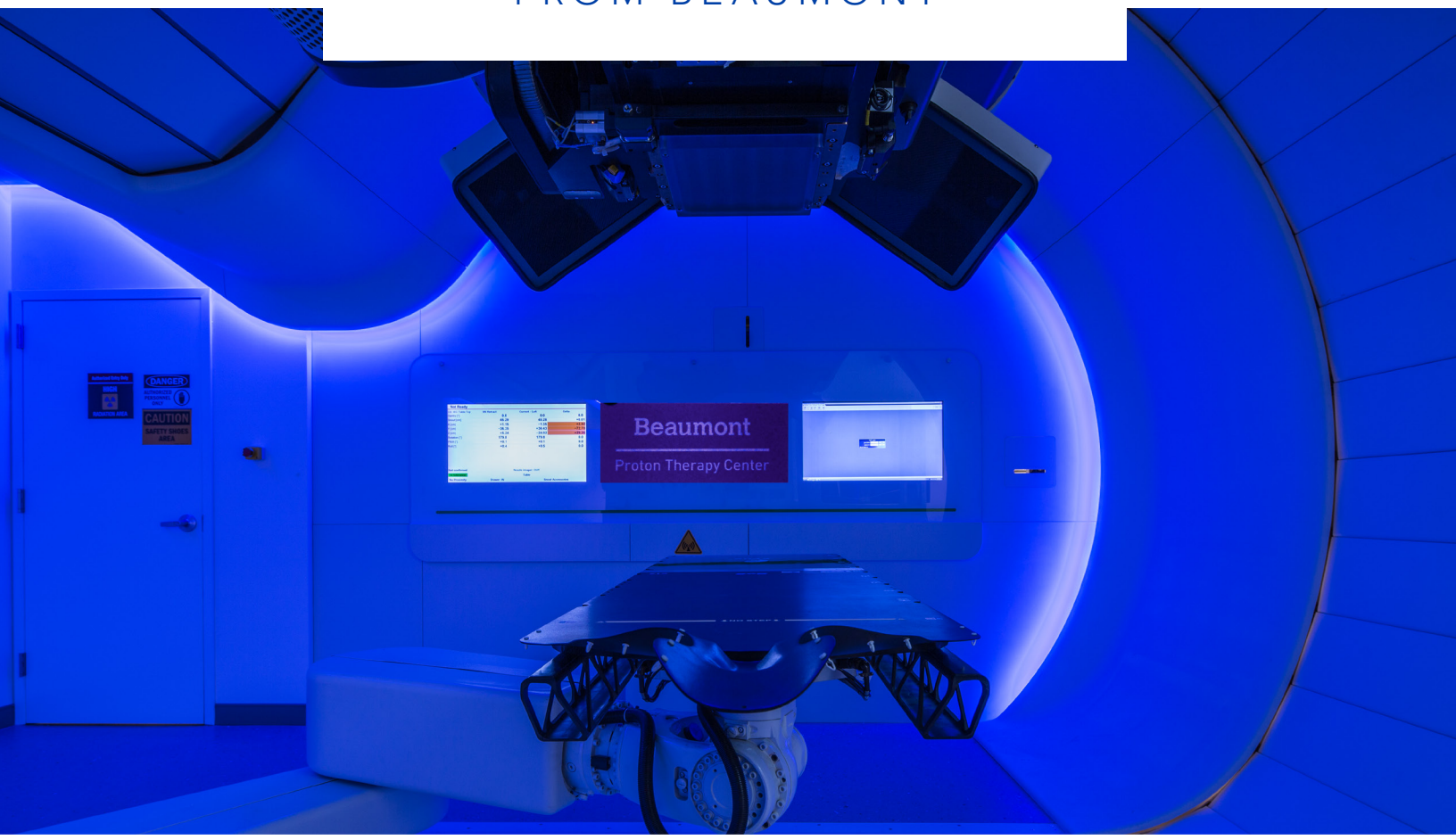
BEAM

RADIATION ONCOLOGY
NEWS AND INFORMATION
FROM BEAUMONT



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Beaumont

Welcome to this edition of the Beaumont Beam, a publication highlighting advances, exciting research and other important news and information about Beaumont's state-of-the-art Radiation Oncology program.
We want to share how we are growing, the world-leading research we are conducting, and perhaps most importantly, how to participate, from patient support groups and clinical trials to supporting our research and education missions.

With this issue of the Beam, I would like to highlight a few aspects of our department.

MESSAGE FROM THE CHAIR

Dear Colleague,
On June 28, we treated our first patient in the Beaumont Proton Therapy Center in Royal Oak.

This novel center blends three types of in-suite imaging with the ability to "paint" the radiation dose with great precision. With proton treatment, we can better target the tumor and spare most adjacent healthy tissues, resulting in better treatment outcomes and fewer side effects. Our Proton Therapy Center delivers intensity modulated protons with the ProteusONE machine, the most advanced compact beam therapy solution on the market with pencil beam scanning (PBS) technique. The Proton Therapy Center is located adjacent to the Beaumont Rose Cancer Center, with full access to all of the programs and services in the Cancer Center. Proton therapy is best suited for well selected patients with brain tumors, head and neck cancers, pediatric malignancies, left-sided breast cancers, sarcomas and ocular melanomas. We will also be able to retreat, and potentially salvage, some patients who failed previous courses of radiation.

Unlike conventional radiation equipment, the process of safely using protons requires that the nuances of each target organ be taken into account. The first organ sites we treated were adult patients with central nervous system (CNS) tumors followed by left-sided breast cancers, soft tissue sarcomas and gastrointestinal malignancies.

We are also now treating pediatric CNS tumors and head and neck cancers, soon to be followed by more complex treatments such as mobile tumors (lung and gastrointestinal), pediatric tumors using anesthesia and ocular melanomas.

