

Cysts and low subchondral bone mineral density: are they relevant to cartilage damage?

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INTRODUCTION: Osteoarthritis (OA) is a degenerative joint disease, typified by a loss of cartilage and subchondral bone at the interface of a joint. It affects bone cartilage and underlying bone. Mechanically, the underlying bone provides support to the healthy growth of the overlying cartilage. However, with the progress of OA, bone losses and cysts occur in the bone [1] and these would alter the biomechanical behaviour of the joint, and further leading to bone remodelling adversely affect the overlying cartilage. .

METHODS: Human femoral head and femoral condyle were collected during hip or knee replacement operation due to the end stage of osteoarthritis (age 50-70), and the cartilage patches were graded and marked [2]. The samples were preserved in 4% formaldehyde in phosphate buffered saline solution. A volunteer patient, with minor cartilage injury in his left knee while the right knee is intact, was used as control. Peripheral quantitative computed tomography (pQCT) was used to scan the bone. The sagittal and coronal slices were used for vBMD analysis. A 2 x 2 mm area of interest (AOI) was used to determine the volumetric bone mineral density (vBMD) distribution.

RESULTS: The examination of retrieved tissue explants from osteoarthritic patients revealed that patches of cartilage were worn away from the articular surface, and patches of intact cartilage were left (Figure 1(a)). The cysts, ranging from a millimetre to 10mm were existed in all osteoarthritic bones, and were located close to cartilage defects in the weight-bearing regions (Figure 1(b)), and closely associated with the grade of cartilage defect as measured by pQCT. The analysis of volumetric bone mineral density (vBMD) distribution demonstrated that the bones around cysts had much higher vBMD than the trabecular bone away from the cysts. The wall of cysts is formed of cancellous bone, whose trabeculae are reinforced by new bone formation. Compared to the subchondral bone under thicker cartilage, subchondral bone within cartilage defect has higher vBMD. This may result from the mechanical stimulation as a result of bone-bone

direct contact with less protection of cartilage in cartilage defect regions.

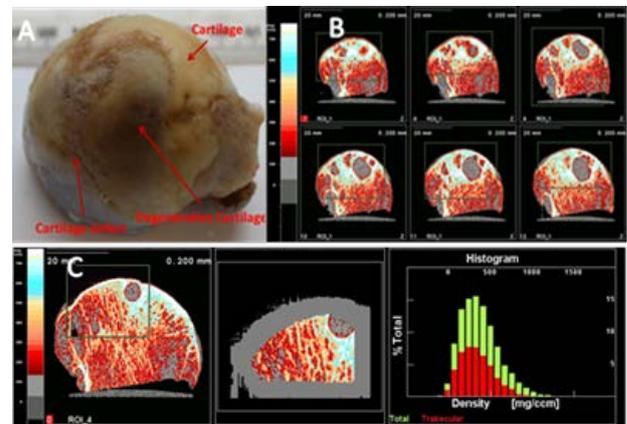


Figure 1: (a) Patches of undamaged cartilage, degenerative cartilage and large cartilage defects were observed (b) pQCT sequential scan revealed large cysts existed in the subchondral bone, and significant bone losses in the peripheral region of cartilage defects, and (c) vBMD distribution within subchondral bone

DISCUSSION & CONCLUSIONS: This study showed an association between cartilage defect and subchondral bone mineral density distribution. Cysts were observed in all osteoarthritic samples and they are located close to cartilage defects in the weight-bearing regions. Cartilage defect altered the loading pattern of the joints, this leading to the bone remodelling and resultant bone structural changes as compared to the normal bone tissues.

REFERENCES: ¹ O. Mass, G. B. Joseph et al (2015) Osteoarthritis and Cartilage 23 (10): 1713-1720. ² Pritzker KPH, Gay S, Jimenez SA, Ostergaard K, Pelletier JP, Revell PA, et al. (2006) Osteoarthritis and Cartilage. 14:13- 20

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