Proton Therapy Training

Treatment Planning & Physics

October 15 – October 20, 2018

THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center
Proton Therapy

Making Cancer History®

Welcome to MD Anderson Cancer Center and the Proton Therapy Center in Houston, TX. We are excited that you have chosen our world-class facilities to further your knowledge and understanding of proton therapy. With the most innovative technology and a multidisciplinary team approach, our cancer experts include radiation oncologist, physicists, medical dosimetrists, nurses, anesthesiologist, radiation therapist and others.

Depending on the training track(s) you have chosen, over the course of the next week(s), our goal is to educate you on Clinical Operations, Treatment Planning and/or Physics and Service Maintenance. Any one or all three of these tracks will better prepare you as you engage in new frontiers with proton therapy and extend its benefits to patients with a wide range of cancers.

Thank you and enjoy the program!

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Associate Medical Director, Proton Therapy Center

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Chief Operating Officer, MD Anderson Cancer Proton Therapy Center - Houston

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Kristin Jones, MBA
Program Coordinator

Lee Chamblee, MBA
Education Program Coordinator

Educational Objectives

After attending the conference, participants should be able to

- Incorporate the knowledge and skills learned through hands-on practice sessions to better prepare for proton therapy treatments, thus improving patient outcomes *(knowledge, competence, performance, patient outcomes)*,
- Interpret the effectiveness of proton therapy to assess which intervention would be most appropriate for patients with different solid tumor cancer diagnoses *(knowledge, competence)*,
- Assess how an interprofessional system will improve the quality of care for patients receiving proton therapy *(knowledge, competence)*,
- Utilize proton therapy clinical trials and assess their outcomes for a better understanding of the importance and significance in the treatment of cancer *(knowledge, competence, performance),*
- Gain a greater appreciation and perspective of the steps and personnel needed to perform quality proton therapy *(knowledge, competence).*

Target Audience

This activity is intended for physicians and fellows in medical oncology, surgical oncology, radiation oncology, pediatrics and radiology, clinical research nurses in oncology and trainees.

Evaluation

A course evaluation form will provide participants with the opportunity to comment on the value of the program content to their practice decisions, performance improvement activities, or possible impact on patient health status. Participants will also have the opportunity to comment on any perceived commercial bias in the presentations as well as to identify future educational topics.

Accreditation/Credit Designation

The University of Texas MD Anderson Cancer Center is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

The University of Texas MD Anderson Cancer Center designates this live activity for a maximum of 58.00 *AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

CME Certificates and Attendance Verification Certificates

Certificates awarding *AMA PRA Category 1 Credit™* or certificates documenting attendance will be distributed to participants when an individual departs the conference. To obtain a CME certificate, physicians must submit a completed evaluation questionnaire and a *CME Verification Form.*

Upon request, a record of attendance (certificate) will be provided on-site to other health care professionals for requesting credits in accordance with state nursing boards, specialty societies, or other professional associations.

The University of Texas MD Anderson Cancer Center has implemented a process whereby everyone who is in a position to control the content of an educational activity must disclose all relevant financial relationships with any commercial interest that could potentially affect the information presented. MD Anderson also requires that all faculty disclose any unlabeled use or investigational use (not yet approved for any purpose) of pharmaceutical and medical device products. Specific disclosure will be made to the participants prior to the educational activity.

Agendas are subject to change because we are always striving to improve the quality of your educational experience. MD Anderson may substitute faculty with comparable expertise on rare occasions necessitated by illness, scheduling conflicts, and so forth.

Photographing, audio taping, and videotaping are prohibited.

