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Lateral collateral ligament reconstruction in atraumatic posterolateral rotatory instability

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ARTICLE INFO

Keywords:

Lateral elbow instability
Posterolateral rotatory instability
Lateral collateral ligament reconstruction
Recalcitrant lateral epicondylitis
Recalcitrant tennis elbow
Lateral elbow pain

Level of evidence: Level IV, Case Series,
Treatment Study

Background: Chronic elbow pain has several causes. Instability pain is one of the differential diagnosis. Posterolateral rotatory instability (PLRI) of the elbow results from lateral collateral ligament (LCL) insufficiency. This instability has been recognized in association with trauma of the elbow. The standard treatment of LCL insufficiency is ligament reconstruction with a tendon graft. Treatment outcome of LCL reconstruction in atraumatic PLRI cases has been rarely reported. This study reports the results of LCL reconstruction in patients with chronic lateral elbow pain from atraumatic PLRI.

Materials and methods: Data were collected from 36 patients referred to our institution for surgery because of chronic lateral elbow pain between November 2011 and June 2015. Six patients with atraumatic PLRI underwent LCL reconstruction with tendon graft. Demographic data, number of steroid injections, postoperative clinical examination, Mayo Elbow Performance Index, 11-item version of the Disabilities of the Arm, Shoulder and Hand score, and complications were recorded with a mean follow-up of 24 months.

Results: Reconstruction resulted in significant improvement of pain. The mean postoperative Mayo Elbow Performance Index score was 97.5 (range, 95–100), and the score of the 11-item version of the Disabilities of the Arm, Shoulder, and Hand was 9 (range, 3.3–33). Postoperative instability test results were negative in all patients. Mean postoperative range of motion was 136° in flexion and 1° in extension. No complications were detected at the follow-up assessment.

Conclusions: We consider LCL reconstruction is one of the reference treatments for atraumatic PLRI because it provides effective and reliable results.

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The most common cause of lateral elbow pain is lateral epicondylitis or tennis elbow.¹⁶ However, lateral elbow pain may have several etiologies, including lateral plica, radial tunnel syndrome, radiocapitellar cartilage lesions, and posterolateral (PL) rotatory instability (PLRI), in which PLRI may coexist with these other etiologies.^{7,13,14,17} In PLRI-induced lateral elbow pain, the characteristic of pain is usually provoked by leaning on the hand in a slight flexion and forearm in supination.

PLRI of the elbow is caused by lateral collateral ligament (LCL) complex insufficiency, mainly implicating the ulnar bundle.¹⁰ Typically, PLRI has been recognized in association with trauma of the elbow. The standard treatment of traumatic LCL insufficiency consists of LCL repair or reconstruction. LCL reconstruction with tendon graft has provided an excellent result.¹⁴

Also, PLRI can be found in nontraumatic event. In lateral epicondylitis, elbow instability theoretically develops when degenerative changes occur in the extensor tendon and stress the LCL in daily life activities. Moreover, repeated corticosteroid injections as the treatment of lateral epicondylitis may disturb the collagen metabolism. Prolonged abnormal forces on LCL or repeated corticosteroid injections, or both, may contribute to LCL complex insufficiency.^{2,7}

To date, limited data have been published regarding the surgical outcome of LCL reconstruction in atraumatic PLRI. This study reports the results of LCL reconstruction in patients who had chronic instability lateral elbow pain in atraumatic conditions.

Materials and methods

We collected data from 36 patients with chronic lateral elbow pain from various causes, except from a traumatic event, who were referred for surgery to 1 of the authors (C.C.) at our hospital between November 2011 and June 2015. A medical history was obtained for all chronic lateral elbow pain patients, and they underwent a physical evaluation, including elbow instability tests and plain radiographs of the elbow. Magnetic resonance imaging (MRI) of the elbow was performed to identify the causes of pain. Arthroscopic

The Srinakharinwirot University Institutional Review Board approved this study (SWUE C/E-053/2560).

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<https://doi.org/10.1016/j.jses.2018.02.004>

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confirmation and treatment were performed for intra-articular lesions. Patients with evidence of PLRI of the elbow underwent LCL reconstruction with tendon graft, whereas the others underwent surgical repair according to the cause of pain pathology, such as arthroscopic plica excision. The exclusion criteria included patients with elbow varus or valgus malalignment, a history of elbow injury, and patients who were lost to follow-up at 6 months after surgery.

