Needle-based navigation system for CT-guided radiofrequency ablation of the liver (P-819)

Keywords
- precise intervention and navigation aid for soft tissue surgery
- real-time observation and supervision
- inexpensive hardware/software equipment

Abstract
Computed tomography (CT)-guided percutaneous radiofrequency ablation (RFA) has become a commonly used procedure in the treatment of liver tumors. One of the main challenges related to the method is the exact placement of the instrument within the lesion.

Technology
To address this issue, a system was developed for computer-assisted needle placement which uses a set of fiducial needles to compensate for organ motion in real time. The purpose of this study was to assess the accuracy of the system in vivo. Two medical experts with experience in CT-guided interventions and two non-experts used the navigation system to perform 32 needle insertions into contrasted agar nodules injected into the livers of two ventilated swine. Skin-to-target path planning and real-time needle guidance were based on preinterventional 1 mm CT data slices. The lesions were hit in 97% of all trials with a mean user error of 2.4 +/- 2.1 mm, a mean target registration error (TRE) of 2.1 +/- 1.1 mm, and a mean overall targeting error of 3.7 +/- 2.3 mm. The nonexperts achieved significantly better results than the experts with an overall error of 2.8 +/- 1.4 mm (n=16) compared to 4.5 +/- 2.7 mm (n=16). The mean time for performing four needle insertions based on one preinterventional planning CT was 57 +/- 19 min with a mean setup time of 27 min, which includes the steps fiducial insertion (24 +/- 15 min), planning CT acquisition (1 +/- 0 min), and registration (2 +/- 1 min). The mean time for path planning and targeting was 5 +/- 4 and 2 +/- 1 min, respectively. Apart from the fiducial insertion step, experts and non-experts performed comparably fast. It is concluded that the system allows for accurate needle placement into hepatic tumors based on one planning CT and could thus enable considerable improvement to the clinical treatment standard for RFA procedures and other CT-guided interventions in the liver. To support clinical application of the method, optimization of individual system modules to reduce intervention time is proposed.

Development Stage
We have developed a prototype including hard- and software, which functionality has been approved at the DKFZ and at the University Hospital Heidelberg, Germany.

Applications and Commercial Opportunity
Development of medical equipment for computer assisted surgery in soft tissue, in particular in liver surgery.

Advantages
- precise intervention and navigation possible especially in soft tissue surgery
- real-time observation and supervision of soft tissue surgery
inexpensive hardware/software equipment suitable not only for bigger hospitals, but also for smaller doctors’ practice

**Inventors**
The invention was jointly conceived by Lena Maier-Hein, Beat Peter Müller-Stich, Hannes Kenngott and Hans-Peter Meinzer of the Division of Division of Medical and Biological Informatics (E130).

**Intellectual Property**
A priority patent application US 61/166,370 was filed April 3, 2009 at the US Patent Office and a subsequent international patent application (PCT) was filed March 4, 2010.

**References**


**Further Information**
No other public information is currently available, but further information (speaking with the inventor) is available under a signed Confidential Disclosure Agreement (CDA).

**DKFZ Contact:**
For further information please contact:

Dr. Frieder Kern
Deutsches Krebsforschungszentrum
Technology Transfer Office T010
Email: F.Kern@dkfz.de
Tel.: +49-(0)6221-42-2952
Fax: +49-(0)6221-42-2956