Radiotherapy techniques explained

Introduction

There are lots of different radiotherapy techniques and methods of treatment in use and the language isn’t always straightforward. Below are some commonly used terms, techniques and descriptions. Each technique is described, including uses, limits and benefits.

Intensity-Modulated Radiotherapy (IMRT)

What is it?

IMRT is a way of giving external beam radiotherapy and is used in most radiotherapy centres across the UK. It can be done using a radiotherapy machine known as a Linear accelerator or LINAC, or other machines known as [TomoTherapy](https://www.cancer.gov/publications/dictionaries/cancer-terms/def/tomotherapy) or [Cyberknife](https://cyberknife.com/cyberknife-how-it-works/). It uses multiple beams of X-rays of different strengths and shapes aimed at the cancer, from various angles around you.

The radiotherapy beams are shaped in a way that means more or less radiation can be given as needed, to different parts of the treatment area.

This controls and minimises impact on healthy tissue, while maximizing the treatment of the cancer with a higher dose of radiation (known as dose escalation).

What is this treatment suitable for?

Brain tumours

IMRT can reduce the radiation dose to the eyes and other critical parts of the brain, like the parts that control memory and hormones. This can really help you have less side effects.

Head and neck cancers

IMRT can help reduce the radiation dose to the salivary glands. This can reduce one of the worst long-term side effects from treating head, neck and face cancers – for example, a dry mouth (xerostomia).

Breast and lung cancers

IMRT can be used to reduce doses to the heart and lungs. In breast cancer IMRT has been shown to reduce skin reactions from treatment. If the cancer is close to the spine, IMRT can allow a higher dose to be delivered without damaging the spinal cord. This treatment is not available or used in every UK centre, but rest assured, every radiotherapy technique is designed to minimise side and late effects.

Abdominal and pelvic cancers

IMRT can be very effective in reducing side effects from treatment of abdominal cancers affecting the stomach, pancreas and lower oesophagus. Radiotherapy for cancers of the bowel (colorectal cancers) often use IMRT to reduce the risk of damage to the bowel and bladder.

Prostate cancer

IMRT is standard treatment now for treating localised prostate cancers.

It can also be used after an operation where the surgery has not removed all the cancer cells.

IMRT gives higher doses to the prostate with more chance of curing the cancer. It also means that the lymph nodes can be more easily treated, with reduced side effects.

The rectum, or lower bowel, sits close to the prostate. In the past this has meant a patient with prostate cancer would have a lower dose of radiation so as not to damage the rectum.

IMRT helps reduce the amount of rectum that is affected by a higher dose. For patients this means less short-term, long-term and late effects.

Cervix and uterine (endometrial or womb) cancer

IMRT is commonly used to treat cancers in this area, whether they affect the pelvic lymph nodes or not.

Again, IMRT increases accuracy, and reduces short-term, long-term and late effects on the bladder and bowel.

Benefits

This treatment works well when dealing with cancers that are close to vital organs or important structures within your body. It can help reduce the risk of damage to healthy tissues from radiation.

IMRT allows treatment to be more accurately delivered to unusually-shaped cancers. It can also create concave (hollow) areas within the high dose region. It means the radiation beam can be manipulated.

This allows the dose of radiation to a sensitive organ like the rectum, lower bowel, or the spinal cord, to be kept to a minimum.

IMRT is used alongside Image-Guided Radiotherapy (IGRT). See below for more details on this.

Limitations

This technique is not available in every UK centre.

Depending on the circumstances, patients having IMRT might find the treatment takes a little longer. This would only be an extra few minutes per treatment.

Stereotactic radiotherapy introduction

Radiotherapy treatment aims to treat only the area affected by disease. The radiation dose is aimed only at the area needing treatment. This is to protect the healthy tissue and nearby structures or organs as much as possible.

Stereotactic is a term used to describe a group of techniques that create these very precise radiation doses. Stereotactic radiotherapy is usually a high dose delivered in one session or over a few sessions. This can control tumours, and even destroy them completely. It is usually a higher radiation dose than typical radiotherapy – but still very safe. It can be used to treat malignant tumours, benign tumours and functional problems like AVM, an abnormal tangles of blood vessels.

A) Stereotactic body radiotherapy (SBRT) and stereotactic ablative radiotherapy (SABR)

What is SBRT/SABR?

These are both advanced forms of radiotherapy used to treat many different types of cancer. Stereotactic body radiotherapy (SBRT) and stereotactic ablative radiotherapy (SABR) mean the same thing.

