

MRIdian[®] PROSTATE Bibliography

FDA-cleared since 2012, ViewRay’s MRIdian is actively being used to treat cancer patients at leading cancer centers worldwide. This bibliography has been prepared by ViewRay to highlight the capabilities of ViewRay’s innovative MRIdian radiation therapy technology.

In this bibliography, we list peer-reviewed publications that have been published by members of the radiation oncology care teams who have pioneered the use of MR image guidance in Radiation Therapy using ViewRay’s MRIdian technology.

MRIdian Clinical Studies	2
GENITOURINARY (GU)	2
OTHER – TUMOR SITES.....	4
MRIdian Advanced MRI Studies	4
MRIdian Technology Description and Evaluation	5
MRIdian Health Economics	6

The materials referenced are for educational and informational purposes only and not for the purpose of providing legal, medical, regulatory, or other professional advice. While an effort is made to post only the most accurate available information, ViewRay does not guarantee that the materials posted, or the information contained therein are the most current. ViewRay does not warrant or make any representations as to the content, accuracy or completeness of the information, text, graphics, links, and other items contained in these materials. The materials referenced are not intended to be a complete presentation of all information or issues for any topic.

MRIdian Clinical Studies

GENITOURINARY (GU)

Prostate

Bohoudi, O., Lagerwaard, F.J., Bruynzeel, A.M.E., Niebuhr, N.I., Johnen, W., Senan, S., et al. (2019). End-to-end empirical validation of dose accumulation in MRI-guided adaptive radiotherapy for prostate cancer using an anthropomorphic deformable pelvis phantom. *Radiotherapy and Oncology*, 141:200-207.

Bohoudi, O., Bruynzeel, A.M., Tetar, S., Slotman, B.J., Palacios, M.A., Lagerwaard, F.J. (2021). Dose accumulation for personalized stereotactic MR-guided adaptive radiation therapy in prostate cancer. *Radiotherapy and Oncology*, 157:197-202.

Bruynzeel, A. M. E., Tetar, S. U., Oei, S. S., Senan, S., Haasbeek, C. J. A., Spoelstra, F. O. B., et al. (2019). A prospective single-arm phase 2 study of stereotactic magnetic resonance guided adaptive radiation therapy for prostate cancer: early toxicity results. *International Journal of Radiation Oncology*Biophysics*, 105(5), 1086–1094.

Cao, M., Gao, Y., Yoon, S.M., Yang, Y., Sheng, K., Ballas, L.K., et al. (2021). Interfractional Geometric Variations and Dosimetric Benefits of Stereotactic MRI Guided Online Adaptive Radiotherapy (SMART) of Prostate Bed after Radical Prostatectomy: Post-Hoc Analysis of a Phase II Trial. *Cancers*, 13, 2802.

Drabble, J., Das, P., George, B., Camilleri, P., Morris, A. (2022). Based on 0.35 T magnetic resonance-guided radiotherapy, what are the nonisotropic PTV margins required for conventional prostate radiotherapy? *Medical Dosimetry*, S0958-3947(22)00055-3.

Farjam, R., Mahase, S.S., Chen, S.L., Coonce, M., Pennell, R.T., Fecteau, R., et al. (2021). Quantifying the impact of SpaceOAR hydrogel on inter-fractional rectal and bladder dose during 0.35 T MR-guided prostate adaptive radiotherapy. *Journal of Applied Clinical Medical Physics*, 22(9):49-58.

Farjam, R., Nagar, H., Zhou, X.K., Ouellette, D., Formenti, S.C., DeWyngaert, J.K. (2021). Deep learning-based synthetic CT generation for MR-only radiotherapy of prostate cancer patients with 0.35T MRI linear accelerator. *Journal of Applied Clinical Medical Physics*, 22(8):93-104.

Hedge, J. V., Cao, M., Yu, V. Y., Kishan, A. U., Shaverdian, N., Lamb, J., et al. (2018). Magnetic resonance imaging guidance mitigates the effects of intrafraction prostate motion during stereotactic body radiotherapy for prostate cancer. *Cureus*, 10(4), e2442.

