

# Understanding Proton Technology Applications to Cancer

By Jack Cox at the Mayo Clinic in Scottsdale Arizona

Cancer is a silent disease. I did not know until 60 days ago that I had Prostate Cancer thanks to my local doctor Jack Coombs with Dignity Health who discovered my high PSA count. I never thought I would have cancer and need to begin a fight to beat it. I had seen my son fight Hodgkin Lymphoma and he was cured. I also witnessed Ovarian Cancer take my sister's life. That all changed in mid-July. I was now facing a battle with cancer.

I needed to get medical treatment quickly. I was fortunate to have the University of California San Diego Medical Center Urology Department accept me as a patient. Dr. Kareem Kader, the Urology Department Chair, diagnosed my condition after I discovered I had a PSA score of 64. A biopsy discovered "high risk" cancer in four out of the 12 samples removed from prostate. I definitely needed treatment quickly and Dr. Kader declared the diagnosis as aggressive cancer with a Gleason Score of 8 out of 10. Following my diagnosis Dr. Kader referred me to the Radiology Department at UCSD. UCSD has also order CT and Bone Scans to see if the cancer has spread. Dignity Health in San Andreas, California discovered that my cancer was confined to my prostate and had not metastasized to other organs or tissues through their tests.



I needed to make a decision on treatment. I knew all about photon, traditional radiation. However, a friend of mine told me about the treatment option of Proton Therapy of which I was not familiar. I discovered that Proton Treatment can be focused just on a single organ and not impacting other adjacent organs or tissues. My research led me to the Mayo Clinic with its advanced machines produced by Hitachi. The Mayo Clinic was founded 157 years ago and is rated as the number one overall hospital in the United States. I made a cold call to the Clinic I encountered wonderful people who really wanted to help me. Within one week of contacting the Mayo Clinic in Scottsdale Arizona, I was registered as a Mayo patient and I had a video interview with Dr. Steven Schild, a radiation oncologist at the clinic with great expertise in Prostate Cancer. The radiology department is located in their Phoenix campus.

Dr. Schild immediately arranged a week-long series of appointments for me to prepare for treatment in Arizona. Within six days following my interview with Dr. Schild, we arrived at the Clinic in Phoenix preparing me for a six-week series of 28 treatments beginning in September. I went through several tests and markers were placed in my prostate to enable the proton beam to be focused on my cancer. In about two weeks my treatment began. Each treatment only takes about 20 minutes with zero after effects. Each week I meet with my doctor who oversees the treatment and long with a team of nurses and technicians.

## Learning About Proton Therapy

I have learned a great deal about Prostate Cancer and the application of Proton Treatment. The idea of utilizing energetic protons as a treatment for cancer was first published by scientist Robert R. Wilson in 1946. He was engaged in the Manhattan ProJet that created atomic weapons. Early treatments were performed at nuclear physics facilities, such as the Harvard Cyclotron Laboratory, and eventually gave way to the first hospital-based proton therapy center in 1990 nearly a half century later.

Actually, work began in Berkeley, California 16 years earlier. The cyclotron, a type of particle accelerator, was first conceived by Ernest Lawrence in 1929. It was built at Berkley Radiation Laboratory at the University of California, Berkley. Eventually it was called Lawrence Berkeley Laboratory that made huge contributions to the applied sciences. The initial research was focused not on the treatment of human malignancies, but on the discovery and exploration of particles and nuclear physics.

Proton technology was used initially for several cancers but is now used on most other cancers including breast, throat, and prostate cancer. I have seen many fellow patients being treated here for a variety of cancers and many much more serious than mine. The proton technology used here is a focused narrow “pencil beam” is used just to kill cancer cells in a particular organ, tissue, or gland. This technology permits the protons to only be concentrated on the diagnosed organ or tissue and this spares nearby organs or tissues from unnecessary and potentially harmful radiation.

After a lot of research, I elected to undertake this Proton Therapy to kill the cancer in my prostate. The purpose of this short paper is to share this information with others and my experience. God has given man great insight and knowledge and the result is marvelous life giving or saving technology. This week I spent time with Dr. Daniel Robertson, a Physicist that helps oversees the Mayo Clinic's proton technology here in Arizona. The following is a summary of the technology and some photos. Beyond the technology, I want to tell you that the entire Mayo Clinic operation is fabulous. They are extremely organized, and patient focused. From Doctors to Nurses to technicians, they are a wonderful caring team.

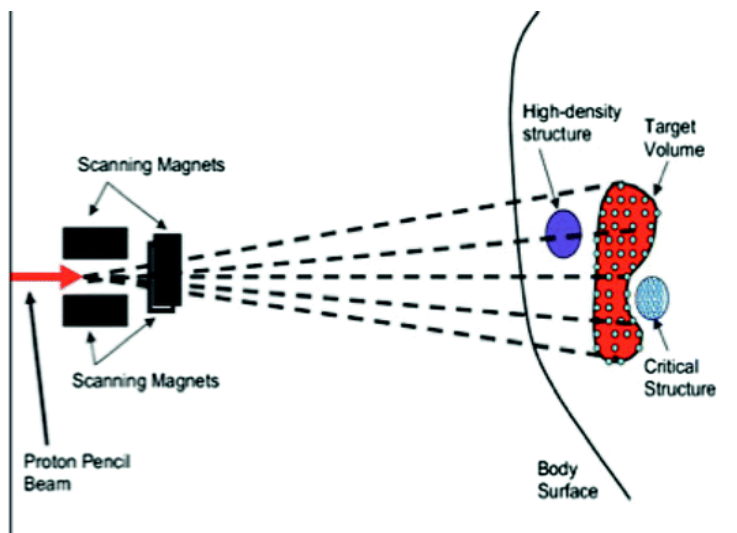
**Proton Technology** Two of the most famous particle accelerators in the world of which I was aware were in Cern Switzerland (seen on the right) and Stanford with its linear accelerator. The CERN accelerator is circular as seen here in Switzerland. The Stanford accelerator is linear and is located on the Stanford Campus in California. I remember when it was being built in the foothills above the campus and I never understood its purpose but now I do and I am a beneficiary.



