NETCARE
cancer care

INFORMATION BROCHURE

Stereotactic Radiosurgery (SRS)

Providing YOU with the best and safest care

NETCARE

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01 Introduction

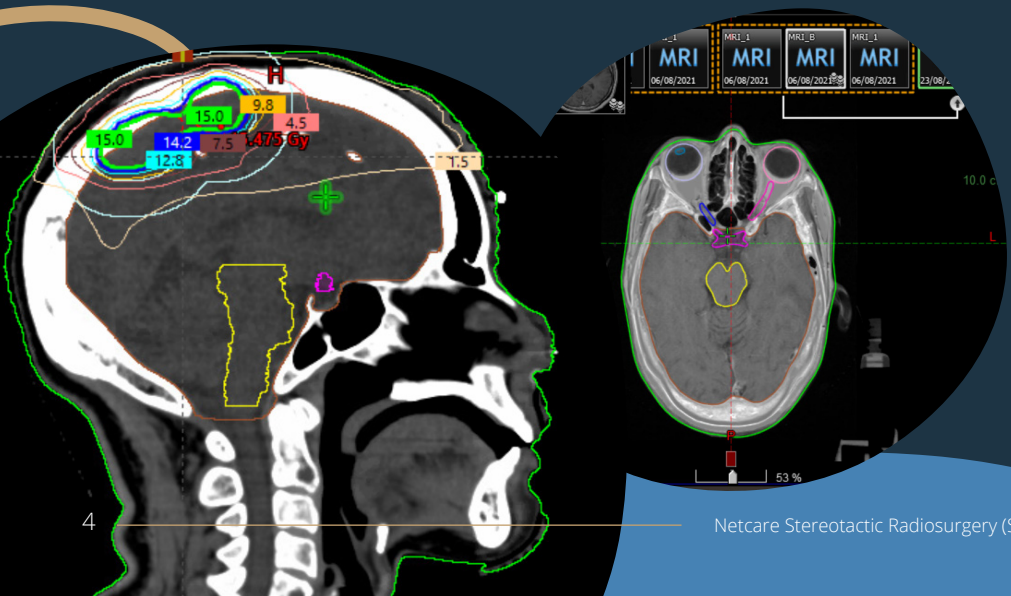
We would like to wish you a warm welcome to our Cancer Care Department and the Netcare family. At Netcare, our core value is care. We care about the dignity of our patients and all members of the Netcare family, including you. We care about the participation of our people and our partners in everything that we do. We care about truth in all our actions. We are passionate about quality care and professional excellence.

The Cancer care team would like to ensure that your radiosurgery experience is as comfortable and easy as possible. The shock of receiving your diagnosis may have left you filled with fear and anxiety but know that you are not alone. We are here for you.

You have received this booklet because your doctor believes that you are a good candidate for stereotactic radiosurgery (SRS). It is an advanced treatment for cancer, vascular abnormalities, benign lesions and certain types of pain and movement disorders.

The most common illnesses treated with radiosurgery include arteriovenous malformation (AVM), acoustic neuroma, brain metastasis, meningioma, pituitary adenoma, glomus, chordoma, glioma/glioblastoma and some functional lesions such as trigeminal neuralgia.

Please refer to the glossary of terms if there are any words you may not understand.



02 What is radiation?

Radiation therapy is the use of high-energy x-rays or other particles to destroy cancer cells. There are a number of different types of radiation therapy of which stereotactic radiosurgery is one.

03 What is stereotactic radiosurgery and how is it used?

Stereotactic radiosurgery (SRS) is the treatment of choice for many types of brain/neurological conditions. It is primarily used to treat benign non-cancerous and malignant cancerous lesions that are located deep within the brain or in areas close to vital structures of the brain. It may not be useful in situations where very large areas need to be treated or where the tumour extends into the surrounding normal brain. In this circumstance, other radiation techniques may be recommended which can safely treat these larger areas. The type of treatment right for you will be discussed with your by your treating doctor.

The procedure does not involve an operation; it is a non-surgical procedure, often used instead of surgery, while sometimes in conjunction with surgery. It is a highly precise form of radiation therapy used to treat small areas. It painlessly shrinks or eliminates tumours and abnormalities. Stereotactic radiosurgery works in the same way as other forms of radiation treatment. It does not remove the tumor, rather, it distorts the genetic makeup of tumour cells. As a result, these cells lose their ability to reproduce and grow.

