

Stereotactic Radiotherapy (SRT)

'Stereotactic' means the use of computers and scanners to produce 3D images that can be used to locate and direct treatment towards a tumour with a high degree of accuracy.

Stereotactic radiotherapy uses this technique to direct many small beams of radiation very accurately at the tumour, from different angles around the head. Where these beams overlap, at the site of the tumour, the dose of radiation is high and the tumour cells are destroyed.

SRT can be given over multiple sessions (fractionated stereotactic radiotherapy or FSRT), or it can be given in one session (stereotactic radiosurgery or SRS). SRS does not involve actual surgery.

In this fact sheet:

- The advantage over conventional radiotherapy
- Can I have SRT?
- Procedure and side-effects of SRT
- Answers to some common questions that you may have about stereotactic radiotherapy

What is the advantage of SRT over conventional radiotherapy?

As with some types of conventional radiotherapy, SRT and SRS deliver radiotherapy beams from various angles around the head. Where they overlap, at the site of the tumour, the doses of radiation add together and so the amount of radiation delivered to the tumour is high. At this higher level, the tumour cells are destroyed.

The surrounding healthy tissue, which receives fewer beams of radiotherapy and therefore less radiation, remains relatively unaffected and can recover. However, to make sure all the tumour receives radiation, an area slightly larger than the tumour is targeted with the higher dose of radiation.

The advantage of SRT/SRS comes from the fact that it uses computers to pinpoint the tumour more accurately and is stricter in keeping your head still during treatment.

This means that a smaller area around the tumour needs to be targeted, so less healthy tissue receives the high dose of radiation. This also means that a higher dose can safely be given to the tumour, or that fewer treatment sessions may be needed.

As a result, people generally experience fewer side-effects with SRT and SRS compared to conventional radiotherapy.

Can I have SRT?

Stereotactic radiotherapy and stereotactic radiosurgery are not suitable for all types of brain tumour. They are generally only used for small tumours (less than 3cm at the widest part). They are not used for larger tumours as the benefit is lost because it is not possible to get the same high dose of radiation across the whole of a large tumour.

Brain tumours that SRT (and SRS) are suitable for include:

- Small low grade tumours with an obvious edge
- Small gliomas that have come back (low and high grade)
- Haemangioblastomas that couldn't be completely removed or which came back after surgery

- Other small low grade tumours, such as:
 - Vestibular schwannomas (acoustic neuroma)
 - Meningiomas at the base of the skull
 - Pituitary adenomas
 - Chordoma
- Secondary brain tumours (metastases)

SRT (and SRS) may NOT be suitable if the treatment area includes particular important nerves, as they may receive too much radiation and become damaged.

Similarly, not all brain tumours benefit from SRT or SRS - conventional radiotherapy is more appropriate in some cases. The decision to treat with SRT/SRS is made on a case by case basis. Your oncologist will discuss your treatment options with you and the wider members of the multi-disciplinary team (MDT) to come up with the treatment plan that is best for you.

Additionally, SRT (and SRS) are not available in all hospitals as they require specialised equipment and staff. This issue is currently under review by the government and the NHS.

What does having SRT involve?

Much of the SRT procedure is similar to that of conventional radiotherapy. SRT differs in the set up of the patient (keeping the head still) and in the greater accuracy, but it uses the same type of radiation i.e. X-rays.

As with conventional radiotherapy, it is vitally important that your head is kept as still as possible, to ensure that the radiotherapy beams accurately reach their target - the tumour cells rather than healthy cells.

The precise targeting is even more important if you are having treatment over several sessions (fractionated SRT), as your head needs to be in the same place for each treatment, so that the beams are accurately hitting the same target each time. This requires much careful planning before your treatment can start.

The planning stages

A multi-disciplinary team of specialists (MDT) work together to plan the best treatment for you. (The MDT will include a neuro-oncologist, a radiographer, a medical physicist and technologist, amongst others.)

Firstly, a way of making sure your head can be kept still during treatment is made specifically for you. There are two main ways of achieving this, which are:

Stereotactic mask

Similar to the mask that is used in conventional radiotherapy, this is often made from a type of plastic called thermoplastic. A sheet of plastic mesh, that is softened in warm water, is placed over your face and head and moulded to fit your individual head-shape exactly. It hardens as it cools. If you have facial hair you may have to shave it off before your mask is made.

As it is even more important to keep your head still for SRT/SRS, the stereotactic mask is closer fitting than the conventional radiotherapy mask. Making the stereotactic mask can take up to 45 minutes.

