Technical Report

Objective Assessment of Proficiency with Bimanual Inanimate Tasks in Robotic Laparoscopy

KENJI NARAZAKI, MS,1 DMITRY OLEYNIKOV, MD,2 and NICHOLAS STERGIOU, PhD1

ABSTRACT

Purpose: Development of objective criteria and optimum training protocols are priorities for robotic laparoscopy. However, studies that have attempted to objectify learning have been limited due to lack of task complexity and absence of comparisons between experts and novices. Our aim was to address these limitations and assess proficiency in robotic laparoscopy using bimanual inanimate tasks.

Materials and Methods: Six experts and 18 novice users of the da Vinci surgical system (Innovative Surgical, Sunnyvale, CA) performed three bimanual surgical manipulations, two of them in opposite directions, for a total of five different test tasks. During each task, elapsed time and kinematics with respect to the instrument tips were measured and a bimanual coordination analysis was conducted to assess the relationship between the simultaneous movements of both arms. Specifically, task completion time, total traveling distance of the instrument tips, and mean absolute relative phase—a variable for the assessment of bimanual coordination—were calculated for each task and compared between groups.

Results: The experts showed significantly shorter task completion times for all tasks ($P < 0.05$). Significantly higher mean absolute relative phase values were observed for the experts in two tasks ($P < 0.05$). There were no significant differences regarding total travel distance.

Conclusion: Expert users of the da Vinci surgical system performed the designed surgical tasks faster and with higher bimanual dexterity than novices. Bimanual coordination analysis and the tasks used in this study show promise for becoming important components of the objective criteria needed to quantify proficiency in robotic laparoscopy.