Biomechanical Comparison of Ulnar Collateral Ligament Reconstruction with the Docking Technique versus Repair with Internal Bracing

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Background & Objectives

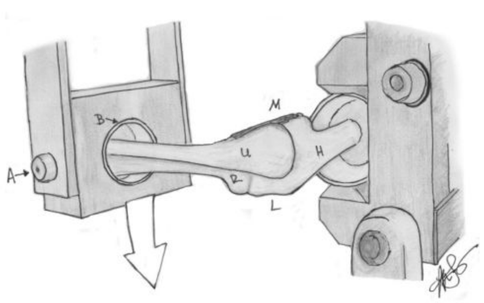
- The modified Jobe technique of ulnar collateral ligament (UCL) reconstruction has previously been biomechanically compared to primary repair augmented with internal bracing[2]
- Lower rates of complications have been reported in reconstruction with the docking, modified docking, and interference screw fixation techniques[4]
- No biomechanical study had been conducted to compare the docking technique with internal bracing
- Sought to evaluate the biomechanical performance of elbows with ruptured UCLs repaired with an internal bracing construct and reconstructed with the docking technique, and to compare these with the performance of the native ligaments
- **Hypothesis:** Load to failure, gapping, and valgus opening angle are similar under valgus loading at 90° flexion between repair with internal bracing and the docking technique for the UCL

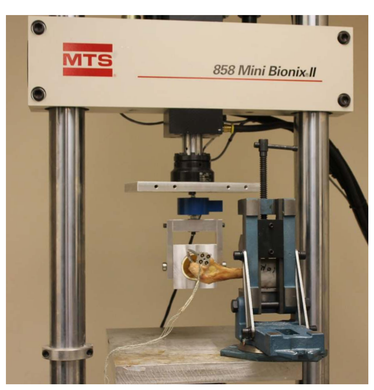
Methods

- 9 matched cadaveric elbow pairs potted
- Palmaris longus tendon graft harvested
- Native UCL testing performed in 90° of flexion/neutral rotation with 0.5 N-m preloaded, followed by a 5 N·m valgus moment to the elbow in cycles of 1, 10, 100, and 1000 at 1 Hz for 1000 cycles with gapping and valgus opening recorded
- Native ligaments loaded to failure on all specimen
- Matched pairs assigned to UCL recon (docking) or repair with internal brace groups
- Biomechanical testing protocol repeated for repaired and reconstructed specimen

Repair with internal brace, as described by Dugas *et al*.[2] A 3.5-mm SwiveLock anchor (Arthrex) was loaded with 2.0-mm suture tape (FiberTape, Arthrex) and a No. 0 nonabsorbable suture and anchored on the apex of the sublime tubercle, at the center of the native UCL attachment. The free ends of the No. 0 suture were passed through the ends of the UCL rupture, and the sutures were tied, repairing the native ligament to its insertion. With the elbow reduced, the proximal ends of the suture tape were tensioned and anchored in the humeral medial epicondyle at the center of the native UCL origin. The repair was reinforced with 3 figure-of-eight No. 0 absorbable sutures.

Docking reconstruction, as described by Rohrbough *et al*.[3] and Dodson *et al*.[1] A 2-cm bone bridge was created through the sublime tubercle with a 3.0-mm drill, and a 15-mm blind tunnel was drilled into the axis of the medial epicondyle with a 4.0-mm drill. Two small exit holes were drilled with a 1.5-mm bit from the proximal end of the humeral tunnel. A sized palmaris graft with No. 2 FiberWire (Arthrex) whipstitched through the ends was passed through the ulnar tunnel and, with the elbow reduced,a the ends were docked in the humeral tunnel and secured by tying the the FiberWire sutures over the epicondylar bone.





Experimental setup. As depicted in the schematic on the left, a downward force (arrow) is applied to the potted radius (R) and ulna (U), resulting in a valgus moment across the elbow. The humerus (H) is also potted. The setup allows for rotation (A) and pistoning (B) to maintain a constant lever arm length. M, medial; L, lateral. The image on the right demonstrates the experimental setup with a specimen loaded into the MTS 858 Mini Bionix II unit.

