

Research Article

The Outcome of Open Surgical Treatment of Posttraumatic Elbow Stiffness

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Abstract

Background: Posttraumatic stiff elbow is a frequent and disabling complication and causes difficulty in placement of hand in space and hence limits the functional capacity. It poses challenges for management. Nonoperative management remains the choice and surgical treatment is indicated when conservative measures for a reasonable period fail to achieve the functional range of motion. The aim of this study was to assess the outcome of open arthrolysis of posttraumatic elbow stiffness.

Patients and Methods: After a mean follow-up period of 8.5 ± 2 months (range: 7-13 months), the total flexion/extension arc improved from a mean of $40^\circ \pm 5.6$ to $105^\circ \pm 4.5$, with a mean gain of $65^\circ \pm 4$. The mean preoperative Mayo Elbow Performance Score of 60 ± 5 points, improved to 85 ± 6 points, with a mean gain of 25 ± 4.5 points. Therefore, a satisfactory functional outcome occurred in 81.25% of cases.

Results: After a mean follow-up period of 8.5 months (range: 7-13 months), the total flexion/extension arc improved from a mean of 40° to 105° , with a mean gain of 65° . The mean preoperative Mayo Elbow Performance score of 60 points, improved to 85 points, with a mean gain of 25 points. Therefore, a satisfactory functional outcome occurred in 81.25% of cases.

Conclusion: The open release of posttraumatic elbow stiffness provides a useful gain in range of motion and marked improvement of elbow function, especially in motivated co-operative patients.

Keywords: Mayo Clinic Performance Score; Open Arthrolysis; Post-Traumatic Stiff Elbow

Introduction

Elbow stiffness is a common complication of trauma to the elbow. It may cause severe functional impairment because of the inability to position the hand in space [1,2]. Morrey et al [3] considered that the minimum functional range of motion (ROM) necessary for carrying out activities of daily living was an arc between 130° of flexion and -30° of extension, with 50° of both pronation and supination, thus totaling a range of 100° both in the sagittal and in the coronal plane. Posttraumatic contractures can be classified into extrinsic (extra-articular), intrinsic (intra-articular) or mixed pathology [4]. Surgical

treatment is indicated when conservative management [including supervised exercise program and splinting (dynamic or static)] fails to achieve the minimal functional ROM.[1,4,6]. Surgical release can be performed using a lateral, a medial, combined lateral and medial, an anterior or a posterior approach [5-8].

Patients and Methods

Between 2013 and 2016, 16 elbows of 16 patients (who were available for follow-up examination) were treated by open elbow release for management of post-traumatic elbow stiffness, at our institution. Surgery was indicated when there was a persistent significant elbow contracture, causing functional impairment [flexion contracture $>30^\circ$ ($>30^\circ$ extension loss) and/or flexion range is $<130^\circ$],

despite conservative management including physiotherapy for an enough period. This was at least 6 months, but was only 3 months if there was a hard mechanical block to movement (bony or mispositioned hardware) [9-11]. The exclusion criteria were nontraumatic causes, inadequate soft-tissue envelope, or burn, unmotivated noncooperative patients and non-compliant patients, such as those with uncontrolled psychiatric conditions or substance abuse. Ten patients were male and six were female, with a mean age of 22 ± 3.2 years (range: 12 - 36 ys.). The dominant limb was affected in nine patients. The study was approved by Institutional Ethical Committee and a written consent to participate in the study after explanation of risks and benefits, was taken.

Preoperative assessment included history taking and examination of both elbows and of shoulder and hand. Clinical assessment included measurement of ROM by goniometry and functional assessment by Mayo Elbow Performance Score (MEPS) [12]. Imaging included plain X-rays and CT with 3D reformats. Photographs and videos were done for all cases. EMG/NCV were done if there was nerve deficit. An important step was discussion with the patients as regards realistic expectations and rehabilitation program [8]. The primary injury was intercondylar fracture (n=3), elbow dislocation (n=2), radial head fracture (n=2), fracture of capitellum (n=1), fracture of medial condyle (n=1), fracture-dislocation (n=4) and local trauma without fracture (n=3). Their treatments included ORIF, closed reduction /casting and splinting. The mean preoperative limitation of extension was $40^\circ \pm 4.5$ (10 to 85), and the mean preoperative flexion was $80^\circ \pm 5$ (45 to 130). The mean preoperative flexion / extension range was $40^\circ \pm 5.6$. The mean pre-operative pronation was $50^\circ \pm 3.4$ (10 to 80) and supination $55^\circ \pm 4.6$ (10 to 90). The mean preoperative Mayo Elbow Performance Score was 60 ± 5 points (range;20-70). The mean time interval between injury and surgical release was 8.3 ± 2 months (range: 3 -12 months) (Figure 1).

