A BIOMECHANICAL COMPARISON OF FOUR RECONSTRUCTION TECHNIQUES FOR THE MEDIAL COLLATERAL LIGAMENT DEFICIENT ELBOW

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INTRODUCTION

Classically, the medial collateral ligament (MCL) of the elbow has been reconstructed using the figure-eight technique.1 As clinical experience with MCL reconstruction increases, concerns have developed regarding the strength of the suture fixation and adequate tensioning of the tendon graft. The literature lacks comparative studies of reconstruction techniques for the MCL of the elbow. The purpose of this study was to compare the initial strength of four different medial collateral ligament reconstruction techniques: a figure-eight, the docking, a single strand reconstruction utilizing interference screws, and a single strand reconstruction which employed an endobutton for ulnar fixation. We hypothesized that the single strand reconstructions would be stronger than the figure-eight and docking techniques.

METHODS

Twenty (ten pairs) unprepared cadaveric upper extremities (mean age 73 years) were mounted in a custom jig (Figure 1) with the elbow at 90° and the forearm and humerus parallel to the floor with the medial side oriented superiorly (ie. valgus orientation). A computer controlled pneumatic loading system was employed. Markers on the humerus and ulna were monitored with an image acquisition system throughout the testing to determine reconstruction stability. Load was applied to the forearm 12 cm distal to the anatomic axis of rotation of the elbow, at a frequency of 0.5 Hz. The actuator was attached to the specimen via a pin-connected linear bearing, such that the resultant load did not produce axial loading on the forearm. An initial cyclic load of 20 N (maximum moment 2.4 N·m) was applied for 200 cycles. The load was increased in increments of 10 N until either complete ligament failure, or a 5 mm increase in the distance between the two bony markers of the anterior bundle of the medial collateral ligament (i.e. 5 mm of joint gapping) occurred. At each load level, 200 cycles were performed.

Following testing of the intact specimen, the paired specimens were randomly divided into Groups A and B. In Group A, the Docking and figure-eight reconstruction procedures were performed. In Group B, two single strand reconstructions, one using interference screws and another using endobutton fixation, were performed (Figure 2).

RESULTS

The average peak load to failure (or 5 mm of joint gapping) was 142.5 ± 39.4 N for the intact, 53.0 ± 9.5 N for the docking, 52.5 ± 10.4 N for the endobutton, 41.0 ± 16.0 N for the interference screw, and 33.3 ± 7.1 N for the figure-eight reconstructions (Figure 3). The peak load to failure was higher for the intact specimens compared to any of the reconstructions (p<0.001). The docking reconstruction showed higher peak loads than the figure-eight or interference screw reconstruction, and the endobutton reconstruction showed higher peak loads than the figure-eight reconstruction (p<0.004). There was no difference in peak loads between the docking and endobutton reconstructions (p>0.05).

DISCUSSION

The initial strength and stiffness of medial collateral ligament reconstructions were considerably lower than the intact ligament in this in-vitro study employing elderly cadaveric specimens. We have shown that the docking technique and a single strand reconstruction using an endobutton for fixation on the ulna showed higher peak loads to failure than the figure-eight reconstruction. Thus, a single strand or multistrand ligament reconstruction can be equivalent with respect to maximal peak cyclic loading. Furthermore, our relative differences in failure loads were in agreement with other reported results in the literature.2,3 We have concerns with regard to the use of interference screw fixation in the clinical situation until further laboratory studies have been performed to optimize this technique. A modified endobutton and docking procedure appears to be a good option for single strand reconstruction of the medial collateral ligament. The advantage of this single strand technique is the decreased risk to the ulnar nerve as only one drill hole is created at the sublime tubercle.

REFERENCES


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