


Practical Use of Forensic Imaging

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Background

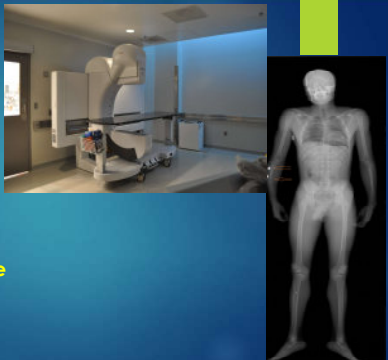
- ▶ State-wide Medical Examiner's office
- ▶ 15337 cases investigated in 2018, including 5604 autopsies (543 homicides)
- ▶ Two imaging modalities: Computed Tomography (CT) and Lodox stat scan
- ▶ Who performs the studies?
- ▶ Training

Background

- ▶ Interpretation of CT images
- ▶ Protocol for CT imaging (BFT cases, MVAs, opposition, pediatric cases younger than 2 years, elder abuse cases, adjunct tool for diagnostic or identification purposes)
- ▶ Protocol for routine x-rays (sharp force injuries, GSWs, burned bodies, unknowns)

Lodox (Low Dose X-ray)

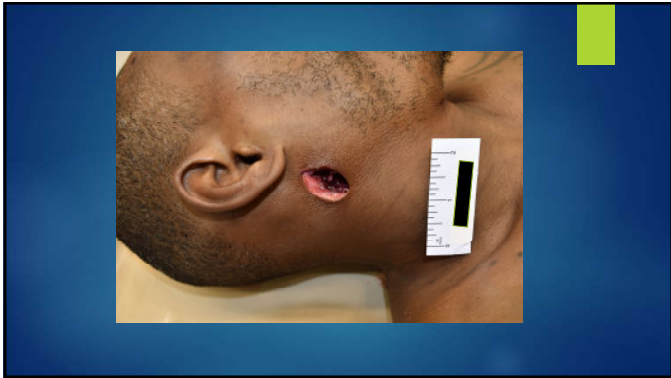
- Digital format
- Easy to operate
- Relatively inexpensive
- Fast

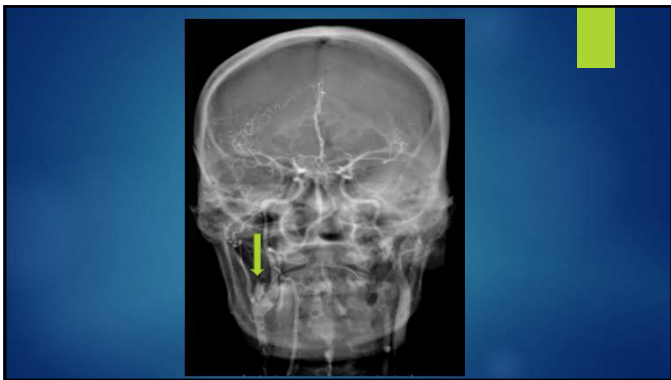


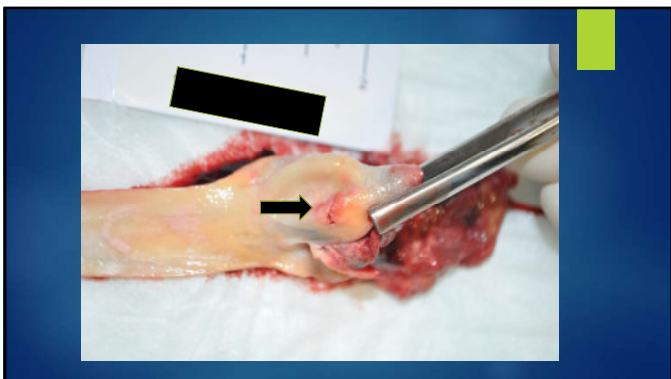
Out of the box use for Lodox

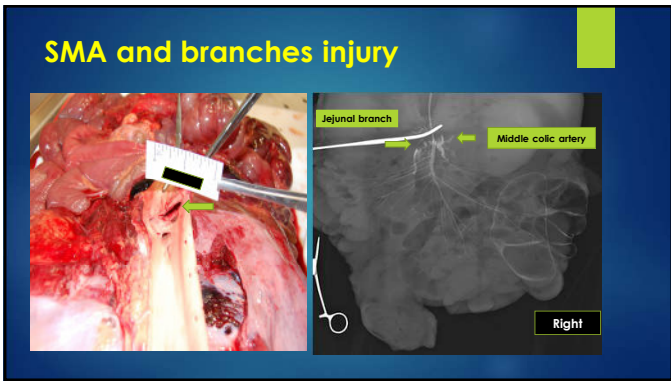
- ▶ Selective contrast imaging
- ▶ Material used (Foley catheter, water based contrast)
- ▶ Fast and easy to perform
- ▶ Cervical and cranial angiography, abdominal angiography, extremity angiography
- ▶ Saves significant amount of time
- ▶ Case selection: suspected cervical, cranial and other difficult to dissect vessels (i. e. vertebral arteries)



