The Effectiveness of Utilizing a Biotenodesis Screw in Elbow Ulnar Collateral Ligament Reconstruction

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Abstract

Ulnar collateral ligament disruptions of the elbow are increasingly common for athletes involved in overhead sports. We reviewed two methods of ulnar collateral ligament reconstructions varying only in their ulnar fixation. Twelve young athletes were reviewed following ulnar collateral ligament reconstructions - six with the traditional bone tunnel method of fixation on the ulna and six with a Biotenodesis screw. The athletes were followed for an average of 33.6 months with all able to return to sports. We conclude that utilizing a Biotenodesis screw for ulnar fixation produces equivalent results to a traditional bone tunnel technique.

Introduction

Ulnar collateral ligament injuries to the elbow have shown a significant rise recently. This may be due to a true increase or an increased awareness and ability to make the diagnosis. [1] In either case, the injury is more prevalent today than it was when Dr. Frank Jobe first described the entity and reconstructed the ligament for pitcher Tommy John. Since that time several advances have been made and the anatomy of the medial elbow is more thoroughly understood. [2] [3] [4]These advances have made it possible in a relatively reproducible manner to reconstruct the ligament and give the athlete an excellent chance to return to the same or a higher level of participation.[5-8]

The anatomy of the ulnar collateral as described by Morrey has three separate segments. [9-11] The anterior band has been demonstrated to be the most significant contributing 54% of the soft tissue stability to valgus torque in 90° of flexion.[11] This portion of the ligament is most active at 60 - 110 ° of elbow flexion which is also the position of maximal stress on the medial elbow as measured in several biomechanical studies.[4, 12-14] Therefore, when reconstructing the UCL it is common to primarily address the anterior band and not the posterior or transverse segments of the UCL.

Primary repair of the UCL has not shown favorable results for those wishing to return to overhead sports and therefore reconstructive techniques have been investigated and described. The first of these as described by Dr. Jobe involves using the palmaris tendon woven through drill holes at the sublime tubercle of the ulna and the medial condyle of the humerus. [15] In most instances there is enough tendon available that 3 or 4 strands of the tendon graft is able to be looped in a figure-of-eight fashion to reconstruct the UCL. The graft is tightened with slight varus stress on the elbow flexed to 30° or more. The graft is sutured at its entrance and exit from the tunnel holes and then to itself. This classic reconstructive method is still performed today with excellent results. However, some concerns regarding the ulnar nerve, short boney bridges, and technical difficulties have led alternative methods to be described.[5, 7, 16-18] [19] One of these, described by David Altchek , termed the Docking technique, eliminates the need for two tunnels to be drilled in the medial condyle.[8] This lessens the possibility of medial condyle fractures though a learning curve with regards to determining the appropriate tendon length and suture passing does exist. Dr. Altchek and others have reported high success rates (greater than 90%) with fewer complications.[8]

A relatively new reconstructive procedure for the ulnar side of the reconstruction has been described by Neal ElAttrache.[17] This utilizes a single blind tunnel at the sublime tubercle and fixation is achieved with an interference screw. This lessens the chances of ulnar bone bridge fracture and decreased the dissection necessary distal to the joint line that the classic reconstructive procedure requires to protect neurovascular structures while achieving excellent biomechanical properties.[20] This type of fixation as also been described on the humeral side of the reconstruction with mixed results in biomechanical studies regarding pull-out strengths.[21]

We, like others, [22] have converted from the classic reconstructive technique to a hybrid technique referred to as the DANE procedure named after its initial descriptors. The DANE utilizes the Docking technique on the humerus (Dave Altchek) and an interference screw on the ulna (Neil ElAttrache). In an attempt to determine if this hybrid reconstructive technique gave equivalent results to the classic Docking technique, we prospectively followed six patients reconstructed in each fashion.

Materials and Methods.

We retrospectively identified six baseball players (5 pitchers and one position player) who had an UCL reconstruction performed via the original Docking procedure and compared them to six baseball players (5 pitchers and a catcher) reconstructed via the DANE procedure. Both groups had an arthroscopy to confirm medial joint space opening with valgus elbow stress and debridement of loose bodies and scar tissue as necessary done without a tourniquet. An ipsilateral gracilis tendon autograft was utilized in each of the athletes. This was harvested in the standard fashion with a tendon length long enough to allow a double stranded reconstruction.

The arms were then exsanguinated, a tourniquet about the upper arm inflated, and a curvilinear approach to the UCL made with care to avoid neurovascular structures. In no cases was the ulnar nerve transposed as none of the athletes had ulnar nerve symptoms prior to the procedure. The humeral reconstructive tunnel for both groups was drilled after dissecting a minimal amount of the flexor-pronator mass to expose the insertion site for the UCL as previously described. A single blind tunnel was drilled with two connecting, smaller tunnels in a Y-shaped configuration for suture passage. Enlargement of the tunnel after measurement of the graft was performed as necessary. During tensioning of the graft the suture material (specifically the knot) was placed on the bone where the maximal amount of soft tissue coverage was possible to help prevent post-operative irritation. A picture of the finished Docking procedure is seen in Fig. 1.

The approach to the ulna was as described for the classic reconstruction. The flexor and pronator muscle mass was split and dissection to expose the sublime tubercle performed. Slightly more dissection was necessary for the classic reconstructive cases in order to visualize the insertion point better and to protect the neurovascular structures. The bone bridge was made by making two holes through the cortical bone with a 3.2mm drill and then connecting them with a small curette. A minimum of a 1cm bridge in all cases was established. The tunnel was enlarged as necessary once the graft was prepared and measured.

