Team collaborative behaviours unveiled during laparoscopic simulation

Laparoscopic surgery, a type of minimally invasive surgery performed in the abdominal area, has become a leading advance in surgery over the past decades. During the procedure, small incisions are made for placing the scope and surgical instruments into the abdominal cavity. With much smaller incisions, laparoscopic procedures offer patients with less pain, fewer complications and shortened hospital stay.

Differing to open surgery where surgeons can see surgical site directly with their eyes, the surgeon who performs a laparoscopic procedure is dependent on his teammate to control the scope to acquire images from a patient's body. In this sense, the team collaboration between the surgeon and camera holder becomes critical for the success of laparoscopic surgery.

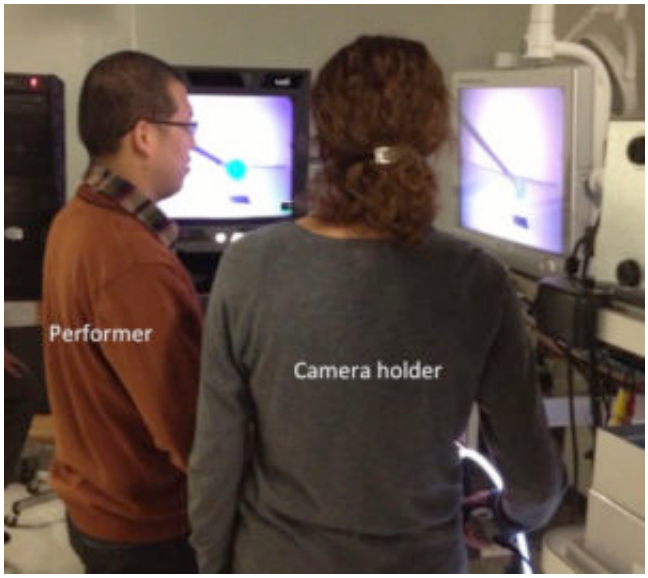

Fig. 1. Two surgeons working in a laparoscopic team in front of two separate surgical monitors.

In this study, we aimed to investigate team behaviours between two surgeons in a laparoscopic team. In such a team, one surgeon performed the surgical tasks and the other manipulated the camera to take good images for the surgeon. We designed a team simulation and required the laparoscopic procedure working under a safe training environment (Fig. 1). Videos of their performance was recorded and used to examine their team collaboration behaviours. Based on the videos, we examined the occurrence of movement de-synchronization between two surgeons. Movement de-synchronization is defined as the discordant movement between the surgeon and assistant. In an ideal situation, movement of the scope (camera) should keep the surgical target

and tips of instruments on the centre of its image. Should the object, tooltip or target fall outside camera view during the surgical task, a de-synchronization event would be recorded. Video analysis was used to investigate team behaviours between surgeon and assistant. We expected to see the number of movement de-synchronizations decrease as the team maturation increases. In plain language, the elite team should perform less movement de-synchronization than the poor team.

In this study performed in the Surgical Simulation Research lab, fourteen surgeons formed a total of 22 dyad teams. Each team performed a laparoscopic task where the camera holder navigated the laparoscope for the surgeon to transport a plastic cylinder between five separated targets (Fig. 2). Key movement landmarks were annotated from recorded surgical videos and used to identify team behaviours and performance. Task completion time, number of movement de-synchronizations, and errors (cylinder drops) were compared over 3 performance groups (elite, intermediate, poor) and 2 types of movements (on-site manipulation vs. position-shifting). On-site manipulation was defined as loading the object to the pin or picking up the object from the pin. Position-shifting was defined as the transportation of the object to different pins and the tool between home and pin.

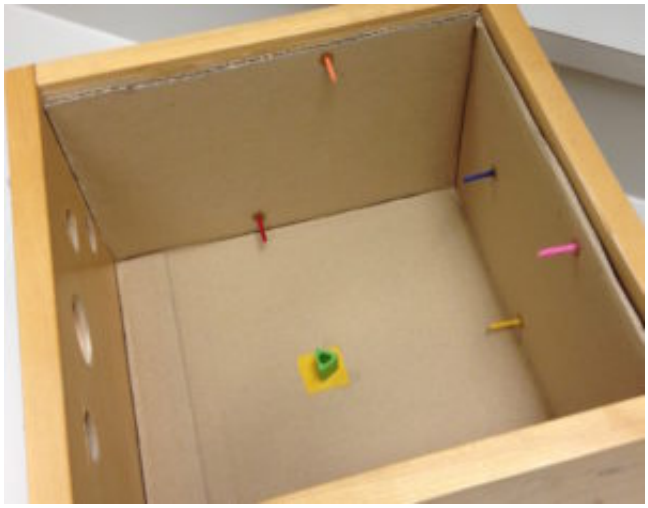

Fig. 2. Training box.

Our results show that the task completion time of elite teams were significantly shorter than intermediate and poor teams. Elite teams made fewer errors and recorded fewer numbers of de-synchronization than poor teams. We also found that the on-site manipulation took longer task time and recorded fewer de-synchronization than position-shifting tasks. Most of the de-synchronization movements occurred during shifting tasks rather than during on-site tasks; this can be explained by the fact that it is more difficult for the camera assistant to track a moving object than a relatively steady object.

In conclusion, video analysis is a useful tool for identifying team behaviours. Movement de-synchronization between a surgeon and assistant reveals the level of team cooperation in a laparoscopic procedure. The evidence where de-synchronization occurred frequently during the position-shifting tasks rather than during the on-site manipulation suggests team collaborative behaviours can be affected by different task requirements. In the future, the training of future surgical teams should be focused on reducing movement de-synchronization.

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Publication

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