Suture Tape Augmentation of the Thumb Ulnar Collateral Ligament Repair: A Biomechanical Study

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Purpose This study aimed to evaluate and compare the biomechanical strength of repair of the thumb ulnar collateral ligament (UCL) alone and repair augmented with suture tape.

Methods Twelve fresh-frozen cadaveric specimens (6 matched pairs) had the UCL divided at its attachment on the base of the proximal phalanx and repaired with or without suture tape augmentation. A material testing machine was used to provide valgus stress at a rate of 0.1 mm/s until failure. The maximum load, load at clinical failure, and mode of failure were recorded.

Results In the specimens with UCL repair augmented with suture tape, the maximum load (46.6 N [SD, 25.6 N]) and load at clinical failure (25.3 N [SD, 18.3 N]) were significantly higher than in the repair-only group (8.02 N [SD, 2.24 N]) and (6.00 N [SD, 2.39 N], respectively).

Conclusions In this model, thumb UCL repair with suture tape augmentation demonstrated greater maximum and clinical failure loads compared with nonaugmented repair at time 0, that is, without any biological healing.

Clinical relevance Suture tape augmentation of UCL repair may be valuable in the setting of acute tears by decreasing the time of postoperative cast immobilization and, therefore, allowing for earlier thumb metacarpophalangeal joint motion and overall faster clinical recovery. (J Hand Surg Am. 2018; ■(■):1.e1-e6. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Thumb, ulnar collateral ligament, repair, biomechanics, suture tape.

The ulnar collateral ligament (UCL) is the primary stabilizer of the thumb metacarpophalangeal (MCP) joint to radial stress. Excessive radial deviation of the thumb is a common cause of injury to the UCL.2–6 Acute injuries are commonly associated with sports, such as skiing,7 whereas chronic injuries result from repetitive stress to the ligament.8 Common eponyms for these injuries include: skier’s thumb for acute injuries,7 gamekeeper’s thumb for chronic injuries,9 and Stener lesions for acute injuries in which the adductor aponeurosis is interposed between the avulsed ligament and the ligament insertion.5

Treatment of these injuries depends on the degree of ligamentous injury, chronicity of the tear, and physical demands of the patient.10–13 Nonsurgical treatment is reserved for partial tears or sprains with less than 15° difference in laxity with valgus stress compared with the contralateral thumb. Operative treatment is indicated for tears in which there is greater than 30° of laxity of the MCP joint with radial stress or a relative increased laxity of 15° compared
with the contralateral side. Operative treatment can be by either direct repair or reconstruction depending on the timing of the injury and the ligament quality.\textsuperscript{14,15} Ligament injuries can often be repaired primarily if the native tissue is robust and easily identified. Stener lesions are an indication for repair because the ligament will not heal anatomically without surgery owing to interposition of the adductor aponeurosis.\textsuperscript{5}

Numerous methods to repair the UCL have been described. These include a transosseous suture tied over a button on the radial side of the proximal phalanx\textsuperscript{16–18} or the use of a suture anchor.\textsuperscript{19,20} Suture anchor repair has become more popular owing to shorter surgical times, fewer soft tissue complications, and lower cost.\textsuperscript{21} Internal bracing is a new augmentation method using suture tape that has been recently applied to a myriad of orthopedic applications, such as anterior cruciate ligament surgery,\textsuperscript{22} knee medial collateral ligament surgery,\textsuperscript{23,24} anterior talofibular ligament surgery,\textsuperscript{25} and elbow UCL surgery.\textsuperscript{26} To date, there are no published data on the biomechanical strength of this augmentation method applied to thumb UCL repair.

The purpose of this study was to evaluate and compare the biomechanical strength of repair of the thumb UCL alone and repair augmented with suture tape. It was hypothesized that maximum load and load at clinical failure would be higher for the augmented repair. Clinical failure was defined as an observed valgus deflection of 30°.

**MATERIALS AND METHODS**

Twelve fresh-frozen cadaveric hand specimens (6 matched pairs) were used in this study. The average age of the specimens was 49.6 years (SD, 4.6 years). From each matched pair of specimens, 1 thumb was assigned to undergo repair alone and the other to undergo repair with internal bracing using suture tape augmentation.

**Specimen preparation**

The thumb was disarticulated from the hand at the carpometacarpal joint. Skin and subcutaneous tissue were removed. Care was taken to ensure preservation of the volar plate, joint capsule, and collateral ligaments.

The specimens were potted in 38 mm polyvinyl chloride (PVC) piping. The inner diameter of the piping was slightly bored out to accommodate the thickest portion of the specimen. A 2-mm hole was drilled through the diameter of the piping about 6 mm from the end of the tubing. The proximal end of each specimen was predrilled through the thickest section using a 1.6-mm K-wire, followed by a 2.4-mm drill bit. The 1.6-mm K-wires were bent to 90° angles at 1 end. The specimen was then placed inside the PVC tubing and the bent K-wires were passed through the PVC piping and the specimen. The opposing end of the K-wire was bent, securing the specimen in the piping. The specimens were then potted using Bondo (3M, Maplewood, MN).

**Surgical technique**

**Repair-only group:** The adductor aponeurosis was released and reflected volarly and the extensor mechanism dorsally. The joint capsule was incised at the dorsal border of the UCL. The UCL was detached from the volar base of the proximal phalanx and left attached at its origin on the first metacarpal. The guidewire for the suture anchor (3.5 mm DX SwiveLock SL; Arthrex, Naples, FL) was placed at the UCL attachment site on the volar base of the proximal phalanx. The guidewire was overdrilled with a 3.2-mm drill. A 3-0 FiberWire suture (Arthrex) was placed around the fork tip of the suture anchor and the anchor was placed into the drill hole, securing the suture in place. The suture was then passed through the distal UCL in horizontal mattress fashion to perform a direct repair of the ligament (Fig. 1).

**Repair with suture tape augmentation group:** The exposure was the same as for ligament-repair only. The guidewire for the suture anchor was again placed at the UCL attachment site on the volar base of the proximal phalanx and overdrilled with a 3.2-mm drill. In addition to the 3-0 FiberWire suture, a LabralTape (Arthrex) was also placed around the fork tip of the suture anchor and the anchor was placed into the drill hole, securing the suture in place. The suture was then passed through the distal UCL in horizontal mattress fashion to perform a direct repair of the ligament (Fig. 1).
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