Progressive surgical release of a posttraumatic stiff elbow

Technique and outcome after 2–18 years in 46 patients

René K Marti[1], Gino M M J Kerkhoffs[1], Mario Maas[2] and Leendert Blankevoort[1]

Departments of [1]Orthopedic Surgery, G4-222 and [2]Radiology, Academic Medical Center, P.O. Box 22700, NL-1100 DE Amsterdam, The Netherlands. E-mail: orthopaedie@amc.uva.nl
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ABSTRACT – We treated 46 consecutive patients (47 elbows) suffering from posttraumatic contracture of the elbow joint with operative release. A lateral approach was used to perform a capsulectomy after release of the extensor muscles in 23 elbows. An additional medial approach was used to excise ulnar adhesions and perform a more extensive capsulectomy and an ulnar nerve neurolysis in 24 elbows. Postoperative rehabilitation consisted of immediate passive range-of-motion exercises. The results were assessed after average 10 (2–18) years.

Before surgery, the mean active arc of motion was 45 (SD 36) degrees, which improved to 99 (SD 34) degrees after release. 7 patients had transient ulnar paresthesia, 4 recurrent stiffness, which did not become worse after surgery, 1 was reoperated on and 2 developed a postoperative infection, which responded to antibiotic treatment after a few months. No patient suffered from joint instability, or an increase in pain. 44 patients were satisfied with the result at the latest follow-up. We found similar improvement in both treatment groups.

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A stiff elbow is usually defined as an elbow having a reduction of more than 30° in extension, or flexion less than 130°. Most activities of daily living are possible if the elbow has a range of motion of 100°, from 30° to 130° of flexion (Morrey et al. 1981). In individual cases, however, such as gymnasts or heavy workers, even a 10°–15° loss of extension may be a problem.

Loss of motion of the elbow is common after trauma, burns or coma and may severely impair function. 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 intra-capsular ligaments and extra-capsular muscles contribute to the development of a contracture (Regan and Reilly 1993, Modabber and Jupiter 1995). Loss of motion of the elbow is difficult to prevent and treat; a variety of treatments, including operative release, have been described (Wilson 1944, Glynn and Niebauer 1976, Tucker 1978, Urbaniak et al. 1985, Kulkarni and Patel 1988, Van Eijck et al. 1991, Gates et al. 1992, Luppino et al. 1992, Morrey 1992, Lamie et al. 1993, Regan and Reilly 1993, Hertel et al. 1997, King et al. 1997, Baksi 1998, Viola and Hanel 1998, Cohen and Hastings 1999).

We analyzed the outcome of lateral release followed by a medial release, if the peroperative range of motion was not to the surgeon's satisfaction, in 46 consecutive patients (47 elbows) treated with lateral release (23) or a lateral and subsequent medial release (24).

Indications

Various types of static progressive and dynamic splinting are of value for small and painful contractures (Figgie et al. 1989, Zander and Healy 1992, Bonutti et al.1994, Karachalios et al. 1994).

Patients having considerable loss of function with or without pain can be treated with physical therapy and splinting as well. However, if the motion does not improve enough, surgery may be considered. Extensive operative release of the contracture is used widely and several approaches have

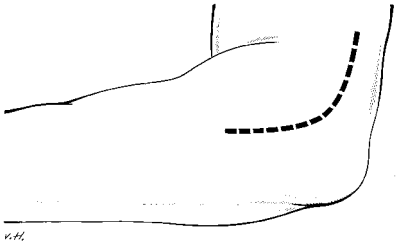

Figure 3. Lateral incision.

been described (Wilson 1944, Urbaniak et al. 1985, Itoh et al. 1989, Weizenbluth et al. 1989, Husband and Hastings 1990, Gates et al. 1992, Hertel et al. 1997, Cohen and Hastings 1998, 1999, Viola and Hanel 1998).

Young patients with severe intra-articular pathology and instability can be treated with postoperative distraction of the joint (Morrey 1992, Regan and Reilly 1993). The use of a distraction device is ideal because soft tissue release may be combined with correction of articular incongruity.

Operative technique

The operative release is performed with the patient in supine position using an arm table and a tourniquet. A single dose of prophylactic antibiotic and indomethacin (to prevent heterotopic ossification) are given (Kjaersgaard-Andersen et al. 1993, McAuliffe and Wolfson 1997).

