Outcomes of open arthrolysis of the elbow without post-operative passive stretching


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The use of passive stretching of the elbow after arthrolysis is controversial. We report the results of open arthrolysis in 81 patients. Prospectively collected outcome data with a minimum follow-up of one year were analysed. All patients had sustained an intra-articular fracture initially and all procedures were performed by the same surgeon under continuous brachial plexus block anaesthesia and with continuous passive movement (CPM) used post-operatively for two to three days. CPM was used to maintain the movement achieved during surgery and passive stretching was not used at any time. A senior physiotherapist assessed all the patients at regular intervals. The mean range of movement (ROM) improved from 69° to 109° and the function and pain of the upper limb improved from 32 to 16 and from 20 to 10, as assessed by the Disabilities of the Arm Shoulder and Hand score and a visual analogue scale, respectively. The greatest improvement was obtained in the stiffest elbows: nine patients with a pre-operative ROM < 30° achieved a mean post-operative ROM of 92° (55° to 125°). This study demonstrates that in patients with a stiff elbow after injury, good results may be obtained after open elbow arthrolysis without using passive stretching during rehabilitation.
A 43-year-old painter and decorator sustained a radial head fracture-dislocation (dominant side) and underwent replacement of the radial head but this was subsequently removed because of symptoms attributed to overstuffing. A staphylococcal infection ensued which resolved after debridement and antibiotics. Figure 1a – anteroposterior (left) and lateral (right) radiographs at 19 months after the initial surgery, at which point significant pain and stiffness prevented him from working, and arthrolysis was performed. Figures 1b and 1c – clinical photographs at six years after arthrolysis, demonstrating a full functional range of movement {extension/flexion} improved from 30°/110° pre-operatively to 20°/135°. Pain and function improved, and he has been working full time for the last six years. This case illustrates how, even in a severely damaged joint, arthrolysis can still be carried out successfully.
facilitating further release, debridement and ‘sculpting’ of the articular surfaces when necessary to ensure a congruous articulation and a smooth arc of movement. Excision of the radial head was carried out in 39 patients (48%) who had impingement, painful crepitus or limited forearm rotation. The distal humerus was stripped of soft tissue as required, preserving the medial ligament; often only the anterior band of the medial ulnar collateral ligament and part of flexor origin was left intact. Lateral closure was achieved by approximating the anterior and posterior lateral soft tissues using sutures passed through drill holes in the lateral column. A total of 55 patients (68%) underwent ulnar nerve decompression, often as part of the approach to the medial structures and specifically to gain access to the posterior band of the medial ligament; 23 patients (28%) also underwent transposition of the ulnar nerve, this being performed when the tissue bed of the nerve after elbow release was judged to be inappropriate for simple decompression. Continuous passive movement with a Kinetec 6080 Elbow CPM machine (Kinetec, Tournes, France) was used for approximately 48 hours after surgery, continuing the brachial plexus block that had been used during surgery in all patients. This was administered via a fine catheter threaded into the brachial sheath using a supraclavicular approach as described by Parikh, Rymaszewski and Scott. Through this, a low dose of bupivacaine (0.125%) was infused, the rate of administration being titrated against pain. The use of CPM was controlled by the patient and permitted for as long as tolerated within the limits of comfort, including overnight if possible, as an adjunct to post-operative mobilisation. The range of movement was set to no more than that achieved intra-operatively. The patients were also taught active exercises with gravity eliminated, for example flexing and extending while the weight of the arm was supported on a table. From a resting position active flexion was performed to the end of the available range, actively held for four seconds and then returned to the starting position. This was repeated for up to five minutes, then extension exercises were carried out in a similar manner. Patients were discharged with advice to use their elbow as normally as possible, usually at three days after surgery. Only simple analgesic medications were provided after discharge and no patient required escalation to stronger analgesics. No patient received any passive stretching at any time and no prophylaxis for heterotopic ossification was used.

Assessments were carried out before surgery and at six weeks, three months, one year and two years (22 patients) after surgery by a single observer (senior physiotherapist (BAD)). Assessments included measurements of the ROM of the elbow and a clinical assessment, including a review of ulnar nerve function. Patients were also provided with advice and reassurance with regard to active exercises. The Disabilities of Arm Shoulder and Hand (DASH) score15 and a visual analogue scale (VAS) for pain were recorded at each review except that at six weeks. The DASH score is derived from a questionnaire containing 30 questions relating to pain and function, with a scoring range of 0 to 100, higher scores indicating worse function. The VAS was scored from 0 (no pain) to 10 (worst pain ever), for five situations: at rest; during the day; at night; lifting a heavy object; and when doing a task with repeated elbow movements. 