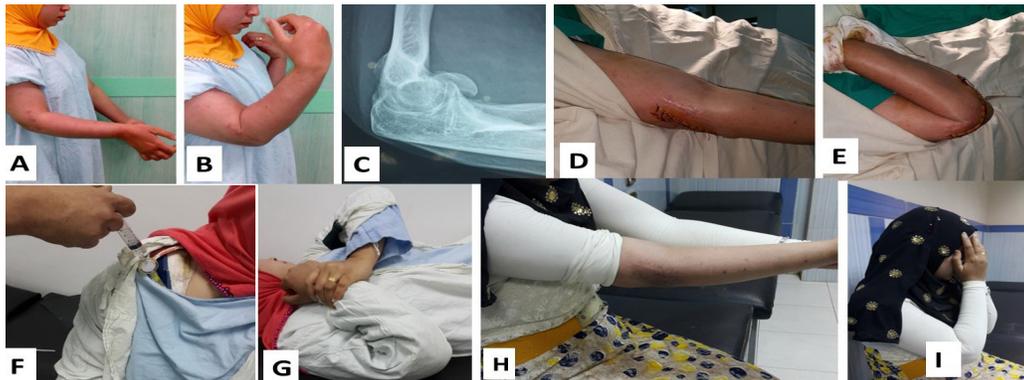


Figure 1: A, B, C) A thirty years old lady with a posttraumatic Rt elbow stiffness of 10 months-duration, after failed ORIF of capitellum fracture. The preoperative ROM = about 30° (60-90); D, E) Intraoperative correction & ROM; F, G) Painless physiotherapy under a regional brachial plexus block; H, I) Final postoperative ROM= about 80° (20-100), with a gain of about 50° .

Operative Procedures

Anesthesia was ultrasonic-guided supraclavicular brachial plexus block with insertion of an indwelling catheter to allow prolonged postoperative pain control and painless early mobilization [13,14]. General anesthesia was added in irritable patients (n=5). Surgery was done in the supine position, without tourniquet. The surgical approach was: lateral (n=10), medial (n=3) and combined lateral and medial (n=3). The medial approach was indicated for preoperative ulnar nerve deficit (n=1) and removal of implants (n=2). Combined lateral and medial were used for severe flexion contractures. Whatever be the approach, to improve elbow flexion, remove posterior soft tissue tethers (posterior joint capsule and triceps muscle adhesions) and anterior mechanical blocks to flexion (fibrous tissue, hardware or osteophytes on coronoid process or in coronoid and radial fossae). To improve elbow extension, posterior impingement at the olecranon tip and floor of olecranon fossa (fibrous tissue, osteophytes, loose bodies or hardware) is removed, and the anterior tethering capsule and brachialis are released [8] (Figure 2).



Figure 2: A, B, C) A fourteen years old patient with a Lt elbow stiffness and ulnar nerve deficit after ORIF of medial condyle fracture. The preoperative ROM was about 45° (75-120); D, E) Postoperative painless ROM under a regional brachial plexus block; F, G) Final outcome: ROM=100° (15-115), with a gain of 55°.

Every effort is made to preserve the lateral collateral ligament and the anterior band of the medial collateral ligament (MCL), to maintain the stability of the joint [4,5,10].

(a) Lateral column procedure - proximal to the elbow joint, this approach is between the humerus and ECRL anteriorly and the humerus and triceps posteriorly. Distal to the joint, this approach is between ECRL and ECRB. Posteriorly, the capsule is incised, and olecranon and olecranon fossa are approached. Any osteophyte, fibrous tissue, or loose body is excised. Anteriorly, the muscle mass is taken off the capsule, which is then excised. Any osteophyte, loose body, or fibrous tissue is also taken off from the distal humerus and radial head. The view toward the medial side is limited through this incision, and if any procedure is required on the medial side, a separate incision on the medial side is required [5,15-17].

