The medial approach for operative release of post-traumatic contracture of the elbow

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We treated post-traumatic contracture of the elbow in 13 consecutive patients (14 elbows) by operative release. Through a single medial approach, the posterior oblique bundle of the medial collateral ligament was resected, followed by posterior and anterior capsulectomies. An additional lateral release through a separate incision was required in only four elbows. The results were assessed at a mean interval of 57 months after operation.

Before surgery active extension lacked 43° which improved to 17° after operation. Active flexion before operation was 89°, which improved to 127°. The mean arc of movement increased from 46° to 110°. All 14 elbows showed scarring of the posterior oblique bundle of the medial collateral ligament.

Neither the interval from injury to operative release nor the age of the patient affected the results. A medial approach is useful to reveal and excise the pathological changes in the medial collateral ligament. It is a safe and effective route through which to correct post-traumatic contracture of the elbow.

J Bone Joint Surg [Br] 2000;82-B:68-73.

Received 5 January 1999; Accepted after revision 26 June 1999

Loss of movement at the elbow after trauma, burns or coma may cause severe impairment of function¹⁻⁴ which is difficult to avoid and to treat. Several differing surgical procedures have been used.⁵⁻¹³ Most have focused on flexion contracture and have achieved gratifying results, but the correction of loss of flexion has been unsatisfactory. These

operations have included anterior capsulotomy, posterior capsulotomy, and release of the lateral collateral ligament. Few reports refer to the medial collateral ligament (MCL).^{9,14}

The MCL of the elbow consists of three parts: an anterior oblique bundle (AOB), a posterior oblique bundle (POB), and a transverse segment.¹⁵ The AOB provides stability.^{16,17} Although the clinical significance of the POB is unclear, its length varies considerably in the course of movement of the elbow¹⁸ and fibrosis of the bundle may have an important role in post-traumatic contracture. Taking this into account we have developed an operative technique to correct such contracture. Through a single medial approach, resection of the POB followed by posterior and anterior capsulectomies was carried out under direct vision. An additional lateral incision was made only when release from a medial approach had proved to be inadequate.

Patients and Methods

Between 1988 and 1997, we treated 14 elbows (13 consecutive patients) with post-traumatic contracture by operative release (Table I). Both elbows were involved in one patient who had burns (cases 13 and 14). There were seven men and six women, with a mean age at the time of surgery of 29 years (10 to 54). All 14 elbows were followed clinically for a mean of 57 months (15 to 126).

The mechanism of injury was local trauma without fracture in six elbows, with a periarticular fracture of the olecranon or epicondyle in five, and an intra-articular fracture in three. Patients with an incongruent humeroulnar articulation were excluded. Previous operations had been carried out on nine elbows which included five open reductions with internal fixation, two anterior transpositions of the ulnar nerve, two split-thickness skin grafts, and one excision of a fragment of the medial epicondyle.

The mean interval from the time of the initial injury was 20 months (3 to 103). As shown in Table II, the mean maximum extension before operation was 43° (20 to 70) and the mean point of maximum flexion was 89° (22 to 120). The mean active range of movement of the 14 elbows before operation was 46° (0 to 100). The mean pronation was 68° (0 to 90) and mean supination 71° (10 to 95).

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0301-620X/00/19782 \$2.00

Table I. Details of the 13 patients (14 elbows) with post-traumatic contracture of the elbow