Stereotactic radiosurgery (SRS) is usually completed in a one-day session. The treatment involves the delivery of a single high-dose (SRS) radiation or sometimes smaller multiple doses of radiation. However, physicians sometimes recommend a fractionated radiation treatment in which sessions are spaced over days or weeks – referred to as hypofractionation (HSRT) or fractionated stereotactic radiotherapy (FSRT) or commonly called Stereotactic Radiotherapy (SRT).

The type, size and location of the treatment area will largely define whether a single treatment or multiple treatment sessions will be of benefit.

Recovery after the initial procedure is fast, and you can resume normal activities shortly after treatment. Following the treatment, malignant cancerous and metastatic which is the spread of cancer from the primary site (place where it started) to other places in the body tumours may shrink rapidly, even within a couple of months. Benign non-cancerous tumours usually shrink over a period of 18 months to two years.

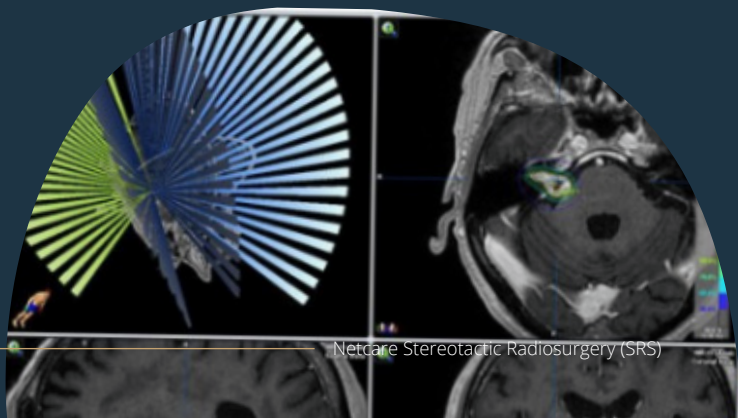
Using a mask which keeps the head completely still and three-dimensional computer-aided planning software, stereotactic radiosurgery minimises the amount of radiation to healthy brain tissue.

04 Who will be involved?

The treatment team comprises of several specialise medical professionals, typically including a radiation oncologist, neurosurgeon, medical radiation physicist and radiotherapists.

The radiation oncologist, a specially trained physician, sets an individualised course of treatment with the assistance of the medical radiation physicist, who ensures the delivery of the precise radiation dose. The medical physicist is also responsible for the quality assurance of all planning and treatment procedures. Informed consent is done with your doctor before these procedures can take place. It is important that you are fully informed of the treatment and the possible side effects which can occur due to the treatment.

Radiotherapists are responsible for the 3D computerise planning and delivery of your treatment plan. The highly trained team provides you with information relating to the treatment procedure and possible side effects.



05 What equipment is used?

There are four basic forms of stereotactic radiosurgery:

- Gamma Knife
- Cyberknife
- Particle beam (proton) or cyclotron
- Linear accelerator (LINAC) Stereotactic

This booklet covers Linac-based Stereotactic Radiosurgery.

Each of these four basic forms uses different instruments and sources of radiation:

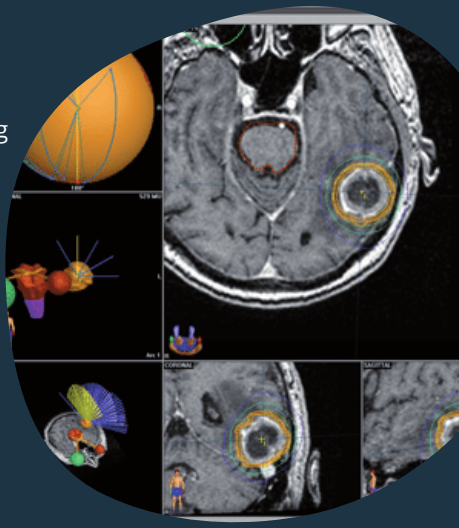
01 Gamma Knife, uses specialised equipment to focus about 200 tiny beams of radiation on a tumour or other target with submillimeter accuracy. Although each beam has very little effect on the brain tissue it passes through, a strong dose of radiation is delivered to the place where all the beams meet and

02 Cyber Knife combines X-ray beams, computers, imaging and robotic technology for target localisation and radiation delivery-not currently available in Africa.

