Stereotactic radiosurgery and stereotactic radiation therapy

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Abstract

In the past two decades, developments in radiosurgery technology have progressed at a torrid pace, with innovations including MR localization, image fusion, dedicated radiosurgery linacs, relocatable frames, micro-multileaf collimators, imageguided (“frameless”) localization techniques, and application to extracranial tumor sites. Guidance for radiosurgery quality assurance has significantly lagged the technological development. The primary reference document today, AAPM Report No. 54 “Stereotactic Radiosurgery” (Schell et al. 1995), was published nearly 15 years ago and covers none of the more recent innovations noted above. Several relevant efforts originating within the American Association of Physicists in Medicine are presently ongoing and are expected to be completed and published in the near future. These include: Task Group 101—“Stereotactic Body Radiotherapy”• Task Group 104—“KiloVoltage Localization in Therapy”• Task Group 117—“Use of MRI Data in Treatment Planning and Stereotactic Procedures—Spatial Accuracy and Quality Control Procedures” Task Group 132—“Use of Image Registration and Data Fusion Algorithms and Techniques in Radiotherapy Treatment Planning” Task Group 135—“QA for Robotic Radiosurgery”• Task Group 155—“Small Fields and Non-Equilibrium Condition Photon Beam Dosimetry” Task group 178—“Gamma Stereotactic Radiosurgery Dosimetry and Quality Assurance” In the absence of a modern, comprehensive radiosurgery QA document, this chapter is intended to provide guidance and examples for assessing and minimizing geometric (localization) and dosimetric uncertainties in cranial stereotactic radiosurgery and stereotactic radiation therapy. Other chapters in this edition are dedicated to gamma-and robotic-based radiosurgery; thus, this chapter focuses primarily on linear accelerator (linac)-based stereotactic radiosurgery/stereotactic radiation therapy. Nevertheless, many of the procedures described here have a much more universal application.
Stereotactic radiosurgery is a type of radiation therapy that uses narrow beams of radiation coming from different angles to very precisely deliver radiation to a brain tumor while sparing the surrounding normal tissue. Also called stereotactic radiotherapy, stereotactic radiosurgery delivers a higher, more targeted dose of radiation than external beam radiation therapy. A special device keeps the patient’s head still so that the radiation is accurately aimed at the tumor. Stereotactic radiosurgery can be delivered in one or many doses through a variety of techniques, including the use of fractionated radiosurgery. Fractionated radiosurgery: Fractionated radiosurgery delivers the radiation in multiple (or fractionated) doses over time, instead of in one large dose. Mayo Clinic: "Stereotactic radiosurgery," MedlinePlus: "Adrenal Gland Disorders." MD Anderson Cancer Center: "Stereotactic Body Radiation Therapy (SBRT)." Memorial Sloan Kettering Cancer Center: "What is SBRT?" National Cancer Institute: "Radiation Therapy to Treat Cancer," "SEER Training/Types of Radiation Therapy." RadiologyInfo.org: "Fiducial Marker Placement." © 2019 WebMD, LLC. Stereotactic radiosurgery/Gamma Knife radiosurgery: The Gamma Knife is considered the "gold standard" for radiation treatment for brain tumors or lesions. The Gamma Knife provides results comparable to or better than conventional surgery in many cases, without the need for a surgical incision or long recovery in the hospital. Radiosurgery is usually a single treatment, although in some cases you may have treatment broken up into a few treatments over separate days. Stereotactic body radiation therapy (SBRT): This type of treatment focuses high doses of intense radiation to targets on the body. Stereotactic radiation therapy is an alternative to invasive or debilitating surgery, especially for deep-seated brain tumors, or tumors that require amputation or radical surgery. To compare the results of both microsurgery and stereotactic radiosurgery, we conducted a study of 87 patients with unilateral, previously unoperated acoustic neuromas with an average diameter less than 3 cm treated by the neurosurgical service during 1990 and 1991. Preoperative patient characteristics and average tumor size were similar between the treatment groups.