Assessment of Human Trabecular Architecture in the Pubis by Three Radiographic Modalities

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Assessment of human trabecular architecture in the pubis by three radiographic modalities

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1. Introduction
The present descriptive technical aspects of an investigation into the use of non-destructive radiological analyses of pubic cancellous bone structure to estimate age-at-death of human skeletal remains. This study stems from findings in X-ray plain films, of increased remodelling and orientation of trabecular structures with age [1]. Likely concern with the microstructural remodelling of the symphyseal surface currently used in estimation of age-at-death.

The study uses three non-destructive X-ray imaging modalities: plain film radiography, computed tomography (CT), and micro-CT (μCT). Plain film radiography has greater spatial resolution than CT [2] and is relatively inexpensive, widely available, and, with portable X-ray units, even accessible in the field for archaeological and forensic applications. CT scanners are largely restricted to clinical settings due to the size, sensitivity, and cost of the machine, but offer a greater contrast resolution than plain film radiography [2]. More expensive and more precise, μCT scanners are further restricted in their availability and accessibility, but CT and μCT modalities provide volumetric data, avoiding the confounding of overall cortical and trabecular structure and the apparent increase in density with element thickness in plain film radiography.

2. Methodology

2.1 Data Acquisition

The pelvis was scanned in a CT scanner (0.2 mm, 2 min.) in the antero-posterior view, using Kodak Ektavision 5 film.

2.2 Data Processing

2.2.1. Line profile tool – measuring changes in pixel value along a line
2.2.2. Standard Axial Scan – 0.625 mm thickness, 120 kV, 200 mA, 0.25 pitch
2.2.3. scout scan – to locate an ROI

2.3. Micro-CT

The pelvis was scanned in a micro-CT scanner (120V, 20 kV), using 300-500 μm voxel size, and 200 mA. The image was taken and re-orientation processes were performed.

3. Results

Jello

In order to improve the resolution of trabecular structures in CT scans, a protocol was devised for simulating soft-tissue in close contact with the sample. While water is the ideal medium for simulating soft-tissue, the scientific value of the simulated remodelling is questionable.

HMH Thresholding

When bone and air are scanned in the same voxel (3D pixel), the resulting density value for that voxel is an averaged value (partial volume effect). As each, a threshold value must be provided which all material is treated as bone and below as non-bone. Difference in threshold value can lead to over- or under-representation of trabecular structures. To ensure reproducibility and objectivity the half-maximum threshold method was used.

Thresholding Method

Adapted from Fujita and colleagues [3].

Orientation was adjusted according to the fit of individual pelvis

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References

Literature cited