

Chronic posterior-lateral instability of the elbow. Ligament reconstruction

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Abstract

Introduction: The aim of this study is to evaluate results in a series of patients with chronic posterior-lateral instability of the elbow treated with reconstruction of the ulnar collateral ligament with tendinous graft.

Materials and Methods: We show 10 patients aged 47 years old on average. Time between dislocation and surgery was 16 months. The pivot shift test under anesthesia was positive in all cases. Under fluoroscopy, seven patients had Horii stage 1, two, Horii stage 3 and one, Horii stage 2 instability. In most cases, we used palmaris longus tendon. Average follow-up was 21 months.

Results: Flexion-extension was 126-3°. Pain was 0 at rest and 1 doing activity, according to the visual analogue scale. The average DASH score was 12 and the average Mayo Clinic score was 95. No patient reported instability sensation. The pivot shift test in the patient awoken was negative in all the cases.

Conclusions: The reconstruction of the elbow lateral collateral ligament with tendinous graft in patients with chronic posterior-lateral instability is effective to get joint stability. The best results were seen in patients with Horii stages 1 and 2 instability. There were no cases of residual instability.

Key words: Elbow instability; posterior-lateral instability; elbow injury; dislocation, reconstruction.

Level of evidence: IV

INESTABILIDAD POSTEROLATERAL CRÓNICA DE CODO. RECONSTRUCCIÓN LIGAMENTARIA

Resumen

Introducción: El objetivo de este trabajo es evaluar los resultados de una serie de pacientes con inestabilidad posterolateral crónica de codo, tratados con reconstrucción del ligamento colateral cubital con injerto tendinoso.

Materiales y Métodos: Se presentan 10 pacientes, con una edad promedio de 47 años. El tiempo entre la luxación y la cirugía fue de 16 meses. El *pivot shift test* bajo anestesia fue positivo en todos los casos. Bajo control radioscópico, siete pacientes tenían un estadio 1 de Horii; dos, estadio 3 y uno tenía un estadio 2. En la mayoría de los casos, se utilizó el tendón del palmar menor. El seguimiento promedio fue de 21 meses.

Resultados: La flexo-extensión fue de 126-3°. El dolor fue 0 en reposo y 1 en actividad, según la escala analógica visual. El puntaje DASH promedio fue 12 y el de la Clínica Mayo de 95. Ningún paciente reportó sensación de inestabilidad. El *pivot shift test* con el paciente despierto fue negativo en todos los casos.

Conflict of interests: The authors have reported none.

Conclusiones: La reconstrucción del ligamento lateral del codo con injerto tendinoso en pacientes con inestabilidad posterolateral crónica es eficaz para lograr la estabilidad articular. Los mejores resultados se observaron en pacientes con estadios 1 y 2 de inestabilidad. No hubo casos de inestabilidad residual.

Palabras clave: Inestabilidad de codo; inestabilidad posterolateral; trauma de codo; luxación, reconstrucción.
Nivel de Evidencia: IV

Introduction

Elbow posterior-lateral instability (PLEI) was described for the first time in 1991 by O'Driscoll et al.¹ This injury is caused by falling with the elbow extended while the forearm rotates externally over the humerus, causing an injury mechanism of soft tissues at elbow level which advances circularly from the elbow lateral side to the medial one. According to Horii, the PLEI can be divided into three stages on the grounds of the types of structures involved (Figure 1).² In stage 1, there is rupture of the ulnar

collateral ligament of the lateral complex (LCCL) with posterior-lateral partial dislocation of the radial head (Figure 2). If the damaging force advances, there is rupture of the elbow front and dorsal capsule; the ulnar-humeral joint gets partially dislocated and the coronoid process is entrapped by the humerus medial condyle (stage 2) (Figure 3). As the injury advances, there is complete dorsal dislocation of the ulnar-humeral joint. This stage can be sub-divided considering if the elbow medial ligament is unharmed (stage 3A) or injured (stage 3B) (Figure 4).

