Abstract:

BACKGROUND: Despite the rapid development of computer-assisted surgery, studies on kinematic measurement for surgical innovation are rare. This study describes a system for kinematic measurement in real operating theater environments. Six laparoscopic cholecystectomies were recorded and analyzed. In addition to a demonstration of the feasibility of the method, basis data for the development of an actuated laparoscopic camera holder are evaluated.

METHODS: The positions of four receivers were recorded by an electromagnetic motion acquisition system. Analysis of the data was performed postoperatively with matlab. Parameters such as coordinates, velocities, angles, angular velocities, workspaces in typical phases of an operation, and subareas of the coordinate ranges were computed.

RESULTS: The workspace during the operation in situ before (II) and after (V) removal of the gallbladder at the upper camera end was as follows: (X, Y, Z; given in cm):

II: 65.5 . 42.7 . 27.3 (subarea 90% = 8.3. 14.0.6.3); V: 57.4.33.3.26.2, (90% = 10.3.16.5.7.9). Workspaces at the lower camera end were smaller: II: 14.8.9.7.15.4; (90% = 3.5.3.1.4.3). During these operation phases, velocities up to 82.9 cm/s were documented. Most of the measured velocities were much smaller. The camera -tilt-angles in left/right (alphax) and head/ feet (alphay) direction were as follows: alphax: -69 degrees to +69 degrees and alphay: -74 degrees to +48 degrees.

CONCLUSION: This
study demonstrates the feasibility of real-time kinematic measurement in the operation environment. The information might be of future value not only as basis data for the development of camera holders, but also for further investigations on robotics, ergonomics, and simulation.

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