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Could image analysis of pQCT scans provide additional information about bone strength?

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According to the mechanostat theory, bone adapts to loading by modelling and remodelling. This modifies the absolute and relative morphology of the periosteal and endosteal bone surfaces. These surfaces define the size and shape of bone and the distribution of its mineral mass, which are determinants of bone strength. Our previous observations from two populations (Cambridge, UK and rural Gambia) with contrasting lifestyles and levels of physical activity, have suggested differences in cross-sectional bone shape and size, such as greater medullary and total cross-sectional area in Gambian subjects. Studies comparing prehistoric hunter-gatherer and agricultural populations with diverse activity levels have also shown differences in tibial shaft shape and strength. However, there is as yet no consistent set of pQCT-based analyses to quantify differences in bone shape and mineral distribution.

We are developing a novel method to quantify differences in bone shape and distribution for pQCT data from cortical sites. The first step involves extracting data from pQCT scans. We have explored exporting images in different formats (jpeg, bitmap, tiff etc.), and at different resolutions (238, 2048 pixels); using raw data directly (.m0* files); and exporting to an image analysis program (Image J). After data extraction, measures of bone size and strength are determined, including moment of inertia, overall bone shape, periosteal contour and orientation, and variation in cortical thickness.

Current work includes optimising the procedure to extract pQCT data, and an algorithm and software development to analyse data. We are using previously collected pQCT scans from Cambridge and Gambian adults. Results will be validated using data from early hominid bones for which dimensions have been obtained directly. We plan to apply this method to compare Gambian and Cambridge populations. This method may be extended to include relevant measures in trabecular sites.

The authors have no conflict of interest.

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