In their original publication, O'Driscoll et al. identified the LCCL injury as the main cause of instability.¹ To get good functional results it is essential to identify properly the injury of the LCCL and that of the rest of the elbow stabilizers.³⁻⁵

There is wide agreement on conservative treatment as the indication for the acute injury, with surgery spared for those cases in which the ligament injury does not heal or heals poorly with subsequent chronic instability. In general, primary reconstruction in patients with chronic instability is not possible; therefore, the recommended treatment is ligament reconstruction.

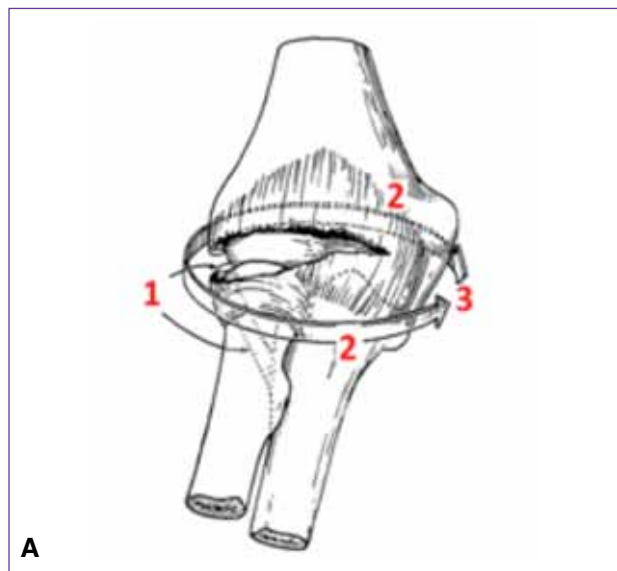
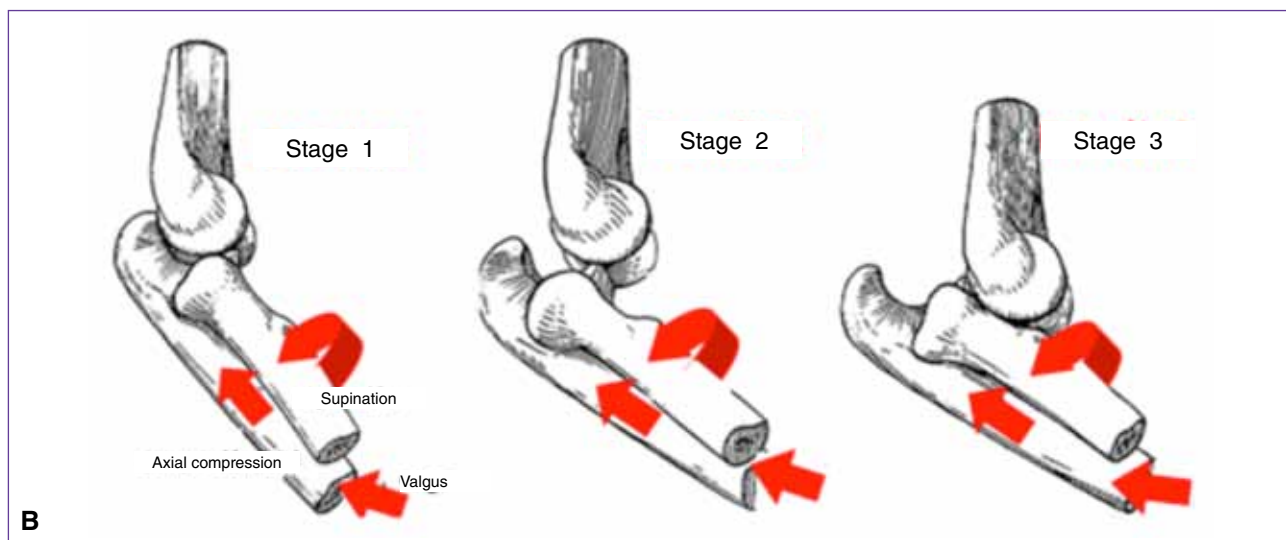


Figura 1. A. Horii circle with circular advance of the injury, from the lateral to the medial side of the elbow
B. Instability stages





▲ **Figure 2.** Postero-lateral instability; stage 1.