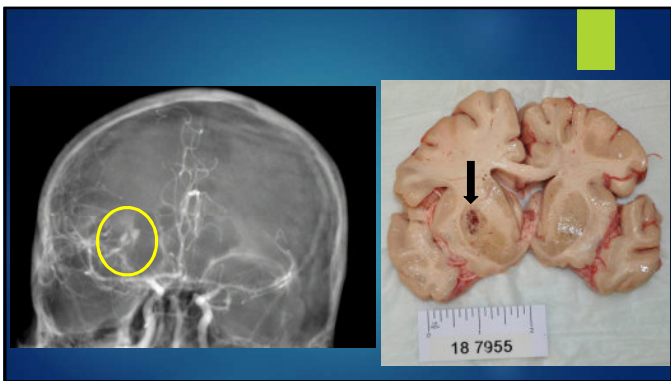








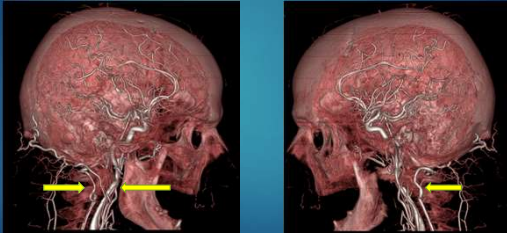




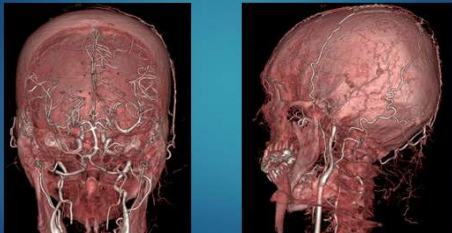
Selective CT angiography (CTA)

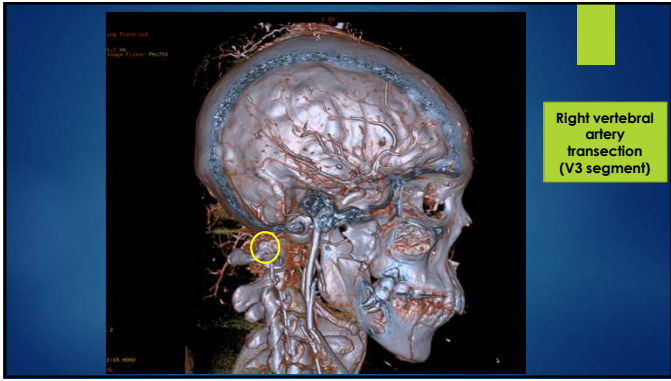
- ▶ Same method as Iodox angiography
- ▶ Contrast is diluted with water (50/50)
- ▶ Excellent detailed information
- ▶ Cervical/cranial imaging in approximately 10 minutes

