Scientists put final pieces into place for seeing cancer with protons

1 December 2015

Scientists are currently in South Africa putting together a unique medical imaging platform which could improve treatment for millions of cancer sufferers by making proton therapy a viable option.

Members of the multi-national research team behind the PRaVDA (Proton Radiotherapy Verification and Dosimetry Applications) project, led by the University of Lincoln, UK, are now building the instrument that will produce for the first time detailed three-dimensional images of a patient's anatomy using protons rather than x-rays.

To produce these Proton CT images, the world-first technology will use the same high energy particles that are used to destroy a tumour during proton therapy treatment.

Like x-rays, protons can penetrate tissue to reach deep tumours. However, compared to x-rays, protons cause less damage to healthy tissue in front of the tumour, and no damage at all to healthy tissue lying behind, which greatly reduces the side effects of radiation therapy.

Led by Distinguished Professor of Image Engineering Nigel Allinson MBE, the PRaVDA team aims to become the first in the world to produce clinical-quality Proton CT imagery. They are currently working near Cape Town at the South African National Cyclotron – a type of particle accelerator.

Professor Allinson said: "Proton therapy is an improved approach for treating challenging tumours especially in the head and neck, and near critical organs. It is likely to become the preferred radiotherapy method for most childhood cancers, as the unwanted exposure to radiation of healthy tissue is much reduced and so the risk of second cancers later in life is also much reduced.

"Having the ability to administer a high dose in a small region is the main underlying advantage of proton therapy, however accurate planning is absolutely essential to ensure that the dose does not miss the target tumour."

Using protons to form an image of the patient will greatly improve the accuracy of proton therapy. Using current methods, there could be a discrepancy of up to 1cm in terms of where the proton beam hits and releases its energy, destroying cells, after passing through 20 cm of healthy tissue. By using Proton CT, this margin for error can be reduced to just a few millimetres.

The PRaVDA researchers believe that Proton CT will soon be used as part of the planning process for cancer patients, as well as during and after treatment.

"Imaging with protons is challenging, because the individual particles are randomly scattered as they pass through tissue," Professor Allinson continued. "Millions of protons make up a single image and each particle has to be individually tracked from the point it enters the patient to the point where it leaves. The PRaVDA instrument is therefore one of the most complex medical instruments ever developed, but it is absolutely essential - the uncertainties in where the protons lose their energy and do damage to either tumour or healthy tissue will only be eliminated by using the same type of radiation to image and to treat."

Provided by University of Lincoln