

Is Supraspinatus Atrophy on MRI Associated with Histologic Atrophy of the Supraspinatus Muscle Fibers?

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INTRODUCTION:

Atrophy of the rotator cuff is a strong negative prognostic indicator after rotator cuff repair. While full-thickness rotator cuff tears accompanied by tendon retraction are commonly associated with decreased muscle cross-sectional area (CSA) on MRI, it is unclear whether this is accompanied by histological atrophy of rotator cuff myofibers. Therefore, the purpose of our study is to 1) assess the association between rotator cuff tear size and supraspinatus CSA, 2) evaluate the correlation between supraspinatus CSA on MRI and supraspinatus myofiber CSA measured histologically, and 3) determine factors associated with decreased supraspinatus CSA on MRI.

METHODS:

Supraspinatus muscle biopsies were obtained from a consecutive series of patients undergoing arthroscopic shoulder surgery. Rotator cuff tears were classified according to their size and thickness. Preoperative MRI was used to measure tendon retraction, cross-sectional area of the supraspinatus in the Y-shaped view, and presence of the tangent sign. Occupation ratio of the supraspinatus in the supraspinatus fossa allowed for a standardized measurement of muscle atrophy, and a value less than 0.5 defined atrophy. Patients without a rotator cuff tear undergoing arthroscopic surgery served as controls. Muscle biopsies were examined using LAMININ to quantify myofiber cross-sectional area. The association between supraspinatus tear severity and measures of histologic and MRI muscle atrophy were compared using Student's t-test and Chi-square. Intra-class correlation used to validate occupation ratio measurements. Intra-class correlation was 0.982 for inter-rater occupation ratio measurements. A Pearson correlation was used to assess the correlation between tendon retraction, histologic myofiber CSA, and occupation ratio. A multivariable logistic regression analysis was used to identify independent predictors of muscle atrophy on MRI.

RESULTS:

Thirty-eight patients were included (8 no tear controls, 14 partial-thickness, and 16 full-thickness). Increasing tear severity from no tear to large-to-massive full-thickness tear was associated with a greater distance of tendon retraction ($p<0.001$), lower mean histologic myofiber CSA ($p=0.004$), lower mean supraspinatus CSA on MRI ($p<0.001$), lower occupation ratio (0.73 vs. 0.66 vs. 0.53 vs. 0.38 in controls, partial, small-to-medium full-thickness, and large to massive full-thickness, respectively, $p<0.001$), and higher rate of tangent sign present on MRI ($p<0.001$). On Pearson correlation analysis, tendon retraction demonstrated a significant correlation with occupation ratio (-0.727 , $p<0.001$) and myofiber CSA (-0.438 , $p=0.006$), while occupation ratio demonstrated significant correlation with myofiber CSA (0.563 , $p<0.001$). Multivariable linear regression analysis demonstrated increasing age ($p=0.038$), female gender ($p=0.034$), and increasing tendon retraction ($p<0.001$) to be independently associated with greater supraspinatus atrophy on MRI (i.e., lower occupation ratio), while histologic myofiber size was not a statistically significant predictor of supraspinatus atrophy on MRI ($p=0.199$).

DISCUSSION AND CONCLUSION:

Our study supports the belief that supraspinatus atrophy appreciated on MRI is associated with atrophy of the supraspinatus myofibers at the histological level. However, when adjusting for multiple variables, our results demonstrate that muscle atrophy appreciated on MRI is more strongly associated with patient age, gender, and distance of tendon retraction, than it is with true histologic myofiber size. These results suggest a potential limitation of assessing supraspinatus atrophy using MRI, as retraction of the muscle belly can lead to an overestimate of muscle atrophy present and thus may influence surgical management.