Statistical analysis. The results were analysed using the paired t-test for range of movement in flexion–extension, and Wilcoxon’s rank sum test for the VAS and DASH scores and for range of movement in pronation–supination. A p-value < 0.05 was regarded as significant.
Results
There were 54 men and 27 women in the study group with a median age of 40 years (15 to 69). The dominant elbow was involved in 42 patients (52%). The mean time from injury to surgery was 36 months (6 to 504). All patients had an intra-articular fracture: 23 (28%) had a fracture of the radial head, 11 (14%) had a fracture-dislocation of the radial head, 12 (15%) had a fracture of the proximal ulna, including one dislocation, three (4%) had a fracture of the capitellum and 32 (40%) had a fracture of the distal humerus. A total of 42 patients (52%) had undergone open reduction internal fixation and nine (11%) had undergone replacement of the radial head. Out of 81 patients, 30 (37%) had not undergone any previous surgery to the injured elbow. Excluding nine patients (11%) who had previous radial head replacement, the radiocapitellar joint was judged from radiographs to be congruent in 36 patients (44%). A total of 48 patients (59%) had a congruent humeroulnar joint, but severe damage to the joint was not a contraindication to surgery (Fig. 1). The mean pre-operative extension was 49° (0° to 90°) and flexion was 118° (45° to 150°); 71 patients (88%) had a loss of extension > 30° and 47 (58%) had elbow flexion < 130°.

In the 71 patients (88%) available at the final follow-up, the total ROM had improved in all but two (3%), whose arc of movement remained unchanged. Both had flexion contractures (45° and 50°, respectively) with full flexion. Surgery had achieved full extension intra-operatively in both. The initial injuries had been a simple radial head fracture and radial head fracture-dislocation with subsequent fixation of the radial head. Both underwent radial head excision at arthrolysis. Although there was no change in the flexion–extension arc, there was an improvement in total forearm rotation of 15° and 60°, respectively. Interestingly, there was significant improvement in both the DASH (by 29 and 56 points, respectively) and VAS for pain (by 13 and 35 points, respectively). Six of 71 patients (8.4%) maintained the ROM that had been obtained intra-operatively, but no patients had a greater ROM than that achieved at surgery by the final review. The mean total arc of movement increased from 69° (10° to 100°) pre-operatively to 109° (55° to 145°) at final review, a mean improvement of 40° (p < 0.001). Mean flexion improved from 118° (45° to 150°) to 136° (110° to 150°) (p < 0.001) and mean extension from 49° (0° to 90°) to 27° (0° to 65°) (p < 0.001) (Fig. 2). Pronation improved from a mean of 73° (0° to 90°) pre-operatively to 84° (30° to 90°) at final follow-up (p < 0.0001). Supination improved from a mean of 69° (0° to 90°) to 77° (10° to 90°) (p = 0.0018). In those patients who underwent excision of the radial head the mean pre-operative pronation was 70° (10° to 90°) and it improved to 84° (45° to 90°) at the latest follow up (p < 0.0001). Supination in this group was a mean of 64° (0° to 90°) pre-operatively and improved to a mean of 75° (10° to 90°) at the latest follow up (p = 0.0034). For the 22 patients with two years’ follow-up data, no significant increase in ROM was seen after one year: the mean ROM was 102° (50° to 130°) at one year and 101° (55° to 135°) at two years. Nine patients who had a pre-operative arc < 30° achieved a mean arc of 92° (55° to 125°) at the latest follow-up. The mean improvement in ROM in this subset of 73° (45° to 95°) was significantly greater than in those patients with a pre-operative arc > 30°, who improved by a mean of 36° (0° to 90°) (unpaired t-test, p < 0.001). The mean DASH score improved from 32 (2 to 79) pre-operatively to 16 (0 to 68) at latest follow-up (p < 0.001). The mean VAS improved from 20 (0 to 46) pre-operatively to 10 (0 to 45) at latest follow-up (p < 0.001). Ten of 81 patients had the last follow-up assessment performed by telephone questionnaire. The questions ‘Are you happy with your surgery?’ and ‘In retrospect would you undergo your surgery again?’ were asked. All ten patients answered ‘yes’ to both.