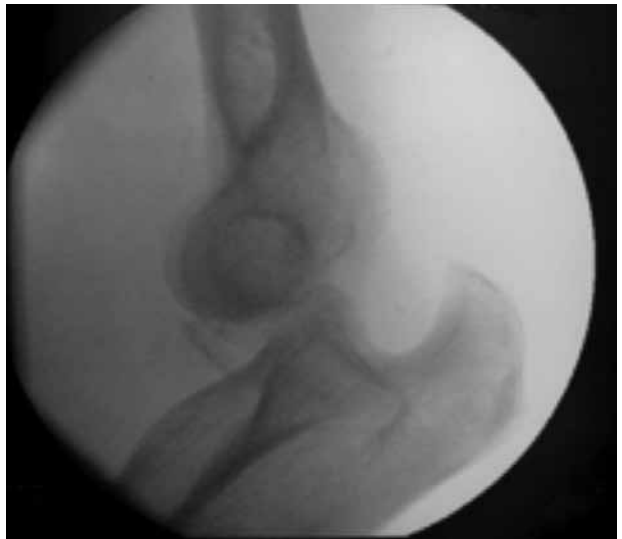


▲ **Figure 3.** Posterior-lateral instability; stage 2.

Even though numerous publications have contributed to the identification of this injury biomechanics, there are just few studies reporting surgical results in the treatment of chronic PLEI.^{6,7}

Patients with chronic elbow instability usually show pain, instability sensation, and locking, which usually shows with extended elbow and supinated forearm.

The pivot shift test is useful to diagnose this injury.¹ It is carried out in the patient in supine position with their shoulder 90° flexed forward over their head and a 90°-flexion elbow. The doctor stands behind the patient and, from here he or she applies a force that combines supination, valgum and axial compression. Taking the elbow to extension there is evidence of partial rotatory ulnar-humeral dislocation. While flexing the elbow back, partial dislocation gets reduced (Figure 5). At the office it is difficult to carry out this test and, generally speaking, the patient only reports apprehension; on the other hand, the test is usually positive under anesthetic effects.



▲ **Figure 4.** Posterior-lateral instability; stage 3.



▲ **Figure 5.** Pivot shift test. **A.** From flexion with the elbow reduced, it is taken to extension applying forces of valgus, supination and axial compression. **B.** Depression seen at the time of elbow partial dislocation (arrow).

To restore stability in chronic cases, it has been recommended to carry out ligament reconstruction.^{1,3,5} There are multiple surgical techniques described to reconstruct this type of instability using autologous tendon, from tissues banks or out of triceps fascia, with satisfactory results in most cases.^{6,8}

The aim of this study is to evaluate results in a consecutive series of patients with elbow PLEI chronic instability treated with elbow PLEI reconstruction with tendinous graft.

Materials and Methods

Between 2010 and 2015, 12 patients with diagnosis of chronic PLEI were operated on at the institution we work at. The inclusion criteria were: patients treated with ligament reconstruction with autologous or tissue bank tendinous graft, with no other surgical procedure carried out at the time of the ligament reconstruction and with minimal follow-up of one year. We included 10 patients Two were excluded: one because the procedure was associated with inferior radio-ulnar ligament reconstruction, and the other one because follow-up was shorter than a year.

Five patients were females and five, males, and at the time of the surgery they were aged 47 years old on average (ranging from 23 to 78). Average time from dislocation to surgery was 16 months (ranging from 2 to 38). In four cases the injured limb was the dominant one. In all patients instability was triggered by a posterior dislocation radiologically documented. In seven patients, dislocation was simple and was treated with immobilization for two weeks (3 cases), with sling (3 cases) and with one-week cast (one case); one patient showed instability consecutive to an elbow fracture-dislocation treated with radial head replacement three months before and, in two patients, the initial injury was elbow terrible triad treated non-operatively.

Two patients showed episodes of recurrent instability at the time of consultation, whereas eight reported instability sensation or locking symptoms at elbow level.

