

Concept Development and Feasibility Study of Image-based Needle Guidance for MR-Guided Interstitial Gynecologic Brachytherapy in AMIGO

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Purpose

Interstitial gynecologic brachytherapy, the placement of radioactive isotopes directly into a cancer of the uterine cervix or vagina in order to eradicate the cancer, requires insertion of hollow catheters with introducers into the tumor. The catheters are guided into place through holes in a template sutured to the patient's perineum. Current clinical practice at BWH/DFCI uses Computed Tomography (CT) and ultrasound images to guide the advancement of these catheters [1]. In the newly constructed *Advanced Multimodality Image-Guided Operating (AMIGO)* suite at BWH/DFCI, intraprocedural Magnetic Resonance (MR) images are acquired to visualize the catheters in relationship to the tumor. The goal of this project is to develop computational algorithms and a visualization workflow to aid catheter placement during MR guided interstitial gynecologic brachytherapy in AMIGO.

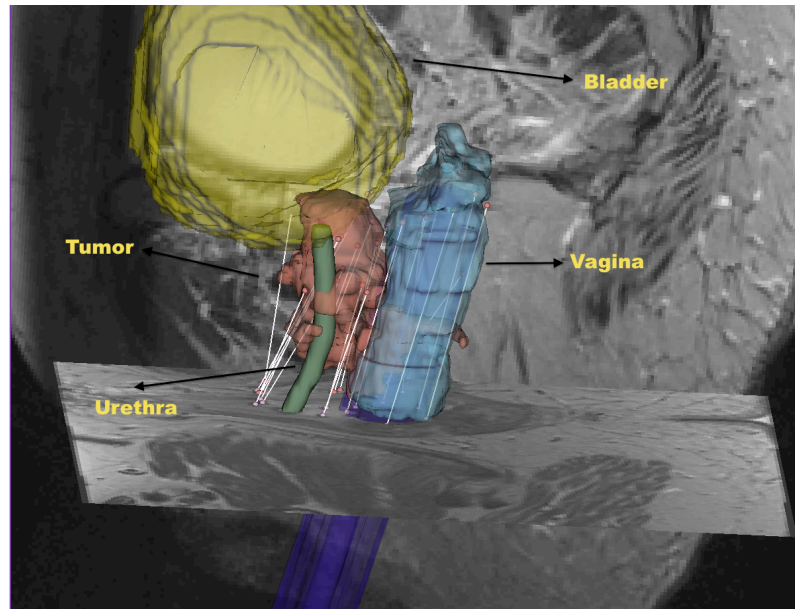
Methods

Imaging: All imaging is performed in the Siemens Verio 3T MR scanner (70cm) in the AMIGO suite. At the start of the procedure, an MR Imaging (MRI) series consisting of T2 Ax, Sag, and Cor slices is acquired (TR 4000, TE 101, Flip Angle 150, Slice Thickness 4mm, Slice Gap 20). At the end of the procedure, a similar T2 weighted MRI series is obtained for final confirmation. During the procedure, alternating T2 and GRE images (plane orthogonal to obturator) are acquired to show the advancing needle and surrounding anatomy.

Image Processing and Visualization

Workflow: The free and open source software platform 3D Slicer [2] is used to implement the following workflow. 1) On the initial MRI, the tumor, the organ of interest (OAR), the obturator and the template are segmented. 2) Each subsequent MRI is registered to the initial MRI, the catheters are marked, and rendered in relationship to the previous segmentations, as illustrated in the figure on the right.

Efforts for optimizing this workflow by automating the segmentation of the obturator, template, catheters, tumor, and OARs in the MRI images are currently underway.



Results and Conclusion

A concept has been developed and prototyped using 3D Slicer for image-processing-based guidance during interstitial gynecologic brachytherapy catheter placement. This has been tested retrospectively, under IRB approval, on data obtained from the first AMIGO gynecologic brachytherapy procedure performed on September 9, 2011. Preliminary results indicate that the prospective use of this guidance workflow in AMIGO will provide a useful means to increase efficiency in interstitial brachytherapy.

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References

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2. 3D Slicer software website <http://www.slicer.org>