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DO BURSAL AND ARTICULAR SIDE OF THE SUPRASPINATUS TENDON HAVE SAME COMPRESSIVE COMPLIANCE?

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INTRODUCTION

The rotator cuff tendon fibers sustain complex loads. When the strength of the rotator cuff tendon is less than the stress transmitted through the tendon, a tear occurs at the structurally weak point. Rotator cuff tears often occur at the critical zone, the anterior part of the attachment of the supraspinatus tendon to the greater tuberosity. Rotator cuff tears occur on the articular side of the tendon as well as on the bursal side. Characterization of the specific material property of the tendon might reveal its relationship to the preferential area of rotator cuff tear. Determination of the compression properties of the cuff tendon in the critical zone is crucial, since compression might be an important mechanism of cuff tendon failure. The purpose of this study was to measure the compressive properties of the supraspinatus tendon as well as to determine whether regional difference exists within or between the bursal and articular sides of the tendon.

METHODS

The supraspinatus tendon was mounted on a rigid flat surface of a biaxial translation table attached to the actuator of the apparatus. An indentor with a flat tip 3 mm in diameter was used. Indentation force was monitored with a load cell, and indentation displacement was monitored with a LVDT attached to the apparatus. Displacement control was performed with a maximum indentation force of 250g and a speed of indentation of 0.1mm/sec. Five fresh-frozen cadaveric shoulder specimens were tested. The experimental protocol consisted of testing both bursal and articular sides of the tendon focused on the critical area. Each supraspinatus tendon was divided into anterior, middle, and posterior thirds of equal width. Each third of the tendon was divided into 5 locations of 5 mm in length including two locations over the greater tuberosity (Fig. 1). An exponential approximation was chosen to describe the deformation-force relationship ($y=a(e^{bx}-1)$; y: force; x: deformation; a and b: coefficients). The initial stiffness was determined by the product of a and b.

RESULTS

The average initial stiffness on the bursal and articular side of the supraspinatus tendon was significantly different ($p<.05$), measuring 3.3 1.4 g/mm and 2.2 1.9 g/mm, respectively. On the bursal side, the anterior third had a significantly higher initial stiffness than the other thirds on average ($p<.05$). On the articular side, the average of the initial stiffness at locations 10 mm proximal to greater tuberosity was significantly higher than the rest ($p<.05$). Thickness averaged 4.2 mm, 4.0 mm, and 3.9 mm for the anterior, middle, and posterior third, respectively.

CONCLUSION

Initial stiffness was determined for each of the fifteen areas of interest on the supraspinatus tendon. Initial stiffness on the bursal side correlates well with the previous study. Higher initial stiffness at locations 10 mm proximal to the greater tuberosity on the articular side may support the rotator cable theory that there are thick bundles of fibers acting like cables in a suspension bridge. We observed the anterior third of the supraspinatus tendon insertion area, where rotator cuff tears frequently occur, to have higher initial stiffness. The analysis of compressive property of the supraspinatus tendon enables us to better understand the potential etiology of cuff tear.

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