Objective evaluation was made assessing mobility with a goniometer. We carried out the pivot shift test with the patient awoken, and then with him or her under anesthetic effects during the surgery.

Subjective evaluation was made assessing pain at rest and while doing activity, by means of the visual analogue scale from 0 to 10, the Mayo Clinic score and the DASH (Disabilities of the Arm, Shoulder and Hand) score.

All the patients were assessed with anterior-posterior and lateral X-rays of the affected elbow plus IMG (except the patient # 3), which showed the rupture of the lateral ligament. Surgical procedures were always carried out by the same surgeon.

Average previous mobility was 135°-flexion (ranging from 120 to 140°) and 7°- extension (ranging from 0 to 25), with total range of motion of 128° (ranging from 105

to 104°). Average pain at the time of consultation was 1 at rest (ranging from 0 to 2) and 4 doing activity (ranging from 3 to 6). The average DASH score was 27 (ranging from 11 to 67) and the Mayo Clinic score was 72 (ranging from 55 to 90) (Table 1).

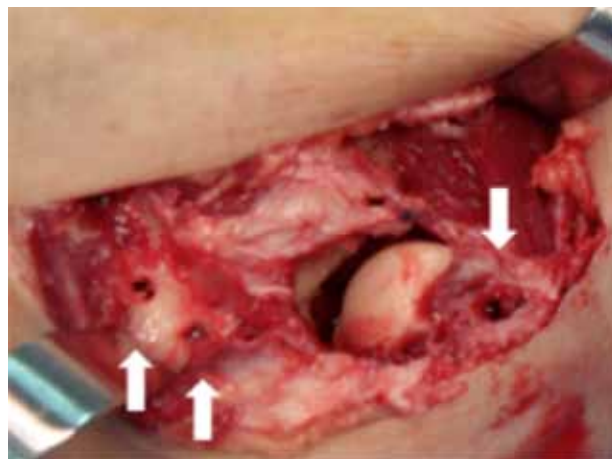
The pivot shift test with the patient awoken was positive in only one case—the rest of them reported apprehension with no partial dislocation. Under fluoroscopy, seven patients showed to be in Horii stage 1, one in stage 2 and two in stage 3.

The tendinous grafts used were: flexor carpi radialis hemi-tendon (one case), corpse graft of semitendinosus muscle (one case) and palmaris longus autologous graft (8 cases).

Surgical technique

The patient should be operated on in supine position with their arm lying on an accessory operating table and under the effects of regional anesthesia and neurolepto-analgesia. The surgical approach recommended is an approximately 8cm-Kocher's lateral approach between the anconeus muscle and the extensor carpi ulnaris muscle. This one should be moved forward and elevated together with the tendon of the extensor digitorum communis muscle, while the anconeus muscle is moved backward leaving the lateral ligament complex of the elbow open. Usually the ulnar collateral ligament shows disattached from the medial epicondyle or enlarged with a joint capsule injured or enlarged too.

Then, what comes is to prepare the tendon insertion spots. It is necessary to identify the supinator muscle's crest tubercle at ulnar level and produce a 4.5mm-diameter hole. Then it should be produced a second hole 2 cm proximal to the first one near the insertion of the annular ligament sparing a bone bridge between both holes. With the aid of a curve cannulated device to introduce the tendon the two holes should be communicated taking special care with the cortex bridge between them. The humeral hole should be produced 2 mm ahead and distal to the epicondyle (Figure 6).



▲ **Figure 6.** Holes at epicondyle and ulna supinator crest levels.

