Age-related changes of thigh muscle fat infiltration in subjects of the OAI MRI cohort with and without radiographic osteoarthritis

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BACKGROUND
Increasing age is a known risk factor for knee osteoarthritis (OA), which results in increased muscle weakness and decreased mobility. Inter- (intra-MAT) and intra-muscular adipose tissues (intra-MAT) are defined as adipose tissue visible between muscle groups and muscle fibers, respectively. Volume and distribution of thigh muscle tissue and of inter- and intra-MAT reflect adverse metabolic effects and muscle function.

OBJECTIVES
1. Propose a robust and highly automated algorithm for the quantitative volume assessment of thigh muscle and inter- and intra-MAT; reduce processing time and operator-dependent precision errors of traditional manual analyses, especially of 3D datasets.
2. Apply this technique to the Osteoarthritis Initiative (OAI) MRI data to compare changes of thigh muscle fat infiltration in subjects with and without non-radiographic osteoarthritis.

METHODS
An automatic quantification framework consisting of 5 major steps was developed (Figure 1): 1) intensity inhomogeneity correction; 2) subcutaneous adipose tissue (SAT) removal; 3) tissue labeling for bone, marrow, fat and muscle; 4) inter- and intra-MAT classification; 5) measurement of volume. Figure 2 shows T1 weighted MRI images of four different subjects together with the segmentation results.

RESULTS
Correlations with age for muscle volume normalized for BMI, for the sum of inter- and intra-MAT and separately for intra-MAT both normalized for muscle volume are shown in Fig 3.

CONCLUSION
In both groups, muscle volume normalized to BMI decreased with age while adipose tissue volume increased. Differences in age related changes between subjects with and without ROA were inconsistent, although numerically correlations with age were slightly higher in the ROA group. The proposed framework provides a fairly automated approach for quantitative thigh tissue assessment in T1 weighted MRI images. Ongoing development efforts include reduction of operator interactions to correct segmentation defects. It will also be of interest to assess individual muscles separately.

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