You will continue to receive more information from us about the benefits of proton therapy for your patients, the treatment process and how referrals can be made. In the meantime, if you have any questions about our Proton Therapy Center, please contact us at 248-551-8402. More information is also available at beaumont.org/proton-therapy. We look forward to partnering with you to make this program a success.

Craig Stevens, M.D., Ph.D.
Chair of Radiation Oncology, Beaumont
Assistant Cancer Center Director for Strategic Development
Professor, Oakland University William Beaumont School of Medicine

BEAUMONT PROTON CENTER

Thomas B. Lanni, Jr FACHE, Vice President - Oncology, Imaging & PMR

The Beaumont Proton Therapy Center has been more than a 10-year journey from initial conception to first patient treatment. Although the proton center project experienced several bumps in the road over the years, one thing remained constant: the leadership of both the department of radiation oncology and of the health system that believed this technological advancement for patient care was essential to the community and the region we serve. This perseverance allowed Beaumont to continue to be leaders in providing the latest in treatment options for cancer patients.

The journey began in 2006 when the department of radiation initiated discussions with ProCure, an organization developing proton centers throughout the United States, to build a center at Beaumont Hospital, Royal Oak. In 2008, Beaumont filed for a Certificate of Need (CON) application to build a four-room proton center for $159 million. Although there were challenges in the CON process, Beaumont was approved to proceed with the project.

Unfortunately in late 2008, the recession hit and financial prudence caused the project to temporarily be put on hold. Although the project was not moving forward, the department continued to protect the CON and evaluate new proton technologies.

In March 2014, the Beaumont Health System Board of Directors approved a single-room proton center to be located at Beaumont, Royal Oak. This new center from IBA called ProteusONE is smaller, less costly and state of the art. This unit allows for intensity modulated proton therapy (IMPT) and image-guidance, which was not an available technology back in 2008. The ProteusONE is also the second unit installed and treating patients in the world.

The Beaumont Proton Therapy Center would not have become a reality without our partners, Proton International, LLC and IBA, facilities management, health system leadership in their continued support, and the vision of department leadership to bring this technology to our patients and Michigan.

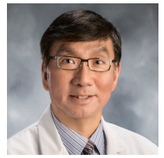
As a leader in offering the most advanced treatment technologies, we are thrilled to offer proton therapy to our patients.

PEYMAN KABOLIZADEH, M.D., PH.D.

Dr. Kabolizadeh is a board certified Radiation Oncologist by the American Board of Radiology and an assistant professor at Oakland University William Beaumont School of Medicine. He is also the Director of Beaumont Proton Therapy Center and associate director of the radiation oncology residency program at Beaumont. After completing his undergraduate degree in chemistry, Dr. Kabolizadeh was accepted into the combined MD/PhD program at Medical College of Virginia. He was then recruited to the radiation oncology residency program at University of Pittsburgh Medical Center where he gained extensive experience in advanced techniques including Intensity-Modulated Radiation Therapy, Stereotactic Body Radiotherapy and Stereotactic Radiosurgery (SBRT/SRS). He then completed fellowship training in Proton Therapy at Harvard Medical School/Massachusetts General Hospital. Dr. Kabolizadeh is active in radiation oncology research authoring numerous articles and abstracts and receiving multiple awards and grants during his training. His clinical areas of interest include gastrointestinal cancers, sarcoma, SBRT/SRS, and proton therapy. Dr. Kabolizadeh's philosophy is to provide excellent multidisciplinary care while working with his patients to establish a comprehensive treatment plan.

DR. ROHAN DERANIYAGALA, M.D.

Dr. Rohan Deraniyagala is a graduate of the University of Michigan and received his medical degree from Wayne State University. He then completed his residency at the University of Florida and a proton therapy fellowship at the University of Florida Proton Therapy Institute. He is an assistant professor in radiation oncology at Oakland University William Beaumont School of Medicine (OUWBSOM), seeing patients at both the Beaumont Royal Oak and Dearborn campuses. His special interests are head and neck malignancies as well as proton therapy. Dr. Deraniyagala maintains an active role in clinical research and has numerous peer reviewed publications in areas such as proton therapy for head and neck tumors and software based medical technology.

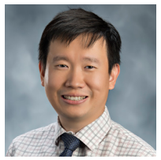


PETER CHEN, M.D., FACR

Dr. Peter Chen is a graduate of the University of Illinois College of Medicine. He is board-certified in both internal medicine and radiation oncology. He did his residency in internal medicine at Beaumont and residency/fellowship in radiation oncology at the University of Michigan. He is co-chair of the Head and Neck Tumor Board, medical director of the Gamma Knife Center and professor at Oakland University William Beaumont School of Medicine (OUWBSOM). He serves as the Chair of the Department Committee on Appointments, Promotion and Tenure (DCAPT). He has widely recognized expertise in breast cancer (particularly accelerated partial breast irradiation (APBI), head & neck malignancies, CNS tumors (including stereotactic treatment using Gamma Knife), skin and pediatric-adolescent malignancies. As a Fellow of the American College of Radiology (FACR), he has contributed to many national research committees, leads clinical trials in shortened course hypo-fractionation for breast cancer and continues to contribute to the literature of radiation oncology not only as a frequent lead author/coauthor of original articles, but also a manuscript reviewer of major peer-reviewed oncology journals. In recognition for his contributions to the specialty of Radiation Oncology, he has been honored with selection to the Best Doctors® in America (2007 to the present), Hour Detroit Magazine's Top Docs (2009 to the present), and Castle Connolly Top Doctors annually since 2016.

DANIEL A. HAMSTRA, M.D., PH.D.

