

Managing MRIdian patients with multiple lesions with a single isocenter



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How does MRIdian fit into your treatment program and why did GenesisCare decide to acquire a second system for the Cromwell Hospital in London?

GenesisCare has long been committed to investing in the latest evidence-based treatments that hold the greatest potential for improved life outcomes, and this has continued throughout the pandemic. The MRIdian is the only linear accelerator model that has automated beam control, meaning that if a tumour moves even a few millimetres, the treatment will automatically pause until it comes back into position, to avoid missing the target and irradiating healthy tissue unnecessarily. The increased accuracy from these live images and automated beam control gives clinicians greater confidence that they are hitting the cancer target 100% of the time. This has been shown to be particularly advantageous in cancers that are situated close to major organs which can move, and if damaged, can lead to severe side-effects. These include prostate, lung, bowel, pancreatic and liver cancers. It can also treat cancers that have spread to other sites in the body. With MRIdian, patients can receive the best care possible with fewer hospital visits required, when it's most needed.

You have recently treated a patient with five liver metastases with a single isocenter. What can you tell us about the patient journey?

This patient presented in 2019 with a primary cancer of the caecum, liver, perihepatic nodal and possible lung metastases. Although liver metastases were resectable at presentation, it was not offered due to the presence of perihepatic nodal disease. Therefore, he went ahead with a right hemicolectomy for his locally advanced primary caecal cancer. He started chemotherapy in July 2019 and managed to enjoy a good quality of life over the intervening 2-years. In September 2021 his follow-up scans demonstrated progression, and several newly onset lesions were identified in the liver. The patient agreed to explore stereotactic MRI-guided radiotherapy options and the case was discussed as part of a multidisciplinary team approach. MRIdian treatment was determined to be an appropriate modality because of the ability for on-table adaptive radiotherapy with real-time soft tissue tracking and automated beam control. This allows reducing treatment margins while confidently escalating the dose and would be a prerequisite to respect mean liver dose constraints and achieve high local control. Good visibility of the lesions without the need for implanted fiducials would be especially critical for one target right below the diaphragm and close to the heart.

MRIdian clinical team spotlight

Dr. Rafiqul Islam, MD, Hannah Harford-Wright

For more information about MRIdian, visit [ViewRay.com](https://www.viewray.com)

What challenges were you presented with during simulation and treatment planning for MRIdian radiotherapy?

We wondered whether all lesions could be targeted with a single isocenter since multiple isocenters challenge beam angle positions in consecutive plans. Diagnostic MRI imaging identified four liver lesions with a fifth lesion discovered during peer-review of the target contours on the MRIdian simulation scans. With five lesions scattered across the left and right liver lobes, it became impossible to prescribe 50 Gy in 5 fractions without violating the mean liver dose constraint. The clinical target margins were down to 3 mm for all five lesions and the planning target margin was 3 mm for the lesion tracked during treatment and 5 mm for all other lesions. It was decided to respect the liver constraints by decreasing the prescription to 45 Gy in 5 fractions. The ability to accurately contour the lesions on the MRIdian treatment images at each fraction made us feel more comfortable about the tight margins. With the mean liver dose constraint respected, the treatment planning attention shifted to increasing the dose heterogeneity inside the target to compensate for the decreased prescription. A uniform MRIdian treatment planning technique was applied to ensure the resulting treatment plan is robust to adaptation for every delivered fraction. This approach relies on the “Skin” object to avoid dose bridging between neighboring lesions and restrict the prescription to the centre of each target. An “Increase Dose” objective for the gross tumor volumes encourages a hotspot inside each target. MRIdian’s fixed field intensity-modulated radiotherapy delivery technique allows to avoid objectives for specific organs like the contralateral kidney in this case by simply not passing through them. This simple concept produces treatment plans robust to real-time on-table adaptation. As a true multidisciplinary approach led by Hannah, our senior dosimetrist, the entire treatment planning process for this patient took three days from start to finish, including discussions to evaluate the best possible strategy.

How did the patient experience the treatment and did the plan turn out as robust as anticipated?

The patient traveled about forty miles by taxi for each fraction, delivered every other day. The treatment was delivered with the patient lying in supine position and his arms down. Even so, after the first fraction, the patient complained about mild aches and pains in the joints which was related to his pre-existing osteoarthritis. With clinicians required to update the contours of five lesions and plenty of critical organs, total in-room duration of his first fraction extended to about ninety minutes. The patient received pain relief killers to alleviate his discomfort at the following fractions and the allocated treatment time slot was extended.

The treatment plan turned out to be very robust with daily re-optimizations led by the radiographers who merely had to renormalize the monitor units as a function of the mean liver dose or the heart. Only one fraction required updating the “Power” of a constraint to achieve an acceptable daily plan. The total amount of monitor units was pretty much stable from day to day and all plans were very conformal. There were no issues with tracking and delivery and the patient was very compliant during breath-hold coaching.

How is the patient doing today following a successfully delivered MRIdian treatment?

Apart from Grade 2 fatigue, he has not experienced any further toxicity. He was reviewed at two weeks post treatment and had a response assessment scan at week 8. All his tumor lesions have significantly reduced in size. Tumor markers have dropped already. He is back to his original chemotherapy and tolerating this well. Coincidentally, this patient was also GenesisCare’s 400th MRIdian patient in UK. He was very pleased with the care and compassion provided by the whole GenesisCare Cromwell team.



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