Demographic data were collected on sex, age, number of corticosteroid injections, duration of symptoms before surgery, and duration of follow-up after surgery.

Surgical technique

All operations were performed with the patient under general anesthesia. The examinations under general anesthesia consisted of varus stress test, posterolateral drawer test, and lateral pivot shift test. The patient was placed in lateral decubitus. The affected arm was laid on an arm support, and the elbow was allowed to move freely for full flexion and extension. A pneumatic tourniquet was applied on the arm as proximal as possible.

The elbow arthroscopic procedure was performed for evaluation and treatment of intra-articular pathology. The associated lesions were repaired by arthroscopic plica excision for plica and arthroscopic extensor carpi radialis brevis (ECRB) released for lateral epicondylitis. Arthroscopic findings that help diagnose elbow instability include the drive-through sign and ulnohumeral joint space widening more than 2 mm when force is applied to supinate the forearm in elbow extension. However, elbow instability still cannot be ruled out even when these findings are negative.

LCL reconstruction with tendon graft was performed. We modified the techniques of LCL reconstruction described by Nestor et al⁹ and Sanchez-Sotelo et al.¹⁴ Briefly, the LCL was exposed on a Kocher approach. The capsule was identified and incised longitudinally to enter the joint. At the ulnar site, the supinator crest was identified, and the first hole for tendon insertion was created over the tubercle using a 3-mm burr. The second hole was placed 1 cm proximally at the same level as the first hole. These 2 holes were connected with a curved awl. At the humeral site, the center of lateral condyle cartilage curvature was identified. At this point, a 4-mm burr was used to create an entry hole for the tendon graft. A 2.7-mm drill bit was used to drill a hole at the supracondylar ridge, proximal to the 4-mm hole of graft entry on each side (volar and dorsal). The tunnel was created between each hole on the supracondylar ridge and the tendon graft entry hole.

An autologous palmaris longus graft was harvested from the ipsilateral forearm. The first end of the tendon was woven in a running baseball-stitch fashion using a 2-0 nonabsorbable blade suture (HiFi; ConMed, Utica, NY, USA). The tendon graft was passed through the bone tunnel from the ulna to the humerus. The first end of the tendon graft was buried in the bone to a depth of 3 to 5 mm. The suture tail was passed to the exit hole on the dorsal side of the supracondylar ridge. The other end was cut at the level so that it could be buried in the bone approximately 3 to 5 mm and woven in a running baseball-stitch fashion using a 2-0 nonblade suture (HiFi) similar to the other end. The end of this suture was passed through the volar hole on the supracondylar ridge.

Both ends of the tendon graft were tensioned with the elbow in 40° flexion, and forearm was rotated in a pronation position. A docking technique was used to tie the suture tail of each tendon end to the other on the supracondylar ridge. Capsular tissue was repaired underneath the tendon graft to prevent possible graft rubbing on the bone (Fig. 1)

Postoperative full-time immobilization was done by using a posterior splint in 40° elbow flexion with the forearm midpronation for 3 weeks after surgery, and thereafter, rehabilitation was initiated. The patients were instructed to remove the splint only when

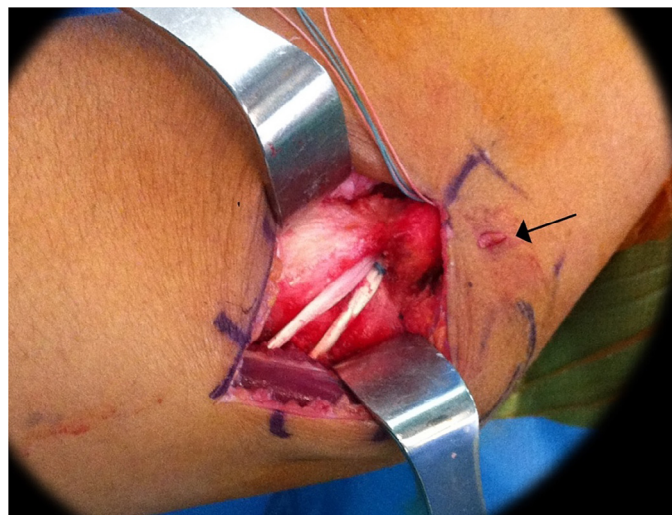


Figure 1 Arthroscopic wound portal is labeled with the black arrow. The docking technique was used to fix the palmaris longus tendon graft over the supracondylar ridge. If disruption of joint capsule was found during the procedure, the capsule was repaired underneath the tendon.

they practiced range of motion exercises at 2 sessions daily (morning and evening), with attention to avoid complete rotation of the forearm to supination and extension position. After 6 weeks, the splint was removed so the elbow could mobilize, with caution not to let the elbow in varus strain position for 3 months. Unrestricted use of the elbow was permitted at 3 months after the operation.