Dr. Hamstra graduated from Calvin College before pursuing his M.D. and Ph.D. with a focus on Cancer Pharmacology at the University of Michigan. His Internship and radiation oncology residency were also at the University of Michigan with a Fellowship in pediatric radiation oncology at St. Jude Children's Research Center. He joined the faculty at the University of Michigan in 2006 rising to Associate Professor and Associate Chair for Medical Education and also served as the Clinical Director for the Radiation Oncology Affiliate Network. He was the sole pediatric radiation oncologist and over time led both the genitourinary and central nervous system programs while also participating in the thoracic service. He also was co-director of the prostate HDR brachytherapy program. Following his time at the University of Michigan from 2015-2017, he joined Texas Oncology at the Texas Center for Proton Therapy in North Texas focusing on treating pediatric, CNS, liver, and prostate tumors. Dr. Hamstra has been an active member of the Radiation Therapy Oncology Group RTOG (now NRG) GU steering committee where he serves as the principle radiation oncologist on RTOG 1115 and on the Patient Centered Outcomes Committee as well as on the Radiation Oncology and Neuroblastoma committees for the Children's Oncology Group (COG). His research focus has been on integrating advanced MRI imaging and radiation techniques into GU and CNS care with a particular emphasis on patient reported health related quality of life. This has led to over 125 peer-reviewed publications as well as an active role in ASTRO, ASCO, the ABR, and RSNA. He is now excited to be back in Michigan and to join the Beaumont team as Clinical Director in Dearborn and a Professor at Oakland University William Beaumont Medical School.



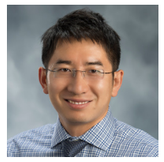
XUANFENG (LEO) DING, PH.D.

Xuanfeng (Leo) Ding, Ph.D. graduated from Wake Forest University (Winston Salem, NC) in 2012. Dr. Ding received his medical physics residency and proton beam therapy training at University of Pennsylvania, Roberts Proton Therapy Center. During the two-year residency training, Dr. Ding published six peer reviewed articles, more than 10 conference abstracts and introduced the first 3-D printed device concept and workflow for the passive-scattering proton arc therapy. In 2014, Dr. Ding was awarded a scholarship from the American Association of Physicist in Medicine (AAPM) Delaware Valley Chapter and named 1st place in young investigator symposium at AAPM annual clinical meeting for his achievements and contributions so early in his career. After his residency, Dr. Ding commissioned the IBA ProteusONE at the Willis-Knighton Cancer Center (Shreveport, LA). He also led the proton physics research in Willis-Knighton and published more than 10 conference abstracts in AAPM 2015 on this new generation of proton beam therapy system and its application. In the summer of 2015, Dr. Ding joined Beaumont Health as the lead proton physicist to oversee the proton project and serve as adjunct professor appointment in the Department of Physics, Oakland University. He is certified by the American Board of Radiology.

Within a year and half since his arrival at Beaumont, Dr. Ding has published and submitted five peer reviewed papers and more than 20 conference abstracts and book chapters. He also gave five invited talks in international meetings and local chapter meetings about proton beam therapy and its new development. Under his leadership and vision in proton beam therapy development, Dr. Ding's group invented a novel algorithm and treatment technique which could significantly improve proton beam therapy treatment outcomes and delivery efficiency. This innovation brings proton beam therapy technique developments into the next era – Proton Arc Therapy. Dr. Craig Stevens, the chairman of Radiation Oncology, named this exciting finding and technique: Spot-Scanning Proton Arc (SPArc) therapy.

AWARDS AND ACKNOWLEDGEMENTS

Xuanfeng (Leo) Ding, Ph.D. and his group published the article, "Spot-Scanning Proton Arc (SPArc) Therapy – The first robust and delivery-efficient proton arc therapy" in the International Journal of Radiation Oncology*Biology*Physics which was featured by Dr. Zietman, Editor-in-Chief, in the Dec. issue 2016. This finding is a critical step forward in proton arc therapy development which demonstrates its clinical benefits and practical feasibility for the first time in history. This development would re-shape the future proton clinical practice and move the society into the next stage of proton beam therapy technique development, the era of proton arc therapy. Several months after this publication Ion Beam Application (IBA S.A. Belgium), the biggest proton beam therapy company in the world and Beaumont's proton vendor, offered Dr. Ding a two-year $200,000 research grant for a joint collaboration to develop this novel proton arc therapy technique at the Beaumont Proton Therapy Center.



XIAOQIANG LI, PH.D.

Dr. Xiaoqiang Li began his medical physics career during his Ph.D. study at The University of Texas M.D. Anderson Cancer Center in 2007. As the first proton center in North America to treat patients using spot scanning delivery technique, he actively joined in the research to design novel treatment techniques to improve proton therapy treatment. This research has resulted in more than 20 journal papers published in top medical physics journals. His most impressive work was to conduct the first study of intensity modulated proton therapy (IMPT) for the treatment of advanced lung cancer. During this study he discovered the great dosimetric advantage of IMPT, which can greatly reduce the radiation dose to normal tissue while maintaining the prescribed dose. Following his Ph.D. studies, Dr. Li continued a two-year comprehensive medical physics residency training at

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XIAOQIANG LI, PH.D.

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M.D Anderson Cancer Center, and then received his certification by the American Board of Radiology in therapeutic medical physics. Dr. Li joined Beaumont as a staff medical physicist specializing in proton therapy in 2015. During his work at Beaumont, he has performed routine clinical studies such as quality assurance testing of treatment machines and patient treatment plans/charts, supporting special treatment procedures, and guaranteeing timely and accurate treatments to the patients. He is actively involved in the improvement of patient care by conducting clinical development projects, participating in the education of residents and students, developing new optimization algorithm in spot scanning proton therapy and designing the first continuous and robust prototype of spot scanning proton treatment in the world.

