Post-traumatic contracture of the elbow

OPERATIVE RELEASE USING A LATERAL COLLATERAL LIGAMENT SPARING APPROACH

M. S. Cohen, H. Hastings II

From the Indiana Hand Center, Indianapolis, USA

We performed a lateral approach for the release of post-traumatic stiffness of the elbow in 22 patients using a modified technique designed to spare the lateral ligaments. They were reviewed after a mean interval of 26 months. The total humeroulnar joint movement had increased from a mean of 74° to 129° and forearm rotation from a mean of 135° to 159°. Both pain and function in the elbow had improved significantly. This modified lateral approach allows release of post-traumatic contracture without disruption of the lateral collateral ligament or the origins of the extensor tendon at the lateral epicondyle of the humerus. The advantages include a simplified surgical procedure, less operative morbidity, and unrestricted rehabilitation.

J Bone Joint Surg [Br] 1998;80-B:805-12.

Received 6 November 1997; Accepted 2 February 1998

Post-traumatic stiffness is common after trauma to the elbow. This has been attributed to fibrosis and thickening of the capsule and periarticular soft tissues.¹⁻³ Minor degrees of stiffness can be managed by physiotherapy and static or dynamic splinting.⁴⁻⁶ When this fails and a marked contracture persists, the elbow can be released surgically by a variety of techniques.^{1-3,7-10}

One of us (HH) has described the treatment of post-traumatic contracture of the elbow using a lateral approach.⁸ An anterior and posterior capsulectomy was performed with release and re-attachment of the lateral collateral ligament and extensor tendon origins at the lateral epicondyle of the humerus. This required postoperative rehabilitation with the shoulder adducted to protect the lateral soft-tissue repair. Two patients developed postero-

lateral instability during rehabilitation secondary to avulsion of the soft-tissue structures from the lateral epicondyle (Fig. 1). Surgical repair was required to restore stability to the elbow.

With a greater understanding of the anatomy and role of the lateral collateral ligament,^{11,12} we have designed a technique for capsular release and debridement of the elbow to preserve the integrity of these structures. Our aim in this study was to determine if post-traumatic contracture of the elbow can be corrected safely and effectively by a ligament sparing approach.

Patients and Methods

Between December 1988 and April 1995 we operated on 23 patients with post-traumatic contracture of the elbow which had occurred despite a supervised programme including dynamic splinting. They had a flexion contracture of at least 30°, or had less than 100° of flexion or both. Radiologically, all the elbows were congruous with an adequate humeroulnar joint space. We excluded all patients with spasticity, burn contractures, associated injury to the head or spinal cord, rheumatoid arthritis or significant heterotopic ossification. One patient was lost to follow-up, leaving 22 available for evaluation.

There were 12 men and 10 women, with a mean age of 35 years (15 to 72) at the time of operation (Table I). The average length of follow-up was 29 months. In 14 of the patients the dominant limb was affected. The mean interval from the initial injury to surgery was 5.8 years (median 2.1).

The details of the injuries are shown in Table I. Two patients had an associated dislocation of the joint with a periarticular fracture. Four patients with a history of remote trauma had radiological evidence of osteochondritis dissecans of the capitellum. A total of 16 operations had been carried out on the affected elbow in 12 patients (Table I).

The office and hospital charts of each patient were reviewed; all returned for assessment and each completed a detailed questionnaire. Pain was rated according to severity and frequency of occurrence. Visual analogue scales were used to assess peak and general levels of elbow pain on an average day, night pain, the limits of the elbow with respect to hobbies or sports and satisfaction with the surgical

M. S. Cohen, MD, Assistant Professor
Department of Orthopaedic Surgery, Rush University, 1725 West Harrison Street, Suite 1063, Chicago, Illinois 60612-3824, USA.

H. Hastings II, MD, Clinical Associate Professor
The Indiana Hand Center, PO Box 80434, 8501 Harcourt Road, Indianapolis, Indiana 46280, USA.

