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Summary of Dissertation

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Utility of an Open-source Video Analysis Software for Motion Tracking in Minimally Invasive Surgery

Motion metrics are reproducible, objective, and resistant to misinterpretation. However, specialized equipment is usually required to obtain these parameters. In this thesis, we explored the utility of an open- source video analysis software and its derived motion metrics in measuring skill acquisition among novices, and how in-vitro motion metrics may correlate with those acquired in-vivo. The objectives of the studies are to assess if open-source video analysis of motion metrics during McGill Inanimate System for Training and Evaluation of Laparoscopic Skills (MISTELS) testing could distinguish operator experience levels and enhance novice training outcomes through feedback, and to compare motion metrics obtained via open-source video analysis software in laparoscopic liver biopsies and motion metrics obtained with the same software in box trainers.

The score and motion metrics of experts and novices performing MISTELS tasks were evaluated. Compared to novices, the experts had significantly lower path length, total time, and number of extreme movements, and significantly higher erratic index, while average speed was inconsistent. The outcome of novices that received motion metrics feedback versus novices that did not were compared. Performance was similar between the two groups regardless of whether motion metrics feedback was provided or not. Finally, motion metrics of laparoscopic liver biopsy forceps were compared to various laparoscopic graspers used in a box trainer setting. All the laparoscopic graspers associated with MISTELS tasks had at least 2 motion metrics that were statistically different from the biopsy forceps.

We showed that an open-source video analysis software may be a useful tool for the assessment of laparoscopic surgical skills. Implementation of the software has the benefit of not requiring additional equipment or costs. The lack of improvement in novices receiving motion metrics feedback could be a limitation of their available mental load, gaps in their laparoscopic skills and/or knowledge, or influenced by the presentation of the information. Future studies investigating the utility of artificial intelligence on improving the motion tracking process are warranted.

Publications

Young KM, Stanley BJ, Degner DA. Balloon catheter as an extraction device for caudal vena cava adrenal tumor thrombectomy in a dog: A case report. Vet Surg. 2022 Aug;51(6):1016-1022. Doi: 10.1111/vsu. 13821. Epub 2022 May 12. PMID: 35546325.

Young KM, Degner DA. Surgical description and outcome of ultrasound-guided minimally invasive parathyroidectomy in 50 dogs with primary hyperparathyroidism. Vet Surg. 2023 Jan;52(1):18-25. Doi: 10.1111/vsu. 13897. Epub 2022 Oct 11. PMID: 36221891

Biographical Data

Born in Taipei, Taiwan