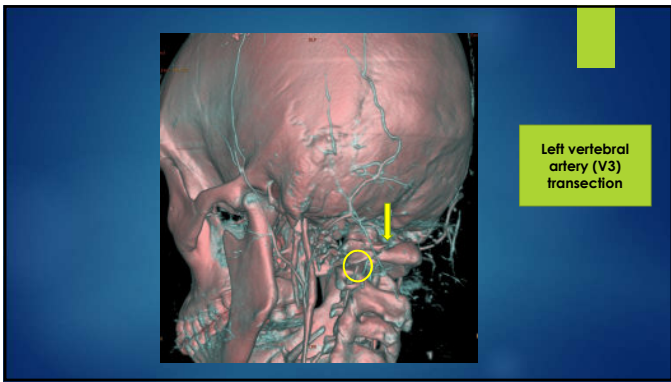
CT angiography

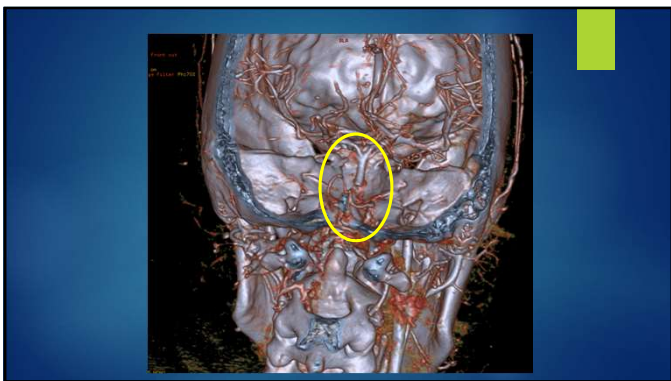


CT angiography





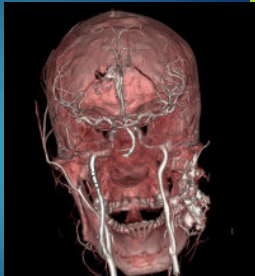
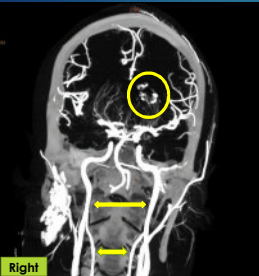




MIP coronal view:
Transection of bilateral
vertebral arteries







MIP coronal view



Identification using CT/CT comparison

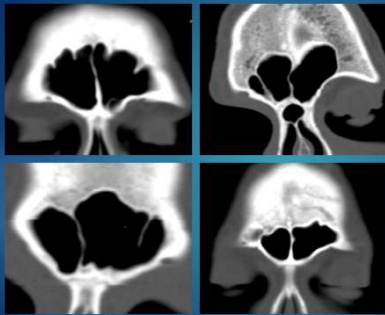
- ▶ CT scanning has proven to be a useful and scientific method of identification, especially in cases of limited radiographic studies or when partial anatomic remains available for identification
- ▶ Retrospectively and prospectively collected cases with postmortem CT images obtained from 2015 through 2017
- ▶ Cases were selected based on the availability of antemortem CT images

Identification using CT/CT comparison

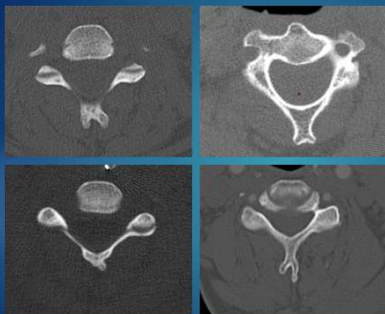
- ▶ Frontal and sphenoid sinuses have high individual variability and are very useful for CT/CT identification
- ▶ Due to their protected location, sphenoid sinuses are less prone to trauma and commonly available for comparison

Human identification

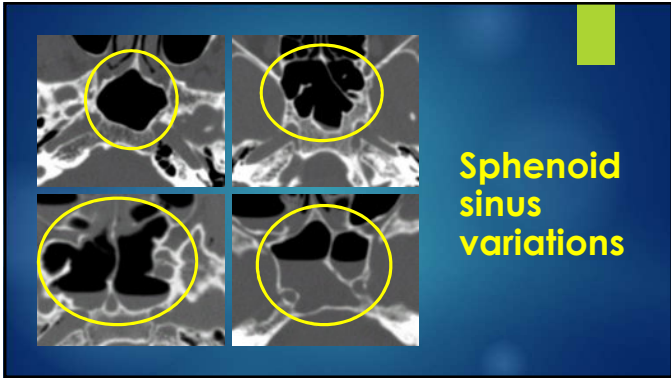
- ▶ Additional useful anatomic structures for identification include, but not limited to, contours of internal table of cranium, spinous processes, and degenerative changes
- ▶ Multiple locations, at least 3, should be used for positive identification

