Correlation of Subchondral Bone Biomechanical Properties to Comprehensive Properties of Articular Cartilage from Osteoarthritic Knees

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INTRODUCTION: Osteoarthritis (OA) is a multifactorial disease progressing from an initial injury to whole-joint inflammation and degeneration causing pain and dysfunction. This study was designed to determine how the biomechanical properties of the subchondral bone correlate with various properties of the articular cartilage. It was hypothesized that there would be important correlations among these assessments of articular cartilage and the subchondral bone from osteoarthritic knees.

METHODS: With IRB approval and patient consent, knee articular surfaces were collected from patients undergoing total knee arthroplasty. Explants were created, separated into individual bone and cartilage explants, and then cultured. The media were collected for biomarker analyses and then the explants were processed for biomechanical testing and histological analysis. A Spearman's correlation was performed to identify correlations between the properties of the bone and cartilage.

RESULTS: The data indicates few important correlations between bone biomechanical properties and the structure and metabolism of cartilage. However, as cartilage thickness decreased, modulus, stiffness, stress, energy and toughness of the bone increased, indicating substantial remodeling of subchondral bone as articular cartilage degrades during OA. Overall, the study indicates no strong relationship between the bone biomechanical properties and the degradative metabolic responses of the cartilage.

CONCLUSION: The results from this study provide direction for research, suggesting that pathways other than those assessed may be of higher importance. Ongoing studies in our laboratory are aimed at further characterization of these complex interactions during development and progression of OA towards better defining disease mechanisms and optimizing preventative and therapeutic strategies.