Targeting

The accuracy of your radiosurgical treatment is only as good as the imaging that provides the target for the treatment. In 1987, Gamma Knife® surgery moved from CT to MRI, which has been determined to be far more accurate for radiosurgical imaging.

The Big Question:

What type of imaging does your system use?

The Answer:

Leksell Gamma Knife® uses MRI, the standard for brain imaging, which provides the best resolution and accuracy.

You should know:

- CT imaging alone is no longer accepted as being clinically sufficient or as a standard of care for radiosurgery.
- CyberKnife permits the use of full MRI in treatment planning in the U.S. through an add-on to the equipment, however tracking still relies on two-dimensional X-rays which are compared to CT data.
- X-ray imaging during treatment with Cyberknife contributes to total radiation dosage, which may cause problems for certain patients.

Overview – Targeting

Gamma Knife® surgery allows the use of an MRI compatible head frame whose accuracy in MR is published to be less than the pixel size in typical MR scanners, thereby saving time and eliminating fusion errors (Neurosurgery 1992 March).

Gamma Knife® surgery used CT until 1987 and then moved to MR, which has been determined to be far more accurate for radiosurgical imaging. Today, 90% of Gamma Knife® treatments are planned on MR alone due to the well-documented MR compatibility of the Leksell® Coordinate Frame.

CyberKnife now permits the fusion of MRI in treatment planning in the U.S., however it still relies primarily on CT. Lacking MR information, many CyberKnife treatments must be fractionated to compensate for errors and to minimize damage to healthy tissue.

Key Points:

- 90% of Gamma Knife® treatments today are planned on MRI alone due to the Elekta Stereotactic frame's well documented MRI compatibility.
- Frame provides exact 3D correlation from imaging to planning to delivery.
- Treatment images are mechanically tied to Gamma Knife® coordinates for highest accuracy.
- The Leksell frame has been shown to be accurate to less than the pixel size in typical MRI scanners.

Attack:

- MRI is the accepted standard for achieving the best imaging of the brain
- CT scans are less accurate and deliver additional radiation
- Leksell Gamma Knife® has used MRI for almost two decades
- CyberKnife can now fuse MRI but must rely on CT

You should know:

CyberKnife states they image every 10 seconds. In clinical usage, this tracking may be significantly less frequent. According to one hospital, the patient is not imaged before every radiation delivery because the X-rays used for patient positioning contribute to the cumulative therapeutic dose. The number of images are therefore reduced to approximately one tenth because of this dose issue, resulting in further opportunities for errors in radiation delivery from patient movement.

Imaging background – comparison

MRI provides a detailed picture of structures and organs inside the body. MRI often provides more detail than other tests, such as a CT scan, and does not require X-rays. MRI is most effective at providing pictures of tissues or organs that contain water.

Magnetic Resonance Imaging (MRI)

MRI, or nuclear magnetic resonance imaging, provides three-dimensional views of an internal organ or structure, especially the brain and spinal cord. MRI uses a powerful magnetic field and radio waves to alter the natural alignment of hydrogen atoms within the body. Computers record the activity of the hydrogen atoms and translate that into images.

MRI offers increased-contrast resolution, enabling better visualization of soft tissues. Also, it allows for multiplanar imaging, as opposed to CT, which is usually only axial. Additionally, it provides highly detailed information without exposing the body to radiation. In many instances, it provides more useful images than CT scanning and ultrasound – particularly for the brain.

Computed Tomography (CT)

A CT scan uses X-rays to produce detailed pictures of structures inside the body. A CT scan is also called a computerized axial tomography (CAT) scan. A CT scanner directs a series of X-ray pulses through the body. Each rotation of the CT gantry represents a “slice” of the organ or area being studied. The slices or pictures are recorded on a computer and can be saved for further study or printed out as photographs.

CT scanning can be used to obtain information about almost any body organ (such as the liver, pancreas, intestines, kidneys, adrenal glands, lungs, and heart), blood vessels, the abdominal cavity, bones and the spinal cord.