(b) Medial column approach - the ulnar nerve is isolated and mobilized. Posteriorly, the posterior band of MCL is cut and excised to improve flexion beyond 100°. The triceps is reflected off the humerus, and posterior elbow capsule is cut. Any osteophyte, loose body, or fibrous tissue from olecranon and olecranon fossa is excised. Anteriorly, the brachialis is raised off the humerus after cutting the medial septum. The anterior half of the flexor-pronator muscle mass is raised from the medial epicondyle in continuation with the distal brachialis. The medial anterior capsule is excised, and any osteophyte, loose body, or fibrous tissue is removed from the distal humerus and coronoid [8,18,19]. Finally, flexion and extension of the elbow were carried out passively to evaluate the gain in movement. Hemostasis was obtained. After surgery, the wound was closed with suction drainage. A long-arm splint was applied with the elbow in extension or flexion depending on the direction in which movement was more resistant to passive manipulation, or in 90° of flexion when there was no major direction of limitation as proposed by Park et al. [1]

Other procedures that were used in association included: removal of synthesis material in 6 cases, excision of the radial head (n=2), excision of ununited part of capitellum (n=1), resection of the tip of the olecranon (n=8), ulnar nerve simple release without transposition (n=1) and anterior transposition of the ulnar nerve (n=5). This was done for preoperative complaint of paresthesia and when tension in the nerve following joint release was noted.

Postoperative Management

Physiotherapy was started on the 2nd. postoperative day. To allow this, pain control was achieved with injection of 0.25% marcaine through the supraclavicular indwelling catheter, three times daily. This produced complete sensory block with maintenance of some motor power [13,14]. We started with passive mobilization then passive and active-assisted full ROM. Between physiotherapy sessions, a splint was worn. The patients were kept hospitalized for two weeks (time of removal of stitches and indwelling catheter). The patients then were discharged and instructed sharply to do physiotherapy (passive, active-assisted and active elbow movements to full range) under supervision of a therapist and at home. At night, the patient wore a splint with the elbow in the position of maximum flexion or extension which could be obtained without excessive pain. Three weeks after surgery, the splint was totally discarded and the patients were encouraged to do vigorous active movements and to use their elbows as much as possible through a full ROM during the day to help maintain the motion that was achieved at operation. Patients were followed-up by a coordinated therapist daily for the first six weeks. The physical therapy was continued for at least 3 months or till a plateau was reached. Patients were followed-up by us weekly for the first three months, then monthly thereafter. The supportive therapy was given for the first six weeks. It included control of swelling (by elevation, ice and NSAIDs), tubular compression

bandage (for elbow support and control of swelling) and a fixed dose of 25 mg of Indomethacin twice daily for a period of six weeks (to prevent heterotopic ossification) [8].

Results

The mean follow-up period was 8.5 ± 2 months (range: 7 - 13 months). The mean pre-operative limitation of extension of $40^\circ \pm 4.5$ (10-85) was reduced by the final follow-up to a mean of $20^\circ \pm 3$ (5 to 30) and the mean flexion increased from $80^\circ \pm 5$ (45-130) to $125^\circ \pm 4.5$ (100 to 135). The total flexion/extension arc improved from a mean of $40^\circ \pm 5.6$ to $105^\circ \pm 4.5$ (60 to 135), with a mean gain of $65^\circ \pm 4$. The mean pre-operative pronation improved from $50^\circ \pm 3.4$ (10 to 80) to $65^\circ \pm 4$ (20 to 90) and supination increased from $55^\circ \pm 4.6$ (10 to 90) to $70^\circ \pm 4.1$ (20 to 90). The mean preoperative Mayo Clinic Elbow Performance score of 60 ± 5 points (20-70), improved at the final follow-up to 85 ± 6 points (70 to 100), with a mean gain of 25 ± 4.5 points. The results were excellent in 6 elbows, good in 7, fair in two and poor in one. Therefore, a satisfactory functional outcome was achieved in 81.25% of cases (Table 1).

Variable	Definition	Points
Pain (max=45 p)	no	45
	mild	30
	Mod.	15
	severe	0
Arc of motion (max=20 p)	>100°	20
	50 - 100°	15
	<50°	5
Stability (max.=10 p)	stable	10
	Mild instability	5
	Gross instability	0
Function; 5 ADLs (max; 25 p)	Able to perform personal hygiene	5
	Able to comb hair	5
	Able to feed himself	5
	Able to put on shirt	5
	Able to put on shoes	5
Total		100 points

Table 1: The Mayo Clinic Elbow Performance score [12]. Overall score: Excellent : (90 - 100 points), Good: (75 - 89 points), Fair: (60 - 74 points) and Poor: (<60 points) [12]. ADLs = daily living activities.