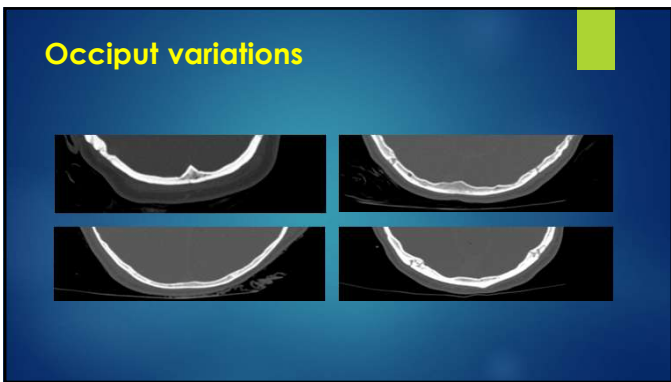


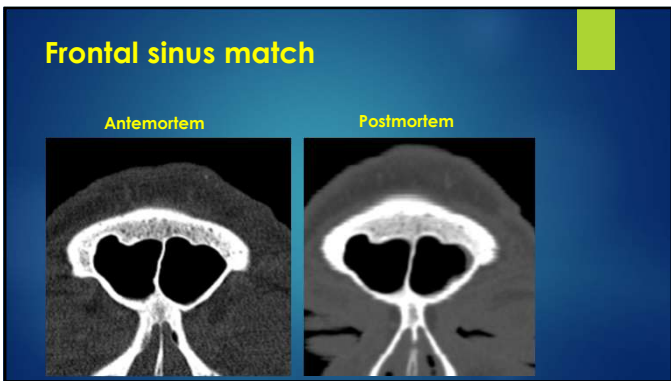
Frontal sinus variations

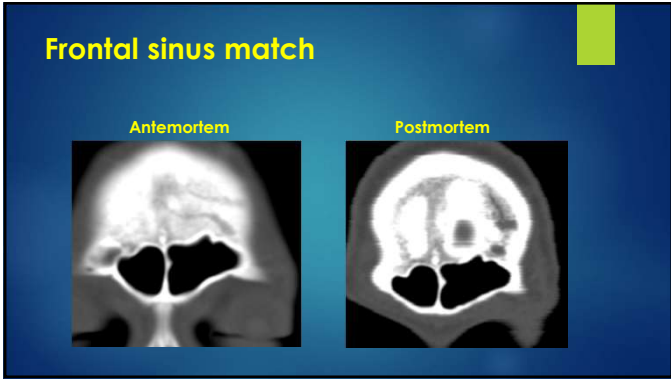


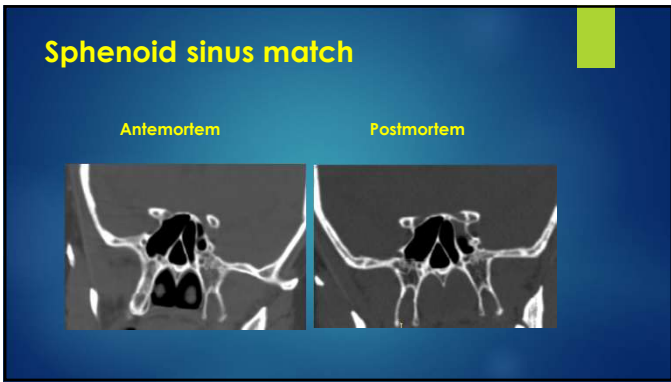
Cervical vertebra C2 variations

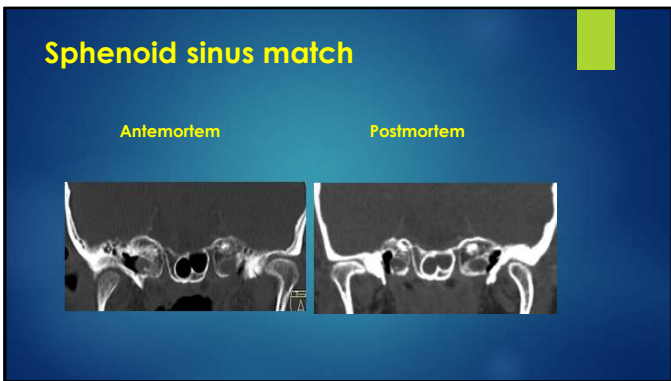


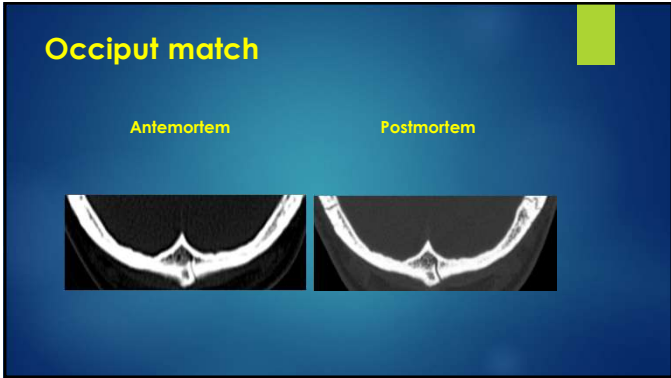


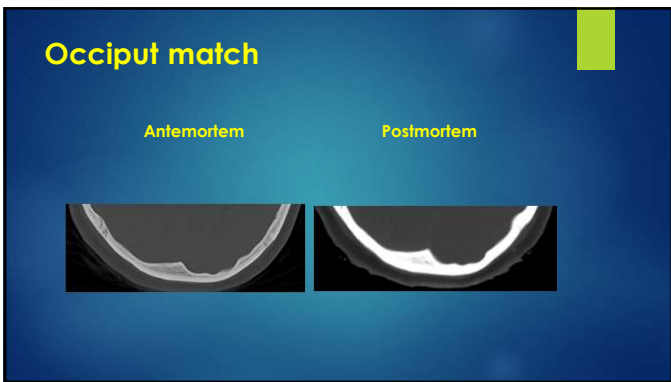


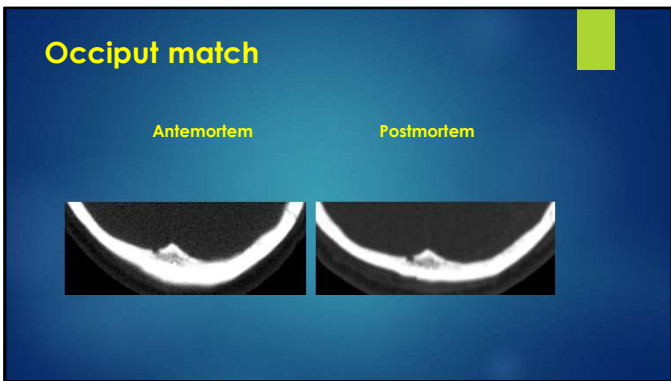


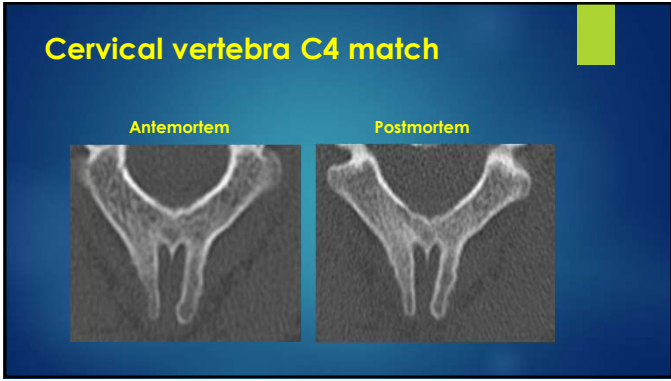


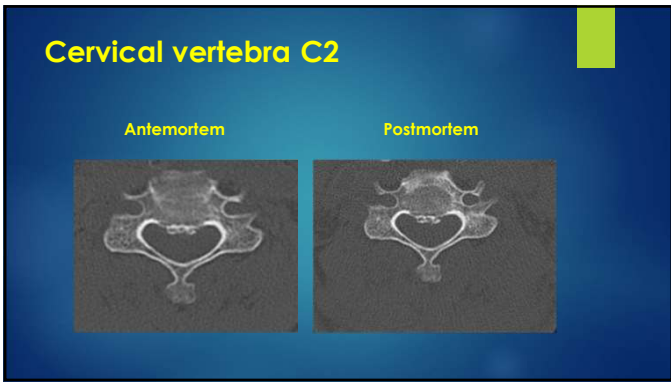


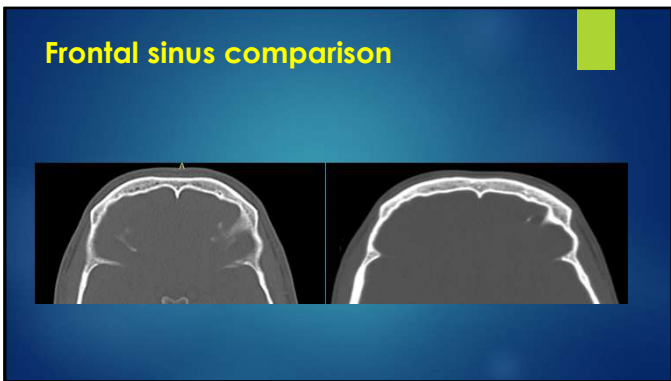


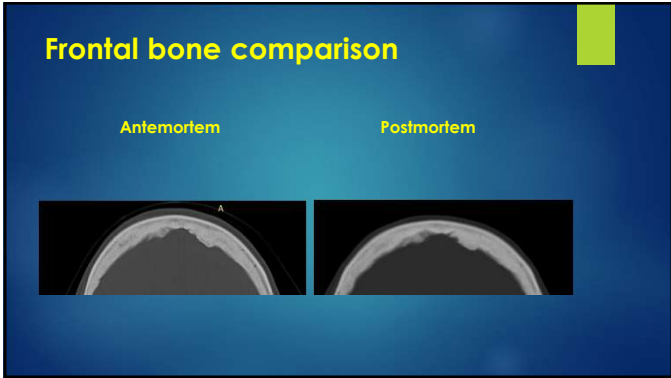


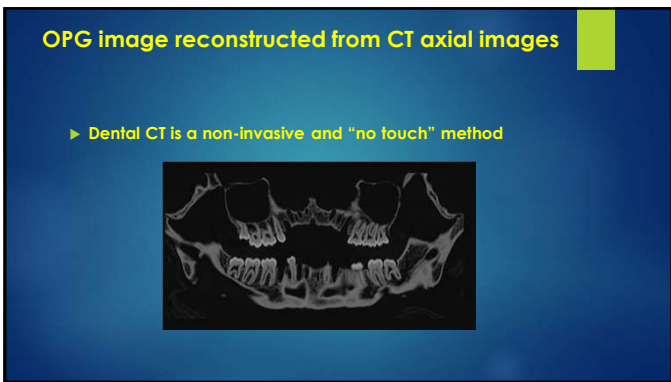