Kim, J., Park, J.M., Choi, C.H., An, H.J., Kim, Y., & Kim, J.H. (2019). Retrospective Study Comparing MR-guided Radiation Therapy (MRgRT) Setup Strategies for Prostate Treatment: Repositioning vs. Replanning. *Radiation Oncology*, 14(1), 139.

Kishan, A. U., Tyran, M., Steinberg, M. L., Holden, S. B., & Cao, M. (2018). MRI-guided dose-escalated salvage radiotherapy for bulky bladder neck recurrence of prostate cancer. *Cureus*, 10(3), e2360.

Leeman, J.E., Cagney, D.N., Mak, R.H., Huynh, M.A., Tanguturi, S.K., Singer, L., et al. (2022). MR-guided prostate SBRT with daily online plan adaptation: Results of a prospective phase I trial and

supplemental cohort. *Advances in Radiation Oncology*, Advanced online publication, <https://doi.org/10.1016/j.adro.2022.100934>

Ma, T.M., Ballas, L.K., Wilhalme, H., Sachdeva, A., Chong, N., Sharma, S., et al. (2022). Quality-of-Life Outcomes and Toxicity Profile Among Patients with Localized Prostate Cancer After Radical Prostatectomy Treated With Stereotactic Body Radiation: The SCIMITAR Multi-Center Phase 2 Trial. *International Journal of Radiation Oncology*Biophysics*, S0360-3016(22)03160-1. doi: 10.1016/j.ijrobp.2022.08.041.

Ma, T.M., Lamb, J.M., Casado, M., Wang, X., Basehart, T.V., Yang, Y., (2021). Magnetic resonance imaging-guided stereotactic body radiotherapy for prostate cancer (mirage): a phase iii randomized trial. *BMC Cancer*, 21(1):538.

Ma, T.M., Neylon, J., Casado, M., Sharma, S., Sheng, K. Low, D., et al. (2022). Dosimetric impact of interfraction prostate and seminal vesicle volume changes and rotation: A post-hoc analysis of a phase III randomized trial of MRI-guided versus CT-guided stereotactic body radiotherapy. *Radiotherapy and Oncology*. 167:203-210.

Michalet, M., Riou, O., Cottet-Moine, J., Castan, F., Gourgou, S., Valdenaire, S., et al. (2022). Magnetic Resonance-Guided Reirradiation for Local Recurrence within the Prostate or in the Prostate Bed: One-Year Clinical Results of a Prospective Registry Study. *Cancers*, 14(8):1943.

Park, J.M., Park, S.Y., Choi, C.H., Chun, M., Kim, J.H., Kim, J.I. (2017). Treatment plan comparison between Tri-Co-60 magnetic-resonance image-guided radiation therapy and volumetric modulated arc therapy for prostate cancer. *Oncotarget*, 8(53):91174-91184.

Pham, J., Cao, M., Yoon, S.M., Gao, Y., Kishan, A.U., & Yang, Y. (2022). Dosimetric Effects of Air Cavities for MRI-Guided Online Adaptive Radiation Therapy (MRgART) of Prostate Bed after Radical Prostatectomy. *Journal of Clinical Medicine*, 11(2):364.

Pham, J., Savjani, R.R, Yoon, S.M., Yang, T., Gao, Y., Cao, M., et al. (2022). Urethral Interfractional Geometric and Dosimetric Variations of Prostate Cancer Patients: A Study Using an Onboard MRI. *Frontiers in Oncology*, 12:916254.

Ristau, J., Hörner-Rieber, J., Buchele, C., Klüter, S., Jäkel, C., Baumann L., et al. (2022). Stereotactic MRI-guided radiation therapy for localized prostate cancer (SMILE): a prospective, multicentric phase-II-trial. *Radiation Oncology*, 17(1):75.

Sandoval, M.L., Youssef, I., Latifi, K., Grass, G. D., Torres-Roca, J., Rosenberg, S., et al. (2021). Non-Adaptive MR-Guided Radiotherapy for Prostate SBRT: Less Time, Equal Results. *Journal of Clinical Medicine*, 10(15):3396.