Correspondence should be sent to Dr H. Hastings II.

©1998 British Editorial Society of Bone and Joint Surgery
0301-620X/98/58528 \$2.00

Fig. 1a

Fig. 1b

Anteroposterior (a) and lateral (b) radiographs of a patient after elbow release through an exposure requiring release and re-attachment of the lateral collateral ligament and the extensor origin.⁸ There is avulsion of the bone anchor used to reattach the lateral soft tissues. This patient developed posterolateral instability and required surgery to restore the integrity of the lateral side of the elbow.

result.¹³ Elbow function was determined by a questionnaire developed at the Mayo Clinic based on the ability to carry out 12 common tasks.^{8,14} Additional questions were included to allow determination of the Mayo Elbow Performance Index for each patient.^{2,15}

The recorded physical findings at follow-up consisted of the range of elbow movement, the presence of tenderness or crepitus, medial or posterolateral instability, a careful motor and sensory examination with determination of two-point discrimination, and grip strength. Anteroposterior, lateral and oblique radiographs were taken and examined for the presence of osteophytes, advancement in joint degeneration, loose bodies or heterotopic bone. We performed statistical analysis using the Student's *t*-test on the numerical data and the Wilcoxon rank-sum test on the visual analogue scales. Differences were regarded as significant when $p < 0.05$. The two-tailed test was used in all cases.

Operative technique. Under regional anaesthesia with a long-acting axillary block an extended Kocher incision was used beginning along the lateral supracondylar ridge of the humerus and passing distally in the interval between the anconeus and the extensor carpi ulnaris (ECU).¹⁶ The anconeus was reflected posteriorly with dissection carried out proximally beneath the lateral epicondyle and along the supracondylar ridge of the humerus, thereby reflecting both the anconeus and triceps posteriorly (Fig. 2). A triceps tenolysis was carried out with an elevator, releasing any adhesions between the muscle and the posterior humerus. The humeroulnar joint was identified posteriorly and the olecranon fossa cleared of any fibrous tissue or scar which would restrict terminal extension. The tip of the olecranon was removed if there was evidence of overgrowth or impingement (Fig. 2). The posterior aspect of the radio-

capitellar joint was inspected after excision of the elbow capsule just proximal to the conjoined lateral collateral and annular ligament complex through the 'soft spot' on the lateral side of the elbow. The proximal edge of this complex lies along the proximal border of the radial head.¹¹

Once the posterior release was completed, dissection was carried anteriorly releasing the brachioradialis and extensor carpi radialis longus (ECRL) from the lateral supracondylar ridge of the humerus (Fig. 3). The brachialis was then mobilised off the humerus and anterior capsule with an elevator, releasing any adhesions between the muscle and the anterior humerus. This dissection was continued distally between the ECRL and extensor carpi radialis brevis (ECRB), allowing exposure of the anterior capsule with preservation of the lateral collateral ligament and the origins of the ECRB, the extensor digitorum communis (EDC) and minimi and the ECU from the lateral epicondyle. Dissection was then carried out beneath the elbow capsule between the joint and the brachialis. The capsule was then excised as far as the medial side of the joint. The radial and coronoid fossae were cleared of fibrous tissue and the tip of the coronoid removed if overgrowth or impingement was noted in flexion. Loose bodies were removed (Fig. 3).

With radiocapitellar degeneration the joint was debrided or the radial head resected through the anterior capsulectomy using an oscillating saw or osteotome without dissection of the lateral collateral ligament complex.^{11,12}

After release of the anterior capsule, gentle extension of the elbow with applied pressure would usually bring the joint out to nearly full extension. In longstanding cases of contracture the brachialis muscle can be tight inhibiting full terminal elbow extension. This myostatic contracture could be stretched for several minutes during the procedure and required attention at subsequent physiotherapy. After clo-

Fig. 2a

Fig. 2b

Diagrams showing the posterior approach to the elbow for operative debridement and release. The interval between the anconeus and ECU is split and anconeus and triceps reflected posteriorly (a). This allows tenolysis of the triceps, resection of the posterior capsule and debridement of the olecranon and its fossa (b).