Postoperative evaluation, assessed by an examiner, included taking a history for subjective instability or complications of surgery. The physical examination included range of motion, lateral pivot apprehension test, PL drawer test, and grip strength.

The patient's subjective outcomes were assessed by the Mayo Elbow Performance Index (MEPI)⁸ and the 11-item version of the Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire.^{12,15} The preoperative and postoperative physical examination, MEPI, and QuickDASH scores were compared.

Results

We collected clinical data from 36 patients with chronic lateral elbow pain. All patients were previously diagnosed with chronic lateral epicondylitis by the referring doctor with failed conservative treatment. After complete physical, radiographic, and arthroscopic evaluations, 6 (1 man and 5 women) of 36 patients with evidence of PLRI were recruited. The mean age was 46 years (range, 39–58 years). Three patients were affected on the right side. Mean duration of symptoms before surgery was 32 months (range, 12–120 months), and the mean number of corticosteroid injections was 5.5 (range 2–10). All 6 patients completed the follow-up period for at least 6 months, and none were excluded from this study (Table I).

The 6 patients were confirmed to have instability by at least 1 positive result on the functional instability test (pivot shift apprehension test, chair rise test, push up test), with a positive pivot shift apprehension test in 5 patients. Of the 6 patients, 3 patients had positive laxity tests (PL drawer, varus stress test, lateral pivot shift test), but when examined under anesthesia, the positive test results had increased to 5 patients (Table II).

MRI was performed in 5 patients preoperatively, and the imaging was reviewed by multiple musculoskeletal radiologists. The results related with the status of the LCLs are reported in Table I. At the

Table I
Details of 6 patients with atraumatic posterolateral rotatory instability

Patient	Age (yr)	Sex	Occupation	Operation side	No. of steroid injections (times)	MRI reports on LCL status	Coexisting lesion with PLRI
1	39	F	Housewife	Right	7	Partial tear at humeral attached side of LCL ligament	Lateral epicondylitis
2	40	F	Self-employed	Right	10	Not available	Lateral epicondylitis
3	56	M	Engineer	Left	7	Complete tear of proximal LCL	Lateral epicondylitis
4	36	F	Nurse	Left	5	Complete tear of proximal LCL and LUCL	Plica
5	58	F	Teacher	Right	2	Sprain of proximal LUCL	Plica+ lateral epicondylitis
6	45	F	Soldier	Left	2	Partial tear of LUCL	Lateral epicondylitis

MRI, magnetic resonance image; LCL, lateral collateral ligament; PLRI, posterolateral rotatory instability; F, female; M, male; LUCL, lateral ulnar collateral ligament.

humeral attachment site, the LCL was partially torn in 3 patients and completely torn in 2 (Fig. 2).

The final coexisting lesions with PLRI confirmed by arthroscopic finding were 4 patients with lateral epicondylitis, 1 with plica lesion, and 1 with combined lateral epicondylitis and plica lesion. The associated lesions were repaired by arthroscopic plica excision for plica and by arthroscopic ERCB release for lateral epicondylitis.

Postoperative assessment was performed with a mean follow-up of 24.2 months (range, 7–50 months). The postoperative range of motion was improved in all 6 patients. The average ranges of elbow flexion were 130° preoperatively and 136° postoperatively. The average preoperative and postoperative elbow extension results were the same at 1° of extension (Table III).

At the last follow-up, none of the 6 patients experienced clinical instability, which was confirmed by negative result in all

instability test (pivot shift test, PL drawer test, and pivot shift apprehension test). There were no intraoperative or postoperative complications and no need for reoperation. The average postoperative grip strength was 21.7 kg on the affected side and 25 kg on the contralateral side. Grip strength in the reconstructed elbow was weaker than the contralateral side, but the average difference was 13%. The average preoperative MEPI was 59.2 (range 50–70), which was considered a poor to fair score. The postoperative MEPI score was considered as an excellent result in all cases, with an average score of 97.5 (range, 95–100; Table III). There was a statistically significant improvement in mean QuickDASH score from 132 (range, 61.3–175) preoperatively to 9 (range, 3.3–33) postoperatively ($P=.028$; Table III). According to the MEPI and QuickDASH scores, treatment outcome was greatly improved compared with the preoperative score in all 6 patients.

