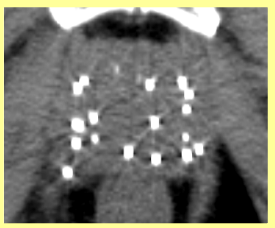
# Automated Three Dimensional (3D) Seed Localization with Contrast-enhanced Magnetic Resonance Imaging (CEMRI) Versus Computed Tomography (CT) in Prostate Brachytherapy Patients: First Experience.

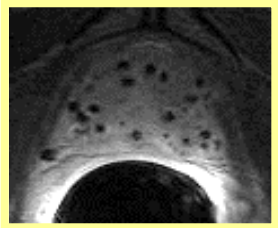
B. N. Bloch[1], E. J. Holupka[2], T. H. Helbich[3], I. D. Kaplan[2], P. M. Meskell[2], G. Mathiowitz[2], A. Mahadevan[2], R. Oismueller[4], R. Hawliczek[4], R. A. Cormack[5], R. E. Lenkinski[1], N. M. Rofsky[1]

[1]Radiology, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States, [2]Radiation Oncology, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States, [3]Radiology, General Hospital Vienna, Medical University Vienna, Vienna, Austria, [4]Institute for Radiation Oncology, Danube Hospital Vienna, Vienna, Austria, [5]Radiation Oncology, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States

**Purpose:** To assess the utility of contrast enhanced MRI for automated 3D seed localization for postplanning in brachytherapy patients. **Background:** CT or CT/MRI fusion is used for post-planning studies in prostate cancer brachytherapy. The limited soft tissue contrast of CT and its consequent poor delineation of clinically relevant adjacent structures, necessitate estimations for topographical dosimetry. To our knowledge, contrast-enhanced MRI has not been previously used in this capacity. **Methods and Materials:** MRI and CT of the post Brachytherapy prostate gland were performed in 3 patients to analyze a total of 249 seeds. For MRI a 1.5 T unit (Vision, Siemens, G) with combined surface and endo-rectal coils (Prostate-Coil, Medrad, USA) was used to obtain dynamic Gd-DTPA enhanced (Magnevist, Schering, G) Gradient Echo (3D-FLASH, 8.1/4; 01 min 35 s; FOV 160, 3mm section) transverse images(1). CT was performed with a transverse section of 5 mm thickness, pitch factor 1.5 on a spiral CT scanner (Somatom Emotion, Siemens, G). To localize the seeds (n=249) in 3 patients a modified automated CT 3D post planning software tool (Interplant®, Computerized Medical Systems Inc.) was used on the MRI images. The parameters for the search algorithm (Hough transform(2)) were adjusted to accommodate the voids (ellipsoids) caused by seeds on MR. Coordinates of located seeds were determined for each modality. The accuracy of this search algorithm has been documented for seed location from CT and serves as the gold standard. The deviations of MR seed coordinate positions from CT seed positions were the measure of accuracy for location of seeds on MR. **Results:** 100% of the seeds were automatically detected with CEMRI. There was an excellent agreement between MRI and CT (total number of implanted seeds n=249; average deviation on X coordinate: -0.003 cm; standard deviation on X coordinate: 0.210 cm; average deviation on Y coordinate: -0.005 cm, standard deviation on Y coordinate: 0.270 cm; average deviation on Z coordinate: 0.004 cm; standard deviation on Z coordinate: 0.226 cm) **Conclusion:** These initial results show that CEMRI is feasible for automated accurate 3D Seed localization. The D90 and V100 dose/volume parameters are more accurately assessed by this MRI protocol, providing a superior soft tissue contrast, delineating clinically relevant intraglandular (e.g. urethra) and periprostatic structures (e.g. rectal wall, penile bulb and neurovascular bundle) and visualizing the seeds and at the same time. High spatial resolution contrast enhanced MRI enables topographically adjusted 3D dosimetry and thus has the potential to serve as the single and sufficient post-planning study. CEMRI protocols might replace CT and MRI/CT fusion protocols for postbrachytherapy evaluation of prostate patients.



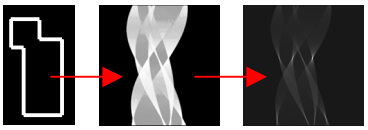
CT



CEMRI

**Table 1**. corresponding axial CT and CEMRI images of the midthird of prostate. Note the seed dislocation to the right neurovascular bundle on the CEMR image.

$$J(\vec{r}) = \begin{cases} 0 & I(\vec{r}) < \lambda \\ 1 & I(\vec{r}) \geq \lambda \end{cases} \qquad 0 \leq \lambda \leq 2^n - 1$$



$$y = \tan\theta \cdot x + \frac{r}{\sin\theta}$$

**Table 2.** Hough Transform Algorithm

**References: 1**. Bloch BN et al. Postbrachytherapy Seed Distribution: Comparison of Contrast-enhanced T1-Weighted and T2-Weighted Endorectal MR Imaging (MRI) Versus Computed Tomography (CT): First Experience. RSNA 2003:Radiology 2003;227 (2): Suppl.

**2**. Holupka EJ et al. An automatic seed finder for brachytherapy CT postplans based on the Hough transform. Med Phys 2004;31(9):2672-2679.