Simulation of fluoroscopic localization for surgical training

M Rullmann, M Hirschfeld, C Petzold, G Bausch, M Sturm, W Korb
Innovative Surgical Training Technologies, Leipzig University of Applied Sciences, Leipzig, Germany,
rullmann@istt.htwk-leipzig.de

Introduction

Fluoroscopy is a widely used imaging technique during spine surgery. While most neurosurgeons act familiar with the x-ray-based image guidance, resident physicians need to learn how to obtain a meaningful image, which requires precise orientation to the unexposed spinal anatomy. We present a simulation system for training of fluoroscopic localization for spinal procedures. After positioning of the patient, the level and site of the skin incision is approved preoperatively by fluoroscopy. Positioning a needle lateral to the spine, which is then confirmed fluoroscopically, defines the so-called localization.

Methods

For simulation we use a radiopaque posterior spine model L3-L5 including spine model housing (Simulab Corporation, Seattle, USA). The model was scanned using a Philips Brilliance CT 64-channel scanner (Philips Medical Systems, Eindhoven, Netherlands). The real world model is tracked using the electromagnetic tracking system Aurora (Northern Digital Inc., Waterloo, Ontario, Canada) and registered to the volumetric data. Aurora’s 6DOF Probe is used as positioning needle model. Combining the given positioning and orientation information of the model, probe and Aurora’s field generator, we developed an algorithm, which calculates a virtual fluoroscopic image. An intuitive GUI was built using MATLAB (MathWorks, Inc., Natick, USA) to offer easy usage of the simulation system.

Results

The computed virtual fluoroscopy image shows a realistic preoperative patient positioning situation including the lateral needle pointing towards the sought vertebra. Therewith, we successfully combine a real-world spine model with its virtual representation, as well as their positioning and orientation information for simulated localization training. Initial feedback from physicians confirms the realistic appearance of the simulation.

Conclusion

We developed a simulation system for realistic fluoroscopic localization for spinal procedures. Therewith, we provide a potential and comprehensive tool for localization training of residents. Additionally, for training purposes, the proposed system eliminates the drawback of fluoroscopy by reducing the radiation exposure to the physician completely.