

An MR-linac (MRL) combines an MRI scanner and a conventional linac into one machine. Here at the Rutherford we have the state of the art Elekta Unity MR linac. It can visualise and treat a specific treatment area and change the shape and size of this treatment area on a daily basis. This allows us to tailor the treatment plan to the individual for each treatment.

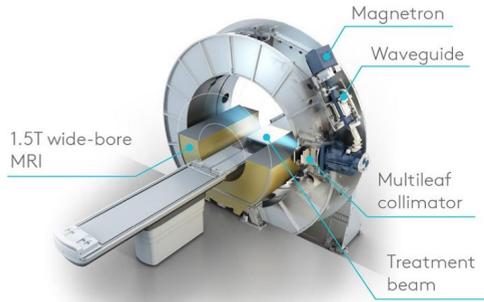


Figure 1

## How does the MR-linac work?

On a conventional linac, radiographers take a CT image directly prior to radiotherapy to ensure treatment is delivered in the correct place. However, the MR-linac attains images using its 1.5 Tesla magnet. This magnet, produced by Phillips, can attain images of a near diagnostic quality. Due to the superior quality of the images attained, the MR-linac is able to implement online daily adaptive radiotherapy.

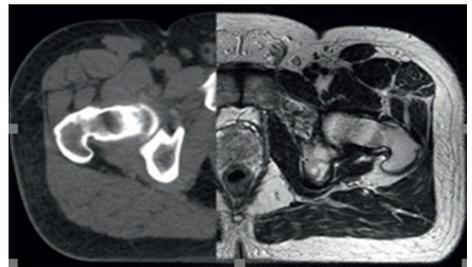


Figure 2

Adaptive radiotherapy can be defined as changing the treatment plan delivered to you based on observed anatomic changes such as tumour shrinkage, weight loss, or internal motion on a treatment by treatment basis.

The MRL Unity has two methods of achieving adaptive radiotherapy called Adapt to Position (ATP) and Adapt to Shape (ATS). ATP allows us to move structures that are outlined on planning images whilst ATS allows us to change the size and shape of these outlined structures. A combination of these methods allows your multidisciplinary team to optimize your treatment based upon what they see on the MR images.

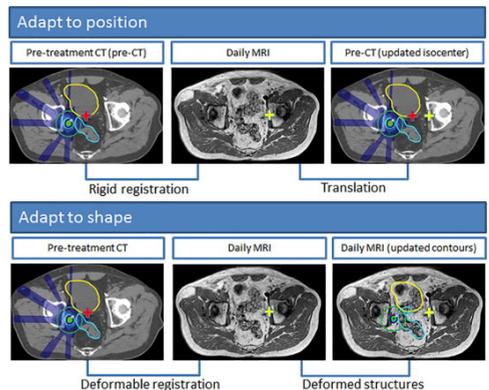


Figure 3

If necessary, your oncologist can make changes to the intended area for treatment, which they had previously outlined on your planning scans. Using the built-in treatment planning system on the MR-linac called Monaco, dosimetrists and radiographers then plan your treatment. The radiation is concentrated on the outlined treatment area whilst avoiding healthy tissue. All of this is undertaken whilst you are lying on the treatment couch.

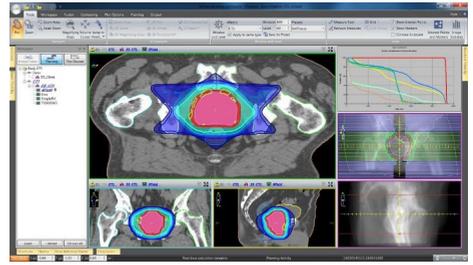


Figure 4

## General information

- Due to the complexity of the workflow on the MR-linac, treatment may take longer than treatment on a conventional linac. Your radiographers will be contactable at all times during your treatment.
- You will not see or feel anything whilst having treatment on the MR-linac. However, the machine can be loud whilst it is taking MR images.
- Unlike CT scans, MRI does not use radiation, therefore the MR-linac reduces the amount of radiation you will receive. We aim to safely minimise the amount of radiation our patients receive from scans. This does not affect the outcome of your radiotherapy treatment.
- The MR-linac allows real time imaging of the area of the body being treated so that adjustments can also be made during treatment.



Figure 5



If you would like any more information on the technicalities of the MR-linac, then please don't hesitate to ask one of the radiographers.

**Due to the MR-linac using strong magnets, not all patients are able to have treatment on this machine. Speak to one of the radiographers if you have any concerns.**

**References:** 1. Elekta 2. Nijkamp, J., de Haas-Kock, D., Beukema, J., Neelis, K., Woutersen, D., Ceha, H., ... Marijnen, C. (n.d.). Target volume delineation variation in radiotherapy for early stage rectal cancer in the Netherlands. *Radiotherapy and Oncology*, 102(1), 14–21. 3. Adaptive radiotherapy: The Elekta Unity MR-linac concept. <https://www.sciencedirect.com/science/article/pii/S2405630819300631> 4. Elekta 5. MR-linac at the Rutherford Cancer Centre North West