Table 1. Patients' characteristics

Patient	Age	Sex	Dominant limb	Time injury-surgery (months)	Initial injury, treatment	Pivot shift test (awaken)	Pivot shift test (under anesthesia)	Pre-operative flexion-extension (°)	Pre-operative VAS at rest	Pre-operative VAS doing exercise	DASH	MC S
1	36	M	No	25	Dislocation, 2 weeks cast	Yes	Stage 1	0-140	0	3	17	85
2	43	M	No	38	Triad, 2 weeks cast	No	Stage 1	0-140	1	4	11	75
3	23	M	No	3	Operated on fracture-dislocation	No	Stage 1	10-130	1	4	15	70
4	69	F	No	11	Dislocation, 2 weeks cast	No	Stage 2	0-140	0	4	36	75
5	29	F	Yes	21	Dislocation, sling	No	Stage 1	0-140	1	6	26	80
6	56	F	Yes	6	Dislocation, 1 week cast	No	Stage 1	10-135	2	4	11	60
7	67	F	No	3	Operated on triad	No	Stage 3	25-130	2	4	36	55
8	78	F	Yes	2	Dislocation, sling	No	Stage 3	20-120	2	6	67	60
9	35	M	No	3	Dislocation, sling	No	Stage 1	5-135	1	4	28	90
10	35	M	Yes	6	Dislocation, 2 weeks cast	No	Stage 1	0-135	1	4	27	75

VAS = visual analogue scale; DASH = DASH score; PCM = Mayo Clinic score.

The palmaris longus graft should be taken by small 1 cm-incisions on the frontal aspect of the forearm. The tendon should be threaded through the holes and sutured with non-absorbable suture in elbow 30°-extension and maximal pronation, trying to imitate the isometric point of the ulnar collateral ligament (Figure 7). In this moment anterior-lateral capsular placcation is an option if gross

laxity. Once the procedure is done, the patient should be immobilized with a 90°-flexion and full pronation long arm cast during six weeks. Once casting is removed, the patient should start active and passive mobilization exercises.

Stretching exercises should start at week eight and free sports allowed six months after the surgery.

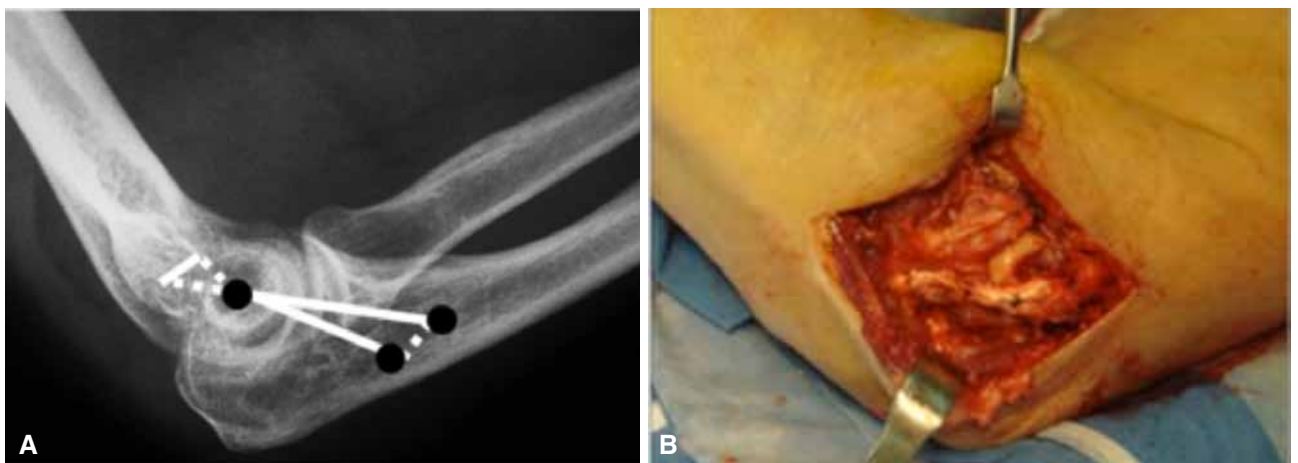


Figure 7. A. X-rays showing the holes ubication. B. Surgical image with palmaris longus tendon.

In this series, objective and subjective post-operative evaluation was made using the same parameters and scores as the ones used pre-operatively. Average follow-up was 21 months (ranging from 12 to 32).