Contributors – Course Materials

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Monday - October 15, 2018

<u>Dosimetry/Physics</u>

9:00am – 9:30am	Registration + Breakfast
9:30am – 10:45am	Overview of Proton Therapy Physics Treatment Planning
10:45am – 11:00am	***Break***
11:00am – 12:45pm	Overview of Proton Therapy Dosimetry Treatment Planning
12:45pm – 1:30pm	**Lunch**
1:30pm – 1:50pm	Tour of the Proton Therapy Center
1:50pm – 3:50pm	Dosimetry Treatment Planning for Prostate (PSPT and SFO)
3:50pm – 4:00pm	***Break***
4:00pm – 4:45pm	Physics – Introduction to Motion Management
4:45pm – 5:00pm	**Q & A**

Tuesday – October 16, 2018

<u>Dosimetry/Physics</u>

8:00am – 9:45am	Dosimetry - Treatment Planning & Demo for Lung (PSPT and SFO)
9:45am – 10:00am	***Break***
10:00am – 12:00pm	Dosimetry - Treatment Planning & Demo for Esophagus (PSPT and SFO)
12:00pm – 1:00pm	**Lunch**
1:00pm – 2:30pm	Dosimetry - Treatment Planning Overview & Demo for Head & Neck (SFO &MFO)
2:30pm – 2:40pm	***Break***
2:40pm – 4:00pm	Dosimetry - Treatment Planning Overview & Demo for Head & Neck (SFO &MFO) (cont.)
4:00pm – 5:00pm	Physics – Introduction to Robust Optimization
5:00pm – 5:15pm	**Q & A**

Wednesday – October 17, 2018

MDs Dosimetry

8:00am – 10:15am	Dosimetry - Treatment Planning Overview & Demo for CSI (PSPT)
10:15am – 10:30am	***Break***
10:30am – 12:00pm	Dosimetry - Treatment Planning Overview & Demo for CNS (PSPT & IMPT)
12:00pm – 1:00pm	**Lunch**
1:00pm – 2:45pm	Dosimetry - Treatment Planning Overview & Demo for GI (Liver)
2:45pm – 3:00pm	***Break***
3:00pm – 4:15pm	Dosimetry - Treatment Planning Overview & Demo for APBI (Partial Breast)
4:15pm – 4:30pm	**Q & A**

Thursday – October 18, 2018

Physics

9:00am – 11:00am	Physics - Commissioning Passive Scattering (Including CT Calibration for Proton Therapy)
11:00am – 11:15am	***Break***
11:15am – 12:20pm	Physics – Commissioning Spot Scanning
12:20pm – 1:20pm	**Lunch**
1:20pm – 1:50pm	Treatment Planning System Commissioning - Passive
1:50pm – 3:00pm	Treatment Planning System Commissioning – Scanning
3:00pm – 3:30pm	**Q & A**

Friday – October 19, 2018

Physics

8:00am – 8:50am	Proton Dose Calculation Algorithms
8:50am – 9:45am	Advanced Optimization for Scanning Beam (Robust Optimization and Robust Analysis)
9:45am – 10:00am	***Break***
10:00am – 10:45am	Advanced Motion Management
10:45am – 11:45am	Machine QA for Passive Scattering
11:45am – 12:45pm	**Lunch**
12:45pm – 1:45pm	Machine QA for Scanning
1:45pm – 2:30pm	Patient Specific QA for Passive Scanning
2:30pm – 2:45pm	***Break***
2:45pm – 3:30pm	Patient Specific QA for Scanning
3:30pm – 4:00pm	**Q&A**

Saturday – October 20, 2018

Physics

8:00am – 2:00pm	Observation

Session Descriptions

MONDAY, October 15, 2018

Overview of Proton Therapy Physics Treatment Planning
X. Ronald Zhu, PhD
This topic will give a physical basis of proton therapy, discuss the uncertainties in proton therapy and planning target volumes and cover methods of proton therapy treatment planning.

Overview of Proton Therapy Dosimetry Treatment Planning
Mayank Amin, CMD
This topic will provide general information of Proton Treatment planning for all disease site and serve as an introduction to the various dosimetry disease site topics for the following days.

Dosimetry Treatment Planning for Prostate (PSPT and SFO)
Katina Crabtree, CMD/Jennifer Johnson, PhD
This topic will give an overview of developing prostate plans utilizing the passive scatter method and scanning beam method.

Demo and Q&A for Prostate
Rachel Hunter CMD
This topic will demonstrate the methods of plan creation and plan evaluation used at MD Anderson for Prostate Planning with protons.

