Release of the medial collateral ligament to improve flexion in post-traumatic elbow stiffness

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Contracture of the collateral ligaments is considered to be an important factor in post-traumatic stiffness of the elbow. We reviewed the results of isolated release of the medial collateral ligament in a series of 14 patients with post-traumatic loss of elbow flexion treated between 1998 and 2002. There were nine women and five men with a mean age of 45 years (17 to 76). They were reviewed at a mean follow-up of 25 months (9 to 48). The operation was performed through a longitudinal postero-medial incision centred over the ulnar nerve. After decompression of the ulnar nerve, release of the medial collateral ligament was done sequentially starting with the posterior bundle and the transverse component of the ligament, with measurement of the arc of movement after each step. If full flexion was not achieved the posterior half of the anterior bundle of the medial collateral ligament was released.

At the latest follow-up, the mean flexion of the elbow improved significantly from 96˚ (85˚ to 115˚) pre-operatively to 130˚ (110˚ to 150˚) at final follow-up (p = 0.001). The mean extension improved significantly from 43˚ (5˚ to 90˚) pre-operatively to 22˚ (5˚ to 40˚) at final follow-up (p = 0.003). There was a significant improvement in the functional outcome. The mean Broberg and Morrey score increased from a mean of 54 points (29.5 to 85) pre-operatively to 87 points (57 to 99) at final follow-up (p < 0.001). All the patients had normal elbow stability.

Our results indicate that partial surgical release of the medial collateral ligament is associated with improved range of movement of the elbow in patients with post-traumatic stiffness, but was less effective in controlling pain.

Stiffness of the elbow occurs commonly after trauma and limits function and activities of daily living.1-3 There are many potential causes of stiffness, broadly divided into those which are intrinsic, involving intra-articular pathology, and those which are extrinsic, involving extra-articular pathology.3-6

The medial collateral ligament (MCL) of the elbow consists of three parts, an anterior bundle, a posterior bundle and a transverse bundle (Fig. 1). Cadaver and clinical studies have documented the role of partial release of the MCL in conjunction with anterior and posterior capsulotomies in restoring a functional arc of movement in cases of global loss of movement of the elbow.8,9

Our aim in this retrospective review was to evaluate the results of isolated partial release of the MCL to improve flexion of the elbow in a group of patients with post-traumatic loss of flexion.

Patients and Methods
We assessed 14 patients, nine women and five men, with a mean age of 45 years (17 to 76) who had undergone surgery for post-traumatic loss of flexion of the elbow between 1998 and 2002. The indication for surgery was a restriction of elbow flexion without loss of forearm rotation which interfered with activities of daily living and which had failed to improve despite physiotherapy for at least 12 weeks. The patients’ pain was evaluated pre-operatively and at the final follow-up. Patients were asked to rate their pain as mild, moderate or severe. Details of the patterns of the injury are given in Table I. None of the patients had been treated for stiffness of the elbow following burns or heterotopic ossifica-
tion associated with a closed head injury or from any other cause. Thus, patients with extrinsic pathology were excluded as were those with scarring of the anterior capsule and those with contractures secondary to a dislocation of the elbow. The mean follow-up was 25 months (9 to 48). Information from the medical records and the latest follow-up included the aetiology of the contracture and previous treatment, the pre- and post-operative range of movement of the elbow and forearm, the stability of the elbow and the function of the ulnar nerve. The radiological and CT findings before and after the procedure, and the pre- and post-operative functional outcome score according to Broberg and Morrey, were also recorded. Based on the Broberg and Morrey score, the functional outcome was rated as excellent (95 to 100), good (80 to 94), fair (60 to 79), and poor (0 to 59). At each follow-up visit the patients were evaluated by the senior surgeon (DSR) for instability of the elbow. This was assessed by applying valgus loading and whether this induced pain in the elbow.

**Operative technique and post-operative treatment.** The procedure was performed under regional block and a tourniquet. Once the tourniquet was inflated digital photography or video was used to document the initial range of movement. A longitudinal posteromedial incision centred over the ulnar nerve was used. Decompression of the ulnar nerve was performed in all patients with proximal and distal release of the arcuate ligament and Osborne’s fascia. The nerve was gently retracted and the overlying pronator teres and common flexor origin separated from the underlying MCL.

