All that fractures is not bone: microscopic anatomy of vertebral bodies

Alan Boyde & David Mills Queen Mary University of London

a.boyde@qmul.ac.uk

Barts and The London School of Medicine and Dentistry

Introduction

The present study began by examining variations in the degree of mineralisation of 'bone' in lumbar vertebral bodies, and progressed to identifying and characterising high density materials in cortices and end-plates.

Material & Methods

3mm thick para-sagittal slices of L2 (38 male, 31 female, 70±15 years); embedded PMMA; micro-milled block surfaces carbon coated; quantitative 20kV BSE SEM; later polished to remove coating & re-imaged, then stained with iodine vapour and imaged again to reveal (uncoated, at 50Pa) uncalcified matrices. Correlation with high-contrast x-ray microtomography (XMT) at 20 or 30 micron voxel resolution, and with thin undecalcified sections cut from block faces by laser ablation microtomy and examined by polarised light microscopy and staining.

Also 50 macerated L3 & L4 slices for 3D SEM imaging.

Results

40-50% of all 'bone' lies in bin 5 of 8 of our qBSE calcified tissue distribution (~ 1.99g/ml) = orange in pseudo-colour images and histogram bars. ~28% is more highly mineralised (bins 6-8, red, pink, grey pseudo-colours). Much or most of this is **not** bone.

Take home message

Central compression fractures +/- implosion of disc content into the central cancellous domain involve failure in calcified cartilage or fibrocartilage of the end-plates. Anterior wedge compression and collapse fractures include the cortex which may be very (or vanishingly) thin or even vanished anteriorly. This frequently contains Sharpey fibre bone, calcified fibrous periosteum, and **calcified ligament**. These five highly mineralised matrices are not bone and should be expected to have different mechanical properties.

Keywords Osteoporosis, bone, fracture, calcified ligament, calcified periosteum.