Physics – Introduction to Motion Management
Heng Li, PhD
This topic will give an understanding of the mechanism and dosimetry impact of repository motion for proton therapy and help gain knowledge of the state of the art motion management technique for proton therapy.

TUESDAY, October 16, 2018

Dosimetry Treatment Planning Overview for Lung/Esophagus (PSPT and SFO)
Rola Georges, CMD and Manny Oyervides, CMD
This topic will provide a general outline of Thoracic proton planning, the major steps of designing a proton plan and an overview of proton dose distribution. A video will show the 4DCT procedure in order to better explain the uncertainties associated with motion in proton therapy. You will get a better understanding of target delineation requirements for proton therapy and a summary of basic critical structures, their dose limits per MDACC guidelines and the importance of overriding the Diaphragm motion and high/low density materials. Also covered will be a list of the Do's and Do Not's for choosing beam angles in order to get an optimal proton plan. By the end of the presentation you will have also have a basic knowledge on proton esophagus planning.

Demo and Q&A for Lung/Esophagus (PSPT and SFO)
Rola Georges, CMD and Manny Oyervides, CMD
This topic will provide a case study showing the final dose distributions to demonstrate the planning goal.

Dosimetry Treatment Planning Overview for Head & Neck (PSPT and SFO)
Mayank Amin, CMD and Richard Wu
This topic will provide information of Proton Treatment planning for head and neck cancers.

Demo and Q&A for Head & Neck
Mayank Amin, CMD and Richard Wu, M.S.
This topic will demonstrate the methods of plan creation and plan evaluation used at MD Anderson for head and neck cancers using protons.

Physics – Introduction to Robust Optimization
Xiaodong Zhang, PhD
This topic will cover the origin of the non-robustness of a proton plan; learn the current methodology to evaluate the robustness of a plan and learn the method to mitigate the robustness of the proton plan.

WEDNESDAY, October 17, 2018

Dosimetry Treatment Planning Overview for CSI (PSPT)

Tyler Williamson, CMD

This topic will explain the rationale on how we position the patient during simulation for Craniospinal treatment at the PTC. It will also explain the procedure on how we design the proton treatment plan for patients having to be treated for Craniospinal proton therapy.

Dosimetry Treatment Planning Overview for CNS (PSPT and IMPT)

Katina Crabtree, CMD.

This topic will give an overview of typical CNS demographics as it pertains to typical treatment sites and planning approach per the MDACC Proton Therapy Center. Special topics will include anesthesia and scanning beam options for complex CNS situations.

Demo and Q&A for CSI and CNS

Katina Crabtree, CMD and Archana Gautam, M. S.

This topic will demonstrate the methods of plan creation and plan evaluation used at MD Anderson for CSI & CNS with protons.

Dosimetry Treatment Planning Overview and Demo for GI (Liver)

David Lege, CMD and Falk Poenisch, PhD

This topic will discuss rationale and techniques for proton treatment planning and delivery for Liver tumors.

Dosimetry Treatment Planning Overview and Demo for APBI (Partial Breast)

Tyler Williamson, CMD and Falk Poenisch, PhD

This topic will demonstrate the methods of plan creation and plan evaluation used at MD Anderson for Partial Breast Irradiation (APBI) with protons.

THURSDAY, October 18, 2018

Physics – Commissioning Passive Scattering (including T Calibration for Proton Therapy)

Narayan Sahoo, PhD

This topic will cover the commissioning data requirements and acquisition procedures for passive scattering proton beams and the reference and non-reference dosimetry of passively scattered proton beams.

Physics – Commissioning Spot Scanning

Falk Poenisch, PhD

This topic will show you how to commission a scanning beam beamline and how to configure the scanning beam data and generate an input data model treatment planning parameter by comparing with measurements. You will also learn how to configure energy absorber in Eclipse treatment planning.

Treatment Planning System Commissioning - Passive

Falk Poenisch, PhD

This topic will give an understanding of the treatment planning principles for passive scattering proton therapy delivery systems and the commissioning of treatment planning systems for passive delivery.

Treatment Planning System Commissioning - Scanning

X. Ronald Zhu, PhD

This topic will give an understanding of the treatment planning principles for scanning proton therapy delivery systems and the commissioning of treatment planning systems for scanning delivery.