Schaule, J., Chamberlain, M., Wilke, L., Baumgartl, M., Krayenbühl, J., Zamburlini, M., et al. (2021). Intrafractional stability of MR-guided online adaptive SBRT for prostate cancer. *Radiation Oncology*, 16(1):189.

Son, J., An, H.J., Choi, C.H., Chie, E.K., Kim, J.H., Park, J.M., Kim, J.I. (2019). Assessment of Dose Distributions According to Low Magnetic Field Effect for Prostate SABR. *Journal of Radiation Protection and Research*, 44(1): 26-31.

Tetar, S., Bruynzeel, A., Oei, S., Senan, S., Fraikin T., Slotman, B. et al. (2020). Magnetic resonance-guided stereotactic radiotherapy for localized prostate cancer: final results on patient-reported outcomes of a prospective phase 2 study. *Eu Urology Oncology*, S2588-9311(20)30061-4.

Tetar, S. U., Bruynzeel, A. M. E., Lagerwaard, F. J., Slotman, B. J., Bohoudi, O., & Palacios, M. A. (2019). Clinical implementation of magnetic resonance imaging guided adaptive radiotherapy for localized prostate cancer.

Physics and Imaging in Radiation Oncology, 9, 69–76.

Ugurluer, G., Atalar, B., Mustafayev, T.Z., Gungor, G., Aydin, G., Sengoz, M., et al. (2020). Magnetic resonance image-guided adaptive stereotactic body radiotherapy for prostate cancer: preliminary results. *The British Institute of Radiology*, 94(1117):20200696

Wahlstedt, I., Andratschke, N., Behrens, C.P., Ehrbar, S., Gabryś, H.S., Garcia Schüler, H., et al. (2022). Gating has a negligible impact on dose delivered in MRI-guided online adaptive radiotherapy of prostate cancer. *Radiotherapy & Oncology*, Advanced online publication, doi: 10.1016/j.radonc.2022.03.013.

Xiong, Y., Rabe, M., Nierer, L., Kawula, M., Corradini, S., Belka, C., Riboldi, M., et al. (2022). Assessment of intrafractional prostate motion and its dosimetric impact in MRI-guided online adaptive radiotherapy with gating. *Strahlentherapie und Onkologie*. Advanced online publication. doi: 10.1007/s00066-022-02005-1.

OTHER – TUMOR SITES

Nierer, L., Eze, C., da Silva Mendes, V., Braun, J., Thum, P., von Bestenbostel, R., et al. (2022). Dosimetric benefit of MR-guided online adaptive radiotherapy in different tumor entities: liver, lung, abdominal lymph nodes, pancreas and prostate. *Radiation Oncology*, 17(1):53.

MRIdian Advanced MRI Studies

Hsu, S.H., Han, Z., Leeman, J.E., Hu, Y.H., Mak, R.H., Sudhyadhom, A. (2022). Synthetic CT generation for MRI-guided adaptive radiotherapy in prostate cancer. *Frontiers in Oncology*, 12:969463.

Pham, J., Savjani, R.R., Gao, Y., Cao, M., Hu, P., Sheng, K., et al. (2021). Evaluation of T2-Weighted MRI for Visualization and Sparing of Urethra with MR-Guided Radiation Therapy (MRgRT) On-Board MRI. *Cancers*, 13(14):3564.

Placidi, L., Cusumano, D., Boldrini, L., Votta, C., Pollutri, V., Antonelli, M.V., et al. (2020). Quantitative analysis of MRI-guided radiotherapy treatment process time for tumor real-time gating efficiency. *Journal of Applied Clinical Medical Physics*, 21:11:70–79.

Rabe, M., Paganelli, C., Riboldi, M., Bondesson, D., Schneider, M.J., Chmielewski, T., et al. (2020). Porcine lung phantom-based validation of estimated 4D-MRI using orthogonal cine imaging for low-field MR-Linacs. *Physics in Medicine & Biology*, 66(5):055006.