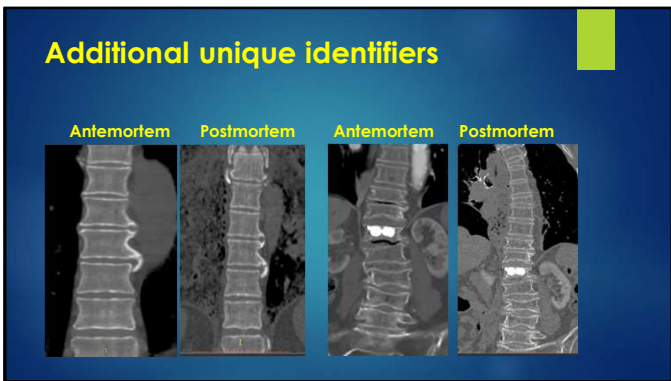












Scapula useful for sex estimation using CT images

- ▶ CT of scapulae in 290 cases were analyzed using logistic discriminant function developed in this study, showed 94.5% accuracy in estimating sex
- ▶ The results of the study showed that data obtained from volume rendered postmortem CT images can be considered reliable and treated as a practical option to standard anthropological methods, especially in mass fatalities as a rapid triage tool for sex determination

FORENSIC SCIENCES

Paper | Pathology