Once the mask is made, you will usually have an MRI scan, without the mask, and then a CT scan wearing the mask. Both of these are used together to help the specialists build-up a 3D picture of your tumour and plan your treatment accordingly. *(Please see the fact sheet on Scans for more information),*

The specialists will work out from the scans exactly where the tumour is and how to aim the beams. You will often be asked to return to the planning team to have the positioning checked before going on to treatment.

The plastic, and therefore the mask, has holes in it so you can breathe. You only have to wear the mask when you go for treatment or have a planning scan.

(For more information about radiotherapy masks, including photographs, please see our Radiotherapy fact sheet).

Head frame

This is more often used for SRS i.e. when the treatment is given in one dose.

Depending on the equipment used, you may need a scan of your head to give information that can be used by the treatment staff to make a frame to fit you. This can take most of a day.

In other cases, the frame will be fitted straight away and measurements taken afterwards with a special ruler. Your radiographer will explain the process to you.

The frame is attached through your skin to the surface of your skull, using four small pins. You will be given local anaesthetic at the points where the frame will be attached.

The local anaesthetic is given by injection into the skin and can cause some discomfort until the anaesthetic takes effect. You may also feel some tightness or pressure, and these areas may be sore afterwards. Fitting the frame takes about 10 minutes.

You will then have another scan (with the frame on) to allow your health team to plan your treatment and set up the machine to target your tumour precisely.

This planning stage can take several hours during which time you can get something to eat or drink. You continue to wear the head frame throughout this process, which can be quite tiring. Your radiographer can arrange for you to have some light pain relief if you find wearing the frame uncomfortable.

Once the planning is completed, you will receive your treatment.

The head frame remains in place throughout the scanning, planning and treatment delivery phases and is removed once your treatment has been given.

The procedure

Fractionated Stereotactic Radiotherapy (FRST)

During the FSRT treatment itself, you will lie on the treatment couch, and the radiographers will position you correctly. Your treatment mask will be fitted over your face and attached to the couch. This usually takes just a few minutes, but can take longer if the treatment is complex.

Before the FRST treatment begins, medical staff will leave the room, but they will be able to see and hear you and you will be able to hear them, as they guide you through the process.

Some patients find music helps them to relax while the treatment is being delivered. Your radiographers can arrange this for you.

The treatment is usually given by a machine called a linear accelerator (LINAC). This is similar to a large X-ray machine and is used to give standard radiotherapy to many different parts of the body. It can, however, be set up to deliver FSRT.

The LINAC has an attachment which moves round your head delivering numerous beams of radiation from different angles. The beams all cross over at the tumour, where they create a high dose of radiation and destroy the tumour cells.

A similar machine you may hear about is called CyberKnife®. This is essentially a LINAC machine, except that it is specially designed to give FSRT. It has a small linear accelerator on a robotic arm, which moves round your head delivering the X-rays (radiotherapy). It also tracks any movements the patient makes and adjusts its positioning before delivering beams of radiotherapy. CyberKnife® is the brand name for this machine - it does not involve an actual knife. There is currently no identified advantage of one machine over another.

Although the actual treatment does not take very long (20- 40 minutes with a LINAC machine; 30-90 minutes with a CyberKnife®), you will be at the hospital for some time as it takes a while for the radiographer to fit your mask, attach it to the table and position you correctly.

Usually, once your treatment has finished, you can go home. It is advisable to arrange transport, so that you don't have to drive, as you may feel very tired. (Patients with certain types of tumour may be prohibited from driving during treatment and for some time after. Your doctor will discuss this with you.) *(Also see the Driving and brain tumours fact sheet.)*

You will need to return to the hospital several times to have your course of treatment. How many times you need to return will depend on your treatment plan. This will be tailored to your individual needs. Typically though, FSRT can take around 5 -25 treatment sessions or doses.

Stereotactic Radiosurgery (SRS)

Once the preparation and fitting of the head frame and the planning of treatment has been done, the actual treatment procedure with stereotactic radiosurgery is much the same as FSRT. The difference is that the treatment is given in just one session.

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Before treatment begins (or shortly afterwards) your doctor may give you steroids to reduce brain swelling, or anti-seizure drugs to help prevent a seizure (fit).

You will lie on the treatment couch and the radiographer will position your head by attaching the frame to a support on the couch. Then the couch and treatment machine will be adjusted into place before the treatment begins.

The staff will leave the room, but will be able to see and hear you, and you will be able to hear them.

SRS can be given using a LINAC machine or similar machines designed specifically to treat the brain. These include the machine called GammaKnife®.

GammaKnife® uses gamma rays rather than X-rays to target and treat the tumour. It is important to note that this is still radiation, therefore still radiotherapy. It does not involve an actual knife. The machine looks quite different to a linear accelerator, but the preparation, delivery and outcome are similar to SRS using a linear accelerator.