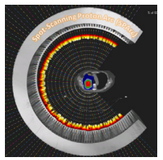

Figure shows a very first Spot-Scanning Proton Arc (SPArc) plan generated by Dr. Ding and his group at Beaumont Health

KEVIN BLAS, M.D.

Kevin Blas is Beaumont's first Proton Therapy Fellow.

Kevin completed his last year of residency training as a radiation oncologist at William Beaumont Hospital in early June of this year and will proudly serve as Beaumont's first Proton Therapy Fellow beginning July 1st. Dr. Blas moved to Michigan in 2003 from his home on the South Pacific island of Guam in order to further his education. He graduated from the University of Michigan with undergraduate degrees in both biology and anthropology in 2008. He went on to complete his medical education at the University of Michigan Medical School prior to starting residency at William Beaumont Hospital in 2012.

His current research focuses on the treatment and clinical outcomes of prostate cancer as well as head and neck malignancies. Dr. Blas also investigates the acute and long-term cardiac toxicities of thoracic radiation in patients in coordination with the Cardiology department, an active area of research with growing awareness nationwide. During his residency, Dr. Blas has participated in clinical research within the Radiation Oncology department and has presented at various national meetings. He has presented on the clinical outcomes of post-prostatectomy patients treated at Beaumont in the James D. Collins Resident/Fellow Research Symposium at the National Medical Association's Annual Convention and Scientific Assembly and was awarded 1st place. Additionally, Dr. Blas completed an academic workshop conducted by a joint partnership of the National Institutes of Health and the National Medical Association. As a fellow, he will continue to build on his research in an effort to improve patient outcomes.

Dr. Blas is passionate about mentoring medical students in the field of radiation oncology and is eager to continue teaching students and residents during his fellowship. He hopes to improve patient care and quality of life through research and teaching. With the clinical need for the precise delivery of radiotherapy, Dr. Blas is honored to continue his training at Beaumont.

NURSE NAVIGATOR ROLE IN THE PROTON CENTER

Lee Decaria, RN

The nurse navigator's role in the Beaumont Proton Therapy Center will assist patients and their families with direct and personal coordination of care from the first point of contact to the final treatment and follow up. This coordination will include providing educational materials that will assist with:

- treatment decision making
- insurance issues
- lodging and transportation needs
- scheduling appointments
- coordinating and/or documenting tumor board case discussions
- coordinating services
- tracking outcomes
- building trusting relationships with other disciplines

The nurse navigator will always stay in close communication with patients and their families across the continuum of care. The nurse navigator will provide emotional support by becoming a strong patient advocate while maintaining confidentiality. Additionally, the nurse navigator will treat the patient/family with the utmost respect by breaking down barriers while providing the highest quality care to every patient, every time.

A nurse navigator, as defined by the Academy of Oncology Nurse Navigators (AONN), is "a clinically trained individual responsible for the identification and removal of barriers to timely and appropriate cancer treatment. They guide the patient through the cancer care continuum from diagnosis through survivorship. More specifically, the nurse navigator acts as a central point of contact for a patient and coordinates all components involved in cancer care including surgical, medical and radiation oncologist; social workers; patient education; community support; financial and insurance assistance; etc. This person has the clinical background and is a critical member of the multidisciplinary cancer team."

In 2015, the Commission on Cancer (CoC), a program created by the American College of Surgeons dedicated to improving survival and quality of life for cancer patients, implemented standards specifically for the oncology navigation process. At Beaumont, we are proud to meet each of these standards and to receiving the 2016 Outstanding Achievement Award for Gold Level standing from the CoC. We are proud because nurse navigation is the right thing to do for our patients.

SUPPORT SERVICES FOR RADIATION ONCOLOGY PATIENTS

The Radiation Oncology department partners with Beaumont's Cancer Resource Centers to ensure that patients have access to the support they need during their cancer treatments and through survivorship. Beaumont's Cancer Resource Centers can connect patients and families with vital support services including disease information, counseling, support and educational groups, patient advocacy, nutritional information and survivorship resources.

There are support groups for breast, prostate, ovarian, and head and neck cancers as well as a caregivers support group and one for individuals with BRCA mutations. They also partner with the American Cancer Society to access other support groups in the area as well.

To see a full listing of the supportive care services offered, please visit our website at beaumont.org/services/oncology/classes-support-resources for a list of classes, support, and resources.

PROTON BEAM THERAPY: THE FUTURE IS HERE

Peyman Kabolizadeh M.D., Ph.D., Rohan Deraniyagala M.D., Peter Chen M.D. and Kate Gowans M.D.

What is proton therapy? – a brief history

Proton therapy is an advanced form of radiation therapy that can deliver precise and accurate radiation treatment to the tumor while minimizing the dose to the adjacent critical normal tissues. The technology uses accelerated subatomic positive particles called protons. Ernest Rutherford, a chemistry Nobel laureate in 1908 showed the existence of proton particles in 1919. Subsequently, in 1946, Robert Wilson, proposed that accelerated protons and heavier ions can be used for radiation treatment of human cancers. His concepts mainly relied on the Bragg Peak characteristic of particle therapy in which the deposited dose increases quite sharply and yields a distinct, localized high-dose region. The advantage of proton therapy is that physicians can direct where the proton releases its cancer fighting energy. Proton therapy will conform its energy to the tumor itself while sparing the adjacent healthy tissues and organs. The clinical benefit of proton therapy is its potential to decrease the treatment toxicities, which is especially important in the pediatric patient population.

The first cancer treatments were performed with a particle accelerator built for physics research at Berkeley Radiation Laboratory in 1954 and at Uppsala in Sweden in 1957. Subsequently in 1961, collaboration began between Harvard University cyclotron and the Massachusetts General Hospital to pursue proton therapy for cancer patients.

