

# SEMI-QUANTIFICATION OF FATTY DEGENERATION WITHIN SUPRASPINATUS MUSCLE BY USING 2-POINT DIXON TECHNIQUE AT 3.0-T MRI

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## INTRODUCTION

In preoperative assessment of rotator cuff tear, it is very important to evaluate the degree of fatty degeneration of the rotator cuff muscles for deciding the indication of operation, and predicting the clinical functional outcome (1). The treatment of massive tears is controversial in current practice because the outcome of operation is not good overall. The higher frequency of re-tear and worse functional outcome after treatment of massive tears may be relevant to preexisting fatty degeneration. Goutallier classification is widely used for evaluating fatty degeneration in current practice (2). However, since this classification is not quantitative but qualitative method, intra- and interobserver reliability is not high (3). The objective of this study is to prospectively quantify fatty degeneration of the supraspinatus (SSP) muscle by using 2-point Dixon technique at 3.0-T MRI, and to evaluate the correlation with severity of rotator cuff tears.

## MATERIALS AND METHODS

359 patients (mean: 59.3 y.o., range: 17 to 91 y.o., sex: 185 males and 174 females) with shoulder pain were enrolled in this study. Informed consent was obtained from the patient, and IRB was approved in our hospital. All MR studies were performed on a Magnetom Verio 3.0-T unit (Siemens Medical Systems) according to standard protocols used at our institution, PD-, fat saturated PD-weighted images were acquired in oblique coronal and sagittal planes, and T2\* sequence in axial image. We also added 2-point Dixon sequence (mode =3D-VIBE, TR=6.5ms, TE=1.225/2.4ms, FA=10, FOV=196mm, imaging plane=oblique sagittal, matrix size=128\*128, slice thickness=2.5mm, acquisition time=2min30sec). Fatty degeneration was quantified in 2-point Dixon sequence after measurement of signal intensity value within the region of interest (ROI) placed over SSP muscle. Each signal intensity value of the image of in phase and fat image was defined as S(In) and S(Fat) (Fig.1). The amount of fat contained in SSP was calculated as S(Fat)/S(In).

Two board-certified musculoskeletal radiologists evaluated the degree of rotator cuff tears in 3 categories: no tear, partial tear, complete tear (Fig.2). We also subcategorized complete tears into massive tears and other complete tears due to Cofield classification. The values of Pearson correlation and Bonferroni correction were calculated for correlation between the amount of fat in SSP and age, the degree of rotator cuff tears by using SSPs.

## RESULTS AND DISCUSSION

The number of patients with full-thickness tear, partial-thickness tear and no tear was 63, 54 and 242, respectively. Pearson's correlation coefficient is 0.348 between age and fat amount in SSP (Fig.3). The value of S(Fat)/S(In) was 0.26±0.12 in complete tears, 0.17±0.07 in partial tears, and 0.13±0.06 in no tears (Fig.4). The degree of fatty degeneration of SSP in the three groups showed statistically significant difference (p<0.001). Within 63 complete tears, the number of massive tears and other complete tears was 23 and 40, respectively. The value of S(Fat)/S(In) was 0.35±0.13 in massive tears, and 0.21±0.08 in other complete tears (Fig.5). This showed statistically significant difference (p<0.001).

The degree of fatty degeneration of SSP did not correlate with patients' age. However, the degree of fatty degeneration of SSP increased as rotator cuff tears progress, with the most severe in massive tears. These results suggest the quantification of fatty degeneration using 2-point Dixon method is easily applied clinically and could be one of preoperative predictive indicators for prognosis of rotator cuff repair in future, especially prognosis of massive tear repair.

## CONCLUSIONS

We were able to semi-quantify and evaluate the degree of fatty degeneration within SSP by using 2-point Dixon technique at 3.0T-MRI. Increased supraspinatus fatty infiltration was correlated with severity of supraspinatus tears.

## REFERENCES

- (1) Barry JJ, et al. The relationship between tear severity, fatty infiltration, and muscle atrophy in the supraspinatus. *J Shoulder Elbow Surg.* 2013;22(1):18-25.
- (2) Goutallier D, et al. Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. *Clin Orthop Relat Res.* 1994 Jul;(304):78-83.
- (3) Laron D, Samagh SP, Liu X, Kim HT, Feeley BT. Muscle degeneration in rotator cuff tears. *J Shoulder Elbow Surg.* 2012 Feb; 21(2): 164-74

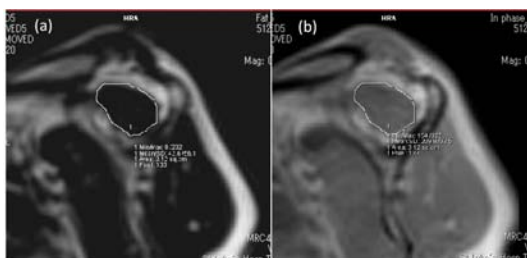


Fig.1 Shoulder MR images of 2-point Dixon sequence. (a) Fat image (b) In phase. We measured signal intensity value within the ROI over SSP as S(fat) and S(In).

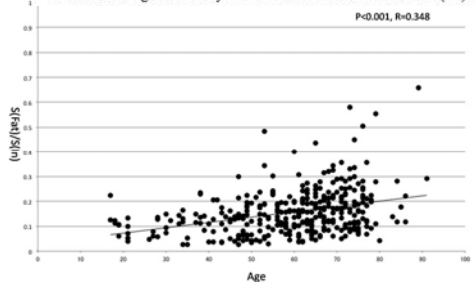


Fig.3 Comparison of ages with S(Fat)/S(In).

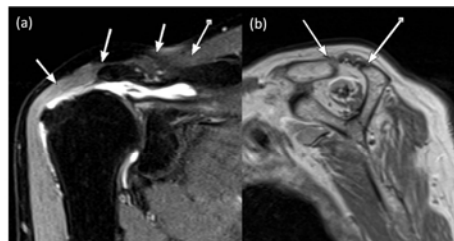


Fig.2 Example of complete tear. (a) Fat saturated PD-weighted oblique coronal image shows full-thickness rotator cuff tear, and increasing fluid within subacromial bursa (arrow). (b) PD-weighted oblique sagittal image shows severe fatty degeneration of SSP (arrow).

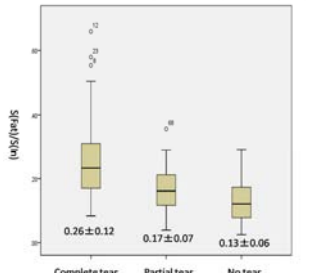


Fig.4 Correlation of the degree of rotator cuff tears with S(Fat)/S(In).

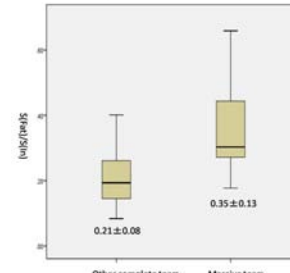


Fig.5 The value of S(Fat)/S(In) from massive tears vs. other complete tears.