SCIENTIFIC ARTICLE

Direct Repair for Managing Acute and Chronic Lateral Ulnar Collateral Ligament Disruptions

Aaron Daluiski, MD, Mark A. Schrumpf, MD, Joseph J. Schreiber, MD, Joseph T. Nguyen, MPH, Robert N. Hotchkiss, MD

Purpose Acute elbow injuries that disrupt the lateral ulnar collateral ligament and result in posterolateral rotatory instability usually require surgical treatment. The 2 technical options reported, direct repair and use of a palmaris longus tendon graft, have usually favored the use of the graft. To balance this emphasis, we report our experience with direct repair of the humeral origin in cases of trauma, whether acute, delayed, or recurrent. It was our hypothesis that because the humeral origin is the point of failure and separation, restoration of this attachment is sufficient to restore stability and durable function without the need for a graft.

Methods Patients with complete disruption of the posterolateral ligaments of the elbow, who were managed with direct repair to the humeral origin, were included. Patients were separated into an acute treatment group (< 30 d from injury to treatment) and a delayed treatment group (> 30 d). Mayo Elbow Performance Scores and postoperative range of motion were collected from patient records.

Results A total of 34 patients were included with a mean follow-up of 42 months. No difference was seen in Mayo Elbow Performance Scores between acute (mean, 90) or delayed treatment (mean, 89) of the lateral ulnar collateral ligament tear. No difference was seen in final elbow flexion or extension. Two patients in the acute group had failure of the direct repair requiring intervention. In the delayed group, no patients had recurrent instability.

Conclusions No significant difference in clinical outcome or range of motion was observed after direct repair of traumatic tears of the lateral ulnar collateral ligament tear between acute and delayed treatment cohorts. Despite complete disruption of the posterolateral ligaments, direct repair of the torn ligament to its humeral origin was effective without supplemental tendon graft reconstruction irrespective of interval from injury to repair, mechanism of injury, or associated fractures. *(J Hand Surg Am. 2014;39(6):1125–1129. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic III.

Key words Posterolateral rotatory instability, lateral ulnar collateral ligament.

From the Department of Orthopaedic Surgery, Hospital for Special Surgery, New York, NY.

Received for publication November 8, 2013; accepted in revised form February 7, 2014.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Aaron Daluiski, MD, Department of Orthopaedic Surgery, Hospital for Special Surgery, 523 E. 72nd Street, New York, NY 10021; e-mail: daluiskia@hss.edu.

0363-5023/14/3906-0014$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.02.011

Upper extremity activities performed in an upright position place a gravitational varus moment on the elbow. The lateral collateral ligaments (LCL) are the primary soft tissue constraint to this varus stress. In the unstable elbow, reconstruction of the LCL is critical to maintaining elbow stability.[1] Specifically, the lateral ulnar collateral ligament (LUCL) provides most of the stability against posterior lateral forces, such as pushing off when rising from a chair.[2,3]

Elbow dislocation frequently results in disruption of the LUCL.[1,4] A subset of patients sustaining this injury can develop laxity of the LUCL and resultant instability of the elbow, referred to as posterolateral rotatory instability (PLRI).[1,3,5] When the LUCL scars into an effectively lengthened position, the elbow is susceptible to instability when axial and valgus moments are combined with forearm supination and elbow flexion.[1,3] The incompetence of the LUCL allows the radial head to subluxate posteriorly, resulting in a subjective feeling of instability and, in some cases, dislocation of the ulnohumeral joint.