Step I. The elbow is approached via a curved incision along the supracondylar ridge of the humerus, over the lateral epicondyle and along the radial border of the ulna (Figure 3). The subcutaneous flaps are mobilized and fixed with a few sutures. The extensor muscles are identified at their origin at the lateral epicondyle and the superficial fascia is opened at both sides of the extensor digitorum muscles. Then the extensor muscles including the joint capsule and the anterior part of the lateral collateral ligament are carefully cut off the lateral epicondyle (Figure 4). This flap, containing contingent calcifications, is mobilized

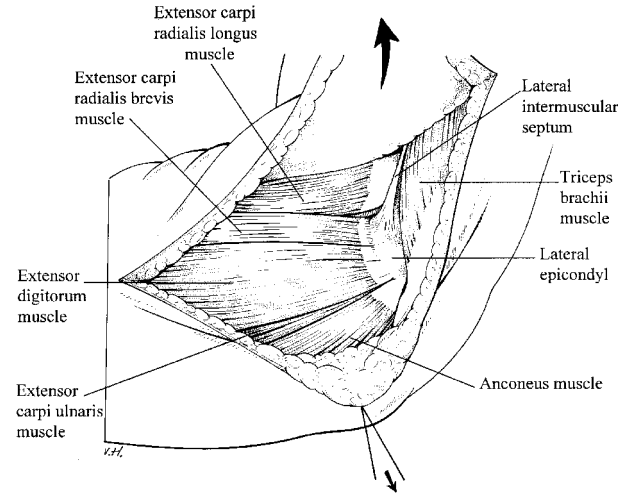

Figure 4. Exposure of the extensor muscles and lateral collateral ligaments.

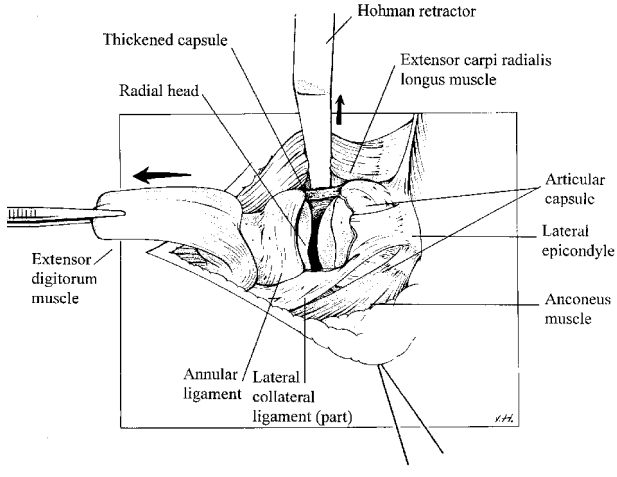

Figure 5. Exposure of the lateral compartment.

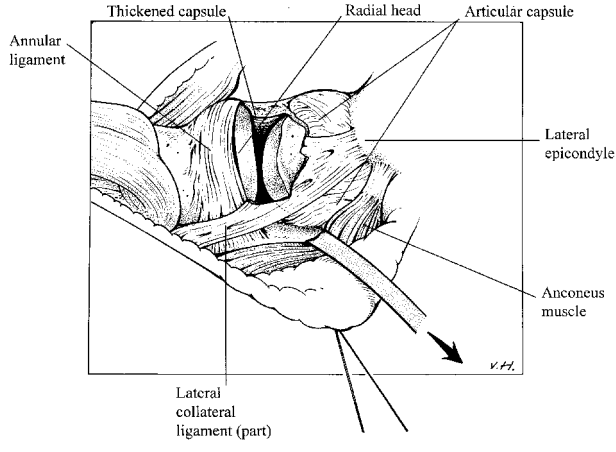

Figure 6. Exposure of the ventral joint capsule.

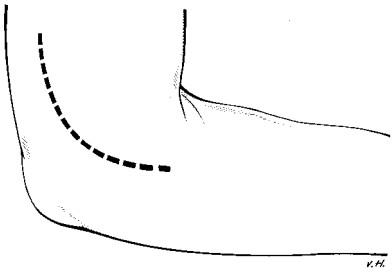

Figure 7. Medial incision.

distally along the border of the anconeus and extensor carpi radialis muscles up to the angular ligament of the radial head. The lateral compartment of the elbow joint is now entirely exposed and intra-articular adhesions or osteophytes can be removed (Figure 5)

Step II. The exposure of the anterior joint capsule is done with a small periosteal elevator and the neurovascular bundle and muscles are protected by one or two blunt Hohman retractors, placed on (not over!) the medial epicondyle. After exposure, the thickened ventral joint capsule can be resected completely (Figure 6).

