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Guidelines for Radiosurgery: our recommendation. American College of Radiology (ACR) and American Society for Radiation Oncology (ASTRO) Practice Guideline for the Performance of Stereotactic Radiosurgery (SRS)

10.20960/radiocirugia.2019.00001

Guidelines for Radiosurgery: our recommendation. American College of Radiology (ACR) and American Society for Radiation Oncology (ASTRO) Practice Guideline for the Performance of Stereotactic Radiosurgery (SRS)

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INTRODUCTION

SRS is a safe and efficacious treatment option of a variety of benign and malignant disorders involving intracranial structures and selected extracranial lesions. SRS involves a high dose of ionizing radiation with a high degree of precision and spatial accuracy. A quality SRS program requires a multidisciplinary team involved in the patient management.

Organization, appropriate staffing, and careful following of established Radiosurgery standards is important to ensure that the program is successful.

Stereotactic radiosurgery (SRS) historically referred to targeting intracranial lesions. As technologies improve, SRS has included extracranial targets. SRS is strictly defined as radiation therapy delivered via stereotactic guidance with approximately 1 mm targeting accuracy to intracranial targets in 1 to 5 fractions.

The delivery of a high dose of ionizing radiation that conforms to the shape of the lesion mandates an overall accuracy of approximately 1 mm. SRS can be delivered using a linear accelerator, a γ-ray treatment device, or a particle beam accelerator. All rules applied for every type of system.

Stereotactic localization of the lesion uses an appropriate imaging modality to identify a reference point for positioning the individual treatment beams. Traditionally, a rigid frame that included a fiducial system for precisely locating coordinate positions within the frame was attached to the patient's

head. “Frameless” approaches have been introduced. These approaches arc referred to as image-guided radiation therapy (IGRT).

REQUIREMENT FOR THE PERSONEL

The qualifications and responsibilities of all the involved personnel, including the radiation oncologist, neurosurgeon, and qualified medical physicist. Quality assurance is essential for safe and accurate delivery of treatment with SRS. Quality assurance issues for the treatment unit, stereotactic accessories, medical imaging, and treatment-planning system are presented and discussed. Adherence to these practice guidelines can be part of ensuring quality and patient safety in a successful SRS program.

QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

Radiation Oncologist

Certification in Radiology by the American Board of Radiology (ABR) of a physician who confines his/her professional practice to radiation oncology, or certification in Radiation Oncology or Therapeutic Radiology by the ABR, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or the Collège des Médecins du Québec may be considered proof of adequate physician qualifications.

Satisfactory completion of a residency program in radiation oncology approved by the Accreditation Council for Graduate Medical Education, the Royal College of Physicians and Surgeons of Canada, the Collège des Médecins du Québec, or the American Osteopathic Association.

If the radiation oncology residency training did not include SRS training and direct clinical experience, then specific training or mentoring in SRS should be obtained before performing any Radiosurgical procedures. In addition, there may be vendor-specific delivery systems that require additional training.

The responsibilities of the radiation oncologist must be clearly defined and, irrespective of the treatment device, his or her duties should include the following:

Participating in initial treatment decision making and obtaining informed consent.

Overseeing radiation therapy management of the patient.

In concert with the neurosurgeon, neuroradiologist, or other physicians, specifying the target volume and relevant critical normal tissues.

Participating in the iterative process of plan development and approving the final treatment plan and dose.

Ensuring that patient positioning on the treatment unit is appropriate.

Attending and directing the radiosurgical treatment delivery, according to Nuclear Regulatory Commission regulations where appropriate.

Following the patient and participating in the monitoring of disease control and comp

Neurosurgeon

Satisfactory completion of an Accreditation Council for Graduate Medical Education-approved neurosurgical residency program. If the neurosurgical residency training did not include SRS training and direct clinical experience, then specific training or mentoring in SRS should be obtained before performing any radiosurgical procedures. In addition, there may be vendor-specific delivery systems that require additional training.

An appropriately trained neurosurgeon is an integral member of the multidisciplinary SRS team and his or her services may include:

Participating in initial treatment decision making.

Placement of stereotactic head frame, where necessary.

Locating and specifying the target volume and relevant critical normal tissues in concert with the radiation oncologist and neuroradiologist or other physicians.

Participating in the iterative process of plan development and approving the final treatment plan and dose.
Ensuring that patient positioning on the treatment unit is appropriate.
Following the patient and participating in the monitoring of disease control and management of treatment complications.