A particle accelerator is a machine that uses electromagnetic fields to propel the charged particles to very high speeds as fast as 40% to 60% of the speed of light. The accelerator generates the energy and contains it in well-defined beams.

This technology has various uses including the space program. However the technology has been very successful as proton therapy to fight cancer. Proton therapy, or proton beam therapy, is a type of radiation treatment that uses a beam of protons to deliver radiation directly to the tumor. Imagine a 196-ton, cancer-killing machine that can target a patient's tumor with a sub-millimeter precision while sparing nearby healthy tissues and minimizing side effects.

The adjacent graphic explains how the beams are deployed to destroy cancer cells in the prostate.





The accelerator at the Mayo Clinic here in Arizona is pictured below. The red images are huge magnets. The picture below is of the accelerator where the proton beam is created. The particles are energized through the magnets and are traveling at 40% to 60% of the speed of light as mentioned earlier in this paper.

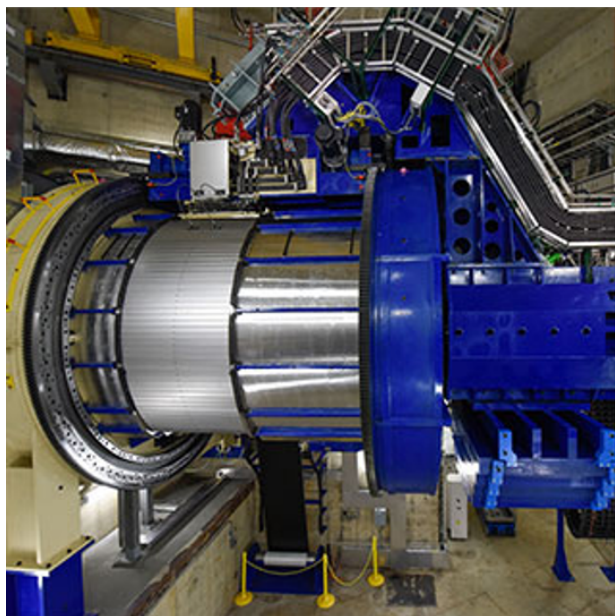


The photo below illustrates how the accelerator is deployed to each of the four-treatment room. The red images in these pictures are magnets used to energize the particles. The pipes then carry the proton energy to each of the four treatment rooms here at the Clinic through a series of pipes as seen in this picture. The treatment room can be seen in the long corridor extending to the right of the photo.



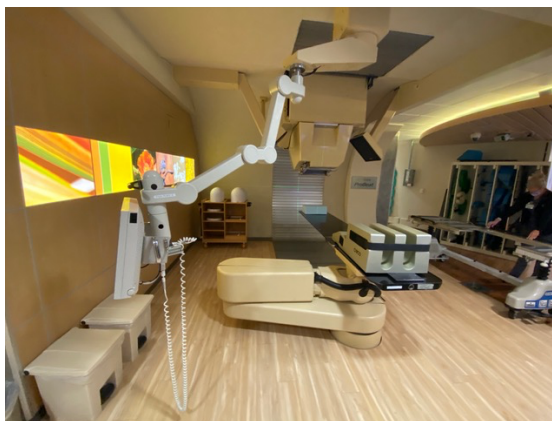
Each of the four treatment rooms are identical. A patient is placed on a table where the beam is applied to the patient from the unit above the table. This is rotated down, and in my case, is nearly level with the table to treat both sides of my prostate.

Behind the wall, on the right, is the large gantry pictured below in blue. These pictures provide the reader with a clear picture of the huge size of these machines. This picture on the right illustrates how the proton radiation machine is used in the connection with the table. The table moves so that the radiation can be applied properly.



The picture on the right provides another perspective of the table and its integration with the machine. A control unit on an arm is manipulated by the technician and it controls the movement of the treatment table. The table is modular so that it can be changed into a variety of formats.

I marvel at this technology each time I lay on this table and received my treatment to kill that cancer within my body.



## Summary

The application of proton technology in dealing with cancer is the result of scientific and engineering progress conducted over the past 75 plus years. As a Christian, I know that God endows man with the genius to approach all sorts of problems and issues. I watch a little girl with brain cancer in a wheelchair entering a treatment room or an older lady or man with serious problems being helped by the staff here. I am deeply gratified that the Mayo Clinic is here to help this people. All of this began with a dedicated doctor and his two physician sons 157 years ago and exists along with thousands of other dedicated institutions and health care workers who each day give themselves to improve the lives and trials of those in need. I thank the Lord for their carrying hands.

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