

Involvement of infraspinatus muscle contractility in the acromio-humeral distance during shoulder abduction in rotator cuff tear patients

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INTRODUCTION: Narrowing of the acromio-humeral distance (AHD) have been linked to retear and poor outcomes after arthroscopic rotator cuff repair (ARCR). It has been reported that rupture of the infraspinatus tendon and fatty degeneration of the infraspinatus muscle are associated with AHD narrowing, and disruption of the transverse force couple consisting of the subscapularis and infraspinatus muscles is thought to be a factor in AHD narrowing. The interaction between the structural rupture of the infraspinatus tendon and the reduction in contractility of the infraspinatus muscle and their impact on AHD is unclear. The purpose of this study was to compare infraspinatus muscle function in patients with rotator cuff tears (RCT) to that of the contralateral healthy shoulder and to determine its relationship to AHD.

METHODS: We enrolled 91 patients who underwent ARCR at our institution between December 2021 and December 2022. To clarify the relationship between infraspinatus muscle function within the transverse force couple and AHD, we excluded patients with subscapularis tendon tears to minimize the contribution of the subscapularis muscle function. Of the 80 patients, 21 with subscapularis tendon tears were excluded. Finally, 59 patients were included in the RCT group. The patients underwent preoperative ultrasonography of the contralateral shoulder, and 24 shoulders with no RCT and no shoulder complaints were included in the control (C) group. The day before surgery, real-time tissue elastography (RTE) was used to measure muscle elasticity of the infraspinatus muscle. The muscle elasticity of the middle partition of infraspinatus muscle was measured at 60° of shoulder abduction (Fig. 1), and the difference in elasticity between resting and isometric contractions was evaluated as an index of muscle contractility (activity value: AV, Fig 2). True anteroposterior radiographs were obtained at 60° of shoulder abduction in the scapular plane (Scapula-60). In Scapula-60, the humeral head was assumed to be a regular circle, and the shortest distance from the circle to the acromion was measured as AHD (Fig. 3). The median AV of the infraspinatus was 0.48 (interquartile range: 0.36-0.68) for the RCT group and 0.69 (0.46-0.88) for the C group, not significantly different ($P = .06$). The RCT groups were divided according to the median AV of the infraspinatus muscle. The AV of 0.48 or greater was defined as the AV maintenance group ($n = 31$), and the AV of less than 0.48 as the AV reduction group ($n = 28$), and AHD was compared among the three groups, including group C. Tear size was measured intraoperatively. The anterior-to-posterior (AP) dimension was measured at the medial edge of the footprint, and the medial-to-lateral (ML) dimension was measured as the distance from the apex of the tear to the lateral footprint.

Fisher's exact test, Mann-Whitney U test, Kruskal-Wallis test, and Bonferroni's multiple comparison were used for statistical analysis. $p < 0.05$ was considered a significant difference. Multiple regression analysis was performed with AHD as the objective variable and age, gender, AV of the infraspinatus muscle, and tear size as explanatory variables. This study was approved by an Ethics Committee.

RESULTS: The mean age at surgery in the RCT group was 68.0 years (63-73), and the male-to-female ratio was 37:22. On the other hand, the mean age at surgery in group C was 66.5 years (56-73), and the male-to-female ratio was 15:9. There were no significant differences in patient background.

AHD (mean \pm SD) was 6.60 ± 1.54 mm in the AV reduction group, significantly smaller than 8.45 ± 2.20 mm in the C group ($P < .01$) and 7.90 ± 1.27 mm in the AV maintenance group ($P < .01$). In the RCT group, the ML tear size was 17.0 mm in the AV maintenance group and 15.5 mm in the AV reduction group ($P = .23$), and the AP tear size was 20.0 mm in the AV maintenance group and 20.0 mm in the AV reduction group ($P = .72$), with no significant differences. Multiple regression analysis revealed that AV of the infraspinatus ($P < .01$) and AP tear size ($P = .04$) were significantly associated with AHD, with standard regression coefficients of 0.534 and -0.392, respectively. AV of the infraspinatus muscle did not correlate with tear size.

DISCUSSION: The AHD during shoulder abduction was narrower in patients with reduced contractility of the infraspinatus muscle. It is possible that the contractility of the infraspinatus muscle is more important than the tear size for the AHD during shoulder abduction in RCT patients.

SIGNIFICANCE/CLINICAL RELEVANCE: (1-2 sentences): If there was no improvement in infraspinatus muscle function after rotator cuff repair, AHD was reduced, which might contribute to poor postoperative outcomes and an increased retear rate.

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IMAGES AND TABLES:

Fig. 1.

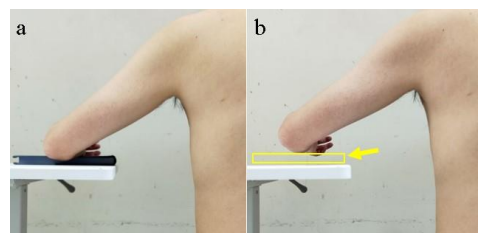


Fig. 2.

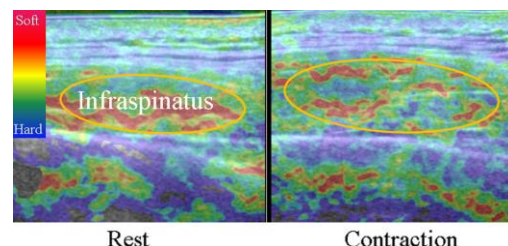


Fig. 3.