The SRS treatment is likely to take longer than FSRT. It may take up to 4 hours. The time taken depends on the size of the tumour, the dose of radiotherapy that needs to be given, or the machine used.

When the treatment has finished, the medical staff will re-enter the room to take you out of the machine and remove the head frame. You will then go back to the ward.

You may be allowed to go home after being monitored for a while by the treatment staff. Or your doctor may want to admit you to the ward for monitoring overnight.

After treatment

Stereotactic radiotherapy treatments (FSRT and SRS) generally have fewer side-effects than conventional radiotherapy, as the area being treated is generally smaller and the dose that the healthy tissue receives is smaller.

Short-term side-effects

It is very common to feel tired for a few days after SRT. Make sure you let yourself rest. Some people experience feelings

of nausea, dizziness or faintness directly afterwards. This is uncommon, however, as doctors often give steroids before or immediately after your treatment, to help prevent these side-effects caused by swelling of the brain.

If you had a head frame, the areas where the frame was attached to your skull may be tender and may bleed slightly or be slightly itchy as they heal. Your health team will give you information about keeping these clean to reduce the risk of infection at the pin sites.

You may also have a dull headache once the anaesthetic wears off. This can be eased with painkillers.

These side effects are generally short-lived.

If your tumour was near the surface of your skull, you may lose some hair, but hair loss is rarely a side-effect of stereotactic radiotherapy treatments.

There is also a slight possibility that you may have a seizure (fit) after radiosurgery (SRS). This is more likely in people who have had seizures before the treatment. As a result, although seizures are rare, the DVLA (DVA in N. Ireland) does not allow you to drive for at least 1 month after your treatment, even if you have not had seizures previously. (For more information, please see our *Driving and brain tumours* fact sheet.)

If you experience any side-effects, particularly ones that you are concerned about, speak to your doctor.

It is also important to be aware that radiotherapy of any type can cause swelling in the tissue around the treated area. This can make it look like the tumour is growing again on a post-treatment MRI scan. This is known as 'pseudo-progression' and can make it difficult to assess the effect of the radiotherapy for a period of time after treatment.

Long-term side-effects

As SRT treatments involve a very high dose of radiation, some people can develop a section of dead cells in the treated area known as 'radiation necrosis.'

This can happen from months to decades after treatment, but it generally occurs six months to two years after the SRT procedure. It is more likely if you have chemotherapy as part of your treatment.

Most people who develop radiation necrosis will have no symptoms as the area will be very small. If symptoms occur due to swelling steroids can be given to treat this. Occasionally, however, surgery may be required to remove the dead tissue.

If you have any concerns, discuss them with your health team.

Why is the word 'knife' used?

Despite the word 'knife' appearing in the names 'Gamma Knife' and 'Cyberknife' there is no actual knife used. The name was chosen because the neurosurgeon who invented it, Professor Lars Leskell, felt that the treatment allows such precision, similar to a surgeon's knife.

What if I have further questions?

If you require further information, any clarification of information, or wish to discuss any concerns, please contact our Support and Information Team:

Call: 0808 800 0004

(Free from landlines and most mobiles:
3, O2, EE, Virgin and Vodafone)

Email: support@thebraintumourcharity.org

Join our closed Facebook group:
bit.ly/facebooksupportgroup
bit.ly/carersupportgroup

About us

The Brain Tumour Charity makes every effort to ensure that we provide accurate, up-to-date and unbiased facts about brain tumours. We hope that these will add to the medical advice you have already been given. Please do continue to talk to your health team if you are worried about any medical issues.

The Brain Tumour Charity is at the forefront of the fight to defeat brain tumours and is the only national charity making a difference every day to the lives of people with a brain tumour and their families. We fund pioneering research to increase survival, raise awareness of the symptoms and effects of brain tumours and provide support for everyone affected to improve quality of life.

We rely 100% on charitable donations to fund our vital work. If you would like to make a donation, or want to find out about other ways to support us including fundraising, leaving a gift in your will or giving in memory, please visit us at thebraintumourcharity.org, call us on 01252 749043 or email fundraising@thebraintumourcharity.org

About this fact sheet

This fact sheet has been written and edited by The Brain Tumour Charity's Support and Information Team. The accuracy of medical information has been verified by leading health professionals specialising in neuro-oncology. Our fact sheets have been produced with the assistance of patient and carer representatives and up-to-date, reliable sources of evidence. If you would like a list of references for any of the fact sheets, or would like more information about how we produce them, please contact us.



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