FRIDAY, October 19, 2018

Proton Dose Calculation Algorithms

Xiaodong Zhang, PhD

This topic will cover the current dose calculation algorithm implemented in TPS and give you knowledge of the method and approach to improve the accuracy of the dose calculation algorithm.

Advanced Optimization for Scanning Beam (Robust Optimization and Robust Analysis)
Xiaodong Zhang, PhD
This topic will show the new development at the Proton Therapy Center Houston regarding the planning, motion management and quality assurance for scanning beam.

Advanced Motion Management
Heng Li, PhD
This topic will go into greater detail in understanding the mechanism and dosimetry impact of repository motion for proton therapy and help gain a greater knowledge of the state of the art motion management technique for proton therapy.

Machine QA for Passive Scattering
Narayan Sahoo, PhD
This topic will cover the quality assurance procedures for passive scattering proton therapy machines.

Patient Specific QA for Passive Scattering
Narayan Sahoo, PhD
This topic will cover patient specific quality assurance tasks performed to check: (1) treatment plans, (2) treatment data transfer to record and verify system, (3) treatment devices, (4) Monitor Units and (5) selective dose distributions of treatment fields.

Machine QA for Scanning
Falk Poenisch, PhD
This topic will explain the periodic QA performed on the pencil beam scanning beamline with a review about daily, monthly and annual QA. You will also learn about the method and results of the periodic QA.

Patient Specific QA for Scanning

X. Ronald Zhu, PhD

This topic will go over the goals of patient specific quality assurance, measurements based patient specific AQ (the difference between IMPT and IMRT) and the development of an effective and efficient QA program.

SATURDAY, October 20, 2018

Physics Observation

X. Ronald Zhu, PhD and Physicist

Observation of the day-to-day activities associated with the physics department at the Proton Therapy Center – Houston.

FACULTY/STAFF BIOGRAPHIES

X. Ronald Zhu is a professor in the University of Texas MD Anderson Department of Radiation Physics and Proton Therapy Center Physics Director. He completed his PhD degree in Chemical Physics at the University of Utah. His primary focus is on proton therapy physics, including commissioning, quality assurance, treatment planning, uncertainties, tumor and normal tissue responses in proton therapy. Ron has been with MD Anderson since September 2003.

Mayank Amin, CMD is a Clinical Supervisor, Medical Dosimetry- Proton Therapy, in the University of Texas MD Anderson Department Of Radiation Oncology. He completed his Medical Dosimetry degree in Medical Dosimetry program at the University of Texas, MD Anderson Cancer Center, Houston. His primary focus is on Treatment planning for Proton Therapy. Mayank has been with MD Anderson for 15 years.

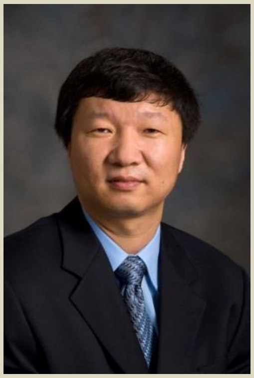
Rachel Hunter, BS, CMD, is a dosimetrist at The University of Texas MD Anderson Proton Therapy Center in Houston. She obtained her degree in Medical Dosimetry from The University of Texas MD Anderson Cancer Center School of Health Professions. She has experience with photon and proton treatment planning. Rachel has been working at MD Anderson since June 2016.

Heng Li, PhD is an Assistant Professor in the Department of Radiation Physics, University of Texas MD Anderson. He completed his PhD in the Electrical and Computer Engineering at the University of Virginia. His primary focus is on thoracic malignancies and motion management. Heng has been with MD Anderson for 10 years.

Rola Georges, CMD is a dosimetrist in the University of Texas MD Anderson Department of Radiation Oncology. She completed her Bachelor of Science in Medical Dosimetry at the UT MD Anderson School of health professions. Her primary focus is on Proton Therapy. Rola has been with MD Anderson for 8 years.