Because of the importance of the LUCL in elbow stability, it is generally accepted that the LUCL should be repaired or reconstructed if the injury is being treated surgically or if there is chronic symptomatic elbow instability.[2,6] In the setting of chronic elbow instability, reconstruction of the LUCL can often cure symptoms of instability.[5,7]

Lateral ulnar collateral ligament insufficiency in the acute phase can be addressed either by direct repair to its humeral origin on the lateral epicondyle or by reconstruction with the use of a tendon graft. Some authors prefer reconstruction with graft in all patients who are undergoing repair for a chronic injury.[2,7]

In contrast, we routinely repair the LUCL back to its humeral origin and plicate the lateral elbow capsule in both acute and chronic cases if the tissue quality is acceptable. Most tears in the LUCL occur acutely rather than from repetitive attritional changes as seen with throwing athletes on the medial side of the elbow.[8,9] Because we have rarely found it necessary to use a graft to augment the repair, we hypothesized that primary ligamentous repair would yield good functional performance in a group of patients with elbow trauma involving disruption of the LUCL.

MATERIALS AND METHODS

We searched an institutional review board–approved retrospective review of our prospective Health Insurance Portability and Accountability Act–compliant elbow disorder database for all patients who underwent an LUCL repair with local tissues. All patients whose surgical procedures included Current Procedural Terminology code 24343, "repair of lateral collateral ligament with local tissue," between 2003 and 2010 underwent chart review.

Sex, age, date of injury, details of associated injuries, surgical procedures performed during the index procedure, and the method of repair of the ligament were recorded. The chart was also reviewed for the final clinical follow-up range of motion, reoperations, and complications.

Patients with follow-up of less than 180 days were excluded from this review. For reporting purposes, patients were separated into 2 groups: those with acute treatment defined as an interval of less than 30 days between injury and treatment and those with delayed treatment in which the index operative procedure was 30 days or more from the date of injury.

At the final clinical follow-up, a senior therapist or surgeon measured the range of motion with the use of a long-arm goniometer. The operating surgeon assessed lateral ligamentous stability through patient history and by assessing varus laxity and posterolateral rotatory pivot shift and drawer tests. All patients were then called, and a phone interview was conducted in which patients were asked about any recurrent instability including subjective instability. Mayo Elbow Performance Scores (MEPS) were calculated at the time of final telephone follow-up, with the use of the range of motion recorded at the final clinical follow-up.[2,6] A statistical analysis was performed using the Mann-Whitney *U* test for the MEPS and Student *t* test for final range of motion. We then completed a post hoc power analysis to ensure adequate power using the MEPS as the primary outcome, with a clinically significant difference set to 15 points. This threshold was selected because it represents the difference between good and excellent outcomes, as defined by the MEPS scoring instructions.[2,6]

Operative treatment

The surgical approach in all patients was a lateral midaxial one that exploited the interval between the extensor digitorum communis and the extensor digiti quinti.[13] This interval overlies the bony midaxis of the radiocapitellar joint and can be recognized by 2 methods. The midaxis can be easily determined by palpating the anterior and posterior margins of the radial head and placing the incision between these 2 landmarks. Alternatively, moving the little finger through a full arc of motion identifies the extensor digiti quinti septum, thereby marking the safe interval to use. All patients in this cohort were noted to have humeral detachment of the lateral collateral ligaments. All repairs were completed using a modified docking technique performed with a drill hole, with suture anchor fixation, or with a combination of both.[10] The ligament repair was executed by passing a nonabsorbable suture in running locking fashion through the substance of the avulsed lateral ligaments. The docking repair was completed by tying

TABLE 1. Demographics of Acute and Delayed Repair Cohorts

Variable	Acute		Delayed		*P* Value
	Mean or N	SD or %	Mean or N	SD or %	
Total	18		16		
Female sex	8	44%	5	31%	.430
Age at injury, y	50	16	43	18	.260
Days to surgery	9	5	513	639	.007
Total follow-up, d	1,258	981	1,084	715	.560
Postoperative flexion (°)	133	13	137	9	.440
Postoperative extension (°)	18	11	21	15	.520
Mayo Elbow Performance Score	90	11	89	13	.910

the loose ends of the suture over a bony bridge located just anterior to the isometric point of the lateral epicondyle. We performed the suture anchor repair in a similar manner with a running locked stitch in the lateral ligaments tied to the anchor placed just anterior to the isometric point of the elbow joint in the lateral epicondyle.