Release of the MCL was performed sequentially starting with the posterior bundle. The release was carried from the posterior capsular insertion on the olecranon and brought distally. After transection of the posterior bundle the elbow

<table>
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<th>Case</th>
<th>Age (yrs)</th>
<th>Gender</th>
<th>Follow-up (mths)</th>
<th>Initial injury (AO fracture type)</th>
<th>Pre-operatively</th>
<th>At final follow-up</th>
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* ROM, range of movement
† B and M score, Broberg and Morrey score
‡ MCL, medial collateral ligament
was then brought into further flexion and the resultant change was recorded using digital photography and the surgeon’s estimation. The transverse component of the ligament was also divided and the arc of movement was estimated again. Although the posterior and transverse bundles of the MCL are relatively indistinct in the normal elbow they may become considerably thickened after trauma to the elbow.

If full flexion could still not be achieved the posterior half of the anterior bundle of the MCL was exposed by splitting the flexor-pronator mass and released (Fig. 1). A complete release of the anterior bundle was not found to be necessary to achieve full flexion in any patient.

Any decision to perform a formal transposition was dependent on the stability of the ulnar nerve as the elbow was brought from extension into full flexion and was therefore postponed until the elbow release was completed. If there was any suspicion of instability of the ulnar nerve it was transposed and this was undertaken in seven patients.

Although the ligament was found to be stiff and non-compliant, histological analysis was not undertaken. After the release the elbow was assessed for stability. There was increased valgus laxity in five patients but fluoroscopic examination did not reveal subluxation, and immobilisation was not felt to be necessary. While some of the posterior capsule was incised to verify complete release a formal anterior capsular release was not performed in any patient. Drains were not used. The subcutaneous tissues and skin were closed with absorbable and non-absorbable sutures, respectively. The mean tourniquet time was 48 minutes (35 to 78).

Passive movement was started with a physiotherapist on the first post-operative day. The patients were encouraged to use their elbow through a complete arc of flexion for an hour and repeat the exercise throughout the day. All patients were supervised by physiotherapists for four to six weeks. The patients remained in hospital for less than 24 hours. All continued with exercises at home for three months after the completion of supervised physiotherapy. Serial static bracing was used in all patients, as this was the surgeon’s preference, with adjustment and discontinuation of the brace at the third week based on their progress. The splint was worn to increase elbow flexion with the forearm in neutral rotation. Patients were instructed to wear the splint between two and four hours a day.

Statistical analysis. The non-parametric Wilcoxon signed-rank test was used to evaluate differences between the study variables pre- and post-operatively. The level of significance was set at $p = 0.05$ for all statistical analyses.

Results

The mean maximum elbow flexion improved from $96^\circ$ (85$^\circ$ to 115$^\circ$) pre-operatively to $130^\circ$ (110$^\circ$ to 150$^\circ$; $p = 0.001$; Table I) at final follow-up. There was a significant increase in mean extension from $43^\circ$ (5$^\circ$ to 90$^\circ$) pre-operatively to $22^\circ$ (5$^\circ$ to 40$^\circ$) ($p = 0.003$) at final follow-up (Table I). The mean gains in flexion and extension were $33^\circ$ and $24^\circ$, respectively, and eight patients regained the full functional arc of movement of $30^\circ$ to $130^\circ$ (Fig. 2). The functional arc of flexion/extension of $100^\circ$ was obtained in 11 of the 14 patients. No patient had reduced movement. A total of 13 of the 14 patients had pain over the medial aspect of the elbow before surgery, while only six had pain at the latest follow-up ($p = 0.014$). Improvement in pain correlated well with the increase in the Broberg and Morrey score.

All our patients had normal post-operative stability of the elbow and none reported loss of stability on the Broberg and Morrey score survey. The mean Broberg and Morrey score was 54 points (29.5 to 85) pre-operatively and 87 points (57 to 99) at the final follow-up visit. According to this score, at the latest follow-up, the eight patients with poor pre-operative scores improved from a mean of 44 (29.5 to 59) to a mean of 88 (57 to 99) at the latest follow-up ($p < 0.001$). Of these four had excellent results, three had good results and one had a poor result. The five patients with fair pre-operative scores improved from a mean of 67 points (61 to 72) to a mean of 85 points (82 to 90) and all had good results ($p < 0.001$). The one patient with a good pre-operative score of 85 improved to a post-operative score of 95 (excellent). One patient (case 3) still
had a poor score despite improvement in the range of movement from 60˚ to 90˚ to 30˚ to 110˚. This patient had marked radiological degenerative changes which may have contributed to his pain despite considerable improvement in the range of movement. Pain relief was achieved in six patients.