Steps I and II of the procedure often lead to complete flexion and extension. A persistent contracture may be caused by residual mechanical problems in the posterior or ulnar part of the elbow joint, which can be corrected by a third step.

Step III. To gain access to the olecranon and fossa olecrani, the anconeus muscle and the radial collateral ligament are dissected from the epicondyle. Resection of peri-articular scar tissue, osteophytes or part of the olecranon is now possible. To improve flexion further, calcifications, osteophytes or malunited fragments can be removed from the coronoid fossa of the anterior part of the humerus. The biceps tendon is not lengthened during this procedure.

Slight persistent loss of motion may be caused by medial mechanical problems.

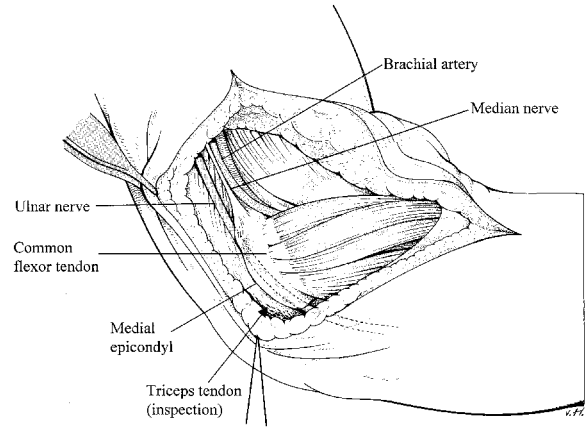

Figure 8. Neurolysis of the ulnar nerve and identification of the flexor muscles.

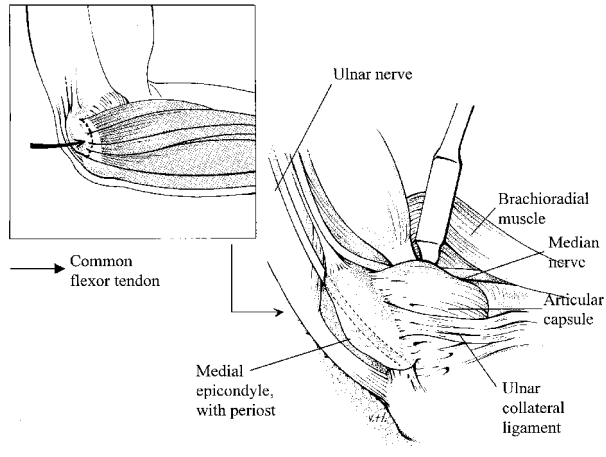

Figure 9. Mobilization of the flexor muscles and exposure of the remaining ventral capsule.

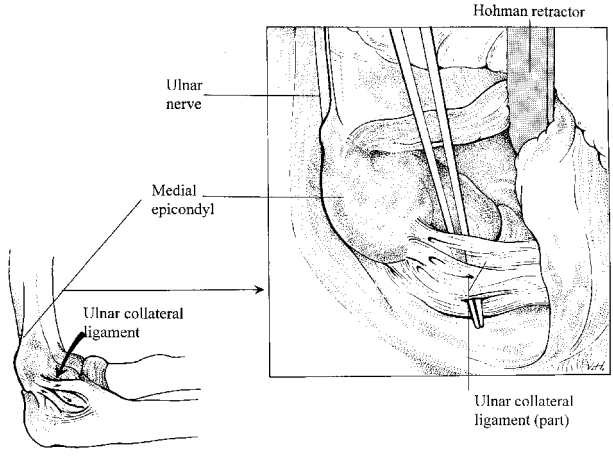

Figure 10. Identification and preservation of the ulnar collateral ligaments.

Initial injuries (n 46)

Fracture of radial head and disloc. of the elbow	11
Supracondylar fracture	8
Fracture of medial condyle	6
Fracture of lateral condyle	5
Transcondylar fracture	3
Hyperextension trauma	4
Fracture of olecranon	3
Monteggia fracture	3
Epiphyseal fract.ure	2
Fracture of ulna	1

Step IV. An arch-shaped approach over the medial epicondyle is made (Figure 7) with neurolysis of the ulnar nerve and identification of the orifice of the flexion muscles at the medial epicondyle (Figure 8). The tendon flap is then dissected from the epicondyle anteriorly with the ulnar nerve kept posteriorly in the sulcus. The remaining anterior joint capsule can now be exposed and excised leaving at least the mid and posterior parts of the ulnar collateral ligament intact (Figure 9). The approach also permits inspection of the posterior part of the joint along the triceps tendon, with the ulnar nerve kept anteriorly (Figure 10). However, we prefer the less risky lateral approach to the olecranon and fossa olecrani and use the medial approach only to dissect capsular adhesions or calcifications.

