Gold Anchor MR+

White Paper

MR-only workflow for prostate SBRT treatments at Tampere University Hospital

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All prostate SBRT patients with MR-only workflow have Gold Anchors™ used as fixed reference points in tracked radiotherapy treatment with Triggered Imaging.

One week prior to MR-imaging, three Gold Anchors™ (2220-10) are implanted with a thin 22G needle transrectally into the prostate using endorectal US guidance. Using a 22G needle for transrectal implantation into the prostate has proven to give a low risk of infection[1]. The anchors are implanted in a compressed form for optimal kV-tracking and tissue attachment[2].

MR-imaging, made with 1.5T Philips Ingenia Ambition RT, consists of T1 and T2 sequences for dose calculation and prostate delineation purposes. T1 3D Dixon sequences are used for creation of synthetic CT (sCT) for dose calculation and automatic OAR contouring. After the T1 sequence, T2 3D and T2 2D axial TSE sequences are imaged for prostate delineation. To minimize the effect of prostate motion between different imaging sequences on the planning accuracy, T2 images used for delineation are registered manually to the sCT, based on the Gold Anchor markers which are made of an alloy of pure gold mixed with a small portion of pure iron for enhanced visibility on MR-imaging[3]. Delineated target structures are copied to sCT for dose optimization and calculation.

Patients are treated with 5 x 7.25 Gy fractionation using two VMAT arcs with 10 MV FFF beams. Treatments are performed with Varian TrueBeam and TrueBeam STx linacs. Treatment localization is based on CBCT which is used for initial positioning and checking of bladder and rectum filling status. An orthogonal kV-kV image pair is taken after the CBCT evaluation to correct the possible prostate motion during the evaluation. Anchor structures delineated on sCT are used as reference structures for the treatment localization with kV-kV, as they do not visualize in sCT based reference DRR images. To detect the anchors well through the pelvic bones, it is advisable to use high kV values for lateral kV-images.

During the irradiation, Triggered imaging with auto beam hold is used for monitoring and mitigation of the prostate intrafraction motion. GoldSeed_1_0x3_0 is used as a marker detection method with circular motion tolerance region of 8 mm diameter. To ensure automatic detection of the Gold Anchors, maximum kV value is used. Imaging interval is 30 degrees.

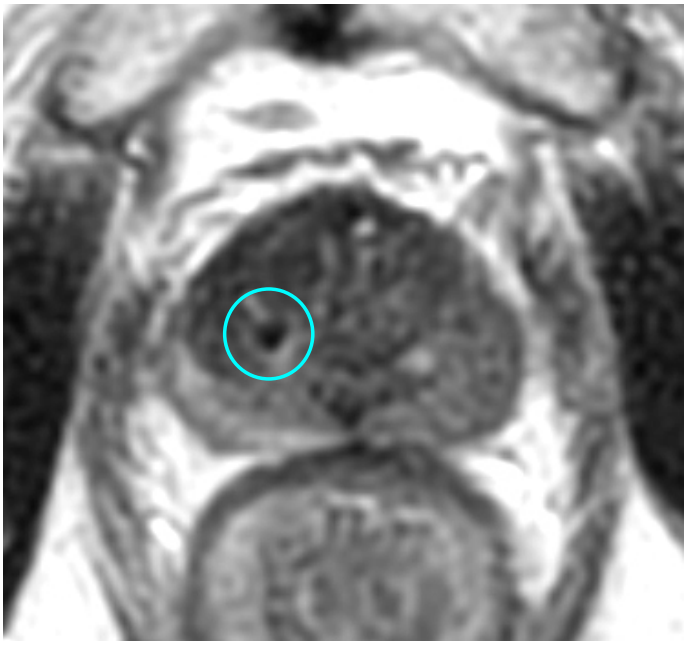

Figure 1. Visibility of one Gold Anchor in T2 2D.

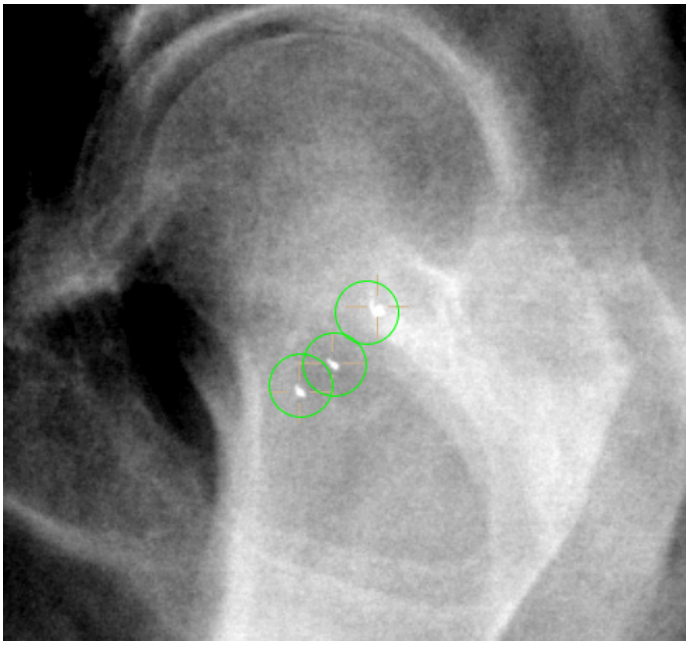

Figure 2. kV-image from triggered imaging.

1 Castellanos E, Wersäll P, Tilikidis A, et al. (October 31, 2018) Low Infection Rate After Transrectal Implantation of Gold Anchor ™ Fiducial Markers in Prostate Cancer Patients After Non-broad-spectrum Antibiotic Prophylaxis. *Cureus 10*(10): e3526. DOI 10.7759/cureus.3526

2 Ingun Ståhl, Magnus Gustafsson, Ulrika Lindecrona, (August 20, 2018) [OA126] Intrafractional imaging during volumetric modulated arc therapy (VMAT) prostate treatment in combination with gold anchor fiducials. *Physica Medica, 52*(1), 47-48. https://doi.org/10.1016/j.ejmp.2018.06.198.

3 Gurney-Champion: O.J. Gurney-Champion, E. Lens, A. van der Horst, et al. Visibility and artifacts of gold fiducial markers used for image guided radiation therapy of pancreatic cancer on MRI. *Med Phys 42* (5), May 2015:2637-47.