Shaverdian, N., Yang, Y., Hu, P., Hart, S., Sheng, K., Lamb, J., et al. (2017). Feasibility evaluation of diffusion-weighted imaging using an integrated MRI-radiotherapy system for response assessment to neoadjuvant therapy in rectal cancer. *The British Journal of Radiology*, 90(1071), 20160739.

Simpson, G., Jin, W., Spieler, B., Portelance, L., Mellon, E., Kwon, D., et al. (2022). Predictive Value of Delta-Radiomics Texture Features in 0.35 Tesla Magnetic Resonance Setup Images Acquired During Stereotactic Ablative Radiotherapy of Pancreatic Cancer. *Frontiers in Oncology*, 12:807725.

Spieler, B., Samuels, S.E., Llorente, R., Yechieli, R., Ford, J.C., and Mellon, E.A. (2020). Advantages of Radiation Therapy Simulation with 0.35 Tesla Magnetic Resonance Imaging for Stereotactic Ablation of Spinal Metastases. *Practical Radiation Oncology*, 10(5):339-344.

Steinmann, A., Alvarez, P., Lee, H., Court, L., Stafford, R., Sawakuchi, G., et al. (2019). MRIGRT dynamic lung motion thorax anthropomorphic QA phantom: design, development, reproducibility, and feasibility study. *Medical Physics*, 46(11), 5124–5133.

Tamura, Y., Demachi, K., Igaki, H., Okamoto, H., Nakano, M. (2022). A Real-Time Four-Dimensional Reconstruction Algorithm of Cine-Magnetic Resonance Imaging (Cine-MRI) Using Deep Learning. *Cureus*, 14(3):e22826.

Thomson, R. M., & Kawrakow, I. (2018). Quantum versus classical Monte Carlo simulation of low-energy electron transport in condensed amorphous media. *Physica Medica*, 54, 179–188.

Tong, N., Gou, S., Yang, S., Cao, M., Sheng, K. (2019). Shape constrained fully convolutional DenseNet with adversarial training for multiorgan segmentation on head and neck CT and low-field MR images. *Medical Physics*, 46(6):2669-2682.

van Houdt, P.J., Yang, Y., and van der Heide, U.A. 2021. Quantitative Magnetic Resonance Imaging for Biological Image-Guided Adaptive Radiotherapy. *Frontiers in Oncology*, 10:615643.

van Timmeren, J.E., Chamberlain, M., Krayenbuehl, J., Wilke, L., Ehrbar, S., Bogowicz, M., et al. (2021). *Physics and Imaging in Radiation Oncology*, 17:43-46.

van Timmeren, J.E., Chamberlain, M., Krayenbuehl, J., Wilke, L., Ehrbar, S., Bogowicz, M., et al. (2020) Treatment plan quality during online adaptive re-planning. *Radiation Oncology*, 15(1):203.

Wee, C. W., An, H. J., Kang, H. C., Kim, H. J., & Wu, H. G. (2018). Variability of gross tumor volume delineation for stereotactic body radiotherapy of the lung with tri-⁶⁰Co magnetic resonance image-guided radiotherapy system (ViewRay): a comparative study with magnetic resonance- and computed tomography-based target delineation. *Technology in Cancer Research & Treatment*, 17, 1533033818787383.

Xu, D., Ma, T.M., Savjani, R., Pham, J., Cao, M., Yang, Y., et al. (2022). Fully automated segmentation of prostatic urethra for MR-guided radiation therapy. *Medical Physics*. Advanced online publication, doi: 10.1002/mp.15983.

Yang, Y., Cao, M., Sheng, K., Gao, Y., Chen, A., Kamrava, M., et al. (2016). Longitudinal diffusion MRI for treatment response assessment: preliminary experience using an MRI-guided tri-cobalt 60 radiotherapy system. *Medical Physics*, 43(3), 1369–1373.

