

## Advancing Clinical Diagnosis of Bone Diseases using X-ray Diffraction

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Bone, teeth and even ectopic calcifications within the human body can be identified as biological hydroxyapatite. This mineral has been extensively studied over the years in its synthetic, geological and biological form with these studies providing a greater understanding of the physicochemical characteristics of hydroxyapatite. Unfortunately, the physicochemical attributes of biological apatites are often forgotten when the human body begins to fail or becomes diseased. The risk of fracture in osteoporotic bone is for example measured using dual energy X-ray absorption (DEXA) which considers only the total volume of bone present and its density. The nanoscale building blocks of bone and consequently the chemistry are rarely considered when bone mechanically fails, yet just like Brooklyn Bridge, the material used to build the structure is equally important as the architecture.

The research presented here details the physicochemical information from biological apatites which can be unlocked from X-ray signatures. Further, the research highlights the parameters which differ between diseased and normal tissues for both osteoporotic bone and breast calcifications. The potential clinical implications this information can provide for both bone diseases and breast cancer is also highlighted. This work has predominately been carried out *ex vivo* within a laboratory setting; however this research has also considered the technological developments required to measure these X-ray signatures and consequent parameters *in vivo*. These novel developments will also discussed during this presentation.

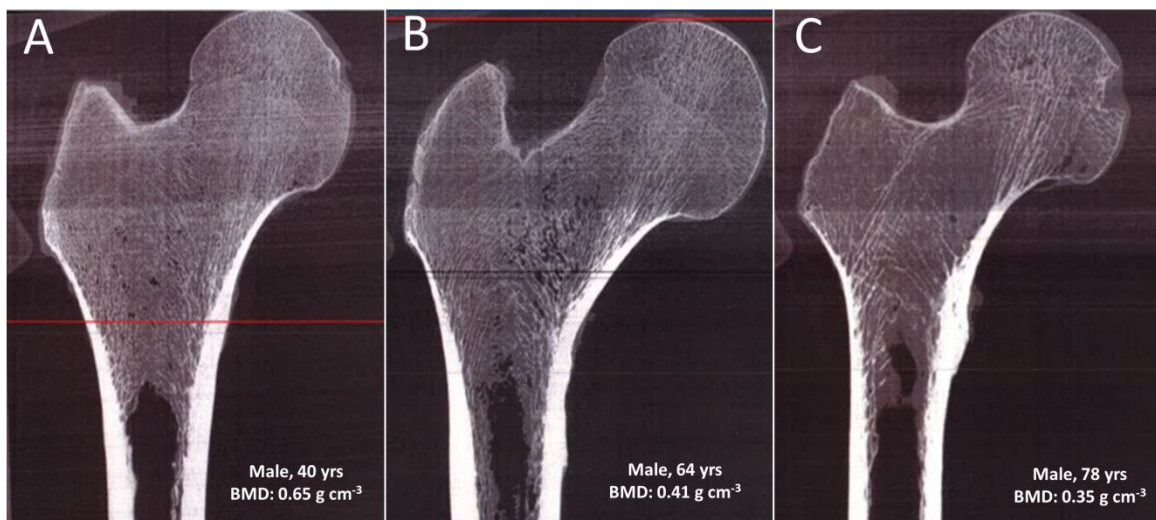


Figure 1: CT images highlighting the progressive loss of bone mineral with increasing age. From the bone mineral density values, calculated using DEXA, individuals B and C would have a high fracture risk. However, can the architecture provide all the answers? How do the physicochemical properties of bone influence the probability of fracture?