This technique gives a higher dose of radiation in each treatment session than common external beam radiotherapy. The word ‘ablative’ is sometimes used as this means to remove or destroy something. In this case, the cancer.

These higher doses are given to you from X-ray beams from outside your body.

As with all external beam radiotherapy, the delivery of this is really precise which is what ‘stereotactic’ refers to. There are several technologies available that can be used to deliver this technique including a specially adapted Linear accelerator, [Cyberknife](https://cyberknife.com/) https://cyberknife.com/ or [Tomotherapy](https://radixact.com/) machine https://radixact.com/.

What is SBRT/SABR suitable for?

SBRT/SABR is a type of radiotherapy where a few very high doses of radiation are delivered to relatively small, well-defined tumours. SBRT/SABR is used to treat small, isolated tumours that lie outside the brain. However, it can be used in some cases on larger areas.

It can be used to treat primary cancer areas: like the lungs or prostate, if that’s where the cancer began. It can also treat secondary cancers (metastasis), where the cancer has spread to areas like the bones, lungs or liver.

Benefits

Treatment can happen in fewer sessions than common radiotherapy.

The technique causes maximum damage to the cancer, and minimum damage to healthy tissues and organs. It’s also helpful when the tumour is likely to move during treatment because of the way our bodies naturally move. For example, a tumour in the lung moves as you breathe in and out. This method can track the tumour movement and makes sure the cancer is targeted, rather than the healthy lung tissue.

When SBRT/SABR is recommended or considered for a patient, it can be used instead of surgery. Like surgery, these types of radiotherapy treat small or medium-sized cancers. Unlike surgery, there is no need for an anesthetic or the risks that come with an operation. This is why SBRT/SABR can be a better option for older or frailer patients: or those with other health issues. It can also be used with surgery for some people.

SBRT/SABR can be a good option for cancers in parts of your body that are difficult or impossible to operate on, like the bones. For this reason, SBRT is called a ‘minimally invasive’ cancer treatment technique. This type of radiotherapy is becoming more common as evidence for its use grows.

Limitations

The disadvantage of SBRT/SABR is that the session often takes longer than conventional treatment. This can mean it is only suitable for patients who are able to stay still and in the same position on the treatment bed for at least 30 minutes.

Not everyone, and every cancer, is suitable for SBRT/SABR treatment. Areas can be considered too large or have sensitive structures nearby.

This technique is not available in every UK centre.

B) Stereotactic radiosurgery (SRS)

What is this?

Stereotactic radiosurgery (SRS) is a treatment for brain tumours. The treatment can be given using a machine called a Gamma Knife. This is not a knife. It is a machine that uses tiny beams of gamma rays to destroy the cancer. Other machines that deliver SRS are a CyberKnife or specially adapted Linear accelerator.

SRS is usually a single session (like surgery) that delivers a very high dose of radiation to specific areas of the brain or the tumour. It can also be delivered over five sessions, known as stereotactic radiotherapy.

You usually have a head frame or a mask fitted for treatment: to help you stay still. One treatment session could take up to an hour, but everyone and every treatment is different. The treatment delivers a high dose of radiation to a very specific pinpoint area using hundreds of tiny beams. This minimizes the dose to the surrounding brain which helps reduce side effects.

[Watch our video series about Gamma Knife treatment.](https://radiotherapy.org.uk/patients-families/during-treatment/gamma-knife-radiotherapy/)

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What is SRS suitable for?

SRS treats brain tumours and other abnormalities in the head area.

Benefits

SRS is a good option when brain surgery might be too risky or not suitable for you. SRS is less invasive than surgery, which helps people recover faster.

The careful planning and practices around this treatment reduce side-effects to a minimum.

Limitations

Not all patients or cancers are suitable for SRS. There are limitations on the number of tumours that can be treated and patients are required to keep still for fairly long periods in the treatment sessions.

This technique is not available in every UK centre.

The actual treatment itself does not cause pain. However, the head frame can cause pressure. Local anesthetic is used to make this more comfortable. If a mask is used, some patients find this claustrophobic. A sedative can help people cope with this.

Like all types of radiotherapy, this can cause side and late effects related to the parts of the brain being treated. Ask you treatment team what this might look like for you.

Learn more about [side effects](https://radiotherapy.org.uk/patients-families/side-effects/) https://radiotherapy.org.uk/patients-families/side-effects/ and [late effects](https://radiotherapy.org.uk/patients-families/late-effects/) https://radiotherapy.org.uk/patients-families/late-effects/

Image-guided radiotherapy (IGRT)

What is this?

