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ACR–ASNR–SPR PRACTICE PARAMETER FOR THE PERFORMANCE OF COMPUTED TOMOGRAPHY (CT) OF THE EXTRACRANIAL HEAD AND NECK

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care¹. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the practitioner in light of all the circumstances presented. Thus, an approach that differs from the guidance in this document, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in this document when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to the guidance in this document will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of this document is to assist practitioners in achieving this objective.

¹ *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing*, ___ N.W.2d ___ (Iowa 2013) Iowa Supreme Court refuses to find that the *ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures* (Revised 2008) sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, *Stanley v. McCarver*, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.

I. INTRODUCTION

This practice parameter was revised collaboratively by the American College of Radiology (ACR), the American Society of Neuroradiology (ASNR), and the Society for Pediatric Radiology (SPR).

Computed tomography (CT) is a radiologic modality for evaluating a variety of disorders involving the extracranial head and neck. CT should be performed only for a valid medical reason and with the minimum radiation dose necessary to achieve an optimal study. Additional or specialized examinations may be required. Although it is not possible to detect all abnormalities using CT, adherence to the following parameters will increase the probability of their detection.

II. INDICATIONS

A. Indications for CT of the soft tissues of the extracranial head and neck include, but are not limited to [1-37]:

1. Congenital anomalies
2. Benign and malignant neoplasms
3. Infections and inflammatory processes
4. Trauma
5. Vascular malformations
6. Evaluation of palpable masses
7. Radiation therapy treatment planning
8. Follow-up after surgery, chemotherapy, or radiation therapy
9. Hemorrhage/epistaxis
10. Thyroid conditions
11. Preoperative and intraoperative planning and/or guidance
12. Cranial nerve defects

B. Indications for CT of the paranasal sinuses include, but are not limited to [11,35,38-51]:

1. Congenital anomalies
2. Fibro-osseous lesions of the midface and sinonasal region
3. Benign and malignant neoplasms of the sinonasal region
4. Facial trauma
5. Acute and chronic infectious or inflammatory disease
6. Follow-up after surgery, chemotherapy, or radiation therapy
7. Radiation therapy treatment planning
8. Hemorrhage/epistaxis
9. Preoperative and intraoperative planning and/or guidance

C. Indications for CT of the orbits include, but are not limited to [35,39-41,45,48,51-56]:

1. Congenital anomalies
2. Proptosis
3. Fibro-osseous disease
4. Benign and malignant neoplasms of the orbital and ocular structures
5. Trauma
6. Infections and inflammation
7. Thyroid orbitopathy
8. Follow-up after surgery, chemotherapy, or radiation therapy
9. Radiation therapy treatment planning
10. Foreign body
11. Diplopia
12. Loss of vision
13. Complications of sinusitis and sinus surgeries

14. Preoperative and intraoperative planning and/or guidance
15. Vascular malformations

D. Indications for CT of the temporal bone include, but are not limited to [35,57,58]:

1. Conductive or sensorineural hearing loss
2. Benign and malignant neoplasms
3. Trauma
4. Acute or chronic otomastoid inflammatory disease
5. Preoperative evaluation prior to mastoidectomy
6. Preoperative or postoperative evaluation for auditory devices
7. Suspected inner ear disease
8. Radiation therapy treatment planning
9. Follow-up after surgery, chemotherapy, or radiation therapy
10. Congenital anomalies
11. Preoperative and intraoperative planning and/or guidance

For the pregnant or potentially pregnant patient, see the [ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#) [59].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the [ACR Practice Parameter for Performing and Interpreting Diagnostic Computed Tomography \(CT\)](#) [60].

IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for CT of the head and neck should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state's scope of practice requirements. (ACR Resolution 35, adopted in 2006)

Head and neck CT protocols require close attention and development by the supervising physician according to specified indications. Protocols should be reviewed periodically in order for the examinations to be optimized for image quality and opportunities for dose reduction. Single-phase CT (noncontrast or postcontrast) is sufficient in the vast majority of cases. (However, if salivary calculi or sialadenitis is suspected, then some operators may also elect precontrast imaging limited to the area of interest.) The supervising physician should be familiar with the indications for each examination, relevant patient history, and potential adverse reactions to contrast media, exposure factors, field of view, collimation, slice intervals, and reconstruction algorithms.

With multidetector CT scanners, high-quality images should be reconstructed in multiple planes from a single data set, obviating the need for separate coronal and axial acquisitions and thereby minimizing radiation exposure. When the area of interest involves scans through the orbital region, attempts should be made to minimize radiation dose to the lens. For contrast-enhanced studies, split-bolus technique may provide better lesion and vascular enhancement.