Table II
Preoperative physical examination in office and under general anesthesia

Patient	Preoperative examination in the office						Preoperative examination under GA		
	Varus stress test	Posterolateral drawer	Lateral pivot shift test	Pivot shift apprehension test	Push up test	Chair rise test	Varus stress test	Posterolateral drawer	Lateral pivot shift test
1	–	–	–	+	N/A	+	–	+	+
2	–	–	–	+	N/A	+	–	+	+
3	+	+	+	+	+	+	+	+	+
4	+	–	–	+	+	–	+	+	+
5	+	–	–	+	+	–	+	+	+
6	–	–	–	–	+	–	–	–	–

GA, general anesthesia; N/A, not available.

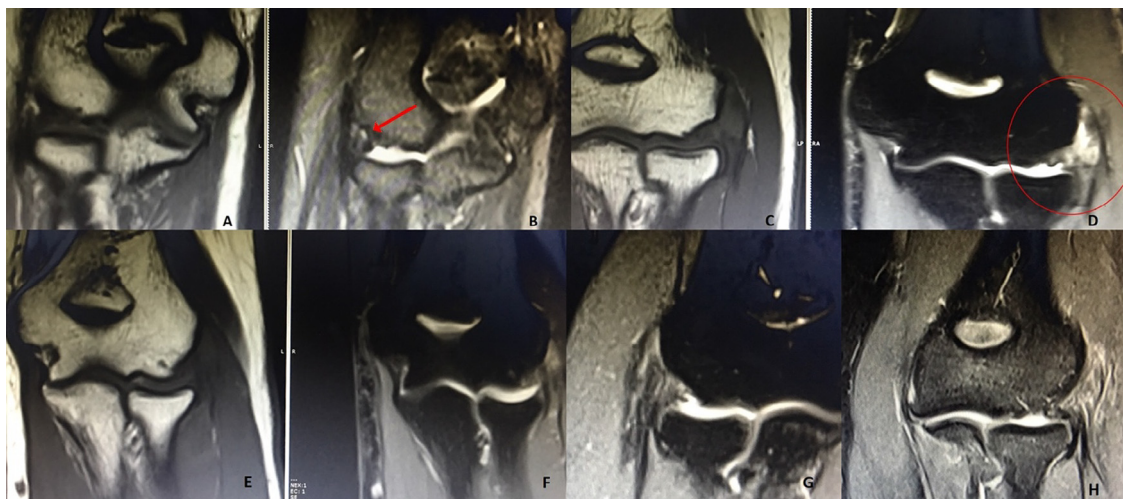


Figure 2 The magnetic resonance image (MRI) shows: (A, B) partial tears of the lateral ulnar collateral ligament (LUCL; red arrow); (C, D) complete tears of the lateral collateral ligament (LCL; red circle); and (E, F) sprain at proximal LUCL. (G) This MRI shows evidence of LCL sprain, but the right elbow showed no sign of instability. Only arthroscopic débridement was done, with a successful result. (H) The patient's left elbow (same patient as in panel G) had clinical signs of instability, and the MRI shows sprain and attenuation of the LUCL. Ligament reconstruction was done for the left elbow.

Table III
Patients' preoperative and postoperative data

Patient	Range of motion (flexion/extension)		Post-op grip strength, kg		Difference (%)	MEPI		Interpretation	QuickDASH Score	
	Pre-op, °	Post-op, °	Surgery side	Contralateral side		Pre-op	Post-op		Pre-op	Post-op
1	95/5	130/5	20	21	-4.8	60	100	Fair to excellent	61.3	3.3
2	140/5	140/5	16	19	-15.7	70	95	Fair to excellent	100	6.8
3	120/-10°	130/-10°	25	39	-35.9	65	100	Fair to excellent	137.5	17.7
4	140/0	135/0	27	20	+35	60	95	Fair to excellent	127.3	33
5	140/0	140/0	18	21	-14.3	50	95	Poor to excellent	175	11.3
6	144/6	140/6	24	30	-20	50	100	Poor to excellent	140.9	4.5
Mean	130/1	136/1	21.7	25	-	59.2	97.5	Poor/fair to excellent	-	-

MEPI, Mayo Elbow Performance Index; Quick DASH, 11-item version of the Disabilities of the Arm, Shoulder and Hand.