Katina Crabtree, B.S. RT (T) CMD is a dosimetrist at The University of Texas MD Anderson Department of Radiation Oncology. She completed her Bachelors of Science in Medical Dosimetry at The University of Texas MD Anderson Cancer Center School of Health Professions. Her planning experience includes photon, proton and brachytherapy planning. Katina has been at Proton Therapy Center Houston (PTCH) since March 2016

Richard Wu has more than 25 years of experience in the field of medical physics. He is board certified in 3 subspecialties: Therapy Physics, Diagnostic Imaging Physics, and Nuclear Medicine Physics and Instrumentation by American Board of Radiology and American Board of Science in Nuclear Medicine.   Richard is currently a Senior Medical Physicist at the Proton Therapy Center and has patriated in all aspects of proton therapy clinical work since 2006. He also actively involved in proton clinical research. Richard serves as a physics oral examiner and question writer for the American Board of Radiology.



Xiaodong Zhang is a physicist in the University of Texas MD Anderson Department of Radiation Physics. He completed his Ph.D degree in Physics at Ohio University. His primary focus is on robust optimization, dose calculation and automatic planning. Xiaodong has been with MD Anderson for almost 12 years.

David Lege' is a dosimetrist in the University of Texas MD Anderson Department of Radiation Oncology. He completed his training in Medical Dosimetry at MD Anderson in 2005. He has worked at the Proton Center since 2007. Prior to training in Medical Dosimetry David worked as a Radiation Therapist at MD Anderson starting in 1993.

Tyler Williamson, CMD is a Dosimetrist in the University Of Texas MD Anderson Department of Radiation Oncology. He completed his Bachelors of Science in Medical Dosimetry at The University of Texas MD Anderson Cancer Center School of Health Professions. His primary focus is on Proton Dosimetry. Tyler has been with MD Anderson for 9 months.

Dr Falk Poenisch is an assistant professor in the University of Texas MD Anderson Department of Radiation Physics. He completed his PhD in Physics at the University of Dresden. His primary focus is on proton treatment planning systems. Falk has been with MD Anderson for 8 years.

Narayan Sahoo is a Professor in the Department of Radiation Physics of the University of Texas MD Anderson Cancer Center. He completed his Ph.D. degree in Physics at the University at Albany, Albany, NY. His professional interests are in the areas of Radiation Dosimetry, Treatment Planning and Quality Assurance in Proton Therapy. He has been with MD Anderson Cancer Center since August 2004 and at the Proton Therapy Center since March 2006.

Glossary of Proton Therapy Terms

Below are many of the terms most commonly used in the field of proton therapy:

A

Adjuvant therapy: A treatment used in addition to the main course of therapy.

Anesthesia: The process where a drug is administered for medical or surgical purposes that will induce partial or total loss of sensation and may be topical, local, regional or general, depending on the method of administration and area of the body affected. At the MD Anderson Proton Therapy Center, anesthesia is administered intravenously (by IV through the vein) and patients do not require intubation which is common practice at other proton therapy centers.

Anesthesiologist: A medical doctor who specializes in administering anesthesia. At the MD Anderson Proton Therapy Center, many of the children we treat require anesthesia to help them remain still during treatment. We have a dedicated on-site anesthesia team that specializes in treating children.

Aperture: A metal block containing a hole through which the radiation (photon or proton) beam passes. Each field or area of treatment for each patient requires a custom-made aperture. The shape of the hole is the approximate shape of the target being treated by the beam. Every patient has her or his own set of apertures, and no other patients use them. At the MD Anderson Proton Therapy Center, apertures are made of brass and created in our on-site machine shop.

B

Benign tumor: A tumor that grows locally but may not spread to other parts of the body. Benign tumors can cause problems because as they grow, they can press and displace normal tissues. They can be dangerous in confined places such as the skull.

Biopsy: Removal of a tissue sample for examination by a pathologist.

Bragg peak: The point at which protons deposit most of their energy. This point occurs at the ends of the protons' paths. Through a process called modulation, radiation oncologists can spread this peak to match the contours of tumors or other targets. The flexibility of the Bragg Peak is one of the things that make protons an excellent and targeted option for the treatment of many types of cancer.