Fig. 3a

Fig. 3b

Diagrams showing the anterior approach to the elbow for debridement and release. The brachialis and ECRL are released from the supracondylar ridge of the humerus exposing the anterior elbow capsule which is excised (a). The coronoid and radial fossae can then be debrided, the tip of the coronoid removed and the radiocapitellar joint inspected (b).

sure the dressing was cut out over the antecubital fossa to allow elbow flexion. Continuous passive movement was started in the recovery room and maintained until the following morning.

Physiotherapy began on the first postoperative day with active and passive movement, intermittent continuous passive movement and the wearing of a dynamic elbow brace. To gain extension, weighted passive stretches using a wrist weight of 1 or 2 kg with the elbow extended over a bolster were performed several times daily. Since the collateral ligaments were not released, there were no restrictions on movement.

All patients had an anterior and posterior release from the lateral side with excision of bony overgrowth and osteophytes. Three patients had metal removed at the time of the procedure. Five had excision of the radial head for arthritis and in nine, loose bodies were identified and removed. Two patients with ulnar neuropathy had an anterior subcutaneous transposition of the nerve through a second medial incision. In none of these was the joint entered or debridement carried out from the medial side.

The patients remained in hospital for an average of 2.4 days after operation. Outpatient rehabilitation was con-

tinued two to three times per week for approximately four to six weeks. Continuous passive movement was continued at home for approximately four weeks. Intermittent dynamic elbow bracing and weighted elbow stretches were continued for eight to 12 weeks and subsequently as required. All patients received oral indomethacin for six weeks after operation as prophylaxis against heterotopic ossification.

Results

Movement. The total elbow movement improved in all patients (Fig. 4; Table I). Extension increased from a mean of 39° to 8° . The mean elbow flexion increased from 113° to 137° , giving a mean increase in the total range of movement in the humeroulnar joint of 55° ($p < 0.001$). Mean supination improved from 68° to 83° and pronation from 67° to 75° ($p < 0.01$).

Pain. As shown in Tables II and III the frequency of elbow pain decreased in all patients ($p < 0.001$). Both peak pain and the general level of pain on an average day diminished significantly at follow-up ($p < 0.001$) as did night pain inhibiting sleep ($p < 0.001$). Ten patients continued to take analgesics. Eight used aspirin or a non-steroidal anti-

Table I. Details of 22 patients with post-traumatic contracture of the elbow

Case	Gender	Age (yr)	Initial injury	Prior treatment	Interval from injury to operation (mth)	Additional procedures	Active extension (degrees)			Active flexion (degrees)			Supination (degrees)		Pronation (degrees)		Complications	Duration of follow-up (mth)
							Preop	Postop	0	Preop	Postop	150	Preop	Postop	Preop	Postop		
1	F	37	Radial head, fracture of the capitellum	Excision osteochondral fragments	7	Radial head excision	50	0	0	120	150	150	35	90	60	90		15
2	F	39	Supracondylar fracture of the humerus	Cubital tunnel release	14		35	10	10	90	135	135	85	95	75	90		35
3	F	44	Ulnar fracture	ORIF*	20	Metal removal	40	10	10	95	150	150	50	65	75	70		33
4	F	20	Radial head fracture		7		40	0	0	120	150	150	45	90	80	90		73
5	F	72	Radial head fracture		4	Radial head excision	40	10	10	70	135	135	20	80	30	70		32
6	M	37	Olecranon fracture	ORIF Metal removal	60		45	25	25	110	135	135	90	90	80	85		16
7	F	52	Radial head fracture		6		40	0	0	120	150	150	55	85	80	90	Transient ulnar neuritis, late synovitis	30
8	M	19	Supracondylar fracture of the humerus	ORIF	36		40	5	5	135	145	145	90	90	90	90	Postop pain	40
9	M	26	OCD [†] capitellum		192		25	5	5	120	125	125	80	75	60	75		36
10	M	40	Radial head fracture		26		30	15	15	120	120	120	80	80	80	80		24
11	F	16	Radial head fracture		6		50	10	10	140	135	135	90	90	90	90	Transient median neuritis	22
12	F	46	Fracture dislocation	ORIF capitellum	8	Metal removal Anterior transposition ulnar nerve	60	15	15	105	150	150	90	90	90	90		15

