

A PATIENT'S GUIDE TO

PROTON THERAPY

WITH THE PROBEAM® SYSTEM



MEDICAL CENTRE
IMAGING
NUCLEAR MEDICINE
PROTON & RADIOTHERAPY



Contents

Introduction

How it works

Advantages

Treatment process

Glossary

Introduction

At Proton SG, we believe you deserve access to the most innovative, cancer-fighting technology available.

That's why we offer an advanced form of treatment called proton therapy. Proton therapy is an exciting, forward-thinking way to treat cancer, and it's here at Proton SG.

As you begin your journey with proton therapy, use this guide as an informational roadmap to help you navigate the process. We've included an overview of how proton therapy works, its advantages, and a step-by-step description of the treatment process. Be sure to discuss any questions you may have about the information contained in this guide with your healthcare team.

The ProBeam® proton therapy system allows us to target tumors with unprecedented precision thanks to its use of high-definition **pencil beam scanning** and best-in-class imaging. Only pencil beam scanning is able to deliver **Intensity Modulated Proton Therapy** (IMPT), which is recognized for its effectiveness and considered an advancement over other proton therapy delivery methods. With remarkable precision, this advanced form of radiotherapy targets the tumor while minimizing damage to healthy organs and tissue.



How it works

Proton therapy is an advanced type of cancer treatment that uses a beam of protons delivered directly to the tumor, destroying cancer cells while minimizing damage to healthy tissues.

Unlike traditional radiotherapy, protons have a unique stopping power. This means they can be targeted to deposit their cancer-fighting energy right at the tumor, thereby minimizing damage to surrounding healthy organs and tissue. Simpler forms of proton therapy have been in use for decades and it is now considered one of the most effective cancer treatments available today.

A key benefit of proton therapy is its precision. As the protons move through the body, they slow down and interact with atoms in the tumor tissue, releasing energy. The point where the highest energy release occurs is the **“Bragg peak.”** A physician can designate the Bragg peak’s location, indicating where to precisely target the tumor cells.

At Proton SG, we use the ProBeam[®] system from Varian for the most sophisticated type of proton therapy currently available: intensity-modulated proton therapy (IMPT).



Advantages

Pencil beam scanning and IMPT

The Varian ProBeam® system allows us to target tumors with unprecedented precision thanks to its use of high-definition pencil beam scanning and best-in-class imaging. Only pencil beam scanning is able to deliver Intensity Modulated Proton Therapy (IMPT), which is recognized for its effectiveness and considered an advancement over other proton therapy delivery methods.

IMPT offers a number of advantages:

- Delivers a high dose of proton therapy **directly to the tumor**
- **Sculpts doses** to the complex shape and size of an individual tumor
- **Sparses more healthy tissues** near the targeted tumor

Types of cancers treated

Proton therapy is effective in treating a number of cancers including but not limited to:

- Liver
- Lung
- Central nervous system
- Base of skull
- Head & neck
- Esophagus
- Breast
- Pancreas
- Prostate
- Pediatric
- Recurrent



Proton therapy vs. photon radiotherapy

All radiotherapy, including proton and high-energy X-rays (photon), destroy cancer cells by damaging their DNA. Healthy cells can repair themselves after exposure, depending on the level of DNA damage. Proton therapy's added benefit is its stopping power, meaning particles (or protons) deposit most of the dose within the tumor—minimizing damage to healthy tissue. This is ideal for treating tumors near vital structures, recurrent cancers, and cancers in children.



Conventional radiotherapy deposits most of the dose at entrance and travels past the tumor.

Proton therapy deposits most of the dose in the tumor with minimal entrance and no exit dose.

Combining proton therapy with other treatments

Depending on your particular situation and type of cancer, proton therapy may be used in combination with chemotherapy, immunotherapy or surgery. You and your doctor will discuss the options to determine if combination therapy is right for you.

Proven technology

Proton therapy has been used to treat cancer for more than 50 years and it is an established form of treatment for specific indications that is widely accepted by physicians, government agencies, and many insurers. There is a wealth of published data on the efficacy of proton therapy and large numbers of ongoing trials continue to examine its clinical advantages.



Accuracy & precision

With the ProBeam® system at Proton SG, our clinicians are able to program pencil beam scanning to the precise depth of your tumor, while sculpting the dose to conform to its complex shape. Varian's imaging system gives us the ability to position the beam with high accuracy. This allows us to target tumors located adjacent to critical structures in the body.

Fewer side effects

Proton therapy delivered by the ProBeam® system is a completely non-invasive procedure that may offer fewer side effects than those associated with traditional radiotherapy, such as: fatigue, pain, loss of appetite¹ and nausea.² There is also less risk of developing secondary cancers.³

Reduced treatment times

Proton therapy delivered with the ProBeam® system allows us to reduce most treatment times to 15-20 minutes. The ProBeam® system's 360-degree gantry rotates around patients, delivering treatment at almost any angle while minimizing the need for repositioning. This makes it easier for patients and allows for faster, more efficient treatment times than other proton delivery systems.

1. Wang XS, Shi Q, Williams LA, et al. Prospective Study of Patient-Reported Symptom Burden in Patients With Non-Small-Cell Lung Cancer Undergoing Proton or Photon Chemoradiation Therapy. *J Pain Symptom Manage.* 2016;51(5):832-838. doi:10.1016/j.jpainsymman.2015.12.316
2. Romesser PB, Cahlon O, Scher E, et al. Proton beam radiation therapy (PBRT) results in significantly reduced toxicity compared with intensity-modulated radiation therapy (IMRT) for head and neck tumors that require ipsilateral radiation. *Radiother Oncol.* 2016;118(2):286-292.
3. Eaton BR, MacDonald SM, Yock TI, Tarbell NJ. Secondary Malignancy Risk Following Proton Radiation Therapy. *Front Oncol.* 2015;5:261.