C

Cancer: Uncontrolled, abnormal cell growth that invades and destroys healthy tissues if not controlled by effective treatment. Cancer is a general term that includes hundreds of different diseases, including Hodgkin's disease and leukemia.

Chemotherapy: Treatment with anti-cancer drugs that may be administered orally (by mouth) or intravenously (by IV through the vein) of a person’s body.

Cobalt-60: A naturally radioactive substance that is used in some therapy machines to treat cancer by external beams.

Combined proton and photon therapy: Using both protons and photons (X-rays or electron beams) to treat cancer or other diseases. Combined treatment is used when neither therapy can be used alone. For example, protons are often used with X-rays to boost the radiation dose to specific parts of a treatment volume in order to provide a higher dose of radiation while protecting nearby tissues.

Used alone, X-rays can deliver too much radiation to normal tissue. If protons alone were used, microscopic cancer in sites distant from the cancer (in lymph nodes, for example) might be missed. Combining the two treatments allows optimal use of both, while reducing the risk of complications.

Compensator: A custom-made, beam-shaping device through which a proton beam is delivered. It is used to absorb some energy from the proton beam so that it stops just on the edges of the target or tumor. This keeps the normal, healthy tissues beyond the tumor from receiving radiation. This is used with an aperture. At the MD Anderson Proton Therapy Center, the compensator for each patient is made from thick acrylic and created in our on-site machine shop.

Couch: The table – often called the “couch” at MD Anderson Proton Therapy Center -- where the patient lies during treatment. In proton radiation treatment, final patient alignment is performed by adjusting the motorized couch with respect to the proton nozzle. This ensures that the treatment position matches the position the patient was in when the planning CT scans were taken.

CT Scan: Computed tomography scan (also known as a CAT scan) is 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 usually noninvasive and brief.

D

Digital Rectal Examination (DRE): A screening procedure prostate and colorectal cancers. The physician feels the rectal wall to assess its smoothness. Abnormalities are evaluated by other tests, generally including biopsy and an exam by a pathologist.

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. At the MD Anderson Proton Therapy Center, our team of 9 medical dosimetrists must have graduated from an accredited program and be certified by the American Association of Medical Dosimetrists.

E

Electron beam: A negatively charged subatomic particle that is accelerated to different energies and used to treat cancer.

External-beam radiation: Radiation delivered from a source outside the body.

G

Gamma rays: High-energy rays that come from a radioactive source such as Cobalt-60.

Gantry: A device that rotates the radiation delivery apparatus around the patient during treatment delivery. The rotation allows treatment from different angles. At MD Anderson Proton Therapy, we have three treatment rooms that house gantries that administer proton beams from 360-degree angles.

Gray: A measure of absorbed radiation dose. One Gray equals 100 rads , which is an older term used to describe this.

I

Ionizing radiation: Radiation of sufficient energy to displace electrons from the atoms of cells and produce ions. Ionized cells are damaged and must repair themselves to stay alive. Normal cells are usually better able to repair themselves than cancer cells.

Immobilization device: A device – mask for the face or a cradle for the body, leg or arm, depending on the area that will receive treatment – used to help prevent the patient from moving during radiation treatment. Some patients who are receiving proton therapy will use these devices during their treatments.

Implant: The process of placing a small source of radioactive material in or near a cancer.

L

Linear accelerator: A machine that creates high-energy radiation to treat cancers. A linear accelerator uses electricity to form a stream of fast-moving subatomic particles. Also called a "linac" (pronounced LYNN-ack).

M

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.

Malignant: Cancers that are capable of spreading and invading normal tissue and to distant tissues (metastasis).

Medical oncologist: A physician who uses chemotherapy to treat cancer. Medical oncologists, like radiation oncologists and surgical oncologists, receive intensive training and serve long residency periods to become experts in their specialty.

Metastasis: The spreading of a cancer from one part of the body to another. Cells in the second tumor are like those in the original tumor.

Modulator wheel: A spinning, polycarbide wheel with vanes of variable depth. In proton radiation therapy, protons passing through the thinner vanes travel farther into the body than those passing through the thicker sections. Different wheels, with different vanes, can be used to shift the peak energy (the Bragg peak) to different depths of the tumor.