13	M	15	OCD capitellum	Arthroscopic removal loose bodies	48		30	5	120	130	60	65	80	70	26
14	F	34	Fracture dislocation	ORIF radial head	4	Metal removal Anterior transposition ulnar nerve	45	0	70	140	30	85	50	50	27
15	M	31	Supracondylar and intracondylar fracture of the humerus	Cubital tunnel release, radial head excision	204		55	5	110	125	75	80	45	50	28
16	F	21	Supracondylar and intracondylar fracture of the humerus	ORIF, metal removal	40		45	10	125	135	90	80	70	45	25
17	M	20	Radial head, coronoid fracture		17		45	10	120	135	80	80	45	70	19
18	M	49	Radial head fracture	Joint debridement	36	Radial head excision	30	15	105	135	60	85	45	65	27
19	M	48	Radial head fracture		24		35	8	120	135	80	80	80	80	25
20	M	30	OCD capitellum	Anterior transportation ulnar nerve joint debridement	180	Radial head excision	35	5	110	135	75	85	45	70	32
21	M	31	Radial head fracture, coronoid fracture		180		30	10	120	135	60	80	50	60	30
22	M	55	OCD capitellum		400	Radial head excision	15	0	130	135	80	85	70	80	33

* open reduction and internal fixation

† osteochondritis dissecans

Fig. 4a

Fig. 4b

Diagram of average active range of elbow flexion and extension (a) and supination and pronation (b) preoperatively and at follow-up.

Table II. Number of patients with elbow pain preoperatively and at follow-up

	Never	Rare (1 to 2 times per year)	Occasional (1 to 2 times per month)	Frequent (every week)	Daily
Preop	0	0	2	4	16
At follow-up	4	8	7	0	3

inflammatory agent, and two intermittently used narcotics. When examined one patient experienced discomfort at the extreme of elbow flexion and another at terminal extension.

Function. The scores in Table IV show a significant improvement, after operation, in elbow function^{8,14} ($p < 0.001$). The Mayo Elbow Performance Index ($p < 0.001$), the patient's assessment of how their elbow limited their most strenuous activities ($p < 0.001$), and the reported overall handicap which the affected elbow caused in the patient's lifestyle ($p < 0.001$) were all better. Patient satisfaction was a mean of 8.8 on a score from 0 to 10.

On examination, no patient had clinical evidence of instability of the posterolateral joint.¹² Two had slight laxity of the medial side during stress testing but this was not a functional problem. Four patients had palpable crepitus during active flexion and extension, and one during rotation of the forearm. The mean grip strength of the affected arm was 44.5 kg at follow-up. This compared

Table III. Level of pain and mean ($\pm$ SD) pain severity score preoperatively and at follow-up in 22 patients

	Pain severity score	
	Before operation	At follow-up
Pain frequency (1 to 5)	4.6 ± 0.7	2.5 ± 1.2
Peak level of pain (0 to 10)	7.3 ± 2.5	1.3 ± 2.0
General level of pain (0 to 10)	6.4 ± 3.0	0.8 ± 1.3
Night pain (0 to 10)	6.1 ± 3.3	0.7 ± 1.0

favourably with the 47.2 kg in the unaffected arm ($p > 0.05$). Preoperative measurements of grip strength were available for 15 patients. In this subset, strength improved from 38.6 kg preoperatively to 49.5 kg at follow-up ($p < 0.002$).