Postoperative management

Range of motion was begun immediately using a previously described overhead motion protocol.[11,14] The protocol instructs patients to perform range of motion exercises in the supine position and with the shoulder flexed 90°. This position decreases the effects of gravity by minimizing the posterior vector forces at the elbow. When coming into this overhead position, it is important to maintain the shoulder in an adducted position with neutral rotation. Internal rotation as well as abduction of the shoulder place a varus moment on the elbow, stressing the repair. While in this position, patients are instructed to perform active-assisted forearm pronation and supination, active and active-assisted elbow flexion without limits, and elbow extension tailored to the instability of the injury. Except when performing exercises, an orthosis is worn at all times to hold the elbow flexed, the forearm pronated to decrease lateral ligamentous stress, and the wrist in neutral to relax muscular attachments. Strength and endurance exercises are typically begun after the sixth week.

RESULTS

A total of 41 patients who underwent repair of the lateral collateral ligament were identified. Over this period, 2 patients were treated for PLRI with a graft. The deficiency in both cases was attributed to lateral elbow steroid injections resulting in irreparable and poor local tissue. Of the patients who underwent repair, the elbow injuries included but were not limited to the lateral ulnar collateral ligament. Of these patients, we excluded 7 (3 in the acute treatment group and 4 in the delayed treatment group) from our review because they had insufficient postoperative follow-up. Complete data were available for all remaining patients, with the exception of 2 who were unable to be reached via telephone for final MEPS calculation.

We performed a chart review on the remaining 34 patients. Injuries in these patients included 17 fracture dislocations of the elbow, 5 cases of simple elbow dislocations, 3 cases of recurrent elbow dislocation, 3 cases of isolated PLRI, 3 radial head fractures without dislocation (1 with a combined coronoid fracture), and 1 each isolated coronoid fracture, supracondylar humerus fracture, and radial head fracture with an Essex-Lopresti lesion.

Eighteen patients were identified in the acute group, and 16 in the delayed group (Table 1). The average time to the index operative procedure was 9 days (range, 1−19 d) for the acute group and 513 days (range, 30 d to 6.5 y) for the delayed group ($P = .007$). No differences were noted when data were analyzed by type of fixation.

The average observed postoperative elbow flexion was 133° (SD, 14°) for the acute group and 137° (SD, 9°) for the delayed group ($P = .440$). The average extension was 18° (SD, 11°) for the acute group and 21° (SD, 15°) for the delayed group ($P = .520$).

Mayo Elbow Performance Scores were collected at final clinical follow-up from all available patients. Two patients in the acute group were unavailable for MEPS scoring and were thus excluded from this portion of the analysis. The mean MEPS score for the acute group was 90 (range, 65−100), and was 89 for the delayed group (range, 65−100) ($P = .910$).

For this analysis, alpha was set to .05, which showed that beta was equal to .92. The analysis revealed that the study was adequately powered to detect a difference between a good and excellent outcome in this patient population.

Complications

Two patients in the acute group with elbow fracture-dislocation as the original injury later had LUCL reconstruction with a tendon graft, 1 owing to recurrent instability and 1 to a subsequent traumatic redislocation. In addition, in the acute group, 1 patient underwent a contracture release and later underwent an anconeus interposition graft. No patient in the delayed group required a revision stabilization procedure during the follow-up period. However, in the delayed treatment group, 1 patient developed a wound breakdown, and the resultant soft tissue defect required a radial forearm flap for coverage with a subsequent elbow contracture release. An additional patient in the delayed group also required an elbow contracture release. One patient developed painful ulnohumeral arthritis and underwent a total elbow arthroplasty. Finally, 1 patient needed an ulnar nerve transposition for persistent ulnar nerve neuritis.

DISCUSSION

This review of our clinical experience demonstrated no discernable difference in outcomes between performing an acute versus delayed primary surgical repair of the LUCL. We observed no clinical or subjective instability in patients who underwent repair of the LUCL more than 30 days after the initial injury.