Estimating Sex Using Metric Analysis of the Scapula by Postmortem Computed Tomography


Sabulhan Ali M.D., Christopher Cox Ph.D., Michalee N. Stock M.A., Abby E. Zandier vanWitland M.D., Paul Butler M.D., Ph.D., David B. Fowler M.D.

Scapula width: 108.1 mm (2D)

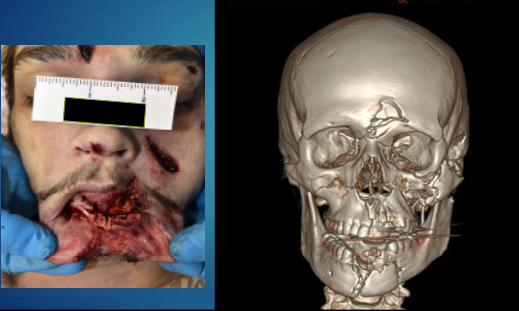
Scapula height: 152.3 mm (2D)

CT for court presentation

The First Use of Postmortem 3D Computed Tomography Images as Evidence in U.S. Criminal Courts: A Report of Four Cases
Zakariah AS, MD, Barry DS, MD, Casel R, Foster MO
First Published December 1, 2015 | Research Article | [Check for updates](https://doi.org/10.21967/2015-069)