Discussion

In the present study, we describe 6 patients who presented with chronic lateral elbow pain and were referred for surgery under the diagnosis of lateral epicondylitis. After examinations and investigations, we subsequently established a final diagnosis of PLRI of the elbow with associated lesions such as plica or lateral epicondylitis. We examined the instability condition of the elbow with combined instability tests, including pivot shift apprehension test, push up test, and chair rise test, to help diagnose PLRI.

Chanlalit and Phorkhar³ reported a series of 44 patients with the clinical diagnosis of tennis elbow (lateral elbow pain, tender at lateral epicondyle, and Cozen sign). Only 1 patient had a positive pivot apprehension test. So they suggested that coexisting instability should be suspected in patients who had lateral elbow pain with a positive lateral pivot apprehension test.³

MRI may be helpful for identifying subtle cases of instability in the detection of LCL insufficiency, but using MRI alone to confirm the diagnosis may be difficult.^{1,11} Grafe et al⁶ reported a patient with chronic PLRI with normal findings on MRI. They considered that confirmation of chronic LCL tear of the elbow by MRI can be difficult and sometimes misleading.⁶

Kalainov and Cohen⁷ reported 3 middle-aged women who presented with lateral epicondylitis and subsequently had clinical findings consistent with PLRI of the elbow. Repeated corticosteroid injections into the tendon and ligament origin may contribute to weakening and ultimate failure of these structures. All patients were treated with débridement of the common extensor tendon origin and LCL reconstruction with a palmaris graft. All 3 patients reported no residual elbow pain or sensation of joint laxity after the operation, but the authors did not report subjective functional scores and objective clinical results.⁷

Dzugas et al⁴ reported 7 patients with chronic lateral epicondylitis who sustained an acute injury that may have damaged the LCL. All patients had received many steroid injections. However, the authors could not conclude that the damage to the ECRB or the treatment with steroid injections into the elbow predisposed these patients to a more significant injury. All patients underwent surgical repair of both PLRI and ECRB damage with arthroscopic techniques. The results showed significant improvement in objective clinical results and subjective functional scores.⁴

All patient in the present study had been treated elsewhere with at least 2 intralesional steroid injections (average, 5.5 injections). It is possible that the intralesional steroid injections may have resulted in collagen necrosis and impaired healing of injured tissue, followed by a decrease in tensile strength of the tendon or ligament tissue, which may lead to instability.^{2,5,7,18}

Sanchez-Sotelo et al¹⁴ demonstrated the treatment of PLRI with LCL reconstruction with tendon graft provided better results compared with the ligament repaired, but most of their patients had sustained a traumatic injury. Although the results of surgery in atraumatic cases were graded as good to excellent, the authors stated

that the operative results in this group were inferior to the group with trauma.¹⁴ During the same periods of the present study, we had performed LCL reconstruction for post-traumatic PLRI in 12 patients, and the results were appreciated by all patients.

According to our series, instability in atraumatic chronic lateral elbow pain should be suspected in patients with recalcitrant lateral elbow pain, a history of multiple steroid injections, a positive functional instability test, and MRI results corresponding to PLRI of the elbow. When atraumatic PLRI of the elbow is diagnosed, the LCL reconstruction is indicated similar to traumatic PLRI because the surgical outcome was highly successful.

Limitations of this study include a small number of patients and short-term to midterm follow-up data of surgical outcome. Nevertheless, this is one of the largest series in LCL reconstruction for the treatment of atraumatic PLRI, with reporting objective clinical results and subjective functional scores.

Our series provides only one perspective of the surgical treatment. Further study of other surgical techniques should be conducted to help elucidate the best proper treatment for atraumatic PLRI.

Conclusions

LCL reconstruction for chronic lateral elbow pain in atraumatic PLRI conditions provided effective and reliable results and also significantly improved outcomes in objective clinical examination and subjective functional scores. We consider LCL reconstruction to be the reference treatment for atraumatic PLRI conditions.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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