Treatment process

There are several steps to any proton therapy or radiotherapy treatment. They consist of **tumor visualization, treatment planning, treatment delivery**, and **follow-up**. Again, your clinical team will determine which treatment technique is right for you, and will be able to answer any questions you may have before, during or after treatment.

Tumor visualization

In order to design your treatment plan, your treatment team will take images to reveal the exact location of the tumor, including its size and position relative to the surrounding tissues

and organs. This is typically done with a **CT scan**. Depending on the general location of the tumor and other factors, additional types of scans may be taken, such as an MRI, a PET scan or an ultrasound scan. With the help of these scans or images, your clinical team can see details of the tumor from a variety of angles.

Depending on your treatment needs, a custom body-mold (or mask if your head is being treated) will be made, and tiny skin marks may be used to help ensure you're in exactly the same position for each treatment session.



Treatment process

Planning

With the completed scans, your clinical team will use sophisticated treatment planning software to develop a three dimensional “picture” of the area where you will receive treatment. They’ll determine the amount of radiation to be delivered, the appropriate angles from which to deliver it, and the number of sessions needed to deliver the prescribed treatment. They’ll also take into account many other factors—including the type of cancer being treated, its location and size, your medical history, and your lab test results—to create a plan uniquely designed for you.

Treatment

Your cancer treatment will be delivered on the ProBeam® system. Proton therapy is typically provided in a number of sessions or fractions, ranging from 5 to 35, usually with one session per treatment day.

Before each treatment session, your radiation therapist (RT) will help position you on the treatment table, or “couch.” Your therapist may use the machine’s imaging system to take a new image of the tumor in that day’s treatment position to verify the correct target. Adjustments to your position may then be made to precisely match the position that was planned for you.

Your therapist will be in constant contact with you through cameras and microphones in the treatment room. The gantry will rotate to the angles determined by your treatment plan. The pencil beam scanning system delivers the proton beam layer-by-layer, spot-by-spot, like a 3D printer. This helps deliver accurate treatment while minimizing radiation exposure to surrounding healthy tissue. You will not see or feel the proton beam.

Follow-up care

After you complete your treatment, your radiation oncologist and healthcare team will monitor your progress with a series of follow-up visits. These visits can include a physical examination, blood screening, additional imaging, and other tests that may be needed. Your follow-up appointments are also a good opportunity for you and your caregivers to ask any questions about your progress, or inquire about the status of your overall health.



Glossary

Bragg peak: With proton therapy, very little dose is delivered along the path prior to reaching the target. Instead protons deliver most of their energy at a prescribed, programmable distance inside the body, known as the Bragg peak.

Computed Tomography Scan (CT or CAT scan):

A computerized X-ray procedure that produces cross-sectional images of the body. The images are far more detailed than X-ray films and can reveal disease or abnormalities in tissue and bone. The procedure is noninvasive and brief.

Dosimetrist: A medical professional who plans and calculates the proper radiation dose for treatment. Dosimetrists work under the supervision of the physician—who prescribes the proper treatment dose—to make sure the prescribed dose is delivered by the therapy plan.

Gantry: A device that rotates the proton therapy delivery apparatus around the patient during treatment. The ProBeam® system's 360-degree gantry can deliver the beam from almost any angle.

Intensity-modulated proton therapy (IMPT):

A highly precise type of proton therapy. Intricate treatment planning and precise proton beam delivery results in modulating the intensity of the proton beam and shaping it to match the contours of the tumor.

Magnetic Resonance Imaging (MRI):

A diagnostic imaging technique that uses a magnetic field and radio waves to produce highly detailed images of the body. Both MRI and CT scans may be used in planning proton therapy.

Pencil beam scanning: A very precise form of proton therapy treatment that delivers dose across the height and width of a tumor. It can be directed to move throughout the tumor's depth to “paint” the treatment volume with the beam.

Photon: A particle representing a quantum (energy packet) of light or other electromagnetic radiation. X-rays and gamma rays are photon radiation (sometimes called “traditional” or “conventional” radiation).

Proton: A positively charged particle found in the nucleus of an atom. Protons used in proton therapy come from stripping a hydrogen atom of its electron. They can be accelerated and controlled to release their energy within a well-defined range in tissues, such as a tumor.

Radiation oncologist: A physician who uses high-energy radiation, including protons, to treat cancer. Radiation oncologists also may use ionizing energy to treat diseases other than cancer. At Proton SG, patients meet with their radiation oncologist before treatment begins, weekly during the course of treatment, and for follow-up as needed.

Radiation therapist: A specially trained health professional who operates the system and administers radiation treatments to patients.



proton-singapore.com

The information in this guide is intended to serve as a general guide to proton therapy and the ProBeam® system. It does not replace full discussions with your doctor and healthcare team. It is important to know that proton therapy, including proton therapy delivered with the ProBeam® system, is not appropriate for all types of cancer. Talk to your doctor about what you can expect from your treatment and to find out if treatment with the ProBeam® proton therapy system is right for you.

varian

varian.com

Palo Alto, CA

Important Safety Information: Radiation treatments may cause side effects that can vary depending on the part of the body being treated. The most frequent ones are typically temporary and may include, but are not limited to, irritation to the respiratory, digestive, urinary, or reproductive systems; fatigue; nausea; skin irritation; and hair loss. In some patients, these side effects can be severe. Treatment sessions may vary in complexity and time. Radiation treatment is not appropriate for all cancers.

© 2020 Varian Medical Systems, Inc. Varian and Varian Medical Systems are registered trademarks of Varian Medical Systems, Inc.