Results

Mobility achieved was 136°-flexion (ranging from 130° to 140°) and 3°-extension (ranging from 0° to 15°) with an average range of motion of 133° (ranging from 120° to 140°). Average pain was 0 at rest (ranging from 0 to 3) and 1 while doing activity (ranging from 0 to 3). The average DASH score was 12 (ranging from 0 to 47) and the average Mayo Clinic score, 95 (ranging from 85 to 100) (Table 2). Eight patients reassumed activities at the same level as previously to the injury, while no patient reported instability sensation.

The pivot shift test in the patient awoken was negative in all cases. In the patient # 2, we carried out the test with the patient under anesthetic effects at the time of surgery for shoulder instability, and it was negative too. We detected neither neurological complications nor infection.

Discussion

We got good functional results in the reconstruction of the elbow lateral ligament with tendinous graft.

Instability is an infrequent complication that follows elbow dislocation.⁹⁻¹¹ Assessment and treatment of an unstable elbow requires acknowledgment of instability pat-

terns, and identification of both the underlying condition and the structures that should be reconstructed to restore stability.¹²

In their original description, O'Driscoll et al.¹ established failure of the ulnar collateral ligament as the main reason for elbow instability.

In general, there is background of traumatic dorsal dislocation of the elbow, but there are reports on instability caused by other factors such as infiltration, radial head osteosynthesis surgery, epicondylitis surgery and elbow varus deformity.^{1,13,14}

Diagnosis is usually confirmed by physical examination and medical records. While trying to identify the causes of chronic instability, we realized that in our series all patients had previously suffered dislocation, but only seven cases were simple dislocations. The other three patients had undergone complex dislocation, i.e., dislocation associated with other injuries, what results in more instability and, in these cases, incorrect initial treatment could be the cause of remaining instability.

It is extremely infrequent that a simple dislocation treated non-operative and adequately develops instability. There are reports that back conservative treatment for these injuries.^{9,10}

As far as we know, only three cases in the series had received appropriate treatment for their initial injury (immobilization for two weeks), whereas the rest of the patients had not been properly treated for their initial injury, with either sling or no cast, and with terrible triads treated conservatively, etc.

One of the patients, who received appropriate immobilization for simple dislocation, had background of shoulder

Table 2. Results

Patient	Graft	Mobility (°)	VAS at rest	VAS doing exercise	DASH	MCS	Follow-up	Complications
1	Flexor carpi radialis hemitendon	0-140	0	0	6	100	32	No
2	PL	0-140	0	1	7	100	30	No
3	PL	0-135	0	0	5	100	21	No
4	PL	0-135	0	1	0	100	18	No
5	Semitendinosus from bank	0-140	0	0	15	100	16	No
6	PL	5-135	1	0	8	85	12	No
7	PL	10-130	1	3	15	85	21	No
8	PL	15-135	1	3	47	85	26	No
9	PL	0-135	0	0	5	100	16	No
10	PL	0-135	1	1	12	95	15	No

PL = palmaris longus; VAS = visual analogue scale; DASH = DASH score; MCS = Mayo Clinic score.

and ankle instability and scapholunate dissociation with no relevant traumatism history. This patient, with generalized laxity and, we believe, properly treated, developed instability too.

Quite frequently, chronic PLEI is sub-diagnosed. Many patients can report pain and locking sensation, but not necessarily elbow partial dislocation or dislocation. Moreover, the pivot shift test is usually negative at the office—only in one patient in our series it was positive.

Ligament reconstruction should be anatomic, isometric and extra-capsular. Moritono et al.¹⁵ describe ligament isometry as a line drawn between 2 mm ahead and proximal to the center of the epicondyle and the ulna supinator crest.

In all our cases we tried this type of reconstruction and, afterwards, we proved by elbow flexion-extension that the new ligament tension was constant.

Several publications have reported the type of graft to use. There are no differences in results, however, whether the graft is autologous or heterologous.⁶⁻⁸ In most of our patients we used palmaris longus tendon.

Olsen et al.⁸ reported good functional results with minimal deficit of triceps extension strength using graft taken from the ipsi-lateral triceps. Sanchez-Sotelo et al.⁷ described the largest published series, with 44 patients with posterior-lateral instability, and 32 of them underwent ligament reconstruction. Three patients developed instability.