MRIdian Technology Description and Evaluation

Alexander, D.A., Zhang, R., Brůža, P., Pogue, B.W., Gladstone, D.J. (2020). Scintillation imaging as a high-resolution, remote, versatile 2D detection system for MR-linac quality assurance. *Medical Physics*, 47(9):3861-3869.

- An, H.J., Kim, J.I., Park, J.M. (2019). Electron streams in air during magnetic-resonance image-guided radiation therapy. *PLoS One*, 14(5):e0216965.
- Andreozzi, J., Brůža, P., Cammin, J., Pogue, B. W., Gladstone, D. J., & Green, O. (2019). Optical imaging method to quantify spatial dose variation due to the electron return effect in an MR-Linac. *Medical Physics*, 47(3):1258-1267.
- Andreozzi, J., Brůža, P., Cammin, J., Alexander, D.A., Pogue, B. W., Green, O., Gladstone, D. J. (2021). Optical emission-based phantom to verify coincidence of radiotherapy and imaging isocenters on an MR-linac. *Journal of Applied Clinical Medical Physics*, 22(9):252-261.
- Cai, B., Li, H., Yang, D., Rodriguez, V., Curcuru, A., Wang, Y., et al. (2017). Performance of a multileaf collimator system for MR-guided radiation therapy. *Medical Physics*, 44(12), 6504–6414.
- Cho, J.D., Park, J.M., Choi, C.H., Kim, J.I., Wu, H.G., Park, S.Y. (2017). Implementation of AAPM's TG-51 Protocol on Co-60 MRI-Guided Radiation Therapy System. *Progress in Medical Physics*, 28(4):190-196.
- Choi, C.H., Park, J.M., An, H.J., Kim, J.I. (2019). Effect of low magnetic field on single-diode dosimetry for clinical use. *Physica Medica*, 60:132-138.
- Choi, C. H., Park, S. Y., Kim, J. I., Kim, J. H., Kim, K., Carlson, J., et al. (2017). Quality of tri-Co-60 MR-IGRT treatment plans in comparison with VMAT treatment plans for spine SABR. *The British Journal of Radiology*, 90(1070), 20160652.
- Cuccia, F., Alongi, F., Belka, C., Boldrini, L., Hörner-Rieber, J., McNair, H., et al. (2021). Patient positioning and immobilization procedures for hybrid MR-Linac systems. *Radiation Oncology*, 16(1):183.
- Da Silva Mendes, V., Nierer, L., Li, M., Corradini, S., Reiner, M., Kamp, F., et al. (2021). Dosimetric comparison of MR-linac-based IMRT and conventional VMAT treatment plans for prostate cancer. *Radiation Oncology*, 16(1):133.

MRIdian Health Economics

- Palm, R.F., Eicher, K.G., Sim, A.J., Peneguy, S., Rosenberg, S.A., Wasserman, S., Johnstone, P.A.S. (2021). Assessment of MRI-Linac Economics under the RO-APM. *Journal of Clinical Medicine*, 10(20):4706.
- Parikh, N. R., Lee, L., Raman, S., Cao, M., Lamb, J., Tyran, M., et al. (2020). Time-driven activity-based costing comparison of CT-guided versus MR-guided SBRT. *JCO Oncology Practice*, 16(11):e1378-e1385.
- Parikh, N.R., Clark, M.A., Patel, P., Kafka-Peterson, K., Zaide, L., Ma, T.M., et al. (2021). Time-Driven Activity-Based Costing of CT-Guided vs MR-Guided Prostate SBRT. *Applied Radiation Oncology*, 10(3):33-40.
- Schumacher, L.E.D, Dal Pra, A., Hoffe, S.E., Mellon, E.A. (2020). Toxicity reduction required for MRI-guided radiotherapy to be cost-effective in the treatment of localized prostate cancer. *The British Institute of Radiology*, 93(1114):20200028.
- Slotman, B.J., Clark, M.A., Özyar, E., Kim, M., Itami, J., Tallet, A., et al. (2022). Clinical adoption patterns of 0.35 Tesla MR-guided radiation therapy in Europe and Asia. *Radiation Oncology*, 17(1):146.