A. Neck CT

The patient should lie on the table in the supine position with the neck slightly extended to exclude the orbits, if possible. The study should be performed with the patient breathing quietly. Reconstruction parameters from a multidetector CT study may vary, but typically contiguous or overlapping sections should be reconstructed through the area of interest. Display slice thickness should not exceed 3 mm. However, in pediatric patients, a thicker slice of ≤ 5 mm may be appropriate. Initial imaging should be performed with the head tilted and/or a gantry angled to avoid streak artifact over the area of interest. In patients with a large amount of dental hardware artifact, additional imaging with different gantry angles and/or head tilt may be necessary. All studies should be reconstructed in soft-tissue algorithm. Additional reconstruction with a suitable edge-enhancing algorithm or technique to improve bone and cartilage depiction may be obtained in patients with a history of infection, tumor, or trauma. Intravenous contrast is recommended in patients without contraindications. For selected indications, a noncontrast examination may be obtained focused to the area of specific interest, such as concern for a foreign body, trauma, salivary stones, or for patients undergoing radioiodine therapy for thyroid cancer as per institutional guidelines [61,62]. If the examination is performed for a vocal cord tumor, axial sections (or axial reformats) should be parallel to the vocal cords or hyoid bone.

Most indications for soft-tissue neck CT can be evaluated with a scanned volume from the skull base (sellar floor) to the top of the aortic arch. For studies specifically performed to evaluate for vocal cord palsy, the inferior extent of the CT examination should extend to the aortopulmonary window. Very thin sections (1.0 to 1.5 mm) with multiplanar reconstructions limited to the larynx may be helpful for evaluating patients for vocal cord neoplasms.

B. Sinus CT

With a multidetector CT, axial images are most commonly performed parallel to the hard palate. The scanned volume should be from above the top of the frontal sinus and continue inferiorly through the maxillary teeth. Routine axial, sagittal, and/or coronal reformations should be reconstructed. In the absence of a multidetector CT, direct coronal images may be performed, if requested. Direct coronal CT may also be useful when assessing anterior skull base cerebrospinal fluid leak. Intravenous contrast should be used to evaluate neoplasms. Contrast is not required for evaluating facial trauma or for routine evaluation of patients with sinusitis. Contrast may be helpful to evaluate patients with sinus infection who have periorbital or facial swelling and have a clinical suspicion of abscess or complications of sinonasal infection, including intracranial or orbital extension. In addition to soft-tissue reformats, studies should be reconstructed in a bone algorithm or another edge-sharpening algorithm.

1. Coronal reformat

Coronal reformations are performed perpendicular to the plane of the hard palate from the nasal vestibule to the sella.

2. Sagittal reformat

Sagittal reformations are performed perpendicular to the plane of the hard palate through the maxillary sinuses.

C. Orbital CT

With multidetector CT, a standard examination should consist of image acquisition in the axial plane, with coronal and sagittal reformations. The patient should be positioned and the gantry angle should be adjusted to optimize image acquisition. The scanned volume should encompass the bony orbit. The display slice thickness should not exceed 3 mm. When evaluating for small foreign bodies, the display slice thickness should not exceed 1.5 mm. In the absence of any contraindication, intravenous contrast should be administered when evaluating neoplasms, infectious/inflammatory disorders, and vascular lesions. Noncontrast imaging may be performed in selected clinical situations, for example, thyroid eye disease, foreign body, and trauma. Studies should be reconstructed in soft-tissue and bone algorithms. Prone, head back, or coronal images with or without Valsalva maneuvers may elucidate some vascular lesions.

D. Temporal Bone

With a multidetector CT, axial acquisitions are most commonly performed. Routine coronal and/or sagittal reformations are commonly reconstructed per institutional guidelines. In the absence of a multidetector CT, direct coronal images or both axial and coronal images may be performed, if requested. All studies should be reconstructed in bone algorithm. The right and left sides may be separately reconstructed using a magnified small reconstructed field of view. Additional reformations of a high-quality multidetector acquisition in the short axis (or Poschl—parallel to the plane of the superior semicircular canals) and long axis (or Stenvers—perpendicular to the plane of the superior semicircular canals) planes may provide additional useful information, particularly in the evaluation of superior semicircular canal dehiscence. Intravenous contrast may be helpful when evaluating patients with acute mastoiditis in order to evaluate patency of the adjacent transverse sinus or to evaluate perimastoid disease, suspected vascular pathology, or when there is concern for a tumor.