Ten patients had significant ulnar nerve symptoms pre-operatively: five underwent decompression and five a subcutaneous transposition. All had some symptomatic improvement post-operatively, apart from one patient with mild sensory symptoms pre-operatively who underwent decompression of the nerve alone and did not report any change in symptoms post-operatively. No patient developed new ulnar nerve symptoms after surgery.

The age of the patient did not appear be associated with the outcome as assessed by improvement in ROM, DASH or VAS scores, but there appeared to be an association with both pre-operative DASH (correlation coefficient = 0.43, p = 0.0004) and VAS (correlation coefficient = 0.42, p = 0.0005) scores when analysed using separate linear regression models. The time from injury to arthrolysis did not appear to have any effect on the final ROM when subjected to similar analysis (correlation coefficient = -0.17, p = 0.15).

Complications. Two patients were referred to the pain clinic with a diagnosis of complex regional pain syndrome, but this did not appear to affect the final outcome. A deep infection developed in one patient but resolved with intravenous antibiotics, and this also did not appear to affect the final outcome. There were no cases of instability, despite 57 patients (70%) having undergone complete release of the lateral ligament complex and subsequent repair using transosseous sutures to the lateral epicondyle. No patient required further surgery.

Discussion
Morrey's classification system distinguishes between extrinsic (peri-articular) stiffness due to soft tissue contracture only, with normal joint surfaces, and intrinsic stiffness involving intra-articular adhesions, cartilage loss and/or distortion of the joint secondary to the original injury or inadequate reduction. Most patients with significant stiffness have suffered an intra-articular fracture and therefore often have both extrinsic and intrinsic contributory factors, i.e. a mixed contracture. All the patients in our study had an intra-articular fracture and 57 (70%) required complete release of the lateral ligament complex. Some regard an extensive arthro-
lysis with complete lateral ligament release, in a joint with damaged articular surfaces, to be a complex problem requiring an external fixator to protect the repair of ligaments, and possibly also to need an interposition arthroplasty. These techniques were not used in this series.

Many operative techniques have been described. The choice of approach is determined by the pathology and needs to be extensible to allow release of all tissues contributing to stiffness; ideally a full ROM is obtained intraoperatively. We found that the patient is likely to achieve less movement, and never more, than that achieved intraoperatively (Fig. 3). Instability after arthrolysis has rarely been reported and there were no cases in this series despite 57 patients (70%) undergoing release and repair of the lateral ligament complex.

Early post-operative mobilisation of the elbow to maintain the ROM achieved at surgery appears to be important. It is essential to provide adequate pain relief, and this was achieved in our series using a brachial plexus block, continued while a CPM machine was used for approximately 48 hours after surgery. It is important to note that CPM, used as an adjunct to post-operative mobilisation, merely maintained as much of the movement achieved intraoperatively as possible, and passive stretching was not used.

A strength of this study is that the goniometric measurements of all patients were performed by a single observer. This improves accuracy, as interobserver error has been shown to be significantly greater than intra-observer measurements for goniometric measurements.

The mean improvement in ROM of 40° was comparable to that in previously reported studies. Nine patients who had a pre-operative ROM of < 30° achieved the greatest improvement, with a final mean flexion arc of 92°. This counterintuitive finding, first identified by Morrey in his classic paper in 1990, has also been reported in other series. However, the reasons for the finding remain unclear. Two patients had no improvement in the ROM with no obvious reason for the failure of treatment. Both had pure loss of extension, accompanied by significant problems with function and pain. There was nothing unusual about their original injury or subsequent treatment and arthrolysis compared to other patients in the study. Although their range of movement failed to improve, it is interesting that they nevertheless had significant improvements in both pain and function at final review.

The aim of surgery in our cases was to improve the ROM, not specifically to address pain. However, improvement in pain following surgery was observed, which may have been due to relief of symptoms from impingement at the end range of flexion–extension or from symptoms of ulnar nerve entrapment. Passive stretching, whether with outpatient physiotherapy, manipulation under anaesthesia, turnbuckle or dynamic splints, does not appear to be required in order to achieve a good result following arthrolysis of the elbow. In conclusion, this study demonstrates that satisfactory outcomes in terms of ROM, function and pain relief can be achieved at one year following open arthrolysis of the elbow without the use of passive stretching in the post-operative period.

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References