A48 Incorporating the "Black Bone" Magnetic Resonance Imaging (MRI) Technique: A Radiation-Free Alternative to Computed Tomography (CT) for Biological Profiling in the Living

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After attending this presentation, attendees will be familiar with a novel, non-ionizing Magnetic Resonance (MR) technique with the potential to eliminate the need for CT in future biological profiling research.

This presentation will impact the forensic science community by introducing the radiation-free "Black Bone" MRI sequence, which, when 3D rendered, provides diagnostic image quality equivalent (for the purposes of age estimation) to that of CT scanning.

For forensic anthropologists, called upon for investigations involving both the living and the recently dead, the future does not lie in the past but in the present. To make the most appropriate profiling estimations, a constantly updated understanding of modern populations and how they change is of paramount importance; however, as reference collections, and he techniques and assumptions based upon them, become increasingly removed from the people of today, this becomes more and more difficult with each passing year. In order to remain knowledgeable about the populations that constitute the bulk of the anthropologist's casework, it is imperative that we begin to update our reference material as quickly and as comprehensively as possible. To do this, an intensified focus into medical imaging is required. Bone is optimally imaged by CT; however, due to ethical considerations regarding ionizing radiation exposure, imaging studies have been limited to patients already being examined for other purposes. This precludes the recruiting of volunteers for specific investigations such as the effect of substance abuse on aging from the fourth rib. For such a study, individual substances would have to be separated so as not to confuse results (smokers often drink and drinkers often smoke, so two groups — a smoking-only group and a drinking-only group — would have to be recruited to isolate these variables). This type of tailoring is currently impossible due to the restrictions surrounding CT, effectively stifling advancement in this area until an alternative can be found.

"Black Bone" MRI offers a potentially revolutionary solution, achieved through a novel approach, to overcome the notorious failures of routine MRI techniques in 3D bone imaging. Utilizing a gradient echo sequence with a low flip angle (optimized to 5°), short Repetition Times (TR=8.6ms) and Gradient Echo times (GE=4.2ms), "Black Bone" MRI enhances the soft tissue-bone interface by reducing the contrast of the surrounding soft tissues and medullary bone. This results in bone appearing densely black (hence "Black Bone") while the surrounding tissue remains a uniform gray, thus lending itself to 3D bone-rendering techniques.[1] "Black Bone" MRI has been utilized in a range of clinical settings, particularly within the head and neck, with successful 3D bone reconstruction. Recognizing the forensic potential of this technique, a small pilot study was focused upon reconstructing the pubic symphysis to investigate its applications for biological profiling.

Five patients undergoing multimodality (both MRI and CT) imaging of the pelvis for routine clinical care at Oxford's Churchill Hospital, United Kingdom, were recruited. "Black Bone" MRI images of the pubic symphysis were 3D rendered utilizing a range of image-processing techniques. Age estimation was performed on both the "Black Bone" MRI and CT images using the Suchey-Brooks method for aging the os pubis.[2] Results for both modalities were then compared and correlated with known age. In each case, "Black Bone" MRI proved an equally suitable medium for age estimation from the pubic symphysis.

In conclusion, this pilot study demonstrates the promising, immediately applicable advantages of the "Black Bone" MRI technique both in current forensic context and as a much-needed potential replacement for CT in future biological profiling research.

Reference(s):

1. Eley K., McIntyre A., Watt-Smith S., Golding S. ''Black bone'' MRI: a partial flip angle technique for radiation reduction in craniofacial imaging. *Brit J Radiol* 2012;85:272–278.
2. Brooks ., Suchey J. Skeletal age determination based on the os pubis: a comparison of the Ascaadi-Nemeskeri and Suchey-Brooks methods. *Hum Evol* 1990;5:227-238.

Biological Profiling, Medical Imaging, Living Participants

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