D34 Object Orientation to Minimize Metallic Artifacts in Multi-Detector Computed Tomography and Maximize Resolution With Plain Radiography

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After attending this presentation, attendees will have a better understanding of basic imaging principles that can be used to improve image quality in forensics that are not as easily applicable in a clinical setting.

This presentation will impact the forensic science community by providing two imaging procedures that will improve image quality. Specifically, the first, related to Multi-Detector Computed Tomography (MDCT), will minimize streak artifact most notable when the data is used to create facial reconstructions. The second, relative to plain radiography, provides a method to avoid missing an occult fracture in a newborn or infant.

Introduction: Patient positioning and radiation dose limitations associated with clinical radiology are not a consideration in forensic imaging. Eliminating these restrictions provides the opportunity to utilize basic imaging principles to improve image quality that are not as easily applicable in the clinical setting. Two examples relative to object orientation will be discussed in the following presentation. The first, regarding MDCT, considers streak artifact created by dental fillings and most notable on three-dimensional reconstruction. When performing a skull examination on a live patient, there are few positioning options. The resulting 3D skull reconstructions of a patient with numerous bilateral premolars and molar fillings will exhibit streak artifacts projecting out of the mouth at right angles to the teeth. The second example relates to the X-ray tube focal spot in general or plain radiography. An object smaller than the focal spot size will appear as a blurred structure on the resulting image. Therefore, the dimensions and orientation of the rectangular focal spot within the X-ray tube is important when positioning an object to maximize resolution of subtle defects such as an occult fracture in a premature or newborn infant. However, in the clinical setting, due to monitoring and life support lines that might be attached to the patient, there may be limited choices for X-ray tube orientation. In addition, concern over the radiation dose will limit the technical factors and image receptor selection.

Materials & Methods: For the MDCT component of the study, the skull of an individual who died in 1886 and had numerous gold fillings was used to demonstrate orientation in an MDCT examination intended for a 3D reconstruction. The detached skull provided numerous positioning options. The skull and attached mandible were positioned with the sagittal suture parallel and perpendicular to the x-ray/detector rotation. In order to demonstrate the importance of positioning relative to the shape of the X-ray tube focal spot, a preserved fetal pig with an induced transverse fracture of the left third rib was radiographed. The specimen, with a crown-rump measurement of 29cm, was positioned with the fracture oriented both perpendicular and parallel to the smaller dimension of the focal spot. In addition, 40 kilovoltage-peak, kVp, much lower than would be clinically acceptable, was used for all the exposures.

Results: In the MDCT study, when the sagittal suture was aligned parallel to the tube/detector rotation, the streak artifacts were projected posterior to the teeth and not visible external to the mandible and maxillae. With the plain radiography, the occult rib fracture was more clearly demonstrated when the fracture was oriented parallel to the smaller dimension of the X-ray tube focal spot.

Conclusion: With fewer limitations regarding patient positioning and radiation dose, basic knowledge of imaging principle can be employed in forensics to improve image quality. Object orientation in MDCT can reduce streak artifact, improving 3D data sets used in facial reconstruction. In plain radiography, low kVp and object orientation relative to the shape of the focal spot improves image quality.

MDCT, Facial Reconstruction, Radiography

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