Radiological evaluation. Radiological analysis showed that no patient had regrown excised osteophytes or produced further loose bodies. One had mild progression of humeroulnar degenerative changes after 24 months and five had small foci of soft-tissue calcification anteriorly or

Table IV. Mean ($\pm$ SD) elbow function score and Mayo performance index in 22 patients preoperatively and at follow-up

	Elbow function score	
	Before operation	At follow-up
Mayo performance index ¹⁵ (0 to 100)	50 ± 14	89 ± 12
Mayo function task analysis ^{8,14} (0 to 12)	6.5 ± 2.8	11.1 ± 1.2
Elbow limitation in activities (0 to 10)	7.8 ± 2.0	1.2 ± 2.0
Elbow handicap on lifestyle (0 to 10)	7.1 ± 2.0	1.5 ± 1.7

posteriorly which did not affect elbow movement.

Complications. One patient had severe pain requiring a regional anaesthetic block on the third day after operation. This eventually resolved after six days in hospital. Three patients developed symptoms of ulnar neuritis and one of median nerve dysfunction but none had measurable motor or sensory deficits. All the symptoms were transient and had cleared by three months.

Two patients developed an episode of late pain and synovitis in the elbow associated with increased activity, one after six months and the other after seven. They were treated by an intra-articular injection of cortisone and a period of reduced activity.

Discussion

Loss of movement after injury to the elbow is common and has been attributed to the intrinsic congruity of the joint, the presence of three articulations in a single capsule and the proximity of the articular surface and capsule to the intracapsular ligaments and extracapsular muscles.² Prolonged immobilisation of the elbow after trauma may result in stiffness. Once established, minor elbow contractures can often be treated successfully by physiotherapy and the wearing of dynamic splints or braces.^{4,6} When conservative measures fail, the elbow can be released by a variety of surgical techniques.^{1-3,7-9,17}

The advantages of a lateral exposure include an internervous plane, an incision in the neutral axis of flexion-extension making wound problems less likely with early movement, and the ability to see and treat both the anterior and posterior humeroulnar and the radiocapitellar joints through one incision. This preserves the collateral and annular ligaments and the origins of the extensor complex while allowing complete exposure of the anterior and posterior elbow. The advantages include a simplified surgical dissection, less operative morbidity and the preservation of the lateral ligaments to prevent subsequent instability.

In our series the gains in rotation can be attributed to concomitant resection of the radial head (five patients), removal of metal, debridement of the radiocapitellar joint and pain relief in conjunction with a supervised post-operative physiotherapy programme. Elbow function, as measured by standardised scales, significantly improved (Table IV). Patients reported their elbow to be less of a disturbance and handicap to their most vigorous activities. No patient had clinical or functional evidence of significant joint instability. These results compare favourably with our previous technique for lateral elbow release⁸ as well as with reports using anterior or medial approaches.^{1,3,10,18}

We assessed pain by a variety of visual analogue scales.¹³ The frequency of pain, the peak and general level of pain in the elbow on an average day and night pain all significantly improved after release and debridement (Tables II and III). The relief of symptoms is probably attributable to the removal of osteophytes, loose bodies,

degenerative radiocapitellar arthritis, and bony and soft-tissue impingement within the joint. Excision of the anterior and posterior elbow capsule, however, may lead to a partial denervation of the elbow. Radiological evaluation showed slight progression of humeroulnar joint degeneration in only one patient at an average follow-up of two years. Long-term follow-up will be needed to determine if there is any deleterious effect from removal of the joint capsule.

