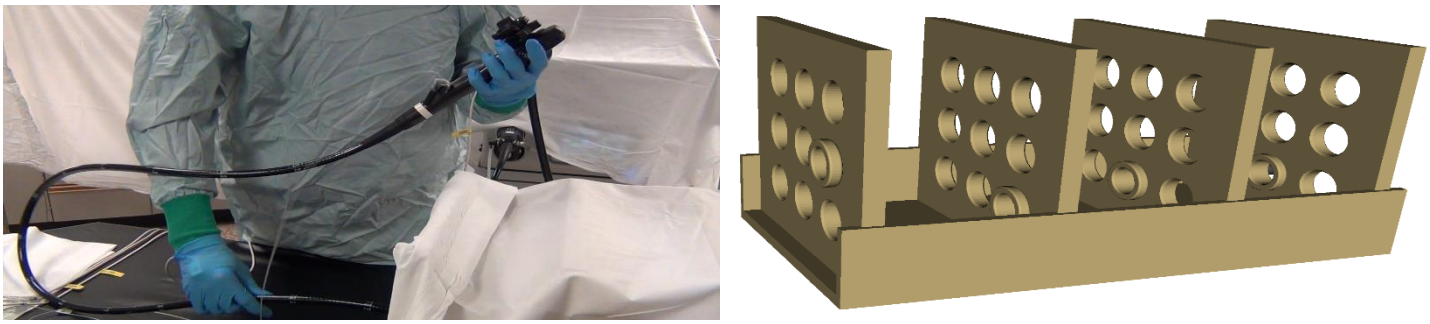

Figure 1: Photograph of operator performing simulated colonoscopy (left), and visualization of the low-fidelity colon model (right).

RESULTS: Novices spent significantly more time than experts performing the navigation tasks. Joint motion analysis revealed, however, that novices spent a significantly lesser proportion of time in extreme ranges of motion for the majority of joints. On the other hand, novices entered into extreme ranges of motion significantly more times than experts for the majority of joints.

CONCLUSION: Joint motion analysis demonstrates promise as a way of quantitatively measuring colonoscope manipulation skill, showing differences between novice and expert groups. More analysis is required, however, to fully analyze these patterns in join motion and to show whether this analysis can be used as an indicator of overall colonoscope manipulation competence.

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[2] C. M. Walsh, *et al.*, "Gastrointestinal Endoscopy Competency Assessment Tool: development of a procedure-specific assessment tool for colonoscopy," Gastrointest. Endosc., vol. 79, no. 5, pp. 798-807, May 2014.