Step V. Wound closure. Both epicondyles are slightly flattened and the tendon flaps are reinserted using transosseous resorbable sutures without tension. The periosteum at the edge of the medial epicondyle is stripped of scar tissue and/or any heterotopic ossification and resutured with atraumatic sutures. At this renewed surface, the ulnar nerve finds a smooth ridge to prevent later adhesions and is therefore placed in its original sulcus.

Postoperative treatment

Immediate postoperative rehabilitation consisted of passive assisted range of motion exercises. Since the introduction of the continuous-passive-motion (CPM) device in 1983, it has been used as additional therapy in 42 of the 47 elbows. Intermittent passive motion was used for a minimum of 12 hours a day, for the remainder of the patient's hospitalization during 10–14 days. Active and passive motion exercises were also done daily under supervision.

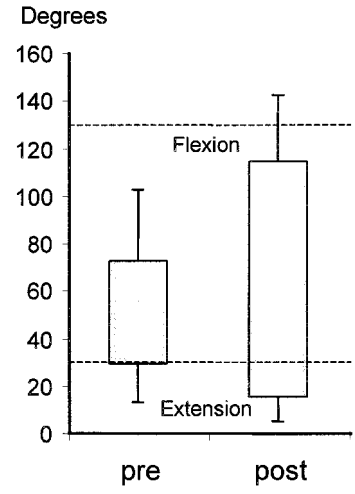

Figure 1. Range of motion (flexion-extension) before and after surgery (n 47). (Error bars indicate standard deviation).

Patients

From 1980 to 1997, we treated 46 consecutive patients (23 women, 47 elbows) having an elbow contracture with operative release. Mean age at surgery was 31 (7–68) years. Nearly all contractures occurred after supracondylar, unicondylar and radial head fractures (Table). No severe malunions were present. The mean interval from the time of injury to operative release was 21 (1–133) months. The mean active flexion pre-operatively was 73 degrees, mean lag in active extension 29 degrees, mean active range of motion of the elbows before operation 45 degrees (SD 36) and mean range of motion of the forearm before operation 159 (SD 34) degrees.

A lateral release alone was done in 23 patients (23 elbows) and a combined lateral and medial release was necessary in 23 patients (24 elbows).

All elbows were evaluated clinically at a mean follow-up of 10 (2–18) years.

Results

The mean postoperative flexion was 114° (SD 28°), mean extension lag 15° (SD 10°), and mean active range of motion of the elbows improved from 45° (SD 36°) preoperatively to 99° (SD 34°) at the latest follow-up (Figure 1). Patients reported their elbows to be less of a disturbance and handicap in

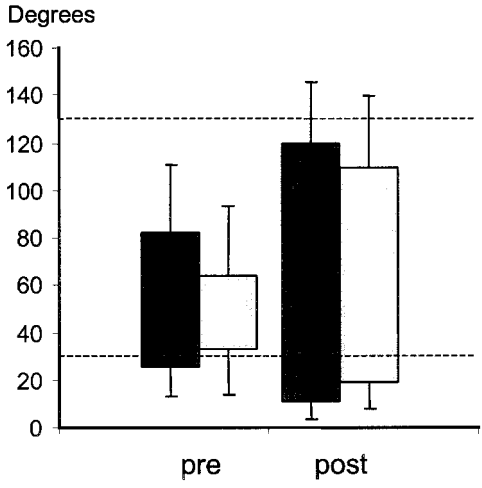

Figure 2. Range of motion (flexion-extension) before and after surgery. Lateral approach results (black; n 23) versus lateral + medial approach results (white; n 24). (Error bars indicate standard deviation).

their daily living, although the minimal range of motion needed to perform these activities (Morrey et al. 1981) was not achieved in all patients (Figure 1).