The cases involved in this review included complex and diverse pathology not limited to isolated avulsion of the lateral ligaments. Therefore, it is unsurprising that a number of patients experienced both major and minor complications. However, the only patients who required revision reconstruction for continued symptomatic instability were in the acute repair group. Furthermore, only 2 of 34 patients who underwent repair of the lateral collateral ligament went on to symptomatic failure.

Little has been published on the results of operative treatment for PLRI. In 1966, Osborne and Cotterill[12] originally discussed the role of lateral ligamentous incompetence as the primary pathologic lesion in recurrent elbow instability. They advocated plicating the lateral elbow capsule with repair of the lateral collateral ligament through transosseous tunnels based on excellent clinical results. O'Driscoll et al[3] defined the clinical syndrome "posterolateral rotatory instability," identified a diagnostic test, confirmed LUCL incompetence as the pathologic lesion, and described a surgical procedure to address the instability using a palmaris longus tendon graft.

Our results are similar to those published by both Osborne and Cotterill[12] and those in the original clinical article by Nestor et al.[6] In the original series, 7 patients underwent reconstruction with a palmaris longus tendon graft, 3 underwent repair of the LUCL with imbrication, and 1 had a triceps fascia graft reconstruction. Although the numbers were too small to compare groups, all 3 patients who underwent direct repair had excellent results. The only patient with clinical failure had undergone reconstruction with a palmaris longus graft with synthetic augmentation.

In a follow-up to their original paper, Sanchez-Sotelo et al[7] published the results of 45 patients, 33 treated with a tendon graft and 12 with direct repair. Recurrent instability occurred in 4 of the 12 patients who underwent repair and in 3 of the 33 patients who underwent reconstruction. The average MEPS for reconstructed patients was 87, compared with 77 for the primary repair cohort. These results led the authors to conclude that the use of a tendon graft provides superior clinical results compared with ligamentous repair. One explanation for the inferior results seen with repair in their series could be the etiology of lateral ligamentous injury, because only 4 injuries resulted from fractures and/or dislocations, 6 were caused iatrogenically in a previous operation, 1 was the result of to a strain, and 1 had an unknown cause. In contrast, no patients in the current series had an iatrogenic or strain injury. We believe that after traumatic events such as fractures and/or dislocations, the local tissue is of high quality and more amenable to direct repair.

Indeed, Morrey and Sanchez-Sotelo[2] advocated for formal repair of the ligament in an acute injury. In the chronic setting, they recommended a tendon graft and noted that ligament repair or imbrication "has been shown to provide inferior results." However, their cited sources did not directly address the chronicity of ligamentous injury or its relation to recurrent instability.[6,7]

It has been our experience that most LCL injuries occur as the result of a traumatic varus moment and not chronic attritional changes that would compromise the integrity of the native tissue. The reliably good quality of the LUCL makes the ligament amenable to repair regardless of the time from injury. Unlike insufficiency of the medial collateral ligament, in which the injury is usually the result of repetitive micro-trauma with subsequent degeneration of the ligament,[8,9] insufficiency of the LUCL is usually the

result of an isolated acute trauma. The acute trauma mechanism leaves the most of the collagen fibers in the ligament intact but detached from their origin. No patients in the present cohort had an etiology that compromised the local tissue quality, such as steroid injections, cubitus varus deformity, or crutch use. Thus, by repairing the LUCL instead of reconstructing, we avoided donor site morbidity and the dangers of allograft. If the results are in fact equivocal, this makes repair a more attractive alternative.

There are 3 reasons why authors may have reported poor results with ligamentous repair compared with our experience. The first is that many authors use the Kocher approach to visualize the lateral elbow. This approach exploits the interval between the anconeus and the extensor carpi ulnaris and can easily lead to iatrogenic transection of the LUCL, especially in cases of injury with humeral detachment. Our approach is anterior to the traditional Kocher, staying between the extensor carpi ulnaris and the extensor digiti quinti.[13] This keeps the dissection anterior to the LUCL, making it less likely to be injured.

