Association Between Morphological Patterns of Medium to Large Rotator Cuff Tears and Retear Rate after Arthroscopic Repair

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INTRODUCTION: Different stress distribution patterns of repaired rotator cuff tendons are reported to be associated with postoperative tendon integrity and functional outcomes. The stress distribution is closely related to the morphological characteristics of the torn rotator cuff tendon. The most common geometric classification for patterns of full-thickness rotator cuff tears categorizes tears into four patterns: crescent-shaped, U-shaped, anterior L-shaped, and posterior L-shaped tears. These morphological characteristics of the rotator cuff tear may be related to the outcomes of arthroscopic rotator cuff repair. However, limited information exists regarding the effects of tear patterns on tendon healing. This study aimed to evaluate factors related to the retear after arthroscopic rotator cuff repair and to investigate whether the impact of these factors varies according to tear patterns.

METHODS: Between 2014 and 2021, patients with symptomatic 2-4 cm full-thickness rotator cuff tears who underwent arthroscopic rotator cuff repair were retrospectively reviewed. Patients who underwent preoperative MRI, performed postoperative MRI or ultrasound regardless of symptoms, and had been followed up for a minimum of 2 years after surgery were included in this study. Rotator cuff retear was defined as complete discontinuity of the repaired rotator cuff tendon on MRI or ultrasonography performed after postoperative 6 months. Based on postoperative imaging, patients were categorized into two groups: a healed group and a retear group. The rotator cuff tear patterns were classified during the arthroscopic surgery after debridement of degenerative tendon tissues as crescent-shaped, U-shaped, anterior L-shaped, posterior L-shaped, and complex tear. Complex tear patterns that accounted for only a minority of cases were excluded. Clinical and radiological parameters related to retear were compared between groups, and subgroup analysis by four tear patterns was performed. For the subgroup analysis, patients were divided into two groups according to tear size: those with small-to-medium-sized tears and those with large-to-massive-sized tears. Multiple regression analysis was performed to evaluate factors related to rotator cuff retear.

RESULTS: Of the 1191 patients with a full-thickness rotator cuff tear, 126 (10.6%) had irreparable tears requiring salvage procedures such as superior capsule reconstruction or tendon transfer, and 51 (4.3%) had complex tear patterns. Of the remaining 1014 patients, 713 had tears sized 2–4 cm. Of these, 605 (84.9%) achieved tendon healing, while 108 (15.1%) experienced a retear. Patients with retear showed significantly advanced age (60.1 ± 10.2 years vs. 64.6 ± 9.1 years, $P<0.001$), more dyslipidemia (50.6% vs. 62.0%, $P=0.028$), larger anteroposterior (22.3 ± 5.9 mm vs. 25.1 ± 6.2 mm, $P<0.001$) and mediolateral (22.2 ± 6.7 mm vs. 24.1 ± 6.5 mm, $P=0.007$) tear size, more atrophy of supraspinatus (9.6% vs. 26.9%, $P<0.001$), and higher fatty infiltration of supraspinatus (0.9 ± 0.9 vs. 1.5 ± 0.8, $P<0.001$) and infraspinatus (0.5 ± 0.7 vs. 1.0 ± 0.8, $P<0.001$) than patients without retear. The proportion of anterior L-shaped tears (8.3% vs. 18.5%, $P=0.007$) and delamination (55.9% vs. 66.7%, $P=0.037$) were significantly higher in the retear group compared to the healed group. In the multiple regression analysis, age [odd ratio (OR)=1.04, 95% confidence interval (CI); 1.01-1.07, P=0.007], anteroposterior tear size (OR=1.07, 95% CI; 1.02-1.11, P=0.002), fatty infiltration (FI) of infraspinatus (OR=1.44, 95% CI; 1.06-1.97, P=0.020) and anterior L-shaped tear (OR=3.30, 95% CI; 1.60-6.80, P=0.001) were the independent factors related to retear. In the subgroup analysis, the most common tear pattern was crescent-shaped (35.1%), followed by posterior L-shaped (32.8%), U-shaped (22.3%), and anterior L-shaped tears (9.8%). The retear rate was significantly higher in anterior L-shaped tears than in other tear patterns (11.6%, 15.1%, 28.6%, and 15.0% for crescent-, U-, and anterior and posterior L-shaped, respectively, P=0.007). Tear pattern–based multivariate analyses revealed that age (OR=1.05, 95% CI; 1.00-1.11, P=0.047), dyslipidemia (OR=3.11, 95% CI; 1.29-7.51, P=0.012), and supraspinatus muscle atrophy (OR=5.23, 95% CI; 2.04-13.76, P=0.001) were significant factors for crescent-shaped tears; FI of supraspinatus (OR=1.13, 95% CI; 1.05-1.21, P=0.001) and anteroposterior tear size (OR=2.10, 95% CI; 1.20-3.65, P=0.009) for U-shaped tears; and FI of supraspinatus (OR=2.41, 95% CI; 1.59-3.66, P<0.001) and delamination (OR=2.38, 95% CI; 1.07-5.29, P=0.033) for posterior L-shaped tears. No independent factors were identified for anterior L-shaped tears.

DISCUSSION AND CONCLUSION: The important findings in the current study were that tear patterns, especially anterior L-shaped tears, were identified as independent risk factors for retear in 2-4 cm full-thickness rotator cuff tears. In addition, the impact of well-known risk factors on retear varies depending on tear patterns. The anterior L-shaped tear disrupts the anterior attachment of the rotator cable, leading to advanced rotator cuff muscle and tendon degeneration and healing failure after arthroscopic repair. The size of a rotator cuff tear increases over time, accompanied by degeneration of the tendon and muscle, and the tear pattern may change. Therefore, factors influencing tendon integrity may vary depending on the tear progression. In conclusion, tear pattern, especially anterior L-shaped tears, was identified as an independent risk factor for rotator cuff retear. Moreover, the impact of established risk factors on retear differed depending on the tear pattern.