Court presentation

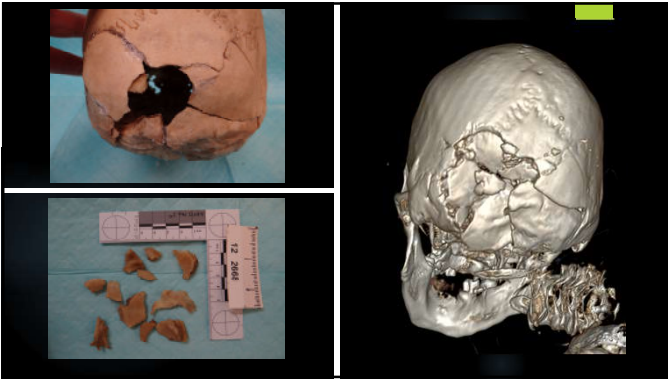


Court presentation

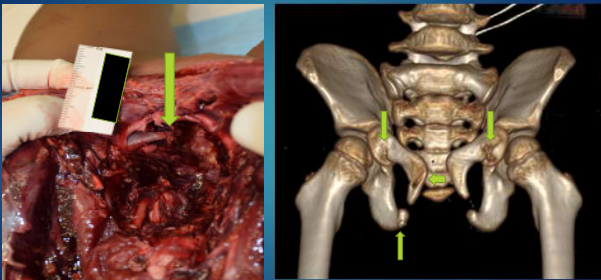


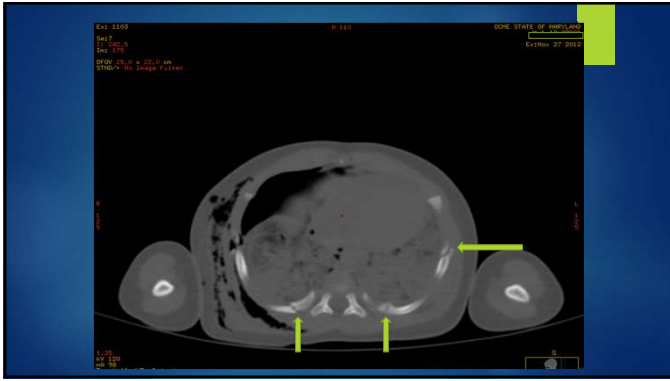
A 58 year-old male found in a wooded area

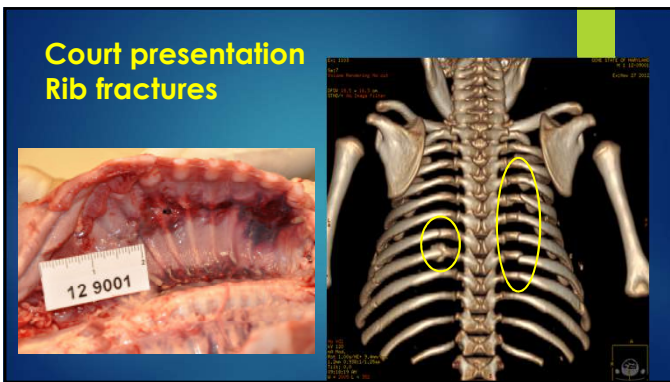


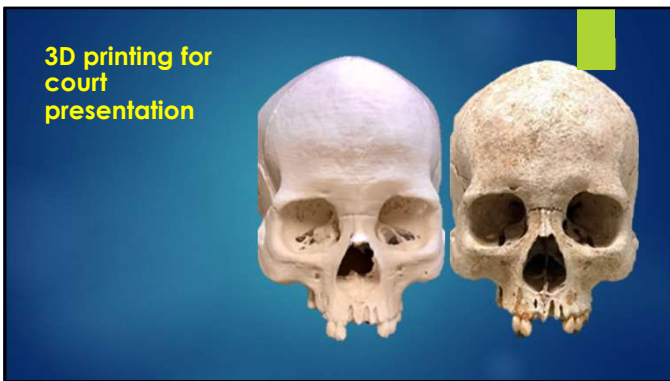


Court presentation (pelvic fractures)









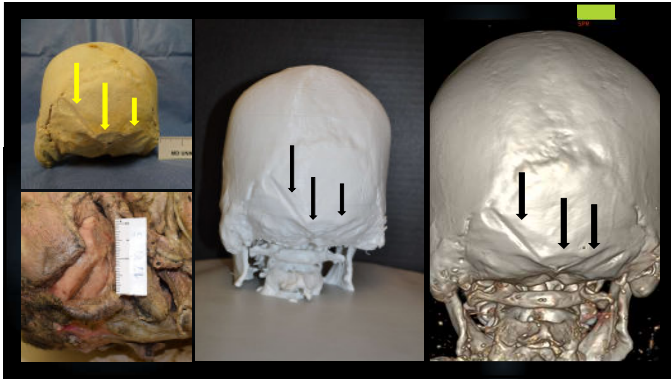
Forensic Sci Int. 2014 May;238:133-40. doi: 10.1016/j.foresint.2014.03.005. Epub 2014 Mar 15.
Accuracy and reliability of measurements obtained from computed tomography 3D volume rendered images.

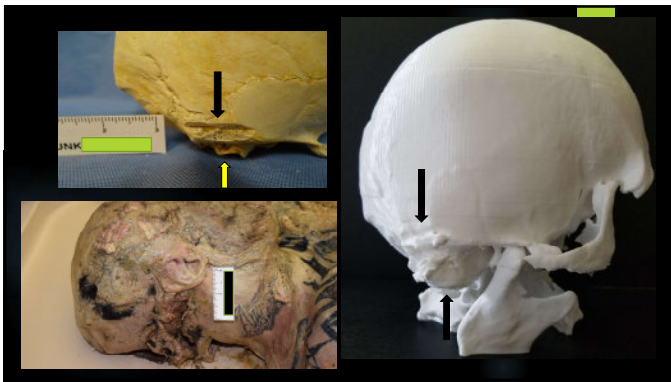
Shi MK¹, Tsai ML², Ah Z³, Fowler DS⁴

- ▶ The CT and dry bone measurements were generally within 2mm for each comparison
- ▶ Overall, minimal differences were found among the data sources and high accuracy was noted between the observers, which proved CT images are an acceptable source to collect osteometric variables



