

A46 Improving Radiographic Visualization of the Frontal Sinus for Scientific Identification

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Learning Overview: After attending this presentation, attendees will understand the conditions that hinder imaging of the frontal sinus and be provided with a method for enhancing the morphology of the frontal sinus radiographically.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating a method of improving radiographic visualization of the frontal sinus using the radiopaque contrast medium Barium Sulfate (BaSO₄) for comparative medical radiography.

Contemporary research and case studies looking at the variability and reliability of the morphology of the frontal sinus for positive identifications have demonstrated the frontal sinus to be a valuable and unique point of correspondence for positive identifications in a medicolegal setting.^{1,2} However, due to the taphonomically altered nature of cases requiring positive identifications, capturing quality postmortem imaging of the cranium can be challenging. Autolysis of neural tissue is one of the earliest signs of decomposition, and in cases of advanced decomposition, liquefaction of the neural tissue increases radiographic attenuation, which can produce blurred features on postmortem imaging.³ Conversely, in skeletonized remains or burned cases with empty or thermally damaged cranial vaults, radiographic attenuation decreases, which can cause the X-ray beam to “burn” through features of interest. With digital radiographic equipment, these imaging concerns can be remedied by adjusting the preset peak kilovoltage (kVp) and milliampere-seconds (mAs) levels. However, this “trial-and-error” method of achieving the optimal settings can be a time-consuming process, especially if the individual conducting the radiography has limited experience or the equipment does not allow custom kVp and mAs settings.

From June of 2014 through September of 2020, forensic anthropologists at Western Michigan University Homer Stryker MD School of Medicine (WMed) conducted 311 comparative medical radiographic identifications for the Office of the Medical Examiner, 116 (37%) of which cited the morphology of the frontal sinus as a point of correspondence. Considering the frequency at which the frontal sinus is utilized, this pilot study aimed to increase the radiopacity of the sinus arcades by injecting the sinus with the radiopaque contrast medium BaSO₄ to improve visualization of the sinus and expedite postmortem imaging.

This study was conducted at WMed in Kalamazoo, MI, on 25 anatomical donors provided by the WMed Body Donation Program. Each donor’s preliminary full body radiographic scan (conducted by donation program staff at donor intake) was reviewed to determine if the donor exhibited a frontal sinus, the approximate number and shape (smooth or scalloped) of the arcades present on each side of the midline, and to determine optimal drill point locations to access the frontal sinus. If the cranium was still fleshed, the area of skin between the eyebrows was removed utilizing a scalpel and forceps, and drill points were made using a 3.2mm round fast-cutting bur. A 20% weight-volume BaSO₄-water solution was then injected into the drill points using a syringe. To reduce the likelihood of the solution following the natural sinus drainage pathway, one side of the hydraulic dissection cart was lowered so the donor’s head was lower than their shoulders. The drill points were overfilled to ensure enough of the solution was injected and spillage was wiped from the area. The donor was then re-positioned and radiography was completed using the preset cranium levels of 80kVp and 12.5mAs at a minimum 40" source-to-image distance.

This method proved to be a quick and effective way to improve visualization of the sinus, reduce the number of postmortem images taken, and standardize kVp and mAs values.

Reference(s):

1. Christensen, A.M. 2005. Testing the Reliability of Frontal Sinuses in Positive Identification. *J Forensic Sci.* 50(1): 18-22.
2. Kirk, N.J., Wood R.E., Goldstein M. 2002. Skeletal Identification Using the Frontal Sinus Region: A Retrospective Study of 39 cases. *J Forensic Sci.* 47(2): 318-323.
3. Levy, A.D., Harcke, H.T., Mallak, C.T. 2010. Postmortem Imaging. *Am J Forensic Med Pathol.* 31: 12-17.

Identification, Radiology, Frontal Sinus