Case	Gender	Age (yr)	Initial injury	Previous surgery	Sites of heterotopic ossification†	Time from injury to release (mth)	Surgical approach	Transposition of the ulnar nerve	Follow-up (mth)
1	M	29	Fracture of olecranon	ORIF*	PM, P	103	Medial	No	15
2	F	54	Dislocation of elbow	Closed reduction	PM	13	Medial	Yes	19
3	M	44	Fracture of olecranon	ORIF	PM, P, PL	21	Medial and lateral	Yes	33
4	M	36	Contusion Spinal cord injury	None	PM, PL	8	Medial and lateral	Yes	29
5	F	19	Distal humeral intra-articular fracture	ORIF Transposition of ulnar nerve	PM, P	11	Medial	Yes	59
6	M	37	T condylar fracture	ORIF Transposition of ulnar nerve	PM, P	9	Medial	Yes	61
7	F	27	Dislocation of elbow	Open reduction	PM	12	Medial	Yes	63
8	M	23	Fracture of radial head Dislocation of elbow	Closed reduction	PM, P, PL A	21	Medial	Yes	75
9	M	13	Fracture of medial condyle Dislocation of elbow	Closed reduction	PM, P, PL	11	Medial and lateral	Yes	114
10	F	10	Neglected dislocation of elbow	None	None	3	Medial and lateral	Yes	41
11	F	51	Fracture of olecranon	ORIF	PM, P	11	Medial	No	118
12	F	14	Fracture of medial epicondyle	Excision of fragment	PM	9	Medial	No	126
13 (L)	M	26	Burn	Skin graft	PM, P	17	Medial	Yes	38
14	M	26	Burn	Skin graft	PM, P	36	Medial	Yes	18

* ORIF, open reduction with internal fixation

† PM, posteromedial; P, posterior; PL, posterolateral; A, anterior

Table II. Movement of the 14 elbows with post-traumatic contracture, before and after operative release

Case	Movement before/after release (degrees)				Total arc of movement before/after release (degrees)	
	Extension	Flexion	Pronation	Supination	Flexion	Extension/ Rotation
1	20/5	120/130	75/75	80/80	100/125	155/155
2	40/2	75/130	85/85	85/85	35/130	170/170
3	60/10	110/122	70/64	80/78	50/112	150/142
4	60/15	75/135	90/90	90/90	15/120	180/180
5	70/35	110/130	90/90	95/95	40/98	185/185
6	38/13	79/112	85/85	85/85	41/99	170/170
7	25/10	90/120	70/70	90/90	65/115	160/160
8	35/10	120/120	30/50	75/70	85/110	105/120
9	65/32	100/124	30/80	25/70	35/92	55/57
10	55/26	70/131	0/0	48/48	15/105	48/48
11	35/28	110/132	80/80	80/80	75/104	160/160
12	30/5	120/135	70/70	80/80	90/130	150/150
13	22/40*	22/135	70/70	10/10	0/95	80/95
14	50/20*	50/120	45/45	60/60	0/100	105/100

*ankylosed at 22° and 50° of flexion

Fig. 1a

Fig. 1b

Fig. 1c

Fig. 1d

Case 1. Figures 1a and 1b – AP and lateral radiographs show heterotopic bone over the posteromedial and posterior aspects of the elbow (arrows). Figures 1c and 1d – Three-dimensional CT shows that the heterotopic bone, mainly located over the posteromedial aspect, corresponds to the POB of the MCL.

Rotation of the forearm was severely impaired in five of the 14 elbows (cases 8 to 10, 13 and 14).

Clinical evaluation. To assess the contracture before the operation, anteroposterior (AP) and lateral radiographs, together with tomographs, were taken of all elbows. CT was carried out on ten and three-dimensional CT on five. Heterotopic ossification was observed in 13 elbows, the location and extent of which were classified as follows: group 1, posteromedial, corresponding to the POB of the MCL; group 2, posterior, corresponding to the posterior humeroulnar joint capsule; group 3, posterolateral, corre-

sponding to the posterior radiocapitellar joint capsule; and group 4, anterior, corresponding to the anterior joint capsule. Figure 1 shows a representative case. As shown in Table I, heterotopic bone was seen on the posteromedial aspect, which corresponds to the POB of the MCL, in 13 elbows.

Pain was classified as: none; mild, occasional pain during use of the elbow requiring no medication; moderate, occurring at night with occasional medication but not limiting activities of daily living; and severe, requiring regular medication and impairing activities of daily living.

Fig. 2a

Fig. 2b

Diagrams of the operative technique. Figure 2a – The concept of the release. The scarred POB of the MCL is excised together with a part of the posterior joint capsule. The AOB is preserved. Figure 2b – The medial approach to the elbow for operative release. The ulnar nerve is protected and the POB is exposed. If an anterior capsulectomy is needed, a part of the common flexor tendon is reflected from the medial epicondyle. The origin of the humeral head of flexor carpi ulnaris is preserved together with the AOB.

