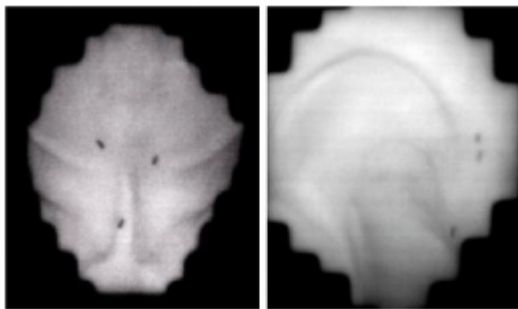


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Image guided radiation therapy (IGRT)



In this example, prior to the planning scan, three tiny gold markers are embedded into the prostate. The radiation therapists image these markers each day and use their positions to accurately align the treatment beam to the exact position of the prostate. This image was taken in 2001 with one of the first amorphous silicon imaging systems, developed at UCSF.

Image-Guided Radiation Therapy (IGRT) is one of the most advanced innovations in cancer technology available. There are many factors that may contribute to differences between the planned dose distribution and the delivered dose distribution. One such factor is uncertainty in patient position on the treatment unit. IGRT refers to the use of advanced imaging (2D and 3D) to assure that the positioning of the tumor will match the highly conformal dose delivery that can be achieved on state of the art machines.

Tumors can move during treatment because of breathing and other movement within the body. IGRT allows our doctors to locate and track the tumor during treatment. With this technology, we can deliver precise radiation treatment to tumors that shift because of breathing and movement of the bladder and bowels.

UCSF has a long history of being at the forefront of the development of techniques to assure highly accurate dose deposition to the tumor. The department was one of the first to implement gold markers for the treatment of prostate cancer to ensure that the prostate is properly positioned on a daily basis before irradiation. The physics team has also played a

key role in the development of on-board 3D imaging systems such as megavoltage cone-beam CT. Today, the department has some of the most diverse technological capabilities in the world and all systems have advanced IGRT capabilities. Our breadth of experience ensures that software and techniques are used to the best of their capacities.

- Varian Truebeam STx: kilovoltage Cone-Beam CT + MV and kV ports + ExacTrack
 - Elekta Versa HD: kilovoltage Cone-Beam CT + MV and kV ports + 4D CBCT
 - Accuray Tomo HD: megavoltage CT
 - Accuray CyberKnife: kV ports
 - Siemens Artiste: megavoltage Cone-Beam CT (kView) + MV ports
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Portal imaging (MV/kV ports)

Portal imaging is the acquisition of 2D images using a radiation beam (or kilovoltage device) that is delivering radiation treatment to a patient. If not all of the radiation beam is absorbed or scattered in the patient, the portion of the beam that passes through the patient may be measured and used to produce images of the patient's anatomy. IGRT would include matching planar images with digital reconstructed radiographs (DRRs) from the planning CT.

CT

Computed tomography is a medical imaging method employing tomography where digital geometry processing is used to generate a three-dimensional image of the internal structures of an object from a large series of two-dimensional X-ray images taken around a single axis of rotation.

MV-CT

MegaVoltage Computed tomography is the same technology as CT, except that it uses the megavoltage range of X-rays.

MV-CBCT

MegaVoltage ConeBeam Computed Tomography is a medical imaging technique that uses the megavoltage range of X-rays to create an image of bony structures or surrogate structures within the body. The treatment plan and the imaging device share the same isocenter. The image guided systems have been integrated with Siemens medical linear accelerators to great success and UCSF has been recognized as a pioneer in that field. With the constant improvements in flat-panel technology, CBCT has been able to provide excellent volumetric imaging. IGRT would include localization of the MV-CBCT dataset with the planning CT dataset.

kV-CBCT

ConeBeam Computed Tomography is an image guided system similar to MV-CBCT, which uses regular range X-rays. The device is mounted perpendicular to the LINAC treatment beam.

In-room X-rays

An in-room X-Ray is a monitoring system that detects intra-fractional tumor motion during treatment delivery, regardless of the couch angle or gantry position. Instantaneous X-Ray imaging with proprietary 6D fusion provides fast and highly accurate positioning information and to help compensate for patient motion or internal anatomical shifts.

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