INTRODUCTION: Acute repair of the medial collateral ligament (MCL) is indicated in the setting of unstable dislocations and fracture-dislocations of the elbow. The optimal method of ligament repair has not been reported to date. Careful rehabilitation is usually recommended to avoid repair failure during ligament healing\(^1\). The purpose of this in-vitro study was to compare the initial stregths of interosseous suture (IS) and suture anchor (SA) methods for medial collateral elbow ligament repair. Additionally, the effects of pretension loads on repair strength were evaluated.

METHODS: Twelve, fresh-frozen upper extremities (66 ± 5 years) were cleaned of all soft tissues except the MCL, lateral collateral ligament and joint capsule. The radius and ulna were fixed in pronation using screws. The ulna/radius and humerus were individually potted in polymethylmethacrylate cement and mounted in a test fixture in rigid valgus orientation with the elbow flexed to 90°\(^1\). Next, the humeral attachment of the MCL and joint capsule were divided and the weight of the ulnar pot assembly was recorded. The MCL was repaired using both an IS placed through the medial epicondyle and a SA (Mini-Revo, Linvatec, Mississauga, ON) in random order. Both repairs were pre-tensioned at either 20 N (n=5) or 40 N (n=7) for 5 minutes. Ethibond #2 (Ethicon, NJ) sutures were used for all repairs. A specialized optical tracking system, employing a digital camera and custom software was utilized. Spherical markers rigidly fixed to the specimen along the MCL line-of-action were used to measure the length change of the repairs. A cyclic (frequency = 0.5 Hz) valgus load was applied 12 cm distal to the medial epicondyle by a pneumatic actuator. The peak load (assembly weight plus applied load) equaled 40 N. Failure was defined as gross reconstruction failure (type I) or an increase in length of 5mm or greater (type II). If the reconstruction survived 200 cycles, the total load was increased by 10N and repeated until either condition of failure was achieved.

RESULTS: The maximum load (± 1 SD, Figure 1) for the IS with 20 N pre-tension was 43 ±5 N; for the SA with 20 N pre-tension: 45 ±5 N; for the IS with 40 N pre-tension: 60 ±9 N; and for the SA with 40 N pre-tension: 68 ±17 N (Figure 1). The maximum number of cycles (± 1 SD, Figure 2) endured by the IS pre-tensioned at 20 N was 100 ±105; for the SA pre-tensioned at 20 N: 132 ±110; for the IS pre-tensioned at 40 N: 401 ±46; and for the SA pre-tensioned at 40 N: 594 ±342. A single missing data value for the SA with 40N condition was replaced by the mean of that condition. There was no significant difference between the IS and the SA for the maximum load and the maximum number of cycles (P>0.05). However, repairs pre-tensioned at 40 N had significantly higher maximum loads and maximum number of cycles than those pre-tensioned at 20 N (P<0.01). At 20 N of pre-tension, none of the repairs exhibited Type I, catastrophic failure. At 40 N of pre-tension, 17% of IS repairs and 100% of SA repairs exhibited Type I failure.

DISCUSSION: These data suggest that the IS and SA methods for repair of the MCL performed comparably during this study. These data suggest that repairs pre-tensioned at 40 N are significantly stiffer than those pre-tensioned at 20 N, probably because there is less slack in the sutures. In practice, when pre-tensioning to 20 N, it may be prudent to employ an interosseous suture as all suture anchor repairs failed catastrophically. If an anchor is employed, a sliding suture technique is needed to ensure a tight repair is achieved during surgery. Using the same apparatus, a prior study found the peak applied load to the intact MCL to be 140 N\(^1\). Therefore, the repairs pre-tensioned to 20 N and 40 N in this study have approximately 31% and 46%, respectively, the strength of the intact MCL. Further clinical and biomechanical studies are needed to determine whether these repair methods have sufficient strength to withstand early postoperative active elbow motion in patients.

REFERENCES: