THE BIOMECHANICAL EFFECTS OF PHYSIOLOGICAL ROTATION ON ROTATOR CUFF REPAIR

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INTRODUCTION:
Uniaxial cyclic loading is a standard method for evaluating rotator cuff repair constructs. This however does not elucidate the effects of physiological rotation on the repair. Comparing testing models (with and without humeral rotation), we hypothesize that rotation simulating post-operative rehabilitation will influence repair strength, gap formation, and strain. Therefore, the objective of this study was to quantify the influence of humeral rotation on the structural integrity of the single row rotator cuff repair.

METHODS:
In six matched pairs of human cadaveric shoulders a single-row rotator cuff repair was performed. In six shoulders, a materials testing machine and a custom testing apparatus (Figure 1) that permits cyclic rotation (0° to 30°) were employed (Group I). In the contralateral shoulders, the apparatus was fixed to prevent humeral rotation (Group II). All repairs were cyclically loaded from 0N to 60N at a displacement rate of 1mm/sec for 30 cycles. The constructs were then loaded to failure. Repair strength, gap formation, and strain were compared between groups. WINanalyze software (Mikromak Service, Berlin, Germany) was employed. A paired t-test was used for statistical analyses; significance was defined as p <0.05.

RESULTS:
The cyclic tests showed that hysteresis was significantly greater in Group I than Group II at each cycle tested (p<0.05); there were no differences in linear stiffness (p>0.05).
There were no significant differences for yield (p=0.94) and ultimate strength (p=0.27). Between groups, Group I gap formation at the anterior tendon was greater both at end-rotation (1.40±0.69 versus 0.60±0.43, p=0.025) and at yield (1.95±0.74 versus 1.06±0.54, p=0.008) (Figure 2); at end-rotation, Group I strain was less in the posterior tendon (-5.94±5.76 versus 2.09±5.48, p=0.044).
For Group I, gap formation and tendon strain were significantly greater in the anterior versus posterior tendon at both end-rotation and yield (p<0.05); there were no such differences for Group II suggesting better load-sharing (p>0.05).

DISCUSSION:
Simulating post-operative external rotation exercises affects gap formation and tendon strain between anterior and posterior supraspinatus tendon regions (Figure 3). Previous testing models without humeral rotation may underestimate gap formation and anterior tendon strain, and overestimate posterior tendon strain.
Persistent tear rates after rotator cuff repair remain high. If gap and tendon strain can influence healing, and therefore understanding regional differences in repair constructs may help optimize the biology between rotator cuff tendon and insertion.

REFERENCES:

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