

Constructing platform for the development of information-powered surgery

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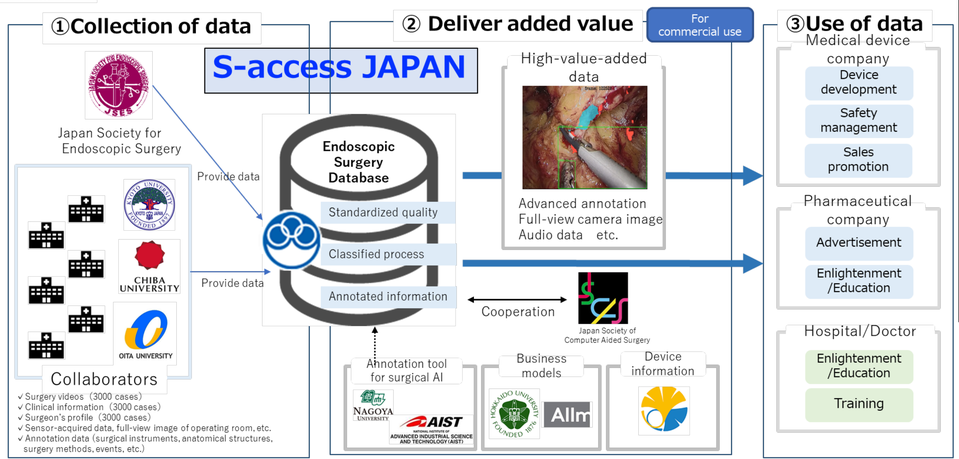
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Introduction: The benefits of endoscopic surgery have been widely recognized in recent years, and the number of procedures performed has been increasing worldwide. On the other hand, endoscopic surgery requires a high level of skills, and disparities in outcomes between expert and novice surgeons have been reported. It is important to visualize "tacit knowledge of surgery" and make use of them for the development of novel surgical support systems and surgical education.

Methods: We are collecting surgical information from all over the country and build a large scale video database of endoscopic surgery to develop information-powered surgical systems with the funding of Japan Agency for Medical Research and Development (AMED). We call this project "S-access JAPAN". The surgical video database including colorectal resection, gastrectomy, hepatectomy, pancreatectomy, prostatectomy and cholecystectomy can be shared with the clinical, academic and industrial collaborators. By using this database, our collaborative team is developing information-powered surgical systems which consist of Information Rich Platform and Autonomous View Control. Artificial intelligence (AI), especially convolutional neural network (CNN)-based deep learning methods, has been introduced to develop the autonomous visual recognition system as elemental technologies for these works.

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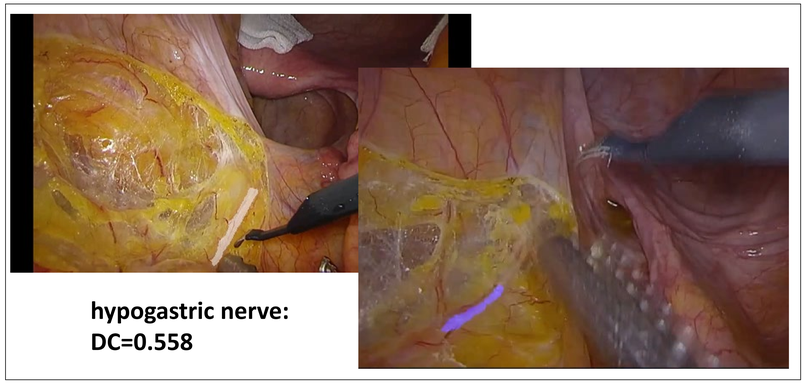
"Cross-sectional infrastructure development contributing to database construction of endoscopic surgery"(2019-21)