03 Particle beam (protons) therapy uses protons rather than x-rays to treat cancer. A proton is a positively charged particle. At high energy, protons can destroy cancer cells. This treatment is available at iThemba LABS in the Western Cape

04 Linear Accelerator (LINAC) machines, prevalent throughout the world, customizes high energy x-rays or electrons to conform to a tumour's shape and destroy cancer cells while sparing surrounding normal tissue. The linear accelerator can perform radiosurgery on lesions in a single session or in multiple sessions.

06 Circular Cone Radiosurgery and Conformal Beam Radiosurgery.



Linac-based machines have two ways of delivering radiosurgery; circular cone radiosurgery and conformal beam radiosurgery.

Circular Cone Radiosurgery (only used for functional SRS i.e., trigeminal neuralgia)

A small circular cone is attached to the head of the linear accelerator – enabling a very small, rounded dose of radiation to be directed at a specific point in the brain. The machine moves around the head while delivering the treatment (Arc therapy).

Conformal Beam Radiosurgery

The highly sophisticated linear acelerator has a collimation system that allows multiple fields, each with its own irregular shape, to deliver a highly conformal dose to any shape tumour. These fields may be static, and the treatment is delivered while the machine is stationary or in arc mode (dynamic) or arcing and modulating (IMRT/VMAT).

07 Is there any special preparation for the procedure?

No, there is no special preparation needed. Stereotactic radiosurgery is usually performed on an outpatient basis. You will need to have a family member, or another support person drive you home afterwards.

08 Will other medication affect my treatment?

Ask the radiation oncologist about taking any medication on the day of your treatment and bring the medication with you to the procedure. You should also tell your radiation oncologist or radiation therapist if any of the following applies to you:

- You are taking oral medications or insulin to control diabetes.
- You are allergic to intravenous contrast material, shellfish, or iodine.
- You have a pacemaker, artificial heart valve, defibrillator, brain aneurysm clips, implanted pumps or chemotherapy ports, neurostimulators, eye or ear implants, stents, coils or filters.
- You suffer from claustrophobia.
- Please disclose if you are pregnant or suspect that you are pregnant.

09 The Treatment Process

Stereotactic radiosurgery (SRS) is a carefully controlled process that consists of a series of steps:

- Consultation
- Positioning
- Imaging
- Treatment planning
- Treatment delivery

Consultation

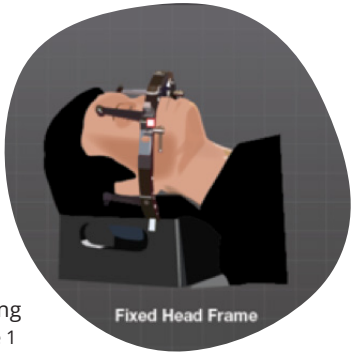
Your initial visit will be with the radiation oncologist or neurosurgeon – they will review your medical history and reports. The radiation oncologist or neurosurgeon will make a recommendation about any further tests that may be required. They will discuss the options available to you and work with you to choose an optimal course of treatment. If SRS is decided upon, the entire treatment process will be completed in one day; if it is SRT, you will be scheduled for a series of appointments. You will be required to sign a treatment consent form once your oncologist has explained the procedure and any side-effects, and you have agreed to the treatment.

Positioning

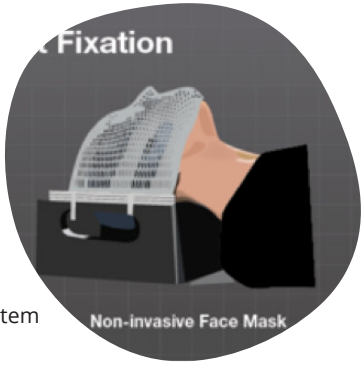
To achieve the precision of a stereotactic treatment, it is important to be accurately positioned and carefully immobilised during treatment. The team will fit you with an immobilisation device to ensure that you remain in the same position, (as comfortably as possible), without moving during the procedure.

