



Oral Abstract

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Intrinsic bone quality in fragility hip fracture patients: altered mineralisation and damage accumulation

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Bone strength is determined by a number of inter-related variables, including bone mass, geometry, and bone quality. Bone quality consists of bone turnover, microarchitecture, mineralisation, matrix composition, and damage accumulation. This study aimed to identify material and structural factors that contribute to bone quality in fragility hip fracture patients (Fx) and age-matched controls (C). Intertrochanteric bone cores were obtained from patients undergoing hemi-arthroplasty surgery for a non-traumatic subcapital femoral fracture (7f, 5m, mean age 80 [67-91] years), and from controls at autopsy (9f, 4m, 77 [65-88] years). Samples were resin-embedded for quantitative backscattered electron imaging of the degree of mineralisation, and morphometric assessment of bone architecture, resorption, and microdamage. Trabecular bone volume, architectural parameters, and indices of bone resorption were not different between groups. Both groups showed normal distributions of percent calcium; however, the fracture cohort was less mineralised (mean % calcium: Fx:24.2%, C:24.9%). Linear microcrack parameters were similar between groups. Whereas diffuse damage was increased in bone from fracture patients ($DxV/BV[\%]$: Fx:1.51(0.19-4.67), C:0(0-0.33), $p<0.01$ [median(quartiles)]). The ratio of damage (cracks and diffuse) density to resorption site density was higher in the fracture group compared to controls (Mdx.Dn/Rs.Dn: Fx:0.44(0.10-0.86), C:0(0-0.31), $p<0.01$), which is suggestive of an unrepaired microdamage burden in the fracture cohort. Collectively, these data suggest that increased fragility fracture risk is associated with under-mineralisation and damage accumulation rather than changes in bone architecture. Inclusion of bone material property data together with other bone quality measures may hold the key to better fracture risk assessment and treatment efficacy.