The DANE reconstructed patients had a single blind end tunnel drilled just distal to the joint line over a pin. The tunnel was sized and drilled after measuring the graft and a 5.5mm Biotenodesis screw (Arthrex, Naples, Fla) utilized for fixation as per the manufacturer's specifications.

After tensioning the graft in 45° of elbow flexion and slight varus stress, the remnants of the native UCL was sutured down over the reconstruction, soft tissues were closed in a layered fashion and the elbow and wrist were immobilized in a splint.

Post-operatively the splint was removed on day 4 or 5 and only the elbow immobilized until the sutures were removed between days 10 and 14. At that point a single hinged elbow brace was applied and motion from 30° to 60° allowed. Therapy was begun for simple ROM exercises and standard therapy for the knee at 2 weeks post-op. Gradually the brace was unlocked with FROM allowed at 6 – 8 weeks post-op. The brace was then worn for protection until 3 months, unlocked. Patients were allowed to start a light

tossing program at 3 months and pitching and/or high velocity throwing allowed at 6 months.

Patients were followed up at regular intervals with x-rays, examination, and completion of outcomes rating scales including the simple elbow score and an elbow athletic score.

Results

Average age of the pitchers was 17.3 (range 14 to 20) for the classic Docking technique patients and 18.5 (range 17 to 20) for the DANE patients. There were 5 right handed athletes and a single left handed athlete in each group. Follow-up was 38.8 months (range 27 to 51 months) for the Docking technique and 28.3 months (range 21 to 37 months) for the DANE patients. All patients were able to return to baseball play at the same level or higher. One in the Docking group has moved on to play at the semi-professional level while all others are participating on their college teams. One patient in the DANE group developed internal impingement in his shoulder which forced him to switch to being a position player. One patient in the Docking group developed knee problems unrelated to gracilis tendon harvest which had him reduce his level of play to college intramurals. On physical exam at final follow-up patients had symmetric range-of-motion when comparing their operative and non-operative elbows with no patients having more than a 5 degree difference side-to-side. Examination also did not reveal any evidence of pain or medial joint space opening on pure elbow valgus stress. The moving valgus stress test and Milking maneuver were also negative on all elbows. All patients felt as if they were improved and would have the procedure again if they knew before what they know now. Their average simple elbow scores were 7.8 (range 7 to 9) and 8.3 (range 7 to 9 out of 10) in the Docking versus DANE patients, respectively. The athletic elbow score was 90.2 (range 85 to 95, 100 is fully functional, normal elbow) and 90.4 (range 83 to 95) for the Docking versus DANE patients. The Docking patients had an average total tourniquet time of 112 minutes and the DANE patients averaged 92 minutes.

Discussion

UCL injuries are becoming more common. This may be due to an increased incidence or merely an increased diagnostic ability of UCL ruptures. In either case, the number of reconstructions has increased and refinements of the procedure are occurring. Given recent refinements, the current success rate of these reconstructions has been improving with results reported between 79 %[5] to close to 90% in more recent publications. [8, 22, 23] Most authors note that the return takes at least a full year to be complete and often occurs in the second season following the surgery. [5, 24]

Complication rates are low with Andrews quoting an overall rate of 10% with less than 1% overall having complications that directly affect the players chance to return to play. [25]

The different techniques described have been evaluated and reviewed. The classic Jobe method had a large incidence of ulnar nerve problems as reported by Conway et al.[26] This problem has been largely corrected by improved methods of transposing the ulnar nerve or not doing so at all. Overall ulnar nerve problems creating long term problems are reported as 0.9%.[25] Other problems of bony bridge fractures or medial condyle fractures have been reported in little more than 1% of cases and after care this usually does not affect full return to play, at least in the elite level throwers. Rehabilitative protocols vary with some authors recommending the use of braces and restriction of early motion while others believe neither of these is necessary.

As addressed in this report, differences in fixation techniques between reconstructive techniques do exist. Biomechanical results have shown that the use of interference screws on both the ulnar and humeral sides of the joint returns valgus stability to the joint compared to the intact contralateral specimen though the reconstruction stiffness did not return to normal.[20] In another biomechanical study the classic Jobe reconstruction was compared to an interference fixation construct.[21] The stiffness and initial strength of the classic reconstruction was better (22Nm vs. 13.4 Nm) with failure occurring by bone bridge fracture for the Jobe reconstructions and graft slippage past the interference screws as the predominant failure mode for the reconstructions utilizing interference screws.[21] We have done pilot trials using the biotenodesis screw for this reconstruction and have been happy with its fixation strength.

Dines et al has reported on a series of athletes reconstructed with the DANE technique with a 86% successful result at 36 months post-op.[22] The results of our study agree with their result that using a gracilis autograft with a biotenodesis screw on the ulnar side and the Docking technique on the humeral side of the reconstruction is at least equivalent to the results using more traditional bone bridge techniques with perhaps lower complication rates and shorter operating/tourniquet times.

This report, while suggesting that the DANE procedure produces similar results to the traditional reconstructive techniques, has some short comings. This is a retrospective review and therefore non-randomized though the groups are comparable as noted above.

The groups have small numbers and though followed beyond their return to active baseball play, longer term follow-up is needed.

Conclusion

The increasing problem of UCL injuries is an issue that many research groups are working on to better understand and hopefully establish methods to reduce. For the foreseeable future, however, it is likely that the incidence will continue to rise and therefore attempts to further refine and improve reconstructive methods is appropriate. Due to the decreased amount of dissection required and the shorter tourniquet time necessary it is possible that this technique will reduce the complication rates associated with the procedure. Further, we provide evidence that the use of a blind tunnel and a biotenodesis screw for ulnar fixation is an acceptable option compared to the classic Jobe reconstructive method.

Legends

Fig. 1

Finished UCL reconstruction performed on a cadaveric right elbow.

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