There are different methods for positioning and immobilization, depending on treatment area. Some single session treatments to the brain require a minimally invasive fixed head frame. (See figure 1 and figure 2). A mask system may be used in other instances, especially for SRT treatments, which are the same as SRS treatments, but delivered over several days.

Positioning
See Figure 1



A mask system
See Figure 2



- **Fixed frame:** The fixed frame is not used often anymore. It is an external metal ring that is affixed to your skull with four screws. Before the neurosurgeon positions and attaches your fixed frame, you will be injected with a local anaesthetic to the front and back of your head, where the small pins penetrate, to numb your scalp. These injections are slightly uncomfortable but will help to minimise the discomfort of fitting the fixed frame. As the fixed frame is pinned to your skull, you will feel pressure or tightness that typically disappears within 15 minutes. If you have been fitted with a fixed frame for SRS, you will need to remain at the treatment facility for the entire treatment process.

- **Mask system:** The mask is made from a lightweight, plastic-type mesh that is individually formed to fit your face and head. The mask is placed in hot water, or in an oven so that the mesh can get soft. Once soft, it is moulded to fit your face. There is no discomfort other than a slightly warm sensation over your face when the mask is made. Accurate re-positioning can be achieved over multiple treatments using this method of immobilization.

Imaging

You will be positioned on the CT couch with your mask or head frame in position, so that a scan can be performed, which will generate images of the area to be treated. A small needle might be placed in your hand or arm to give contrast enhancement material which may be needed to highlight the lesion and surrounding critical structures on the CT scan.

This scan, along with any other CT, PET, MRI, and X-ray images you may have had, provides information not only to create a treatment plan but to ensure that you are positioned correctly at the time of treatment. An MRI scan is usually done a day or two before the frame is fitted or on the same day the mask is made.

Treatment Planning

With the information gathered during the positioning and imaging steps, a dedicated medical team will design the best treatment plan for your diagnosis. This planning team may include experts from different disciplines like radiation oncology, neurosurgery, medical physics, and radiotherapy. They will use a sophisticated software program to generate a customized plan for your treatment.

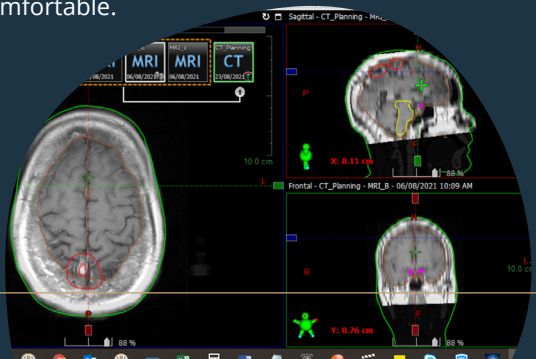
Treatment delivery

SRS and SRT treatments can take anything from 30 minutes to an hour – in specialised cases, treatment can be longer. Most of the time is used to ensure that you are accurately positioned for your treatment. You will see laser lights in the room. These help the radiotherapist to make sure you are level and straight on the treatment couch. You may see and hear the linear accelerator/ linac (treatment machine) as it is moved into position. The Linac will move around you to deliver beams from different angles, according to your treatment plan. It will not touch you. Sometimes the couch will move as well.

You will be alone in the room for a few minutes at a time when the Linac is switched on from the outside console area by the radiotherapists. (You do not have to be afraid as the radiotherapists can see and hear you at all times via an intercom and closed-circuit television systems). Should you have a problem and need assistance, you may raise your hand to notify the radiotherapist who will be watching you at all times.

The Linac emits a loud buzzing noise as it produces the radiation beams. The radiation beam itself is invisible. You may also hear the quiet whirr of the beam-shaping device and see the leaves (multi-collimator leaves that shapes the beam) move. This is all normal and part of the treatment process.

Radiosurgery treatments are similar to having an x-ray. You will not be able to see, feel or hear the x-rays. There is no pain or discomfort from the actual treatment. If you experience pain for other reasons, such as back pain or discomfort from the head frame, let your oncologist or radiotherapist know. You may experience nausea and/or a headache and can ask your radiation oncologist for medication to help make you feel more comfortable.



