Section: **Validierung**

ID: 122

Abstract-Title:
ERSTE EXPERIMENTELLE ERFAHRUNGEN MIT EINEM MAGNETISCHEN TRACKINGSYSTEM IM OPFIRST EXPERIMENTAL EXPERIENCE WITH AN ELECTROMAGNETIC TRACKING SYSTEM IN THE OPERATION THEATRE

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Abstract-Text:
Purpose
The exact position of a tumor in relation to the intrahepatic vessels is an important topic in liver surgery. In our clinic we develop a 3D-ultrasound based navigation system to display this intraoperative location for computer aided resection of the tumors[1]. The navigation system is based on the optical tracking system POLARIS (Northern Digital).
The disadvantages of optical systems are the large sensors and that line-of-sight must be maintained between the sensor and the camera. The advantages are the higher accuracy and the insensitivity against fero – and electromagnetic fields. Newer electromagnetic measuring systems promise to better compensate the disadvantages[2]. The feasibility to use the AURORA system (Northern Digital) in the OR should be analyzed here. For the future the measuring system is the basis to tracking tumors, vessels and resection planes.

Method
The coordinate systems of an optopelectronic and a magnetic tracking system were aligned with a landmark registration. Optical system POLARIS was used as reference. An optical sensor was mounted to a fix position in relation to the field generator of the AÚRORA system. In addition we collected points distributed over the hole working range of the AURORA system with an optical, respectively an electromagnetical pointer. The measurements were performed in a circle shape volume with a diameter of 22cm. This should be a typical range for liver surgery. In this volume 12 measure points were uniformly distributed (Fig.1). A sensor of each tracking system was connected fix and the local coordinate systems were adjusted. The registration was performed in the laboratory under optimal conditions (no fero- or electro magnetical fields). We have repeated the measuring under the same settings in the OR on a surgical table. Different instruments, clamps and mounting arms were putted in the working range of AURORA (Fig. 2). We computed the error as difference between the electro magnetical system and the optical reference.

Results
The Root Mean Square Error (RMS) in the laboratory without interferences was 0.8mm (+-0.4mm).By the same scenario in the OR on the surgical table the RMS was 2.1mm (+-0.8). For a laparoscopic setup different Endo scissors were position close to the sensors. The RMS was 2.8 mm (+-1.1mm). For a simulation of a scenario for open liver surgery several

mounting arms and clamps were mounted on the surgical table (Fig.3). As expected the error was most highly with 4.1 mm caused by large metal instruments, especially if the wide metal clamps were brought directly between the field generator and the sensor.

Conclusion

The results of the different OP scenarios show promise. Especially in laparoscopy the measurement system reached a higher accuracy. In the setup for open liver surgery large surgical instruments are a critical factor. With a better setup (e.g. no hooks for laparotomy between the magnetic field generator and the sensors) the interferences could be reduced.

In summary the AURORA system is appropriate to use in the OR by an accuracy requirement of 2-3 mm. Particularly adapted field generators, closer to the OP field would be helpful for an higher accuracy. Acknowlegements: Northern Digital, Inc. supplied us with Aurora systems for evaluation, special thanks to Stefan Kirsch.

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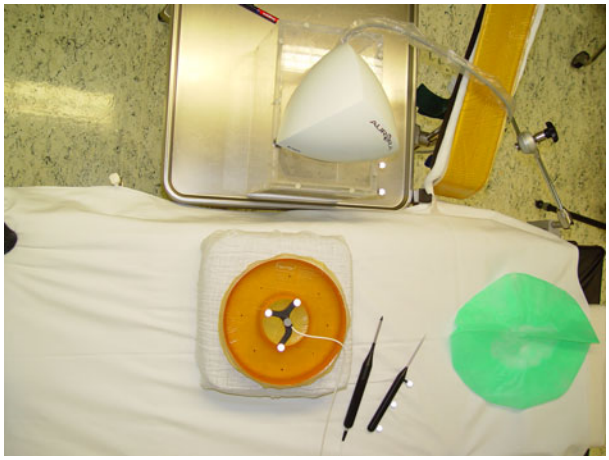
Bild 2/JPG



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