Technology and Innovation

Technology

Radiation therapy is one of the most widely used cancer treatments but also one of the most technologically advanced specialties in medicine. Our multidisciplinary team of dosimetrists, medical physicists, radiation oncologists, and radiation therapists combine the most advanced technologies with the best research to deliver optimal treatment, designed individually for each patient.

Brachytherapy

High Dose Rate and Low Dose Rate
UCSF is a world renowned leader in brachytherapy. Our program is one of very few centers in the United States that provide High Dose Rate (HDR) brachytherapy for a wide array of complex cancers (prostate, cervical, head and neck, and many others).

- Brachytherapy [1] - Read about our dedicated procedural suites and treatment areas in our Brachytherapy section.
- I [2]nverse Planning [3] - Advanced software for inverse planning was designed at UCSF by Dr. Jean Pouliot and his research group.

Hyperthermia Suite

Our comprehensive clinical service has state-of-the-art ultrasound, microwave, and electromagnetic/RF (radio frequency) technologies that allow us to selectively tailor the hyperthermia [4] treatment to patient-specific requirements. Our external ultrasound and microwave applicators are used to heat superficial tumors up to approximately 8 centimeters deep. Interstitial and endocavity microwave applicators can be used for deep-body sites treated with high dose rate (HDR) brachytherapy [1]. Our electromagnetic deep heating system can treat sites deep within the body.

CT-Driven Virtual Simulation

UCSF has a CT Simulator dedicated to simulating radiation treatments for each individual patient. These simulations are used to test various treatment fields and devices used to immobilize the patient during therapy. Data from the CT simulator ensures, before patients start treatment, that they get the appropriate setup.

Linear Accelerators (LINAC)

A Linear Accelerator (often shortened to linac) is a sophisticated machine specifically designed to generate high energy X-rays and electrons for the treatment of patients. A radiation oncologist plans and calculates the best treatment method and delivery for each individual patient.

At UCSF, patients are treated with state-of-the-art Linear Accelerators capable of delivering sophisticated therapies including Intensity-Modulated Radiation Therapy (IMRT [5]), Image Guided Radiation Therapy (IGRT [6]), Stereotactic Radiosurgery (SRS [7]), Stereotactic Radiotherapy, Stereotactic Spine Radiotherapy, and Stereotactic Body Radio Therapy (SBRT [8]). A few of our machines are highlighted below:

- ARTISTE [9]
- TomoTherapy [10]
- TrueBeam System [11]
- V [12]ersa HD [13]

Proton Beam Radiation Therapy (PBRT)

UCSF?s proton therapy [14] program for eye tumors is *one of two* major centers in the United States and one of 12 in the world with an active and long-established dedicated proton ocular beam line. The technique we use employs a finely targeted beam with adjustable penetration to ensure tumor coverage and to avoid normal tissues. Designed exclusively to treat eye tumors, this 67.5 MeV beam provides optimal dose delivery and has been used in clinical practice successfully for decades.

Stereotactic Radiosurgery (SRS)

Stereotactic radiosurgery [7] involves a single, high-dose application of radiation to the tumor, instead of the many smaller doses given in standard treatment. Several radiation beams are precisely aimed to converge upon a small tumor. The patient lies on a couch that rotates 180 degrees for maximum targeting, while minimizing exposure to surrounding tissues. This technique is used to treat brain tumors and other intracranial cancers.

- CyberKnife [15]
- Gamma Knife [16]

Stereotactic Radiotherapy (SRT)

This term represents the stereotactic [7] methodology with IMRT [5] delivery. Patients receiving such treatments include those with tumors in the central nervous system and head and neck regions.

Stereotactic Spine Radiotherapy

Stereotactic guided radiation is combined with CT guidance for the highest possible dose to spinal tumors while minimizing harmful side effects.

Stereotactic Body Radiation Therapy (SBRT)

SBRT [8] combines elements of three-dimensional conformal radiotherapy (3D-CRT)/intensity-modulated radiation therapy (IMRT), which links CT scans of the tumor site with treatment-planning software to determine optimum radiation beam direction and intensity, and image-guided radiation therapy (IGRT) [6] techniques that address tumor motion and anatomy shifts during the course of radiotherapy.

SBRT allows the delivery of an ablative dose of radiation to the target in significantly shortened treatment time; individual treatments, called "fractions" have been reduced from 35 to fewer than 5 using this approach, while minimizing damage to normal tissues in the tumor region. This technique has been used in patients with early stage or isolated recurrent/metastatic cancer in the lung, liver and other sites.

- CyberKnife [15]
- TrueBeam System with Novalis Radiosurgery [11]

Innovation

- 3D Printer [17]
- Informatics [18]
- Salvage Radiotherapy [19]

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UCSF Main Site

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[3] http://radonc.ucsf.edu/inverse-planning-simulated-annealing-ipsa
[4] http://radonc.ucsf.edu/hyperthermia
[5] http://radonc.ucsf.edu/intensity-modulated-radiation-therapy-imrt
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