The most common complication was the development of transient paraesthesiae in the distribution of the ulnar nerve which was seen in three patients. This may in part be related to improved flexion after surgery. Tension in the ulnar nerve increases in elbow flexion and may lead to symptoms in a nerve which is compromised to a subclinical degree. Trauma can itself lead to oedema and fibrosis in the cubital tunnel with resultant nerve symptoms. Three of the 22 patients in our study had had prior surgery for cubital tunnel syndrome and two had anterior transposition of the ulnar nerve at the time of their elbow release. We now recommend release and transposition of the ulnar nerve in patients with symptoms or in those who have positive provocative tests for impingement of the ulnar nerve (a Tinel's sign or a positive elbow flexion test).¹⁸

Special mention must be made of the postoperative rehabilitation required after capsular release. The rehabilitation programme consists of daily continuous passive movement at home, weighted elbow stretches, active and passive exercises at home and under supervision, and a dynamic elbow brace. Patients must be motivated and understand the commitment required. Although most improvement occurs within the first six to eight weeks, patients must continue their home programme since movement can continue to improve for up to three to four months after the procedure. This is especially true for longstanding contractures.

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

References

1. Gates HS, Sullivan FL, Urbaniak JR. Anterior capsulotomy and continuous passive motion in the treatment of post-traumatic flexion contracture of the elbow: a prospective study. *J Bone Joint Surg [Am]* 1992;74-A:1229-34.
2. Modabber MR, Jupiter JB. Current concepts review: reconstruction for post-traumatic conditions of the elbow joint. *J Bone Joint Surg [Am]* 1995;77-A:1431-46.
3. Urbaniak JR, Hansen PE, Beissinger SF, Aitken MS. Correction for post-traumatic flexion contracture of the elbow by anterior capsulotomy. *J Bone Joint Surg [Am]* 1985;67-A:1160-4.
4. Dickson RA. Reversed dynamic slings: a new concept in the treatment of post-traumatic elbow flexion contractures. *Injury* 1976;8:35-8.
5. Green DP, McCoy H. Turnbuckle orthotic correction of elbow-flexion contractures after acute injuries. *J Bone Joint Surg [Am]* 1979;61-A:1092-5.
6. Hepburn GR, Crivelli KJ. Use of elbow dynasplint for reduction of elbow flexion contractures: a case study. *J Orthop Sports Phys Ther* 1984;5:269-74.
7. Hastings H II. Elbow contractures and ossification. In: Peimer C, ed. *Surgery of the hand and upper extremity*. New York: McGraw-Hill, 1996:507-34.

8. **Husband JB, Hastings H.** The lateral approach for operative release of post-traumatic contracture of the elbow. *J Bone Joint Surg [Am]* 1990;72-A:1353-8.
9. **Morrey BF.** Post-traumatic contracture of the elbow: operative treatment including distraction arthroplasty. *J Bone Joint Surg [Am]* 1990;72-A:601-18.
10. **Willner P.** Anterior capsulectomy for contractures of the elbow. *J Internat College Surg* 1948;11:359-61.
11. **Cohen MS, Hastings H.** Rotatory instability of the elbow: the anatomy and role of the lateral stabilizers. *J Bone Joint Surg [Am]* 1997;79-A:225-33.
12. **O'Driscoll SW, Bell DE, Morrey BF.** Posterolateral rotatory instability of the elbow. *J Bone Joint Surg [Am]* 1991;73-A:440-6.
13. **Huskisson EC.** Measurement of pain. *Lancet* 1974;2:1127-31.
14. **Morrey BF, An KN, Chao EYS.** Functional evaluation of the elbow. In: Morrey BF, ed. *The elbow and its disorders*. Philadelphia: W. B. Saunders, 1985:73-91.
15. **Morrey BF, An KN, Chao EYS.** Functional evaluation of the elbow. In: Morrey BF, ed. *The elbow and its disorders*. Second edition. Philadelphia: W. B. Saunders, 1993:86-97.
16. **Crenshaw AH,** ed. Surgical approaches. In: *Campbell's operative orthopaedics*. 7th ed. St Louis, etc: CV Mosby Co, 1987:23-107.
17. **Wilson PD.** Capsulectomy for the relief of flexion contractures of the elbow following fracture. *J Bone Joint Surg* 1944;26:71-86.
18. **Novak CB, Lee GW, MacKinnon SE, Lay L.** Provocative testing for cubital tunnel syndrome. *J Hand Surg Am* 1994;19:817-20.