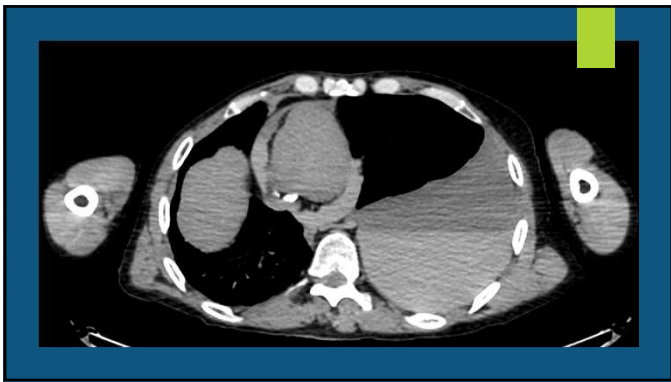


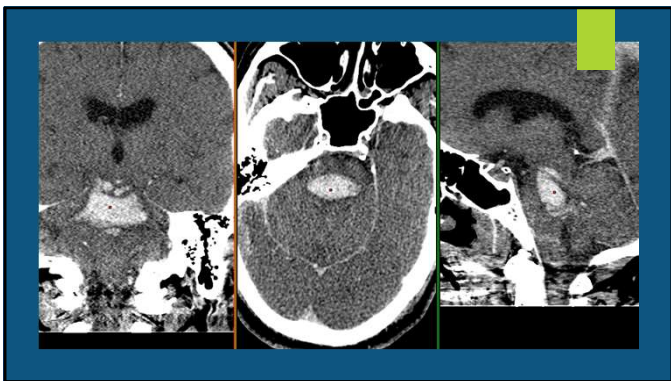




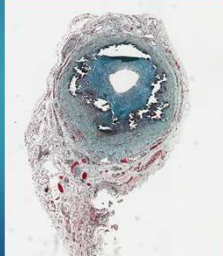
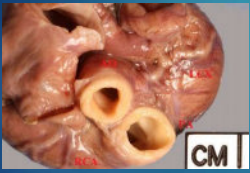
Examples of Cases in which CT helped with Diagnosis and cases of family opposition







Generalized Arterial Calcification of Infancy (GACI)



Conclusion

- ▶ CT is a very useful adjunct modality for forensic diagnosis
- ▶ CT volume rendered images and 3D printing are valuable tools for court presentation
- ▶ Selective CT and analog x-ray angiography are easy and inexpensive to perform and can eliminate the need for tedious dissections

Conclusion

- ▶ CT is extremely valuable in cases of family opposition and trauma cases
- ▶ Drawbacks of operating CT (expensive), lack of identification of surface injuries, visceral trauma
- ▶ CT is useful for identification
- ▶ CT measurements are accurate and can be used in anthropology without the need of soft tissue removal

References

1. Ali Z, Cox C, Stock MK, Zandee vanRiland EE, Rubio A, Fowler DR. Estimating Sex Using Metric Analysis of the Scapula by Postmortem Computed Tomography. *J Forensic Sci.* 2018 Sep; 63(5):1344-1349. doi: 10.1111/1556-4029.13751
2. Zabiullah Ali, Barry Daly, David R. Fowler. The First Use of Postmortem 3D Computed Tomography Images as Evidence in U. S. Criminal Courts: A Report of Four Cases. *Journal of Academic Forensic Pathology.* 2015 Dec1
3. Ali Z, Bolster F, Goldberg F, Li L, Fowler DR. Systemic air embolism complicating upper gastrointestinal endoscopy: A case report with postmortem CT scan findings and review of literature. *Forensic Sci Res.* 2016; 1 (1): 52-57 doi:10.1080/20961790.2016.1252898
4. Accuracy and Reliability of Craniometric Variables Obtained from 3D-Computed Tomography Images. Kyra E. Skull, M.S, Meredith L. Tise, M.S., Zabiullah Ali, M.D., David R. Fowler, M.D. *Forensic Sci. Int.* 238 (2014):133-140
5. Ferdia Bolster, Zabiullah Ali, Pamela Southall, David R. Fowler. Generalized arterial calcification of infancy—Findings at post-mortem computed tomography and autopsy. doi.org/10.1016/j.foresciint.2015.06.017