Medical physicist

The medical physicist is responsible for many technical aspects of radiosurgery and must be available for consultation throughout the entire procedure: imaging, treatment planning, and dose delivery.
Those responsibilities include the following:

- Acceptance testing and commissioning of the radiosurgery system to assure its initial geometric and dosimetric precision and accuracy.

Localization devices used for accurate determination of target coordinates.
The treatment-planning system.
The radiosurgery external beam delivery unit.
The precision of the imaging device, such as the MRI scanner, used for target and critical structure identification. Implementing and managing a QA program for the radiosurgery system to monitor and assure its proper functioning.
Initiation and maintenance of a comprehensive QA checklist that acts as a detailed guide to the entire treatment process.
Directly planning, supervising, or overseeing the treatment-planning process, including verification of dosimetric calculations using monitor unit double-check software.
Consulting with the radiation oncologist and/or medical dosimetrist to determine the optimal patient plan.
Using the plan approved by the radiation oncologist and an appropriate patient-specific measurement technique and checks the appropriate beam-delivery parameters.

Supervising the technical aspects of the beam-delivery process on the treatment unit to assure accurate fulfillment of the prescription of the radiation oncologist.

Radiation Technologist and or dosimetrist when applicable

A radiation therapist must fulfill state licensing requirements and should have American Registry of Radiologic Technologists certification in radiation therapy.

The responsibilities of the radiation therapist must be clearly defined and may include the following:

Preparing the treatment room for the SRS procedure.

Assisting the treatment team with patient positioning/immobilization.

Operating the treatment unit after the clinical and technical aspects of beam delivery are approved.

Contour clearly discernible critical normal structures.

Ensure proper orientation of volumetric patient image data on the radiation therapy treatment-planning system (from computed tomography and other fused image data sets).

Design and generate the treatment plan under the direction of the radiation oncologist and medical physicist as required.

Generate all technical documentation required to implement the treatment plan.

Be available for the first treatment and assist with verification for subsequent treatments as necessary.

If the radiation therapy training did not include the training, they must attend capacitation and or training as per the facility where they work.

QA OF THE TREATMENT UNIT

Radiation-beam alignment testing to assure the beam can be correctly aimed at the targeted tissues (see the Quality control of stereotactic accessories section for a complete list of the references describing this test).

Calculation of radiation dose per unit time (or per monitor unit) based on physical measurements for the treatment field size at the location of the target.

- Quality control of stereotactic accessories.
- Quality control of images.
- QA for srs treatment-planning systems.

System Log

Maintain an ongoing system log indicating system component failures, error messages, corrective actions, and system hardware or software changes.

System Data Input Devices

Check the input devices of image-based planning systems for functionality and accuracy. Devices include digitizer tablet, input interface for medical imaging data (CT, MRI, angiography, etc.) and video digitizers. Assure correct anatomic registration: left, right, anterior, posterior, cephalad, and caudad from all the appropriate input devices.

System Output Devices

Assure the functionality and accuracy of all printers, plotters, and graphical display units that produce, using digitally reconstructed radiographs or the like, a beam’s-eye view rendering of anatomic structures near the treatment beam isocenter. Assure correct information transfer and appropriate dimensional scaling.

System Software

Assure the continued integrity of the radiation therapy treatment-planning system information files used for modeling the external radiation beams. Confirm agreement of the beam modeling to currently accept clinical data derived from physical measurements. Similarly, assure the integrity of the system to render the anatomic modeling correctly.

VALIDATION OF THE TECHNIQUE AS IMPLEMENTED

Once the individual components of the SRS planning and treatment technique are commissioned, it is recommended that the QA program include an “operational test” of the SRS system before clinical treatment begins, or whenever a plan modification is implemented for a fractionated treatment schedule.

FOLLOW-UP

There should be follow-up of all patients treated and maintenance of appropriate records. The data should be collected in a manner that complies with statutory and regulatory guidelines to protect confidentiality.

DOCUMENTATION

Procedure documentation should be in accordance with the ACR Practice Guideline for Communication: Radiation Oncology.

CONCLUSION

Radiosurgery is an involved procedure requiring participants from many disciplines. High spatial accuracy is expected, and there may be time constraints. Numerous systems to achieve optimal accuracy have been developed, and specific training in their use is required. All of the above demands a highly organized and efficient SRS team. Checklists are required to ensure that all aspects of the procedure are completed properly by each team member.