10 Follow-up care

Your oncologist or neurosurgeon will monitor your progress over a series of visits. Clinical evaluations, blood tests and additional MRI scans may be requested at these visits. These follow-up schedules will be discussed in detail by your oncologist.

These appointments are opportunities to discuss any problems you may have and review how to stay healthy after treatment. Ask about nutrition, exercise, and other basics for maintaining a healthy lifestyle. You can also find out about support groups for survivors of cancer or neurological conditions. Your well-being is important to us. Please remember that the team is always available – we will do our utmost to assist you. We care and are always here for you.

11 New Technology

Head and Neck Radiosurgery

Treatment in the head and neck area will involve a mask made to hold your head and neck in place during the radiosurgery treatment, similar to what was described earlier in this booklet.

This enables precise treatment of areas outside the brain, e.g mouth (oral cavity), throat (pharynx), voice box (larynx) and cervical spine. Treatment is given in lower doses of radiation over several visits rather than all at once.

Extracranial Radiosurgery

Extracranial radiosurgery is stereotactic radiosurgery (SRS) performed to treat cancer in body systems outside the brain.

New imaging techniques help radiation oncologists understand the three-dimensional shape and movement.

The new imaging techniques and software allow us to treat these lesions to a very high degree of accuracy. It improves dose delivery while sparing critical structures in close vicinity.

Extracranial radiosurgery usually consists of four or more treatments to the prescribed cancer. Cancers of the lungs, liver, pelvis, and other areas of the body may be treated in this way.

12 Glossary of Terms

Acoustic Neuroma: Vestibular schwannomas are commonly known as acoustic neuromas. A benign tumour of the nerve of hearing (the 8th cranial nerve.) This tumour is usually very slow growing.

AVM (arteriovenous malformation): An abnormal, congenital cluster of tangled blood vessels within the brain or spine that is at risk of bleeding. Depending on the AVM location, bleeding can cause symptoms ranging from headaches and seizures to paralysis and even death.

Benign Tumour: A growth or lesion that is not cancerous i.e. does not spread to other areas of the body. However, their growth and enlargement can cause symptoms by compressing nearby tissue or structures such as nerves. Over time some benign tumours may become malignant.

Chemotherapy: Cancer treatment that is administered through the use of drugs that are injected into the body or taken orally over a period of time. This is a form of systemic therapy - i.e. as the drugs circulate in the bloodstream, the entire body is affected.

CNS (central nervous system): The combination of the brain and spinal cord.

Cold spots: Are under-dosed areas within the target that receive a less than optimal amount of radiation dose. In situations of under-dosing, there is a risk that all tumour cells will not be destroyed.

Critical Structures: Refers to healthy tissues near the tumour or other target tissue; radiation to critical structures must be limited to low, non-damaging levels For example; the spinal cord is the primary critical structure of concern when treating spinal lesions.

CT (computerized tomography): A diagnostic imaging technique where an x-ray machine and computer are used to create detailed images of tissues and structures in the body. A dye, or contrast agent, may be injected into the patient to highlight abnormalities.

Extracranial: Refers to any location of the body “outside of the skull”. Examples of extracranial sites include the spine, lung, liver, pelvis and other areas of the body.

Fiducials: Fiducials are markers found on either the head frame or bite block. Additionally, x-ray visible fiducials may be surgically implanted for treatment of spinal or other tumours. The fiducials act as markers to precisely identify the location of a tumour or other target.

Fixed Frame (Stereotactic Head Frame): An external metal ring that is affixed to the patient's skull with four screws. It contains markers (fiducials) that are visualized on the CT and/or MRI scan. Local anaesthesia is used during the frame attachment procedure. Nearly all radiosurgical techniques for brain tumours (excluding the CyberKnife System), including the Gamma Knife, use such head frames.

Fractionated stereotactic radiotherapy (FSRT): This is particularly beneficial for radiosurgical treatment of larger tumours and tumours located near critical structures. Each individual treatment is called a fraction.

Fractionation: Dividing the total dose of radiation into multiple smaller doses (usually administered daily), thereby permitting the surrounding exposed healthy tissue time to repair.

Glioma: Tumours that arise from the supportive tissue of the brain. These are the most common primary brain tumours. Examples include astrocytoma, ependymoma, oligodendroglioma and glioblastoma.

