A novel computer program to support MR-guided gynecologic brachytherapy

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Purpose/Objective
To describe a novel computer program designed and implemented to provide an overall system for supporting MR-guided gynecologic brachytherapy

Material/Methods
From September 2011 to January 2012, 10 gynecologic-cancer patients requiring brachytherapy underwent image-guided applicator insertion in a multimodal operating suite with integrated MR scanner, ultrasound and PET/CT scanner. In order to increase the physician's speed and monitor the consequences of inserting interstitial catheters in real time, a novel computer program was designed and implemented and is described here.

Results
The overall system starts with pre-implant imaging and the integrated software permits measurement of relevant sizes for intervention leading to automatic inventory control and specific applicator request. Next, a device is selected (e.g., tandem and ring/ovoid +/- interstitial needles or interstitial needles alone) that is modeled in the preoperative images. Virtual modeling and visualization of several instruments for direct device comparison is enabled to identify the optimal one. In the intraoperative stage, the patient is imaged using 3 Tesla MRI with legs in the insertion position. The computer-visualized template allows guidance to an optimal position for dose delivery. Serial imaging examinations are superimposed on the visualization of the modeled device. With this interactive novel software program, the physician can select which interstitial needles may best benefit the patient, and at what depth they should be inserted, as determined by the MRI image viewed during the insertion process. The physician then inserts the correct interstitial needle into the necessary applicator hole based on the tumor location as visualized on intra-operative 3T MRI.

Conclusion
Novel software was developed that aids in the integration of preoperative assessment, intraoperative 3T imaging and applicator insertion. Novel features include 1) linking a diagnostic imaging set in real-time to a 3D CAD model of a medical device; 2) precise identification of catheter location in the 3D imaging model with real-time imaging feedback and 3) the ability to perform patient-specific pre-implant evaluation by assessing in the computer the placement of interstitial needles prior to an intervention via virtual template matching with a diagnostic scan.