N

Nozzle: The device through which protons are delivered to the patient. Proton beam delivery begins in the accelerator, where an ion source generates protons. At the MD Anderson Proton Therapy Center, the accelerator (synchrotron) energizes the protons to a prescribed energy and sends them to the beam transport system, which sends the beam to the treatment rooms.

Each treatment room has a nozzle, which looks much like the nozzle of a water hose and is the final element in the beam delivery system. The nozzle not only delivers the beam to the patient, but also monitors beam uniformity, alignment, and dose delivered.

O

Oncologist: A doctor who specializes in treating cancer.

P

Pencil beam scanning: A very precise form of proton therapy treatment that uses protons to deliver radiation treatment 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 radiation from the beam. MD Anderson Proton Therapy Center is one of the only centers in the world to use pencil beam scanning, also called spot scanning or active beam, to treat patients.

Photon: A quantum (energy packet) of electromagnetic radiation; the elementary particle of photon radiation therapy. X-rays and gamma rays are photon radiation (sometimes called "traditional" or "conventional" radiation).

Positron Emission Tomography (PET): A nuclear medicine imaging procedure that can identify areas of cancerous tissue based on their higher than normal metabolic activity. It can be used in radiation treatment planning to help identify tumor tissue by the behavior of its cells, sometimes in cases where the tumor tissue is not visible on CT scans or MRI.

Prostate-Specific Antigen (PSA): A protein that serves as a marker for prostate cancer or benign prostatic hyperplasia. PSA levels can be used to help detect prostate cancer, to monitor prostate cancer treatment and to warn of possible recurrence.

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.

R

Rad: "Radiation absorbed dose" or a measure of the amount of radiation absorbed by tissues. This term has been replaced by the Gray (100 rad = 1 Gray).

Radiation: Energy carried by waves or a stream of particles. Visible light, X-rays and proton beams all are examples of radiation.

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 the MD Anderson Proton Therapy Center, 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 medical professional who deliver the ionizing radiation with specialized treatment machines. At the MD Anderson Proton Therapy Center, patients will work with a team of specialized radiation therapists each day during proton therapy treatment.

Radiation therapy: The use of high-energy penetrating rays or subatomic particles to treat disease. Types of radiation include X-rays, electrons, protons, alpha and beta particles, and gamma rays. Radioactive substances include cobalt, radium, iridium, and cesium.

Radiologist: A physician specially trained to interpret diagnostic X-ray images and perform specialized X-ray procedures.

Radiotherapy: Another word for radiation therapy.

S

Simulation: The use of X-ray pictures to plan radiation treatment. The area to be treated is located precisely and marked for treatment. At MD Anderson Proton Therapy Center, all patients who receive proton therapy will first go through a simulation.

Snout: The part of the nozzle closest to the patient. The snout supports the aperture and compensator.

T

Target volume: Often used to describe a tumor or area of concern that will receive proton treatment.

Treatment volume: Generally a bit larger than the target volume, the treatment volume surrounds the target with an additional margin to include the cancer and surrounding tissues, which may harbor microscopic extensions of cancer. With proton therapy, treatment of surrounding tissues is limited to what is absolutely necessary in order to achieve the result of destroying cancer cells.

Treatment port or field: The place in the body at which the radiation beam is aimed.

Treatment table: The table – often called the “couch” at MD Anderson Proton Therapy Center -- that the patient lies on during treatment. In proton radiation treatment, final patient alignment is performed by adjusting the motorized table with respect to the proton nozzle. This ensures that the treatment position matches the position the patient was in when the planning CT scans were taken.

Tumor: An abnormal mass of tissue. Tumors are either benign or malignant.

X

X-rays: High-energy, ionizing, electromagnetic radiation that can be used at low doses to diagnose disease or at high doses to treat cancer.

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Notes

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MD Anderson

~~Cancer~~ Center

Proton Therapy

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https://www.mdanderson.org/patients-family/diagnosis-treatment/care-centers-clinics/proton-therapy-center.html