Indication for operation. Operation was recommended if movement of the elbow was restricted such that the patient considered that function was seriously limited, and had not improved despite supervised physiotherapy for at least 12 weeks. The importance of any given amount of stiffness varied according to the activities and needs of each patient. Those in whom loss of rotation of the forearm was the major complaint, were not included. Pronation and supination were determined for all patients who were included in the study before operation and at follow-up.

Operative technique. A medial skin incision was used, beginning distally, curving along the line of the ulnar nerve, and continuing proximally to the posterior aspect of the upper arm. The ulnar nerve was identified and freed, and the POB of the MCL exposed. If necessary, a part of the flexor/pronator origin was detached from the medial epicondyle. The POB was scarred and thickened in all 14 elbows and was excised, together with the medial aspect of the posterior joint capsule. The AOB of the MCL was preserved (Fig. 2). At this point, an improvement in flexion was obtained in all our patients. The dissection was then extended posteriorly. Defining the interval posteriorly

between the triceps and the posterior aspect of the humerus gives an excellent exposure of the posterior aspect of the elbow and the olecranon fossa. Removal of contracted fibrous tissue and heterotopic ossification in this region and release of the posterior capsule could easily be accomplished. The elbow was then moved through its fullest extension and flexion.

An anterior capsulectomy was carried out in eight elbows because extension remained limited. The common origin of the flexor and pronator muscles was released subperiosteally from the medial epicondyle of the humerus (Fig. 2b). Contracted scarring of the anterior capsule was

Table III. The mean extension, flexion and total arc of movement (in degrees) for the 14 elbows with post-traumatic contracture before and after operation

	Preop	Postop	Gain
Extension	43	17	26
Flexion	89	127	39
Total arc of movement of the elbow	46	110	64

excised under direct vision. No patient required tenotomy of the biceps or myotomy of the brachialis muscle. Satisfactory improvement in the range of movement was accomplished in ten elbows. In the remaining four, an additional release of the lateral collateral ligament and excision of heterotopic bone were carried out using the extended Kocher approach.¹⁹

The origin of the flexor/pronator muscles was repaired using a non-absorbable multibraided suture passed through drill holes in the medial epicondyle. The ulnar nerve was transposed anteriorly in nine elbows in which the detachment and repair of the flexor/pronator origin were carried out. In two elbows, in which there had been a previous transposition of the ulnar nerve, the nerve was protected during operation and placed back subcutaneously on the flexor/pronator fascia. In the remaining three elbows, the nerve was simply retracted and replaced in its groove. The wound was closed over suction drains, which were removed 24 hours later.

Postoperative therapy. The elbow was immobilised for three to five days, after which active and assisted exercises were begun under the supervision of a physiotherapist. Aggressive postoperative manipulation was not allowed because it can cause bleeding.

Emphasis was placed on slow stretching of the elbow under gravity, which lessens pain and allows stress relaxation to occur. The patient lay on the bed with the shoulder at 40° to 90° of abduction and the elbow at maximum possible extension under gravity. This position was held for five minutes, allowing the soft tissues to relax. The patient then elevated the upper arm and placed the elbow in maximum possible flexion under gravity. This routine was self-directed and incrementally increased by the patient every five minutes, with the pattern repeated for half an hour in either flexion or extension. The patient was then encouraged to use the elbow through his best range of movement for an hour and repeat the exercise throughout the day. Splintage was not used. Continuous passive movement was used in the first seven patients. All patients were supervised by physiotherapists for six to eight weeks.

Results

The mean preoperative limitation of extension of 43° was reduced to 17° and the mean preoperative flexion of the elbow improved from 89° to 127°. The mean gains in extension and flexion movement were 26° and 39°, respectively. The total range of movement of the elbow improved from a preoperative mean of 46° to 110°. Thus, the mean arc of movement increased by 64° (Table III). Subsequently, there has been no significant loss of range of movement.

