Quantification of Surgery: Clinical Utility of Digital Anatomical Measurements

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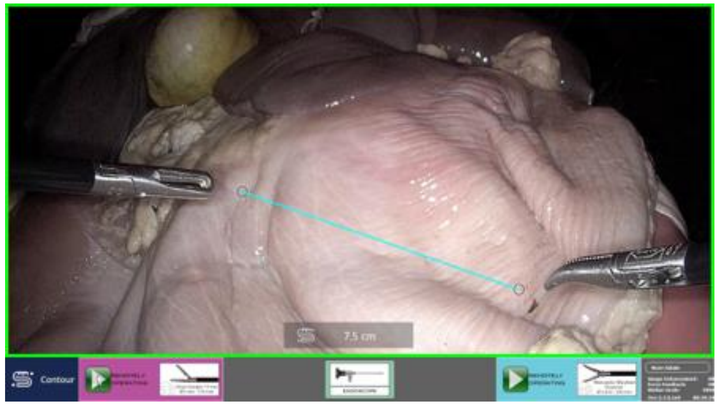
Description and Clinical Application

The ability to accurately measure is a critical need for surgery. Allowing surgeons to measure quickly and accurately intraoperatively is a functionality that does not exist today on any robotic platform. Applications will extend to multiple surgery disciplines, but early conceptual utility includes bariatric procedures such as sleeve gastrectomy where the ideal size and shape of a sleeve remains unclear. In open and laparoscopic procedures today, manual size estimates are made intraoperatively based on surgeon expertise. By providing surgeons tools to make accurate measurements, both point-to-point and along curvatures, surgeons can begin to quantify sleeve sizes and take the larger leap to correlate sleeve sizes to postoperative complication rates, weight loss, and other patient outcomes. The ability to optimize hernia mesh sizing could also be applied. An additional feature to digitally “tag” key critical anatomy and track during the procedure can help to reduce avoidable complications.

Objective

Surgery today is inconsistent as surgeons of all skill levels, experience, and training perform similar procedures but can have vastly different outcomes. Technology advancements are positioned to help reduce avoidable complications by decreasing surgical variability. The first step towards democratizing surgery to reduce variability is through capabilities on advanced platforms that enable quantification and digitization of surgery, modernizing techniques that exist primarily as manual steps today.

Laparoscopic techniques have become the gold standard approach for several general, gynecological, and bariatric procedures with robotic assistance becoming increasingly more widely adopted. However, the digital era is on the horizon. Performance-guided surgery is even further intensified with innovative augmented intelligence features such as digital measurement and annotation capabilities that will challenge today’s gold standard methodologies.



Contour measurement functionality enabling surgeons to measure along a 3D contour path between two points along the surface of a tissue.



Point to Point measurement functionality enabling surgeons to measure the distance of a straight line between two indicated point.

Preliminary Results

Initial results from simulated use studies utilizing porcine tissue and patient models by three surgeons experienced in laparoscopic and minimally invasive abdominal surgery techniques have shown that measurement functionality using 3D video imaging system to be accurate for clinical use. Two methodologies for intraoperative measurement functionality have been determined to have clinical utility: linear point to point and measurements along a contour.

In 32 trials, average error has been demonstrated to be as low as 0.97mm utilizing a 0° endoscope and point-to-point measurement techniques and as low as 0.88mm in 32 trials utilizing a 0° endoscope utilizing contour measurement techniques.

Conclusions and Future Direction

Clinical utility remains to be explored but the principle of utilizing digital features of augmented intelligence to make precise measurements and digitally annotating critical structures during surgery are set to be considerable advancements towards reducing surgical variability that can lead to complications, regardless of surgeon expertise. In addition, the ability to record these measurements will create a new class of metrics for comparing results between surgeons and across specialties. Enabling accurate tools to characterize anatomy and digitize the interface between surgeon and patient will unlock new approaches and create a more democratized surgical methodology.

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