Image-guided radiotherapy (IGRT) is the use of X-rays, Cone beam CT scans or MRI scans taken before or during treatment to pinpoint the right area before radiation treatment is given. These scans are used to make fine adjustments in real time to the treatment or patient position to ensure accuracy – giving better outcomes for you.

Sometimes small markers made of metal (for example, gold) or other materials that show up well on imaging, are put inside a cancer or organ. These markers are very clear on X-rays. They help guide the treatment team to exactly where the radiation needs to go. These markers are very safe.

What is it suitable for?

IGRT can be helpful for treating lung cancer because therapeutic radiographers can take images during the treatment so that they can work with the movement caused by breathing. This is known as 4-dimensional radiotherapy (4D-RT) where the fourth dimension is ‘time’.

Benefits

Every radiotherapy treatment strives for high accuracy. IGRT is a technique that supports this. The more the radiation is directed only at the cancer, the less healthy tissues and cells are affected. This can reduce side and late effects for patients.

Intra-operative Radiotherapy (IORT)

What is this?

Intraoperative radiotherapy (IORT) is a radiation treatment given during surgery. IORT gives direct radiation to the treatment area while sparing normal surrounding tissue.

What is it suitable for?

It is most commonly used to treat breast cancer but can be used on any part of your body where there is a concern that surgery will not remove all the cancer cells.

Benefits

If IORT is given at the same time as breast conserving cancer surgery, it can remove the need for External Beam Radiotherapy (EBRT). EBRT is usually given as five treatments or ‘fractions’ per week, for three weeks, so avoiding it can be less disruptive for you. Breast conserving surgery means cutting out the tumour and a small area of surrounding tissue from the breast.

IORT can treat cancers that are difficult to remove during surgery and when there is a concern that small amounts of cancer cells may remain.

IORT allows higher doses of radiation to be used compared with conventional radiotherapy. It’s not always possible to use very high doses during typical radiotherapy, because sensitive organs can be too close. IORT also allows doctors to temporarily move nearby organs or shield them from radiation exposure.

Limitations

This technique is not available in every UK hospital.

Superficial Radiotherapy (SRT) and Kilovoltage (kV) radiotherapy

What is this?

Superficial X-Ray Therapy or Kilovoltage (kV) radiotherapy is the use of low energy X-rays to treat cancer and other conditions that are on the skin surface or very close to it.

During SRT you will visit for a 3-minute treatment 3-5 times a week for up to 3 weeks. Depending on the size and location of the skin cancer, a cone-shaped attachment will be placed on the SRT machine, and X-rays will be applied to your skin.

You will not feel the X-rays at the time of treatment. A scab will gradually form in the treatment area, which will come off several times over the course of a few weeks before the skin heals.

What is it suitable for?

Superficial Radiotherapy (SRT) is a non-surgical treatment for skin cancers such as:

Basal cell carcinoma (BCC)

Squamous cell carcinoma (SCC)

Bowen’s carcinoma

Benefits

It is an alternative to surgical removal of skin cancer and gives patients more freedom to have an active lifestyle during treatment.

Limitations

Like all types of radiotherapy, this can cause side and late effects in the area where you are treated.

Learn more about [side effects](https://radiotherapy.org.uk/patients-families/side-effects/) https://radiotherapy.org.uk/patients-families/side-effects/ and [late effects](https://radiotherapy.org.uk/patients-families/late-effects/) https://radiotherapy.org.uk/patients-families/late-effects/

FLASH-RT

What is this?

Ultra-high dose rate (FLASH) radiotherapy is a way of treating tumours with a higher dose of radiation with less impact on healthy tissue.

Benefits

Recent outcomes of experiments show that FLASH radiotherapy can reduce radiation-induced damage in healthy tissue without decreasing the damage done to cancer cells. FLASH radiotherapy treatment time is very short – another advantage for patients. The first human patient received FLASH-RT in Switzerland in 2018.

Limitations

FLASH radiotherapy is still a developing technique. More research is needed to fully understand FLASH radiotherapy and the ultra-high dose rates make it unsuitable for many patients. The different effects this type of radiotherapy has on healthy tissue and tumours is unclear. Much more research is needed to prove that FLASH-RT can provide more protection to healthy tissues.

At present, FLASH is not used in the UK, except within some clinical trials.