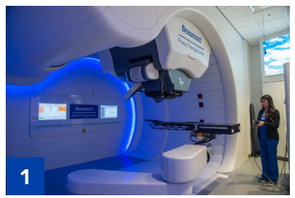

Figure 1

Beaumont Proton Therapy Center – the first of its kind in the country

The Beaumont Proton Therapy Center has one of the most sophisticated, and precise proton therapy machines called ProteusONE. IBA is the manufacturer of the ProteusONE and also has the most experience in building the proton therapy machines. This machine's cyclotron is the first of its kind built with superconductive materials and therefore using much less energy than older larger cyclotrons. This machine has the capacity to deliver intensity modulated proton therapy-pencil beam scanning with the highest precision and accuracy. (Figure 1: picture of our current room)

THE ROLE OF PROTON THERAPY IN CANCER TREATMENT

Breast cancer

Breast cancer is the most common non-skin cancer in women. The treatment paradigm usually involves radiation of the chest wall or breast. Recent studies have shown that treating the regional lymph nodes such as internal mammary lymph nodes improves disease control.[2] Nevertheless, these lymph nodes are in close proximity to the heart and recent studies have shown a strong association between cardiac radiation dose and cardiovascular disease in women and ultimately overall survival.[3]

Proton beam therapy enables breast cancer patients to receive radiotherapy to their breast and these regional lymph nodes while sparing the unnecessary radiation dose to the heart. Consequently, patients will receive the benefit of radiotherapy without the collateral damage to their cardiovascular system.

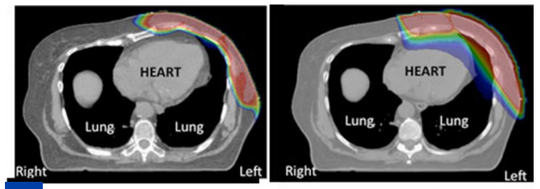

Figure 2

Head and neck cancer

Head and neck cancer is a challenging malignancy to manage because of the delicate balance between disease control and treatment toxicity. The role of surgical resection is limited given the close proximity of critical organs to the tumor site. Hence, complete removal of tumor in complex areas such as the paranasal sinus and nasopharynx is often not feasible. Thus, radiation therapy is required in addition to surgical resection in order to maximize disease control. Unfortunately, there are many obstacles to overcome when delivering conventional photon radiotherapy to the head and neck region given the adjacent critical normal structures such as eyes, brain and optic nerves. Proton therapy allows for normal tissue sparing while allowing an adequate dose delivered to tumor cells thus resulting in minimal toxicities. Furthermore, a recent meta-analysis showed that proton therapy could be associated with superior outcome and survival benefit.[4]

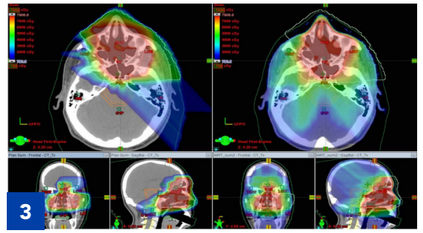

Figure 3: The image on the left shows a proton therapy plan compared with a conventional X-ray plan on the right. The proton therapy plan protects the adjacent critical normal organs such as brain and eyes.

Pediatric cancers

Survival for pediatric cancer patients has increased considerably over the past few decades and currently close to 80 percent of pediatric patients will survive their cancer. Radiation therapy plays an important role in cancer therapy for many pediatric patients as the developing tissues are more sensitive to radiation therapy even at low doses. As a result, the late radiation side effects that can occur over the years can be significant with conventional photon radiotherapy. These toxicities can consist of kidney damage, diminished bone growth, secondary cancer, cardiac dysfunction, neurocognitive deficits, hearing loss, infertility, etc. Hence, maintaining outcomes while decreasing the toxicities has become a priority and proton therapy will provide the means for such end point. In striving to achieve such a therapeutic ratio, many trials have attempted to omit radiation, yet radiation therapy has been shown to remain an important part of the comprehensive treatment of many pediatric and adolescent patients. Technical improvements in radiation therapy aim to deliver full dose to the tumor target while avoiding normal, uninvolved tissues. If done carefully with high precision, such advanced technology reduces toxicity without the risk of decreasing tumor control. This reduction of dose to normal tissues is made possible by the physical trait of the proton beam with no exit dose and with specialized dose delivery in the form of pencil beam scanning, which allows for dose painting to the tumor while sparing of radiation dose to adjacent normal tissues.

Examples of childhood cancers for which proton therapy allows for maximal dose sparing of adjacent normal structures while appropriate doses are delivered to the index tumor site(s) include brain tumors such as medulloblastoma requiring craniospinal axis irradiation (Figure 4); Hodgkins lymphoma where protons can eliminate dose to anterior cardiac vessels and breast tissue; and pediatric sarcomas where protons may be particularly beneficial to treat tumors near the orbit (sparing vision and neurocognitive development) or near gonadal tissue.

As more childhood and adolescent cancer patients are cured, the number of survivors across the United States and worldwide will continue to increase. Such cancer survivors are recognized to be at risk for a myriad of late effects. Proton therapy has the potential to dramatically decrease these late morbidities. Proton therapy has shown and will continue to demonstrate its ability to decrease late effects. Diligent studies of these long-term effects are needed through patient registries, in-house study protocols and perhaps most importantly through national cooperative groups.

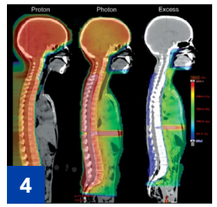

Figure 4: Craniospinal radiation involves radiating the entire brain and spinal cord. The excess radiation from photon radiation delivers long-term toxicity to the child's organs of the mouth, neck, chest, abdomen and pelvis. Proton therapy delivers essentially no dose to these structures.

