J Shoulder Elbow Surg (2016) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Progression of degenerative changes of the biceps tendon after successful rotator cuff repair

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Background: This study investigated the morphologic changes in the biceps tendon using ultrasonography before and after successful arthroscopic posterosuperior rotator cuff repair.
Methods: Forty-four patients (44 shoulders) underwent arthroscopic posterosuperior rotator cuff repair with 1-year postoperative magnetic resonance imaging (MRI) follow-up. The patients comprised 22 men and 22 women with an average age of 61 years. The cross-sectional area (CSA) of the biceps tendon in the bicipital groove was measured, and the vascularity in the bicipital groove was graded as 0 to 3, based on the signal density of the anterior circumflex artery, using power Doppler ultrasonography. The preoperative and postoperative CSA and vascularity grades were compared. The pain score on the University of California, Los Angeles Shoulder Rating Scale was used to analyze the correlation between vascularity and postoperative pain.
Results: The average preoperative and postoperative CSA of the biceps tendon was 15.4 ± 6.5 and 17.9 ± 7.5 mm^2, respectively. The postoperative CSA was significantly larger than the preoperative CSA ($P < .01$). Although no significant difference in the vascularity of the bicipital groove was observed between preoperative and postoperative grading, a negative correlation was observed between the vascularity and postoperative pain score on the University of California, Los Angeles scale ($r = -0.369$).
Conclusions: The biceps tendon in the bicipital groove becomes thicker over time, even after successful posterosuperior rotator cuff repair. In addition, an increase in the vascularity around the biceps tendon in the groove is correlated with pain symptoms after successful repair.
Level of evidence: Level II; Prognosis Study

Keywords: Long head of the biceps; ultrasound; power Doppler sonography; arthroscopic rotator cuff repair; biceps hypertrophy; anterior shoulder pain

Abnormalities of the long head of the biceps tendon (LHB) are often associated with rotator cuff tears and could be a cause of persistent shoulder pain.[5,10] Recent progress in arthroscopic surgery has revealed the various pathologic processes involved in biceps tendon disease, including degeneration, partial tears, and subluxation with rotator cuff tears. When

The Funabashi Orthopaedic Hospital Institutional Review Board approved this study (2012004).

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1058-2746/$ - see front matter
http://dx.doi.org/10.1016/j.jse.2016.09.052

treated with arthroscopic subacromial decompression, most patients with macroscopic degeneration of the LHB developed rotator cuff tears.[10] Kempf et al[14] reported that among 210 patients who underwent arthroscopic rotator cuff repair, 77% exhibited biceps tendon disruption or degeneration, and 44% exhibited dislocation or subluxation. An hourglass biceps, which induces entrapment caused by hypertrophic change in the bicipital groove, has been reported.[6] In addition, pain relief shortly after spontaneous rupture of the biceps tendon has often been observed.[26]

Because the LHB is known to be a pain generator in the setting of rotator cuff tears, failure to address LHB lesions can result in persistent shoulder pain and poor satisfaction after rotator cuff repair.[25] Therefore, many surgeons prefer to perform biceps tenotomy or tenodesis when repairing rotator cuffs if biceps tendon degeneration is confirmed during surgery.[8,26] Furthermore, improvement in surgical outcomes was reported after isolated LHB tenotomy or tenodesis in patients with massive irreparable rotator cuff tears.[7]

We normally perform biceps tenotomy or tenodesis when repairing anterosuperior tears. In some cases, it is possible to preserve the biceps tendon when it appears healthy intra-articularly with a negative hourglass test[6] during arthroscopic posterosuperior rotator cuff repair. However, we sometimes observe patients who complain about persistent anterior pain even after a successful rotator cuff repair. Therefore, we hypothesize that degeneration of the preserved biceps tendon could progress even after successful repair and become a source of shoulder pain. This study investigated the degree of biceps tendon degeneration in the bicipital groove using ultrasonography before and after successful arthroscopic posterosuperior rotator cuff repair.

Materials and methods

Patient selection

From January 2012 to April 2013, 252 patients who underwent arthroscopic rotator cuff repair were preoperatively evaluated by ultrasonography. The biceps tendon was preserved in 103 shoulders with posterosuperior tears because the biceps tendon was confirmed to be healthy arthroscopically and an hourglass test was negative. Among these patients, the repaired cuff integrity and biceps tendon were evaluated by MRI and ultrasonography in 51 patients 1 year after surgery. Forty-four patients who exhibited type 1 to 3 repairs according to the MRI-based Sugaya classification[23] were confirmed to have intact shoulders in terms of cuff integrity. Therefore, this study included 44 patients (44 shoulders), comprising 22 men and 22 women, with an average age of 61 years.

Ultrasound examination

Both shoulders were examined preoperatively and postoperatively by 2 experienced radiologists (H.M., M.M.) with a high-resolution ultrasonography system (EUB7500; Hitachi Medical Corporation, Tokyo, Japan). The ultrasound images were acquired using a high-frequency transducer (14 MHz). Our routine shoulder ultrasound protocol was as follows: The supraspinatus, infraspinatus, and subscapularis tendons were imaged along both shoulders. The incidence of rotator cuff tears was recorded, and the length was measured in both the long and short axis using an automated measurement. Ultrasound assessment of the LHB tendon was performed with the shoulder in a neutral position at the patient's side. The ultrasound probe was placed in front of the anterior shoulder (Fig. 1). When the greater tuberosity and lessor tuberosity were visualized, the LHB was identified as a highly echoic area in the intertubercular groove. The cross-sectional area (CSA) of the LHB was measured in the bicipital groove using the trapezoidal shape of the lessor tuberosity as a benchmark (Fig. 2).

Figure 1 Posture for cross-sectional area measurement. The shoulder was placed in neutral rotation at the patient's side. The ultrasound probe was applied perpendicular to the bicipital groove.

The vascularity in the bicipital groove was investigated using power Doppler sonography (PDS), which depicts the vascularity by demonstrating the microvascular flow. The PDS signal is positively correlated with the vascularity of synovial tissue in patients with rheumatoid arthritis.[9,24,27] We modified the grading of rheumatoid arthritis to evaluate the vascularity in the bicipital groove, which was divided into 4 categories depending on the signal strength. The details of the grading scale are as follows: Grade 0 shows no signal or a signal of an anterior circumflex artery, which indicates no increase in the vascularity. Grade 1 shows a single-vessel signal other than the anterior circumflex artery. Grade 2 shows the integration of signals, which occupied less than half of the image area in the area surrounding the LHB. Grade 3 shows the integration of signals, which occupied more than half (Fig. 3). To evaluate the vascularity grade, the highest signal in the image was chosen in each patient in both the preoperative and postoperative examinations.

Variability in ultrasound measurements

The intraobserver and interobserver variabilities in ultrasound measurements were evaluated in 16 shoulders of 8 asymptomatic volunteers. These 8 volunteers included 2 men and 6 women with an average age of 52.5 years (range, 50-59 years). To measure the interobserver variability, 2 technicians independently measured the