Fundamental types of radiation particle beams
(Photon, Neutron, Proton, Electron, Gamma Ray, Carbon Ion)

Photon
This is the most common, widely used type of radiation, and is available at most treatment centers and hospitals. This is widely used to treat most cancers including known or suspect residual ACC which was not able to be removed with surgery by itself. In simple terms, it is fundamentally a very high dose X-ray beam. This is also the type of radiation beam utilized for most of the pinpoint targeted types of radiation treatments, such as CyberKnife, TomoTherapy and Novalis. Most hospitals have photon radiation available and the beam is generated by a beam accelerator device that takes up the space of a typical bedroom. Some of the newer manufacturers have developed a more compact beam accelerator, such as the CyberKnife.

Neutron
Neutron radiation therapy is a unique, high-LET radiation (the particles are accelerated at a very fast rate) with very specific differences in how it affects DNA in ACC cancer cells when compared to standard Photon radiation. Neutrons are produced from a large and expensive particle accelerator called a cyclotron. This high-LET (high linear-energy-transfer) radiation is also referred to as “fast neutron therapy”. Neutrons, pions and heavy ions (such as carbon, neon and argon) deposit more energy along their path than x-rays or gamma rays, thus causing more damage to the cells they hit. The cyclotron accelerator produces protons and then a series of powerful magnets bend and aim the beam to strike a beryllium target, where the interaction produces neutrons.

Since it is so unique it is available at just three locations in the US, with the University of Washington Medical Center in Seattle being the primary site for treating ACC. As reported in 2008 they see around 65 head and neck and salivary gland cancer patients per year, and of those patients a substantial number are of the ACC type. Neutron beam has shown itself to be highly effective on ACC cells as compared to other types of cancer, and in some cases has been the only viable choice for inoperable head and neck tumors.

Proton
A highly targeted type of radiation that "skips over" good tissue to deposit the radiation in a more central spot where the tumor is located. A good image to use to understand how it works is that of a shepherd’s staff. This is not as widely available as the standard photon radiation and is used to treat a very specific targeted area and not radiate any area around it. The equipment for generating this type of radiation is very large and expensive, housed in a large three story building structure and costing in excess of $100 million to build today. Since 2000 there have been more facilities built, and that trend continues to take place.

Electron
Used primarily as an add-on or in combination with other radiation treatments, electron beam delivers its damage primarily on the outer surface, rather than going deeper into the tissue. It is also used for interoperative procedures when an area is radiated while exposed during a surgical procedure.

Gamma Ray (Gamma Knife)
Gamma rays are a form of photons produced from the decay of certain elements or radioactive isotopes such as radium, uranium and cobalt 60, and uses cobalt sourced gamma ray photons. This particular treatment is historically one of the oldest radiation platforms. It was designed originally for only treating tumors in or near the brain, which is still true today, but newer updates to the equipment are being used for treating tumors in the spine area as well.

The gamma knife utilizes a technique called stereotactic radiosurgery, which uses multiple beams of radiation converging in three dimensions to focus precisely on a small volume, such as a tumor, permitting intense doses of radiation to be delivered to that volume safely. Gamma knife treatments are given in a single session. Under local anesthesia, a special rigid head frame incorporating a three-dimensional coordinate system is attached to the patient's skull with four screws. Imaging studies, such as magnetic resonance imaging (MRI), computed tomography (CT), or angiography are then obtained and the results are sent to the gamma knife's planning computer system.

Carbon Ion
There are only two centers in the world with this type of radiation, one being in Japan and the most available center being in Heidelberg, Germany, which has treated several ACC patients. Ion radiation does not use photons, but positively charged ions, atomic nuclei which have lost their electrons from the atom shell. The particles mainly used are Hydrogen atomic nuclei (protons) and Carbon atomic nuclei, which are very heavy. This particular type of ions is therefore called heavy ion. Atomic nuclei are accelerated in large devices to about three quarters of the speed of light and shot into the tumor. The depth of penetration can be enhanced by speeding up the ions.

Ion beams have always been interesting candidates for radiation therapy, since they have special physical characteristics: When they hit the body they travel very fast through the outer layers and lose hardly any energy before they decelerate in the depth and eventually get stuck and transfer their entire deleterious energy to the surrounding tissue. Therefore, ion beams are tailor made for treating tumors located deeply inside the body.