Combining the most advanced technology in the world with specialized care, Beaumont's proton radiation therapy system is state-of-the-art and will provide many benefits to patients requiring radiation for their cancers. It delivers less radiation to healthy tissue and will reduce the risk of secondary cancers and developmental delays among the pediatric patient population.

Sources

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PHYSICS OF PROTON BEAM THERAPY

Leo Ding, Ph.D.

BASIC PRINCIPLES

Proton therapy uses positive charged hydrogen atom nuclei, also called protons, whose relative mass is about 2,000 times higher than that of electrons. In proton beam therapy, protons are accelerated to approximately 230MeV (mega-electron volts), which enables the tumor to reach a depth of about 30cm inside the body. The unique feature of protons is that they are able to release significant energy at the end of a proton range that is also called the "Bragg Peak." By using this Bragg Peak, proton beam therapy can accurately release the greatest part of proton energy into the tumor while protecting the healthy tissue behind the tumor. Normally, patients treated with proton beam therapy receive less than half the total radiation dose delivered to the healthy tissue via traditional photon radiation treatment.

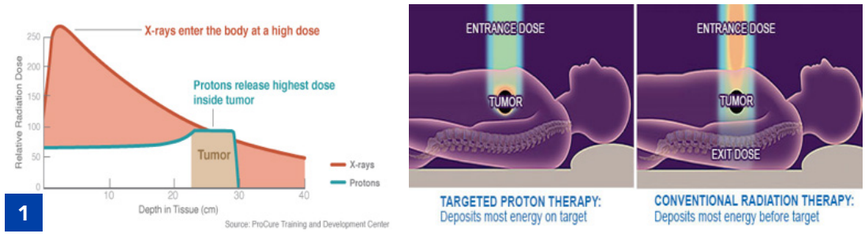


Figure 1

Figure 1 depicts the depth dose curve for protons and X-ray radiation. While the X-ray curve loses its energy continuously and gradually, the proton depth dose curve shows that proton energetic loss is small upon entry to the body, reaches its maximum at a specific depth, (the Spread-out Bragg peak) where the energy is transferred to the target area of the tumor and then decreases to zero. This protects the healthy tissue at the distal end of the tumor. These unique physical properties of the proton beam enable extremely precise modulation of dose distribution inside the patient's body.

STATE-OF-THE-ART PROTON BEAM THERAPY TECHNIQUE – PENCIL BEAM SCANNING

Spot scanning, or pencil beam scanning (PBS), allows a higher degree of precision and minimizes the overall exposure and radiation to healthy tissue. PBS technique uses a magnetic field to steer the position of the small proton beam and uses an energy layer selection system to choose the precise depth of the tumor, just like the 3D painting technique used in X-ray therapy (Figure 2A). With this state-of-the-art technique, the Beaumont Proton Therapy Center is able to offer our patients the most advanced proton treatment – intensity modulated proton therapy (IMPT).

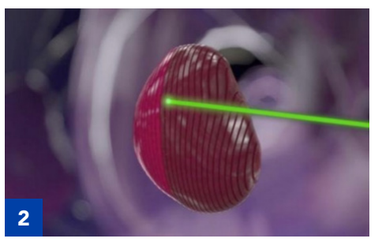


Figure 2A

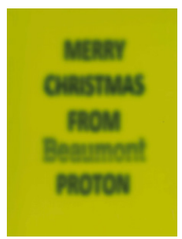


Figure 2B

Figure 2A shows a small pencil beam delivering dose to the tumor volume layer-by-layer. Figure 2B shows the very first film irradiated on the Beaumont IBA ProteusONE machine on Christmas 2016. This film result demonstrated that PBS technique calibrated on Beaumont ProteusONE has the ability to deliver the radiation dose precisely to any complex shaped tumor, just like writing on a piece of paper.

BEAUMONT PROTON THERAPY CANCER (PTC) AND ROSE CANCER CENTER

The first of its kind in Michigan with the IBA ProteusONE system, the Beaumont Proton Therapy Center is a two-story, 25,000-square-foot center. The system delivers intensity modulated protons, the type of proton therapy that is the fastest to deliver and has the best ability to spare healthy tissue. It will also have the ability to image patients daily while on the treatment table to ensure that the radiation is always delivered as intended. The first floor will house the Proton Therapy Center, a 10,000-square-foot space that includes a cyclotron to produce the proton beams and a single-room treatment area. The second floor is the pediatric oncology clinic. ProteusONE is the most advanced compact proton beam therapy solution on the market with pencil beam scanning technique. The system is also equipped with the most advanced cone-beam computer tomography (CBCT) as well as the most advanced stereotactic imaging system for protons in the world. The Beaumont Proton Therapy Center is next to the Beaumont Rose Cancer Center with full access to all the equipment including 3T Philips MRI scanner, Philips PET/CT scanner, four Elekta Linacs, one Elekta Gamma Knife and High Dose Rate Brachytherapy program. Beaumont is well-known for modern technique development in Radiation Oncology. Cone-beam CT and Intensity Modulated Arc Therapy (IMAT), which evolved into RapidArc and Volumetric Modulated Arc Therapy (VMAT), were invented in the early 2000s at Beaumont and implemented in most of the cancer centers around the world.

Figure 3

A) Beaumont Proton Therapy Center (B) Beaumont IBA ProteusONE treatment room configuration and display animation.