Before operation, rotation of the forearm was impaired in five elbows. The mean rotation was 35° pronation (0 to 70) to 44° supination (10 to 75). Postoperatively, the mean rotation was 49° pronation (0 to 80) to 52° supination (10

to 70). Only one patient (case 9) regained a full arc of rotation.

One patient (case 1) had moderate pain and one (case 3) mild pain over the medial aspect of the elbow before operation. None of the patients had pain at the latest follow-up.

There was a delay in healing in one of the wounds in the patient with burns (case 13). This was successfully treated by a local flap and a split-thickness skin graft. There were no complicating infections and no nerve palsies in any of the patients. None complained of instability of the elbow.

The patients were divided into two groups based on the mechanism of injury. In the eight patients with a peri-articular or intra-articular fracture of the elbow, the total arc of movement improved from a preoperative mean of 65° to a mean of 109°. The other five patients (six elbows) had local trauma without fracture or burns. The total arc of movement improved from a mean of 31° to a mean of 111°. The postoperative improvement in the total arc of movement was significantly better in the group of patients without fracture (Student's *t*-test, $p < 0.05$). There was no correlation between the improved range of movement and the time between injury and operative release, the postoperative use of continuous passive movement, or the age of the patients.

Discussion

Morrey and An¹⁸ described the functional anatomy of the MCL of the elbow in detail. The humeral attachment lies posterior to the axis of flexion and in this position a cam-like effect is created so that the tension of the ligament varies with flexion. The length of the AOB remains nearly constant throughout the entire arc of movement. By contrast, the POB is attached further from the axis of rotation and thus has great variation in length; it increases in length by 9 mm between 60° and 120° of flexion. The range of movement of the elbow is greatly reduced if the POB becomes contracted after trauma.

In our series, preoperative radiographs showed heterotopic ossification over the posteromedial aspect, which corresponds to the POB, in all but one elbow. We also observed thickening and scarring of the POB in all cases at operation. This was also noted by Itoh et al⁹ and Hida.¹⁴ It appears that a fibrous contracture of the POB is one of the most important pathological changes in the stiff elbow.

The medial approach and the technique which we describe have several advantages over both the anterior and lateral approaches. Pathological changes in the POB of the MCL can be observed and excised under direct vision. Anterior and posterior exposure is possible through one medial incision, through which a complete soft-tissue release and excision of part of the olecranon and coronoid process can be undertaken if necessary. Preservation of the AOB of the MCL maintains stability for the elbow and facilitates early movement. Additional lateral exposure is

indicated only if the medial approach has proved to be inadequate.

According to Cohen and Hastings,²⁰ the most common complication of their lateral approach was the development of transient paraesthesia in the distribution of the ulnar nerve. They recommended release and transposition of the ulnar nerve in patients with symptoms or in those who showed positive provocative tests for impingement. In the medial approach, the ulnar nerve is routinely released and protected under direct vision which decreases the risk of damage. Transposition can be carried out easily if indicated.

The arc of elbow movement improved in all our patients. The functional arc of flexion/extension (30° to 130°) was obtained in seven of the 14 elbows. The mean increase in the arc of total movement was 64°, which compares equally or favourably with other reports.^{8,10,11,20,21} An improvement in flexion, as well as a gain in extension, contributed to the good results. The incidence of complications was low. None of the patients developed symptoms related to the ulnar nerve.

The primary indication for medial release is improvement of movement and this was accomplished without increase in pain in all patients. It is our impression that post-traumatic pain and discomfort over the posteromedial aspect of the elbow result from scar formation in the POB of the MCL.

Early active movement is a key factor in postoperative management. Gates et al²¹ found that the postoperative use of continuous passive movement improved active flexion and the total arc of movement. Bonutti et al²² and Hertel et al¹³ described static progressive stretching using a turn-buckle-type splint. In our patients, continuous passive movement was applied only to the first seven. There was no significant difference between the improvement obtained with continuous passive movement and that without. Although our protocol is simple, patients must be motivated and show commitment. The elbow was immobilised for three to five days to lessen postoperative pain and swelling in the patients whom we have described but we have now shortened the period of immobilisation and gentle active movement is initiated on the second postoperative day.

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.

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