Augmented Reality in a Tumor Resection Model

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Objective: To develop a new model of the laparoscopic experimental tumor and to evaluate the accuracy of tumor resection, with the use of Augmented Reality.

Design: Prospective, experimental study.

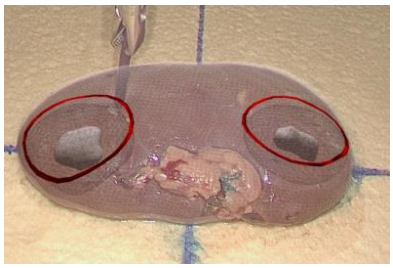
Setting: International Laparoscopic Surgery Centre.

Patients: Porcine (Landrace/Large White-Pietran) kidneys.

Interventions: Alginate was injected ex vivo into the parenchyma of porcine kidneys (2 to 3 pseudotumors). Alginate easily allowed creating 1-3 mm pseutumors. Kidneys were then imaged by MRI (T1-weighted) in three plans. We improved MRI settings to have a 0,4mm resolution, and pseudotumors were easily identified.

Measurements and main results: Augmented Reality (AR) is a technology that can allow a surgeon to see sub-surface structures in an endoscopic video. In our technique, three phases are necessary: Phase 1: segmentation phase: using the MRI images, the kidneys and pseudotumors' surface are delimited to construct a 3D mesh model. Phase 2: the intra-operative shape on the kidney is determined. Phase 3: fusion phase: pre-operative and intra-operative models are fused with the laparoscopic view. This blending gives the impression that the kidney is semi-transparent and the surgeon can see the exact location of the tumor inside it.

On this 2D image, to improve the depth localization of the tumor the AR software allows to display in real-time kidneys' surface meshes in addition to tumors meshes. Our software also allows displaying the resection margins defined preoperatively by the surgeon (5mm margins in our model).



30 tumors were resected using AR. The mean tumors volume was 0,17cm3 +/-0,12. Our preliminary results showed macroscopically tumor-free margins, for all tumors except one.

Conclusions: Our AR system allows to the accurate localization of very small tumors. Crucial information (such as resection margins and vascularization) can be displayed. Our system could be used in various laparoscopic surgical procedures.