BRAIN TUMOR RECURRENCE, TECHNOLOGY LEADS HIM TO BEAUMONT, ROYAL OAK

Robert Ortlieb, Media Relations

Bill Baker's life has had highs and lows, like spending summers with his family at their vacation home at 10,100 feet up in Leadville, Colorado. And the lows of health issues, such as finding out this past February his brain tumor was starting to grow again.

Baker, 86, a retired manufacturing engineer, from Elsie, Michigan, is no stranger to tumors and cancer. He's a colorectal cancer survivor. In 2009, doctors detected a brain tumor. Brain surgery seemed to help, but seven years later, an MRI scan revealed the tumor was growing again and getting larger. "I'm a religious man," said Bill. "But it was a series of events that gave me optimism about what I should do about my tumor." Some might call it serendipity.

'MEDICAL ADVICE FROM A POLITICIAN'

He explained, "I happened to be channel surfing one day, L. Brooks Patterson was on PBS talking about all the great things that were happening at Beaumont Hospital. He said they had this new machine, a proton beam therapy machine; it would treat tumors and cancers without damaging other healthy cells surrounding them. And I told my wife, that sounds just exactly what I need. I did some research online to find out more details. "I did joke with my wife, 'Here I am taking medical advice from a politician.' I didn't know how that was going to go over, but it has been fruitful for me."

ENGINEERING PERSPECTIVE

With his professional background and pragmatic approach, Baker sought second opinions when diagnosed with his colorectal cancer back in 1985. In 2009, when his brain tumor was confirmed, he sought care 600 miles from his Mid-Michigan home at Mayo Clinic in Minnesota. He told his wife Barbara and his family physician, "I'm going to the best place I think I can go." Surgeons at Mayo were able to remove 85 percent of his tumor, but because of its location, 15 percent remained. Said Baker, "I'm an engineer. I look at things from an engineering perspective. The more I learned about proton therapy technology, it boggled my mind - positively charged particles, accelerated by a cyclotron, destroying cancer cells. It's like something out of science fiction."

PERSISTENCE AND DETERMINATION

He called Beaumont's Proton Therapy Center in Royal Oak hoping he'd qualify for treatment at the new facility. After a doctor shared his cell number, Bill called him on several occasions.

Baker recalled, "I was concerned I would not be accepted into the program. I kept pestering them. But the doctors called me back and said, 'Yes, you are eligible.' Which made me feel good. They told me I was their first patient."

On Bill's desire to be treated with proton therapy, Prakash Chinnaiyan, M.D., Beaumont radiation oncologist and brain tumor specialist said, "He did his homework and definitely knows what he wants. His repeated phone calls to my colleague, Dr. Peyman Kabolizadeh, demonstrated his persistence and determination."

LIFE-THREATENING MENINGIOMA

Dr. Chinnaiyan, the Proton Therapy Center's Central Nervous System chief, said Bill's tumor is a meningioma. They form on membranes covering the brain and spinal cord. Left untreated, the tumor's growth can be life-threatening.

He explained meningiomas are usually slow growing. The goal of Bill's six-weeks of proton therapy radiation, "is to stop his tumor from continuing to grow, which would eventually lead to new neurologic symptoms. Because the tumor's response to treatments is also slow, after proton therapy is completed, our team will continue close follow-up to monitor its status."

PROTON TREATMENT

Bill's treatments began June 28. When asked about what it's like, he said, "After I am on the treatment table, there is a mask they have made for me that they put on, and a cradle for my head to keep me in the correct position. You just lay there on the table and that's it. The nurses, therapists and doctors take care of everything. There is no discomfort. It is painless. The treatments, including setup, probably last about 15 minutes. It's amazing technology."

Each Friday, after his morning treatment, Barbara and Bill drive about 100 miles home to Elsie, north of Lansing, where dairy cows outnumber people. During the week, they stay in a hotel close to Beaumont Hospital, Royal Oak.

CARE EXPERIENCE

"We've been to many different hospitals through the years, and at no time have we ever been treated as well as at Beaumont," said Baker. "I can't say enough about all the people here, they have been great. The facility and care has been outstanding."

RADIATION NUTRITION

Beaumont's Radiation Oncology department offers free nutrition counseling for patients who are actively receiving or have been treated with radiation therapy. Adequate nutrition during cancer treatment is fundamental to meet the increased nutrient demands of the oncology patient in order to support the healing process. Fewer complications, improved quality of life and ability to tolerate full treatment as prescribed by the physician are a few of the benefits to optimal nutrition during cancer treatment.

For high nutrition risk cancer patients, the dietitian will screen, assess, and monitor the oncology patient throughout their course of radiation. Through this process, the dietitian will be able to identify patients at risk for malnutrition and start early intervention. Dietitian services are also available to low nutrition risk cancer patients who desire guidance on optimal nutrition in the cancer care continuum.

RADIATION PHYSICAL THERAPY

Beaumont Physical Therapy offers a free cancer screen for any patient going through radiation therapy for their cancer diagnosis. The screen will assess whether a patient needs physical therapy for the following issues: pain, decreased range of motion, strength and endurance or increased swelling, fatigue, or incontinence, difficulty with gait, balance or with activities of daily living and work or if the patient is having difficulty getting into their radiation position. If the patient has difficulty with any of these issues, physical therapy is recommended or the Cancer Survivorship Program. A physical therapist will observe the patient on weekly basis while they are going through radiation therapy to make sure each patient is doing well, but if changes occur, the physical therapist will recommend physical therapy. The goal for physical therapy is to maintain or improve patients' overall health and minimize deconditioning and fatigue while going through radiation therapy for their cancer diagnosis.

Beaumont Physical Therapy offers various specialties for patients: orthopedics, neurology (strokes, amputees), pediatrics, lymphedema, pelvic floor, and vestibular therapy.

