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Computerunterstützte Planung von Brust-Biopsien mit DynaCAD

Computer Assisted Planning of Breast Biopsies with DynaCAD

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Purpose

Magnetic Resonance (MR) imaging is a sensitive method for detecting and localizing sonographically and mammographically occult breast lesions. Since histologic analysis of these otherwise occult lesions is very important, the demand for accurate MR guided breast biopsy has increased. Computer assistance in this field can improve the accuracy and speed of the procedure, while minimizing the probability of errors. A software package, DynaLOC (MRI Devices Corporation, MeVis), was developed and validated for interactive planning of MR guided percutaneous interventions with focus on applications which utilize a bilateral breast MR coil. We report on a phantom study which demonstrated the feasibility and validated the accuracy of the computer assisted planning software for percutaneous needle localization and biopsy.

Material & Methods

98 test biopsies were performed using two different bilateral breast coils (MRI Devices OBC and BBC coils), each with two localization systems (grid and pillar), over a range of needle sizes (9G to 18G). Both lateral and medial access approaches were used on the BBC. MR imaging was performed on two 1.5T MR scanners (Siemens Magnetom Vision, GE SIGNA) using a sagittal 3D spoiled gradient echo sequence with water excitation or fat suppression. The target test object was an MR compatible anthropomorphic breast phantom made of gelatin.

A baseline scan was acquired and a random target point inside the phantom was selected using the MR scanner console. The target coordinates were manually recorded and the images were transferred to DynaLOC for intervention planning. The first step was automated calibration of a set of fiducial markers (Vitamin E or Gadolinium contrast agent). The coordinates for needle placement were computed relative to the fiducial marker and the target point locations.

DynaLOCprovided a visual representation of the biopsy device and numerical locations on the grid or the pillar system were used to place an MR compatible biopsy needle. A verification scan was acquired and, via the MR scanner console, the position of the needle tip was recorded. From these position measurements, 2D and 3D localization errors were computed.

Results

Accuracy results were calculated for the four different devices combinations (OBC Grid, OBC Pillar, BBC Grid, BBC Pillar). The mean localization accuracy was comparable between the two different coils, for the BBC Grid method, a mean 2D error of 2.6 mm (+/- 1.4 mm) was measured, the 3D error was slightly larger (3.6 mm +/- 1.4 mm), mainly due errors in the depth of needle placement (within allowed tolerance). For the BBC Pillar method, the respective values were 3.6 +/- 1.2 mm (2D) and 5.6 +/- 1.6 mm (3D). Automatic calibration of the fiducial markers occurred almost instantaneously, after that, the procedure was planned interactively.

Conclusion

We have demonstrated that the combination of a dedicated breast MR coil together with planning software (DynaLOC) provides a tool which is able to reliably and accurately automate much of the breast biopsy image analysis activities by eliminating the need for error-prone manual calculations. Computerized procedure planning should prove to significantly decrease time needed for the intervention planning and concurrently increase the precision of the intervention.