The second reason is that we err on the anterior side of the isometric point on the lateral epicondyle when fixing the ligament. Although this may induce a small flexion contracture, as exhibited in our data, it prohibits patients from placing the limb in the provocative position of elbow extension and forearm supination.

The final reason we believe that ligamentous repairs have had a better clinical outcome in our hands is because of our rehabilitation protocol.[11] The overhead protocol instructs the patient to perform range of motion exercises in the supine position, allowing gravity to induce a reducing force at the elbow.[14] This takes tension off the repaired LUCL, allowing it to heal in a functional position and preventing recurrent instability.

The data were collected retrospectively, and the length of follow-up by physical examination was limited to the last clinical encounter date. We were unable to get adequate follow-up for 7 of the patients in our series, and 2 other patients were unavailable for MEPS assessment. The exact repair methodology was also not uniform. Although the basic premise remained unchanged, patients underwent repair of the LUCL in a heterogeneous fashion (anchors vs tunnels), with repair techniques evolving over time. In addition, this group of patients represents diverse pathology and was not strictly limited to isolated LCL tears. However, it has been our experience that most of these injuries occur in concert with other elbow injuries.

REFERENCES

1. Mehta JA, Bain GI. Posterolateral rotatory instability of the elbow. *J Am Acad Orthop Surg*. 2004;12(6):405–415.
2. Morrey BF, Sanchez-Sotelo J. *The Elbow and Its Disorders*. 4th ed. Philadelphia, PA: Saunders/Elsevier; 2009:1211.
3. O'Driscoll SW, Bell DF, Morrey BF. Posterolateral rotatory instability of the elbow. *J Bone Joint Surg Am*. 1991;73(3):440–446.
4. O'Driscoll SW, Jupiter JB, Cohen MS, Ring D, McKee MD. Difficult elbow fractures: pearls and pitfalls. *Instr Course Lect*. 2003;52:113–134.
5. Jones KJ, Dodson CC, Osbahr DC, et al. The docking technique for lateral ulnar collateral ligament reconstruction: surgical technique and clinical outcomes. *J Shoulder Elbow Surg*. 2012;21(3):389–395.
6. Nestor BJ, O'Driscoll SW, Morrey BF. Ligamentous reconstruction for posterolateral rotatory instability of the elbow. *J Bone Joint Surg Am*. 1992;74(8):1235–1241.
7. Sanchez-Sotelo J, Morrey BF, O'Driscoll SW. Ligamentous repair and reconstruction for posterolateral rotatory instability of the elbow. *J Bone Joint Surg Br*. 2005;87(1):54–61.
8. Jobe FW, Glousman RE, Pink M. Medial instability of the elbow in throwing athletes: treatment by repair or reconstruction of the ulnar collateral ligament. *J Bone Joint Surg Am*. 1992;74(1):67–83.
9. Jobe FW, Stark H, Lombardo SJ. Reconstruction of the ulnar collateral ligament in athletes. *J Bone Joint Surg Am*. 1986;68(8):1158–1163.
10. Rohrbough JT, Altchek DW, Hyman J, Williams RJ III, Botts JD. Medial collateral ligament reconstruction of the elbow using the docking technique. *Am J Sports Med*. 2002;30(4):541–548.
11. Wolff AL, Hotchkiss RN. Lateral elbow instability: nonoperative, operative, and postoperative management. *J Hand Ther*. 2006;19(2):238–243.
12. Osborne G, Cotterill P. Recurrent dislocation of the elbow. *J Bone Joint Surg Br*. 1966;48(2):340–346.
13. Schrumpf M, Daluiski A, Richards J, Hotchkiss RN. The midaxial (universal) approach to the lateral elbow. *Techn Shoulder Elbow Surg*. 2011;12(1):6–11.
14. Lee AT, Schrumpf MA, Choi D, et al. The influence of gravity on the unstable elbow. *J Shoulder Elbow Surg*. 2013;22(1):81–87.