CLINICAL TRIALS

Joanne Gondert, RN

The clinical trials team at Beaumont continues to research and improve ways we treat patients with radiation therapy. This commitment to research includes studies that compare modalities, like external beam photon radiation vs proton radiation therapy. Other areas of research includes designing and implementing tumor immobilization techniques, which lead to better targeting of cancers and imaging studies that identify biomarkers to indicate the best therapy for an individual patient. Cancer treatments are not one size fits all.

Our research team combines the expertise of physicians, scientists, physicists and biologists to bring research from the bench to the patient, expanding our treatment capabilities so that more patients can benefit from proton therapy.

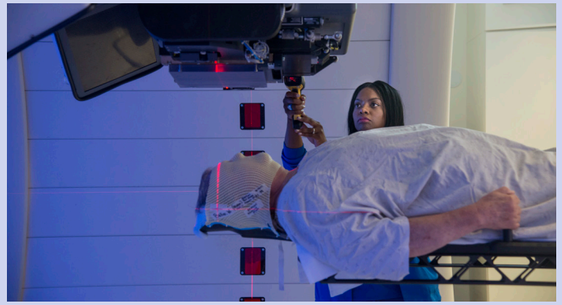
In the last year, our investigators presented proton research at national and international conferences such as PTCOG (Particle Therapy Co-Operative Group), ASTRO (American Society for Radiation Oncology) and AAPM (The American Association of Physicists in Medicine).

Soon, Beaumont will be participating in a registry for the adult (>18 years old) patients receiving proton therapy. This registry will allow us to combine de-identified treatment information and information about cancer with other proton centers participating in the registry. This continued analysis will benefit future patients, just like the patients who are being treated today are benefitting from the knowledge generated from years of previous research.

RADIATION THERAPISTS ROLE IN RADIATION ONCOLOGY

Faith Harrington, RT

Radiation therapists provide a crucial role in our patients' care team and are at the forefront of the patient experience undergoing radiation therapy treatment. The radiation therapists have a very unique role in a patient's life, as they are the faces that the patient sees every single day for their entire course of treatment. A course of treatment can vary from a single fraction to an eight week course of treatment, in which the patient comes Monday through Friday daily. Through their special bond with the patients, therapists become the first line of defense in advocating for each individual patient. As they are interacting with the patients and their families daily, they are constantly monitoring individual emotional and physical needs. They often are the first ones to notice changes in a patient that could adversely affect their overall treatment experience. The therapists are in constant interaction with the rest of the patients



care team consisting of the physicians, nurses, dosimetrists, physicists, dieticians and social workers to ensure that each patient receives the best care possible.

In addition to their special bonds that they build with their patients, therapists also perform other critical, highly technical roles within the radiation oncology department. They are responsible for simulating patients to determine the best position and immobilization for their treatments. They provide education and resources to patients to prepare them for their treatments and to resolve fears and concerns throughout their course of treatment. They perform daily quality assurance on any equipment that is used for patients' treatment delivery. The most important and most recognized role of the radiation therapist is the daily, proper administration of the radiation therapy treatments to their patients. During this process the radiation therapists acquire daily x-rays, 3D and 4D CT images to re-align their patients according to the physicians orders and to provide accurate targeted radiation therapy treatments.

Radiation therapists at Beaumont are specialized people who have dedicated their lives to the well-being of their patients. It is evident that in the warm, safe atmosphere they set, each patient receives individualized care and attention. Our mission is to deliver compassionate, extraordinary care every day for every patient.

BEAUMONT PHYSICIANS INSPIRE WITH "MEET THE DOCTOR" LECTURES

Priscilla Perkins

As part of the "Meet the Doctor" lecture series, Peter Chen, M.D., FACR, and Daniel Krauss, M.D., shared with guests of the Beaumont Health Foundation many of the details regarding how the new Proton Therapy Center and other advances in radiation oncology at Beaumont will impact patient care in the months and years to come. The lectures included a tour of the proton center and offered advocates and supporters of Beaumont a chance to ask questions and learn more about this dynamic new technology.

Dr. Chen's presentation, "Personalizing Radiation Treatment from Brachytherapy to Protons," outlined the ways in which cancer treatment is no longer a "one size fits all" effort. Dr. Chen shared with guests the ways in which today's physicians are working to individualize treatments to meet patient needs and physiologies in a way that makes outcomes more positive and side effects reduced.

Dr. Krauss built on that message of groundbreaking care, outlining the ways in which single fraction high-dose rate brachytherapy will broaden options and enhance outcomes for prostate cancer treatment.

Events such as these are vitally important to community members in order to better understand the importance of advanced technology and innovation in patient care. Each lecture is an opportunity to get better acquainted with Beaumont physicians and learn more about what inspires them as researchers and caregivers. It also provides a venue for Beaumont advocates to learn details and gain insights that they can share with their colleagues, friends and families in the greater communities.

The time and effort that Dr. Chen and Dr. Krauss contributed to the success of these two "Meet the Doctor" events was deeply appreciated by all who attended as well as by the Beaumont Health Foundation team.

For information regarding the Beaumont Foundation, please contact Priscella Perkins at 248-551-5330.

Beaumont's Radiation Oncology Department is partially dependent on philanthropy to supports its research and technology innovation.

If you are interested in making a contribution, please contact Priscilla Perkins at the Beaumont Foundation at 248-551-5338 or at priscilla.perkins@beaumont.org. You may also make a contribution online at: beaumont.edu/foundation/ways-to-give and specify that your gift go to Radiation Oncology. 100% of your gift will go directly to support radiation oncology research and program support.

FOR INFORMATION AND APPOINTMENTS:

Royal Oak 248-551-5490 | **Troy** 248-964-3070 | **Dearborn** 313-593-7335 | **Proton** 248-551-8402

Other inquiries, please call 248-551-8402

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