Nestor et al.¹³ reported results in a series of 11 patients that had undergone repair or reconstruction of the ulnar collateral ligament. At 42-month follow-up, four patients reported instability. Lin et al.⁶ reported the relationship between the degree of posterior-lateral partial dislocation and functional results. In 14 patients with ligament reconstruction they found that, those with stages 1 and 2 instability showed better results than those with stage 3 instability. In our series, the two patients with lower functional results suffered stage 3 instability. This concept may be relevant at the time of predicting functional results. The status of the medial collateral ligament may play an important role in final results.

The limitations to our study are its retrospective nature and the size of the sample; however, we believe that the frequency of this condition makes ours a considerable number of patients. Among its strengths we find the exclusion of the patients subject to associated treatments and the fact that all the patients completed follow-up.

Conclusions

Reconstruction of the elbow lateral ligament with tendinous graft in patients with chronic PLEI is effective to get joint stability. Best results were seen in patients with stages 1 and 2 instability. There were no cases of residual instability.

Bibliography

1. O'Driscoll SW, Bell DF, Morrey BF. Posterolateral rotator instability of the elbow. *J Bone Joint Surg Am* 1991;73:440-6.
2. O'Driscoll SW, Morrey BF, Korinek S, Ann KN. Elbow subluxation and dislocation: A spectrum of instability. *Clin Orthop* 1992;280:167-97.
3. Cohen MS, Hastings H 2nd. Rotatory instability of the elbow: the anatomy and role of the lateral stabilizers. *J Bone Joint Surg Am* 1997;79:225-33.
4. Olsen BS, Sojbjerg JO, Dalstra M, Sneppen O. Kinematics of the lateral ligamentous constraints of the elbow joint. *J Shoulder Elbow Surg* 1996;5:333-41.
5. Olsen BS, Vaesel MT, Sojbjerg JO, Helmig P, Sneppen O. Lateral collateral ligament of the elbow joint: anatomy and kinematics. *J Shoulder Elbow Surg* 1996;5:103-12.
6. Lin KY, Shen PH, Lee CH, Pan RY, Lin LC, Shen HC. Functional outcomes of surgical reconstruction for posterolateral rotator instability of the elbow. *Injury* 2012;43:1657-61.
7. Sanchez-Sotelo J, Morrey BF, O'Driscoll SW. Ligamentous repair and reconstruction for posterolateral rotator instability of the elbow. *J Bone Joint Surg Br* 2005;87:54-61.
8. Olsen BS, Sojbjerg JO. The treatment of recurrent posterolateral instability of the elbow. *J Bone Joint Surg* 2003;85:342-64.
9. Borris LC, Lassen MR, Christensen CS. Elbow dislocation in children and adults: a long-term follow-up of conservatively treated patients. *Acta Orthop Scand* 1987;58:649-51.
10. Josefsson PO, Johnell O, Gentz CF. Long-term sequelae of simple dislocation of the elbow. *J Bone Joint Surg Am* 1984;66:927-30.
11. Osborne G, Cotterill P. Recurrent dislocation of the elbow. *J Bone Joint Surg Br* 1966;48:340-6.

12. O'Driscoll SW, Jupiter JB, King GJ, Hotchkiss RN, Morrey BF. The unstable elbow. *Instr Course Lect* 2001;50:89-102.
13. Nestor BJ, O'Driscoll SW, Morrey BF. Ligamentous reconstruction for posterolateral rotator instability of the elbow. *J Bone Joint Surg Am* 1992;74:1235-41.
14. O'Driscoll SW, Spinner RJ, McKee MD, Kibler WB, Hastings H 2nd, Morrey BF, et al. Tardy posterolateral rotatory instability of the elbow due to cubitus varus. *J Bone Joint Surg Am* 2001;83:1358-69.
15. Moritomo H, Murase T, Arimitsu S, Oka K, Yoshikawa H, Sugamoto K. The in vivo isometric point of the lateral ligament of the elbow. *J Bone Joint Surg Am* 2007;89:2011-7.