Discussion
Contracture of the elbow is a well-recognised sequelae of injury to this joint. When non-operative techniques fail to increase the arc of movement of the elbow, surgical intervention may be indicated. Several surgical procedures have been reported, most of which have focused on the management of post-traumatic loss of elbow extension.12-19 In the absence of heterotopic ossification or malunion, excision of the thickened anterior capsule has given a satisfactory outcome regardless of approach. The aetiology and the treatment of loss of flexion of the elbow have received less attention. Previous procedures have included complete anterior and/or posterior capsulotomy, with or without preservation of the lateral collateral ligament.20 Only a few reports9,16 have referred to the role of the MCL and one study by Hotchkiss and Weiland15 highlighted the role of the MCL in the loss of flexion biomechanically.

While the results of the study by Hotchkiss and Weiland15 clearly demonstrate the role of the MCL in contractures, the pathoanatomy is not as clear. Previous authors5,9,13 have examined the isometry of the MCL and indicated the role of the anterior and posterior bundles in providing stability in both flexion and extension. They postulated that the cam shape of the distal humerus may contribute to the difficulty in achieving flexion once contracture of the MCL has occurred. Similar changes are seen in the metacarpophalangeal joint when a finger has been too swollen to allow flexion after trauma.9,16 This has yet to be demonstrated in cadaver models, but the analogy may prove to be accurate. In most of our patients there were no discrete posterior and transverse bundles present in the MCL. A band of scar tissue was found which had to be released necessitating preservation of only the anterior half of the anterior bundle.

Wada et al16 treated post-traumatic contracture in 14 consecutive elbows and using a medial approach, the posterior oblique bundle of the MCL was resected, and then posterior and anterior capsulotomies were performed. All elbows had thickening of the posterior oblique bundle of the MCL. Additional lateral release of the lateral collateral ligament and excision of heterotopic ossification were required through a separate incision in four elbows. At a mean follow-up of 57 months, the mean active flexion improved from 89˚ to 127˚ and the mean extension from 43˚ to 17˚. Only one patient regained a full arc of movement.

In our study of medial release at the elbow, the arc of movement improved in all patients. The functional arc of flexion/extension of 100˚ was obtained in 11 of the 14 patients. The mean increase in elbow flexion was 33˚, which compares with the findings of Wada et al.16 A substantial increase in extension from a pre-operative mean of 43˚ to a post-operative mean of 22˚, was also observed in our patients.

Loss of flexion is a greater functional problem than loss of extension in the elbow and is reflected in the Broberg and Morrey score. In our study an increase in flexion was matched by an increase in the Broberg and Morrey score.

Of the 14 patients in our series, one had a poor Broberg and Morrey score pre- and post-operatively. This appeared to be due to persistent pain showing that improvement in movement may not correlate with relief from pain. We observed pain relief in half our patients and postulate that pain is due to soft-tissue tension, degenerative changes in the joint and to the formation of scar tissue around the ulnar nerve. Relief from pain is probably provided by lysis of the adhesions, soft-tissue release and a reduced stretching of the medial aspect of the elbow.

The medial approach to the elbow has several advantages over both the anterior and lateral approaches since the posterior bundle of the MCL remains the most important anatomical structure involved in the stiff elbow. It provides superior exposure with lesions in the posterior bundle observed and excised under direct vision. Secondly, the incision can be extended to allow anterior and posterior exposure if necessary.

The role of decompression of the ulnar nerve in this procedure must be emphasised. Previous authors2 have noted that the ulnar nerve is at risk in procedures which restore elbow flexion after longstanding contractures. None of the patients in our series had complications associated with the nerve, but we recommend that transposition is performed if anterior subluxation of the nerve is noted and if the surgeon has concern over entrapment of the nerve in the medial joint due to the transient valgus instability seen in some patients.

Concern over persistent valgus instability after this procedure did not prove to be justified. While some laxity was thought to be present after the release in five patients none had humero-ulnar subluxation which required immobilisation or ligament reconstruction. This is probably because the lateral complex was not disturbed thereby preventing the posterolateral instability associated with most post-traumatic conditions.12 Additionally, none of our patients took part in high-demand throwing sports in which valgus instability may have been a consequence.

The use of continuous passive motion in post-operative care is controversial.2 Although sometimes this may be beneficial we did not use it because its success depends on attention to detail and on-going maintenance which are hard to achieve in the outpatient setting.

Our findings indicate that isolated sequential release of the MCL reliably restores flexion in selected patients in whom other causes of restricted movement have been eliminated. The approach allows decompression and/or trans-
position of the ulnar nerve protecting it from injury which may otherwise occur after release of contractures. Post-operative evaluation did not show symptomatic valgus laxity. Finally, the restoration of elbow flexion correlates well with the functional outcome but to a lesser degree with relief from pain.

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