Physical and structural obstacles for post-mortem computed tomography quality

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Introduction

- Post Mortem CT (PMCT) image quality is affected by the same factors as *in vivo* CT image quality, as well as new factors such as decay and incineration

- Impaired image quality can lead to ambiguous or erroneous conclusions

- Of relevant factors are:
  - Correct centering, so that the scanner can calculate dosage correctly, for optimal image quality.
  - Positioning of the body, so anatomy does not overshadow other anatomy and the entire region of interest is within the scan field of view
  - Metal artefacts, hereunder localization and amount

- Knowledge of the distribution and nature of the factors that reduces the image quality, is important to be able to address them

- The aim of this study was to retrospectively explore the types and frequencies of factors leading to reduced diagnostic quality of PMCT scans, at a facility where PMCT's were performed by non-technologists

Materials and methods

- One hundred PMCT scans, 2018–2019, were examined retrospectively.

- Inclusion criteria were: over 15 years of age at death and Full Display Field Of View scan

- All scans were performed on a GE Healthcare Lightspeed VCT 64 slice scanner

- For each scan, anatomy outside of scan field of view, localization of metal objects, centering, body type and state of decay was registered.

- The observations were made on a high-quality screen and evaluated by two observers.

- The data was analyzed in Stata 15.1

ACQUISITION PARAMETERS	
TUBE VOLTAGE (KV)	120
AUTO MA RANGE	150-700
SLICE THICKNESS (MM)	1.25
HELICAL PITCH	0.516
ROTATION TIME (S)	0.60
NOISE INDEX	21

Results – centering

- The deceased was off-center in 77% of the scans

- Off-centering was correlated with the condition of the deceased at the time of scanning

- Weight status also correlate with centering. One hundred percent of underweight, 76% of normal weight and 70% of the overweight deceased were off-center
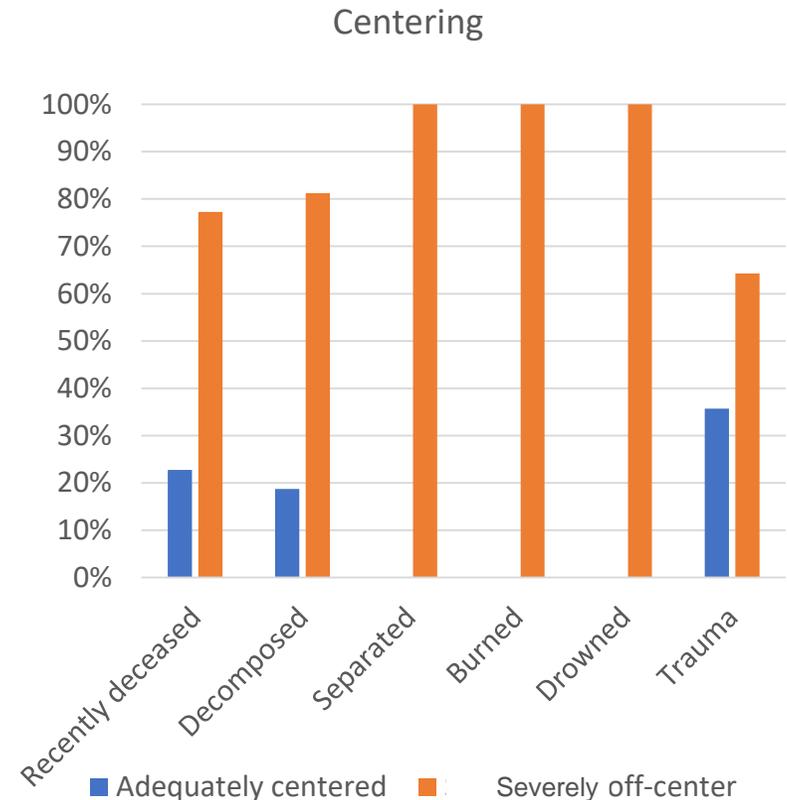
Centering