Results

- No significant differences among groups for gapping or valgus opening for any cycle
- No significant differences among groups for ultimate load to failure

Modes of failure, internal brace repair:

Mode	#
Distal anchor pullout	4
Proximal anchor pullout	1
Suture pullout from anchor	2
Proximal	1
Distal	1
Ulnar fracture at distal anchor	3

Modes of failure, docking reconstruction:

Mode	#
Ulnar tunnel fracture	2
Midsubstance graft rupture	1
Failure at proximal tendon-suture interface	6

	NDR	NRIB	DR	RIB	*P*-value ANOVA	*P*-value Welch
Gapping (mm)						
C1	1.74±0.87 (1.08-2.41)	2.16±0.82 (1.53-2.79)	2.30±0.48 (1.93-2.67)	1.99±0.91 (1.29-2.69)	0.488	-
C10*	8.60±3.76 (5.71-11.49)	7.93±2.44 (6.06-9.81)	10.07±4.61 (6.53-13.62)	8.89±2.67 (6.83-10.94)	0.625	0.672
C100*	11.38±6.29 (6.54-16.21)	8.96±2.74 (6.85-11.06)	13.03±6.65 (7.92-18.14)	10.38±3.18 (7.94-12.82)	0.387	0.356
C1000	14.17±6.61 (9.08-19.25)	11.57±4.36 (8.22-14.92)	16.64±7.20 (11.11-22.18)	13.38±4.76 (9.72-17.04)	0.339	-
Failure	50.94±15.29 (39.19-39.29)	36.93±16.65 (24.14-49.73)	47.87±15.16 (36.21-59.52)	41.92±11.50 (33.09-50.76)	0.208	-
Valgus Opening (°)						
C1	0.99±0.51 (0.60-1.38)	1.29±0.43 (0.96-1.62)	1.31±0.28 (1.10-1.52)	1.14±0.52 (0.74-1.54)	0.397	-
C10*	4.90±2.15 (3.25-6.55)	4.53±1.37 (3.48-5.59)	5.76±2.62 (3.74-7.77)	5.08±1.52 (3.91-6.25)	0.618	0.664
C100*	6.48±3.53 (3.76-9.19)	5.09±1.56 (3.89-6.29)	7.40±3.72 (4.54-10.26)	5.92±1.80 (4.54-7.31)	0.380	0.345
C1000	8.02±3.67 (5.20-10.85)	6.61±2.45 (4.73-8.50)	9.40±3.99 (6.34-12.46)	7.61±2.67 (5.55-9.66)	0.351	-
Failure	26.62±7.05 (21.20-32.04)	19.87±7.98 (13.73-26.00)	25.21±6.92 (19.89-30.53)	22.55±5.55 (18.29-26.82)	0.193	-
Load to Failure (N·m)						
Failure	28.98±10.02 (21.28-36.68)	29.54±9.30 (22.40-36.69)	23.14±9.05 (16.19-30.10)	23.28±10.06 (15.55-31.01)	0.328	-

The table (above right) depicts the comparison of gapping in millimeters (mm), valgus opening angle, and ultimate load to failure for native docking reconstructions (NDR), native repairs with internal bracing (NRIB), docking reconstructions (DR) and repairs with internal bracing (RIB). Values are presented as mean ± standard deviation (95% confidence interval). C1: cycle 1, C10: cycle 10, C100: cycle 100, C1000: cycle 1000.

*Note: The Levene test was significant for gapping and valgus opening for cycles 10 and 100. No significance was found with the Welch ANOVA for gapping or valgus opening for these cycles.

Conclusions

- Biomechanical comparison of internal brace repair with a reconstruction technique widely considered to have less of a learning curve and possibly fewer complications when compared with Jobe/modified-Jobe reconstructions[4]
- UCL reconstruction with docking technique and repair augmented with internal bracing both provided valgus stability to the medial elbow comparable to the native ligament in 90° of flexion
- No significant differences were noted between docking reconstruction and repair techniques for load to failure, gapping, or valgus opening angle during cyclic loading at time zero or
- Results support previous findings[2] of no difference in biomechanical performance of repair with internal brace compared to reconstruction
- Exercise caution in generalizing biomechanical data to expected clinical outcomes
- Walters *et al.*[5] demonstrated 92% return to play with UCL repair and internal bracing at 6 months

References

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