1. Axial imaging

The patient should be placed in the supine position for the axial plane. For scanners where the gantry can be angled, the gantry angle should be parallel to the infraorbital-meatal line. If the gantry cannot be angled, the patient should be positioned appropriately for the scanner. The scanned volume should be from above the superior-most mastoid air cells above the bony portion of the external auditory canal (EAC) through the mastoid tip inferiorly. The display slice thickness should not exceed 1.5 mm and preferably not exceed 1.0 mm. Reconstruction of the posterior fossa using soft-tissue algorithm with a wide field of view is recommended.

2. Coronal imaging (for the rare instances when reformatted coronals from the axial are not possible/adequate)

The patient should be placed in the prone position with head tilted back for direct coronal plane acquisition. For patients who cannot tolerate prone positioning, supine positioning with a pillow under the shoulders and the head tilted posteriorly, along with gantry tilt, may be acceptable. The gantry angle should be perpendicular to the infraorbital-meatal line. The scanned volume should be from approximately the level of the posterior temporomandibular joint anterior to the bony portion of the EAC through the entire mastoid air cells. The display slice thickness should not exceed 1.5 mm and preferably not exceed 1.0 mm. Multiplanar reformatted coronal views from direct axial imaging may be substituted for direct coronal imaging.

V. DOCUMENTATION

Reporting should be in accordance with the [ACR Practice Parameter for Communication of Diagnostic Imaging Findings](#) [63].

VI. EQUIPMENT SPECIFICATIONS

A. Performance Guidelines

For patient imaging, the CT scanner should meet or exceed the following specifications:

1. Gantry rotation period: minimum, not >1 second
2. Display slice thickness: minimum, not >1.5 mm
3. Biphasic injection split-bolus technique: Some operators may elect to administer contrast material in 2 boluses prior to a single postcontrast CT. Delay between the 2 boluses and prior to postcontrast CT should be sufficient to afford optimum lesion enhancement. Limiting spatial resolution: must be measured to verify that it meets the unit manufacturer's specifications
4. Table pitch: no >2:1 for single-row-detector scanners

B. Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications. The equipment and medications should be monitored for inventory and drug expiration dates on a regular basis. The equipment, medications, and other emergency support must also be appropriate for the range of ages and sizes in the patient population.

VII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, registered radiologist assistants, radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, “as low as reasonably achievable” (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel that work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection and application of dose limits) and the principles of proper management of radiation dose to patients (justification, optimization and the use of dose reference levels) http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1578_web-57265295.pdf.

Nationally developed guidelines, such as the ACR’s [Appropriateness Criteria](#)[®], should be used to help choose the most appropriate imaging procedures to prevent unwarranted radiation exposure.

Facilities should have and adhere to policies and procedures that require varying ionizing radiation examination protocols (plain radiography, fluoroscopy, interventional radiology, CT) to take into account patient body habitus (such as patient dimensions, weight, or body mass index) to optimize the relationship between minimal radiation dose and adequate image quality. Automated dose reduction technologies available on imaging equipment should be used whenever appropriate. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available at the Image Gently[®] for children (www.imagegently.org) and Image Wisely[®] for adults (www.imagewisely.org) websites. These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be measured and patient radiation dose estimated for representative examinations and types of patients by a Qualified Medical Physicist in accordance with the applicable ACR technical standards. Regular auditing of patient dose indices should be performed by comparing the facility’s dose information with national benchmarks, such as the ACR Dose Index Registry, the NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director’s National Evaluation of X-ray Trends. (ACR Resolution 17 adopted in 2006 – revised in 2009, 2013, Resolution 52).

For further information on pediatric patients, see the [Image Gently[®] website](#) [64].

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR website (<http://www.acr.org/guidelines>).

When possible, it may be prudent, particularly in pediatric and young adult patients, to consider using magnetic resonance imaging (MRI) or ultrasound instead of CT to reduce radiation dose [65-70]. In patients with biopsy-proven advanced malignancies, positron emission tomography (PET) CT should be considered for staging [71]. In all patients, the lowest possible exposure factors should be chosen that would produce images of diagnostic quality. This is particularly true in pediatric patients. Whenever possible, multiplanar reconstruction should be used to avoid repeated direct scans.

For specific issues regarding CT quality control, see the [ACR Practice Parameter for Performing and Interpreting Diagnostic Computed Tomography \(CT\)](#) [60].

Equipment monitoring should be in accordance with the [ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography \(CT\) Equipment](#) [72].

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