Table 1.
Ratio of deceased that are adequately centered, or severely off-center, categorized on status of the deceased

Results – missing anatomy and positioning

- One hundred percent of scans had some anatomy out of Field Of View, resulting in out of field of view artefacts. Missing anatomy was predominantly vertex and elbows

- Part of the anatomy was also missing in the truncal area; thorax area was affected in 21%, abdomen in 19% and pelvis 26% of scans

- In 53% of the scans, the head was not centered correctly

- Arms were placed next to, or on the trunk, and often asymmetrically

Figure 1. Example of scan with anatomy outside scan field of view.
Besides missing information, the incomplete projection also results in streak artifacts, causing sub-optimal imaging of the thoracic cavity

Results – metal artefacts

- More than 90% of the scans had metal artifacts that affected the imaging

- Metal objects were found both internally and externally of the deceased

- Loose metal (keys, coins, phones), were often placed on top of the body, or next to the head
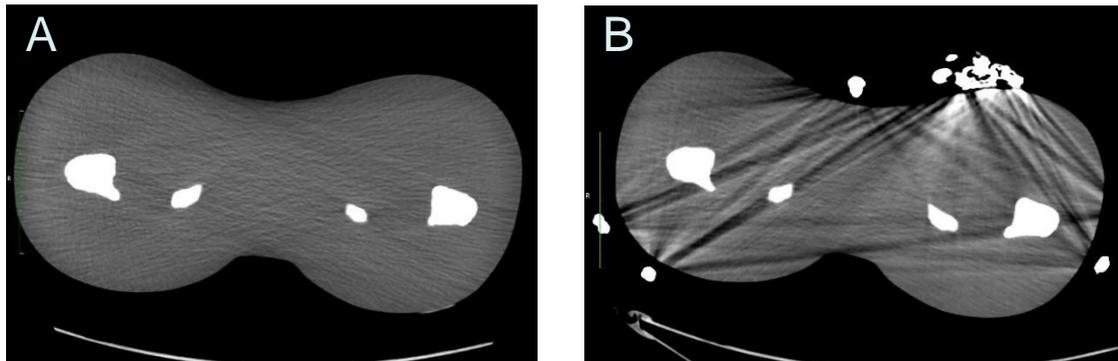

Figure 2. Metal artefacts from dental implants.
A represents deceased without dental implants.
B represents deceased with dental implants. Notice how metal interacts and cause streak artifacts in the scan.

Figure 3. External metal in the pelvic area.
A represents deceased where no metal is present.
B represents deceased with metal objects present; keys, zipper, buttons and studs.
The metal interacts, even over large distances, and causes streak artifacts and shadows that can mask anatomy

Conclusions part 1

- PMCT pose a set of challenges, partially overlapping with *in vivo* CT

- Image quality is directly linked to diagnostic potential of the images

- Most of the factors that reduced image quality can be avoided

- Correct positioning of the deceased is complicated both by legal and practical challenges

Conclusions part 2

- External metal should be removed whenever possible. Belt buckets, rings, coins, keys, phones, chains and metal buttons can interact substantially with image quality

- If the deceased must be scanned with all objects, loose metal is preferably located near the feet, rather than near the head

- Overall, when PMCT is performed by non-technologists, education in image quality is essential

- We suggest: Place a poster in the scanner room, to remind scan personnel of factors that increase image quality

Suggested poster

Before scan, please make sure that:

- Loose metal is removed from the body, or placed by the feet

- Vertex and toes are within the scan field

- Body and head is centered, to the degree possible

- The body is placed symmetrically

- When possible, place the arms over the head of the deceased
  - If not possible, distance arms from the trunk using a pillow

Thank you!

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Limitations

- The study was performed at only one institution

- Study population was limited to one hundred scans, with a low number of burned, drowned and severed deceased present

Ethics committee approval / Funding

- This study was a quality improvement study and did as such not require ethics committee approval under Danish law

- There has not been applied for funding for this study