The 23 elbows treated with a lateral release alone showed an improvement in mean active range of motion from 51° (SD 38°) preoperatively to 98° (SD 36°) postoperatively; the 24 elbows treated by a lateral release and an additional medial release showed an improvement from 39° (SD 34°) preoperatively to 100° (SD 33°) postoperatively (Figure 2). This was not significantly different ($p = 0.8$), and there were no differences between both groups regarding complications ($p = 0.7$) or patient satisfaction ($p = 1.0$).

Before operation, pro- and supination of the fore-arm was impaired in 2 patients. The pro- and supination range of motion in these patients improved from mean 8° before surgery to 98° after surgery. The total range of motion of the fore-arm improved from 159° (SD 34°) preoperatively to 163° (SD 18°) postoperatively.

Of the total group, 4 patients had frequent mild pain and 18 patients occasional mild pain at the elbow before the operation. At the latest follow-up, only 6 patients complained of occasional mild pain. Preoperatively and postoperatively, none of the patients complained about instability of the elbow. 7 patients had transient ulnar paresthesia, which caused no disability in daily living in any of them and disappeared during rehabilitation. 4 patients suffered from recurrent stiffness, one was reoperated on and gained an additional 85°. The other 3 accepted their condition. 2 patients developed a postoperative infection, which responded to a few months of antibiotic treatment. 44 patients were satisfied with their result, as regards range of motion and activities of daily living, at the latest follow-up.

We found no correlation between the results and the mechanism of injury, the operative release, or the age of the patients.

Discussion

Many techniques have been described for the operative release of a posttraumatic stiff elbow (Wilson 1944, Cauchoix and Deburge 1975, Glynn and Niebauer 1976, Tucker 1978, Kulkarni and Patel 1988, Van Eijck et al. 1991, Gates et al. 1992, Luppino et al. 1992, Morrey 1992, Lamie et al. 1993, Regan and Reilly 1993, Sojbjerg 1996, Hertel et al. 1997, King et al. 1997, Baksi 1998, Cohen and Hastings 1998, 1999, Viola and Hanel 1998). Advocates of a lateral approach claim a few advantages. First, the risk of nerve damage is less with an incision situated in an internervous plane. Secondly, an incision located in the neutral axis of flexion-extension makes wound problems less likely; and thirdly, this incision permits evaluation and treatment of both the anterior and posterior ulnohumeral joints and the radiocapitellar joint via one incision (Kulkarni and Patel 1988, Husband and Hastings 1990, Cohen and Hastings 1998, 1999). Cohen and Hastings (1998, 1999) stated that the commonest complication of their lateral approach was transient ulnar paresthesia. Therefore, they recommended release and transposition of the ulnar nerve in patients having symptoms. With the medial approach, the ulnar nerve is routinely released and protected under direct vision, which reduces the risk of damage. According to Wada et al. (2000), their medial exposure has several other advantages over both the anterior and lateral approaches. Pathological changes in the posterior oblique bundle of the medial collateral ligament can be seen and excised under direct vision. Ante-

rior and posterior exposures can be done via one medial incision, through which a complete soft-tissue release and excision of part of the olecranon and coronoid process can be performed, if necessary. An additional lateral exposure is indicated only if the medial approach proves inadequate.

The preservation of the collateral and annular ligaments, as described by some authors (Hertel et al. 1997, Cohen and Hastings 1998, 1999, Viola and Hanel 1998), to prevent subsequent instability was only partly confirmed by our series. The lateral collateral ligaments were not completely spared in any of our patients, but instability did not develop in any of them. However, the medial collateral ligaments must be handled carefully because resection of these ligaments can cause instability (Husband and Hastings 1990, Viola and Hanel 1998), as shown with cadaver experiments (Floris et al.1998). It seems possible that the annular and lateral collateral and even medial collateral ligaments remodel during functional postoperative rehabilitation which stabilizes structures in this special group of patients. According to this theory, the mere placement of ligaments at their orifice without tension and motivating the patient to continue functional postoperative treatment can prevent instability. None of our patients, including those subjected to aggressive medial release in 24 elbows, complained about medial instability.

Early active motion after an intensive passive range of motion program is a key factor in postoperative management. The results of our rehabilitation program support the statement by Gates et al. (1992) that the postoperative use of continuous passive motion improves active flexion and total range of motion. Hertel et al. (1997) and Bonutti et al. (1994) described static progressive stretching using a turnbuckle-type splint.

The method we describe is a combination of existing approaches rather than a completely new one. Both the advantages and disadvantages of the lateral and medial approaches, as described above, apply also for progressive release. However, it provides a peroperative choice for the surgeon to perform an extended release with good outcome.

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