Image-guided stereotactic surgery

- Ablation combined with video-assisted thoracic surgery hybrid technique for multiple primary lung cancer
- Elective Regional Nodal Irradiation in Prostate Cancer
- Liver-Directed Therapies in Colorectal Cancer: Old Hats and New Tricks
- Innovations in radiotherapy
- A comparison of outcomes after radiosurgery in non-small cell lung cancer patients with one versus more than twenty brain metastases: an international multi-center study
- Evaluation of the Accuracy of Patent Fixation System Using a Bi-directional X-ray Image Matching System during Spine Stereotactic Body Radiation Therapy
- Online adaptive stereotactic body radiotherapy for localized prostate cancer in patients with lower urinary tract symptoms and/or prostate hyperplasia (X-SMILE)
- Management of Stage IVB Cervical Cancer Including the Role of Radiotherapy

A method in neurosurgery for locating points within the brain using an external, three-dimensional frame of reference usually based on the Cartesian coordinate system.

The term stereotactic (Greek: stereo = 3-dimensional, tactic = to touch) surgery was initially used in animals, and was based on atlases of three-dimensional coordinates compiled from dissections. The term was then used for surgery performed in humans, usually for thalamic lesioning to treat Parkinsonism.

The techniques of stereotactic surgery are utilized in some functional procedures (e.g. DBS) as well as for biopsies (see Stereotactic biopsy) cyst drainage, etc. The term stereotactic (Greek: stereo = 3-dimensional, tactic = to touch) surgery was initially used in animals, and was based on atlases of three-dimensional coordinates compiled from dissections. The term was then used for surgery performed in humans, usually for thalamic lesioning to treat Parkinsonism, see Parkinson's disease surgery, where the target site to be lesioned was located relative to landmarks with intraoperative pneumoencephalography or contrast ventriculography. Use of this procedure fell off dramatically in the late 1960s with the introduction of L-dopa for Parkinsonism [1)]

Indications

see Stereotactic surgery indications.

For image-guided stereotactic surgery, in the first part of the procedure, a CT scan or MRI (or occasionally, angiogram) is performed. For increased precision, “fiducial” markers or a stereotactic frame is attached to the patient’s head during this image acquisition phase. Acceptable accuracy for biopsy can often be obtained using high resolution thin cut imaging slices (usually with a 0 angle of the gantry), and then surface matching algorithms in the guidance system will match the pre-op CT/MRI to the patient’s head. This is not accurate enough for lesion generation or electrode placement. The second part of the procedure usually takes place in an operating room. The patient is “registered” with the pre-op images, and then tracking cameras follow the movement of instruments with appropriate attachments to show in “real-time” the location of the instrument with respect to the pre-op image. An important limitation to be aware of is the fact that the pre-op images are “historical”

and are not updated as the surgical procedure alters the anatomy of the patient. Even the administration of mannitol can cause brain shifts that may cause the target of the surgery to move away from its pre-op location by several millimeters [2].

1)
Gildenberg PL. Whatever Happened to Stereotactic Surgery? Neurosurgery. 1987; 20:983–987
2)
Bucholz RD, Yeh DD, Trobaugh J, et al. The correction of stereotactic inaccuracy caused by brain shift using an intraoperative ultrasound device. In: Lecture Notes in Computer Science. Berlin: Springer; 1997. DOI: 10.1007/BFb0029268