Hot spots: Are areas where treatment volumes overlap, causing some tissue to be overdosed with radiation. Excessive radiation exposure of normal tissue increases the risk of complications, especially with critical structures such as the highly radiosensitive optic chiasm and acoustic nerves.

Hypofractionation: Delivers higher doses of focused radiation to a lesion over a series of 2-5 treatment sessions, thereby enabling a biologically more effective total dose to be administered. This is referred to as hypofractionated stereotactic radiosurgery (HSRT).

IMRT (Intensity Modulated Radiation Therapy): The intensity of the radiation can be changed during treatment to spare adjoining normal tissue while increasing the dose to the tumour.

Inaccessible/Irresectable tumour: A tumour that often cannot be removed surgically because it is located in an area that is difficult to access by open surgery. Because of location, surgical resection of these tumours has a high probability of damaging vital areas of the brain or spinal cord.

Inoperable: A tumour that cannot be removed surgically due to contributing factors making the surgical procedure risky. This may be due to a medical reason or other.

Intracranial: Refers to location "inside the skull" or brain.

Isocentric Treatment Planning: All Stereotactic Radiosurgery System devices (with the exception of the Cyber Knife System) are restricted to using a fixed isocentre as the standard for treatment. Isocentric treatment, or multi-isocentric treatment, involves packing the lesion with a single (or multiple, overlapping) spherically shaped dose distributions.

Malignant: Malignant tumours are cancerous and are capable of spreading from one site in the body to another, usually via the bloodstream in a process called metastasis.

Meningiomas: Generally benign tumours that develop from the meninges, thick strong membranes that cover the brain.

Metastatic tumour: A tumour arising from cancer cells that originate elsewhere in the body and travel to a new anatomical site through the bloodstream.

MRI (magnetic resonance imaging): An imaging technique that uses magnetic fields rather than x-rays to delineate structures in the body. MRI generally provides more detailed images of soft tissue anatomy (as opposed to bone) compared to CT. A dye may be injected prior to the scan to improve visualization of many tumours. MRI scans are painless.

Non-Isocentric Treatment: The Cyber Knife System's multi-jointed robotic arm enables the delivery of radiation for more complex-shaped lesions. The radiation beams are delivered from arbitrary points in the workspace to the lesion without intersecting a common point or isocentre. Non-isocentric treatment allows the Cyber Knife System to "paint" the lesion volume with a nearly uniform dose while simultaneously helping to contour radiation away from nearby healthy tissue.

PET (positron emission tomography): An imaging technique that provides a picture of cellular activity by measuring positrons emitted from injected substances "labelled" with a radioactive marker.

Primary brain tumour: A tumour arising from unhealthy/mutant cells in the brain or surrounding tissue (in contrast to a metastatic tumour).

Robotic Radiosurgery: Non-invasive procedure in which a computer-controlled robot is used to deliver high-dose radiation to tumours throughout the body without stereotactic frames. It treats solid tumours anywhere in the body in one to five visits.

Stereotactic: (stereotaxis or stereotaxy) "Stereo" makes reference to ones position within 3-dimensional space. Stereotaxy or stereotaxis is the science and practice of precisely locating a tumour within 3D space.

Surgical Resection: Conventional open surgery (with a scalpel) to remove a tumour or other lesion.

Target Localisation: Identifying the location of the target precisely in 3-Dimensional space.

Treatment Planning: Customising the radiosurgery treatment parameters (such as radiation dose and shape of the field) to the individual patient using specialised software. The process is typically computer-based and involves integrating information from CT/MRI scans to delineate and contour the target.

The treating physician must define a specific dose and other key treatment parameters depending on pathology and the location of nearby critical structures. Typically the treating surgeon, radiation oncologist and medical physicist are all involved in this process.

Tinnitus: Buzzing or ringing in the ear.

Vascularity: The blood supply of a tumour.

Vertigo: Dizziness.

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Notes

Disclaimer:

The information contained in this booklet is provided for information purposes only and is not intended to be a substitute for professional medical advice, diagnosis or treatment. Always seek the advice of your physician or other qualified health professional with any questions you may have regarding a medical condition.

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