INTRODUCTION:
Subchondral bone marrow lesions (BMLs) are associated with joint pain and risk for knee joint structural worsening, such as cartilage loss. The ability to predict which knees and compartments will worsen would inform the design of therapies to minimize worsening. Estimation of articular contact stress, using discrete element analysis, has been useful in predicting risk for incident symptomatic knee OA.(1) However, this technique has not been used to predict risk for structural worsening. Since cartilage damage and BML have been cross-sectionally associated with higher compartmental loading, the study’s purpose was to assess whether estimates of articular contact stress may longitudinally predict risk for worsening of cartilage morphology and BMLs.

METHODS:
This study was conducted within the Multicenter Osteoarthritis (MOST) Study cohort of 3,026 adults with or at high risk for knee OA. Tibiofemoral geometry was manually segmented on baseline knee MRI, obtained using a coronal short T1 inversion recovery pulse sequence (ONI Medical Systems, Inc, Wilmington, MA). Peak contact stresses for the medial and lateral femoral and tibial articular surfaces were estimated in one knee per subject. Point clouds for the tibia and femur were generated, and triangulated surfaces were fit to the point clouds using Geomagic Studio software (Geomagic, Inc., Research Triangle Park, NC). These models were registered into subject-specific loaded MRI and biplanar knee radiographs for approximately 6000 knees in this cohort will enable these relationships to be more thoroughly evaluated. Use of discrete element analysis to generate estimates of contact stress has previously been shown to be an efficient and accurate means of predicting risk for development of incident symptomatic knee OA.1 The results of the current study suggest that this technique may also prove useful for predicting anatomic worsening.

Numerous large epidemiological studies have yielded cohort-based predictors for development of risk for incident and worsening knee OA. However, the utility of discrete element analysis includes the ability to generate knee sub-region-specific estimates of contact stress, as well as to possibly identify biomechanical mechanisms of effect for knee joint worsening. Knee OA accounts for a significant portion of disability and falls in older adults. The ability to elucidate the pathomechanics associated with knee joint damage, as well as to predict risk for worsening, may inform development of both preventive strategies as well as direct clinical resources to those patients at greatest risk.

CONCLUSION:
The presence of higher estimated contact stress up to 30 months prior to development of cartilage worsening suggests a role for mechanical loading in the etiology of knee joint structural worsening. Study of a greater number of knees is indicated for assessment of predictive value for BML and other features of structural worsening. Estimation of articular contact stress with discrete element analysis is an efficient and accurate means of predicting sub-region-specific knee joint worsening.

REFERENCES:

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