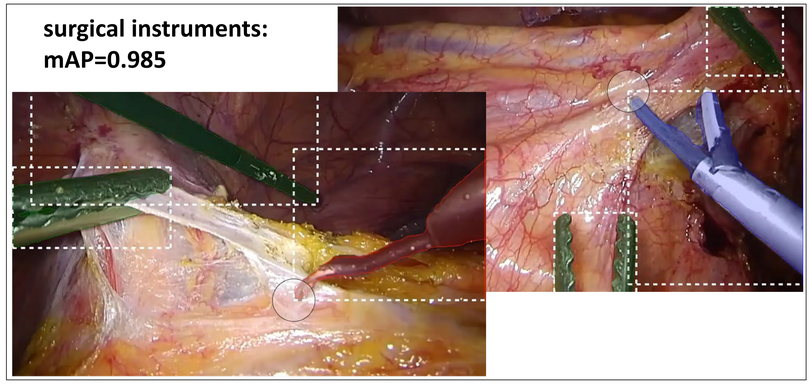


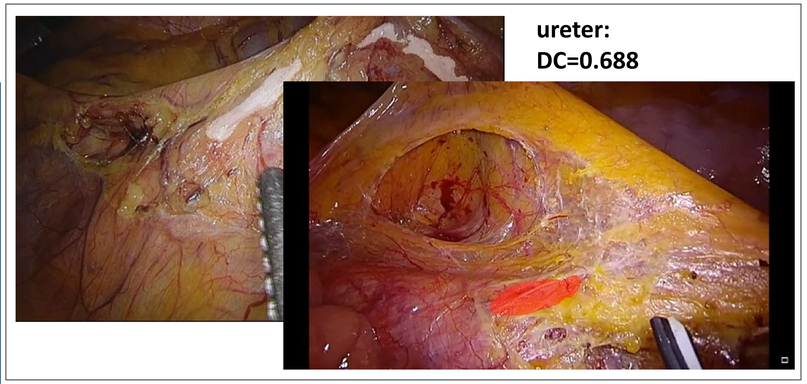
A total of 256 operative videos of laparoscopic left-sided colorectal resection were collected and utilized.

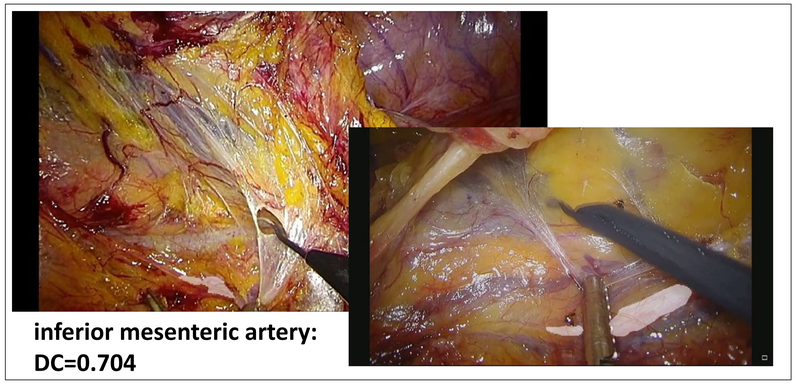
1) Information Rich Platform: According to the progress of each operation, the anatomy, landmarks and risk factors such as bleeding are navigated to ensure the safety of operations. It also shares significant information of the surgical process with staffs inside and outside operating room during surgery.

2) Autonomous View Control: Autonomous control of the endoscope using AI and other technologies can adapt a field of view in accordance with the progress of each surgical steps and the status of the operative field to perform operations efficiently.









Results: In the recognition of the inferior mesenteric artery, ureter and hypogastric nerve, the accuracy was evaluated by test images and the Dice coefficients (DC) were 0.704, 0.688 and 0.558, respectively. In the recognition of surgical instruments, the mean average precision (mAP) was 0.985.

Conclusions: Using our database, we were able to achieve high accuracy recognition. Information-powered surgery by CNN-based deep learning methods has significant potential in multiple clinical applications in the future.