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Subchondral bone microarchitectural and mineral properties and expression of key degradative proteinases by chondrocytes in human hip osteoarthritis

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Abstract

Background: The purpose of this study was to investigate the relationship between the expression of key degradative enzymes by chondrocytes and the microarchitectural and mineral properties of subchondral bone across different stages of cartilage degradation in human hip osteoarthritis (OA). **Methods:** Osteochondral samples at different stages of cartilage degradation were collected from 16 femoral heads with OA. Osteochondral samples with normal cartilage were collected from seven femoral heads with osteoporosis. Microcomputed tomography was used for the investigation of subchondral bone microarchitecture and mineral densities. Immunohistochemistry was used to study the expression and distribution of MMP13 and ADAMTS4 in cartilage. **Results:** The microarchitecture and mineral properties of the subchondral plate and trabecular bone in OA varied with the severity of the degradation of the overlying cartilage. Chondrocytes expressing MMP13 and ADAMTS4 are mainly located in the upper zone(s) of cartilage regardless of the histopathological grades. The zonal expression of these enzymes in OA (i.e., the percentage of positive cells in the superficial, middle, and deep zones), rather than their overall expression (the percentage of positive cells in the full thickness of the cartilage), exhibited significant variation in relation to the severity of cartilage degradation. The associations between the subchondral bone properties and zonal and overall expression of these enzymes in the cartilage were generally weak or nonsignificant. **Conclusions:** Phenotypic changes in chondrocytes and remodelling of subchondral bone proceed at different rates throughout the process of cartilage degradation. Biological influences are more important for cartilage degradation at early stages, while biomechanical damage to the compromised tissue may outrun the phenotypic change of chondrocytes and is critical in the advanced stages. © 2021 by the authors.

Author keywords

ADAMTS4; Cartilage degradation; MMP13; Subchondral bone microarchitecture; Subchondral bone remodelling; Tissue mineral density

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