Complications

Superficial infection occurred in one patient (that cured on antibiotic and local care) but, no deep infection. One case of preoperative ulnar nerve deficit recovered finally after anterior transposition. Two patients had postoperative transient paresthesia of ulnar nerve, but without a measurable motor or sensory deficit. Recurrence of stiffness occurred in one patient (6.25%). This was a 12 ys. old patient who did not cooperate and complete the rehabilitation program. We did manipulation under anesthesia with improvement of ROM, but he again did not cooperate and finally

rated poor. No case of heterotopic ossification had occurred.

Discussion

Elbow stiffness is a frequent and disabling complication of elbow trauma [9-11]. Surgical release is indicated in posttraumatic stiff elbows when non-operative treatment has failed and function is severely impaired [1-5]. Patient selection is a very critical point, as not all patients are suitable candidates for surgical release. Before planning the procedure, the surgeon should try to assess the expectations of the patient and the limitations that the patient is facing and exclude unmotivated noncooperative patients, as the success of treatment is dependent on patient's understanding and willingness to comply with a rigorous postoperative protocol [6,8,10]. Timing of elbow arthrolysis is controversial. In our study, we operated after at least 3-6 months to allow for the inflammatory phase of soft tissue healing to resolve, as proposed by many authors [4,8,9]. By contrast, Swaroop et al, [19] confirms that longer the elbow remains stiff, the poorer the prognosis and he proposed surgery after 3-4 weeks. A useful arc of about 100° with a painless stable joint is the objective [4,6].

In our series, the total flexion/extension arc improved from a mean of 40° to 105° , a mean gain of 65° . The mean preoperative Mayo Elbow Performance score of 60 points, improved at the final follow-up to 85 points, with a mean gain of 25 points. The results were excellent in 6 elbows, good in 7, fair in two and poor in one. Therefore, satisfactory functional outcome occurred in 81.25% of cases. Our results compare favorably with previous reports that have shown an overall improvement in movement of the elbow [1,2,4,6,7,11,16,17].

Different surgical approaches have been described. The choice of approach is based on surgeon preference and patient factors such as the site of any previous incision, the presence of neuropathy, the location of periarticular ossifications, intra-articular deformities and mispositioned hardware. The surgical approach chosen must allow all relevant pathology to be addressed [1,16,18,20,21]. The proponents of the lateral approach are its simplicity, less wound problems and direct access to both the anterior and posterior ulnohumeral and radiocapitellar joint through one incision, with preservation of the collateral ligaments. Its opponents are (a) inability to safely reach the medial side to treat cases with ulnar neuropathy or calcifications in MCL. (b) Ulnar paresthesia is the main complication seen after the release by lateral incision. This was attributed to traction neuritis caused by the abrupt increase in elbow flexion during the operation [2,5,16,17]. The advantages of the medial approach are (a) direct access to the ulnar nerve (for safe release and/or transposition), the posterior oblique bundle of MCL (proposed to be a restraint to terminal elbow flexion) and anterior and posterior aspects of the elbow joint, via one medial incision, thus providing subsequent safe access to the anterior and posterior aspect of the elbow.

(b) a more favorable cosmetic scar. The disadvantages are (a) inability to address lateral joint pathology (b) proximity of the medial antebrachial cutaneous nerve (c) potentially greater muscle morbidity [6,7,8,18]. In most instances, a complete elbow release can be performed through either approach, but occasionally a dual (medial and lateral) approach is required to address all relevant pathology [20]. However, in patients requiring a combined medial and lateral approach, a single posterior skin incision has been advocated to address both the medial and lateral aspects of the elbow and to lower the incidence of cutaneous nerve injuries that can occur with more direct medial and lateral approaches. However, this incision requires raising large skin flaps that may lead to subsequent seroma formation [1,20,21]. Urbaniak et al. [21] described an anterior approach. It was used for excision of an extensive anterior heterotopic ossification. However, it does not allow addressing any posterior pathology [22].

The most frequently reported complications after open elbow release are ulnar neuritis, wound complications (including wound hematoma and infection), loss of ROM, heterotopic ossification, pain, complex regional pain syndrome, triceps insufficiency, and instability [6,10,11,16,17,19,23]. The significant complications in our series were transient ulnar paresthesia in two and recurrence of stiffness in one patient. The ulnar nerve deserves special mention. Ulnar nerve decompression (\pm anterior transposition) through a medial approach is indicated for preoperative nerve symptoms, in severe flexion contractures and for cases of iatrogenic ulnar nerve deficits [1,5,6,8,10,18,20].

Although there is no consensus in the literature for the optimum postoperative rehabilitation protocol, there is agreement that postoperative physiotherapy plays an equally important role to surgery itself in the final outcome and it should be instituted as early as possible, to prevent intra-articular adhesion formation. It is very important in minimizing the loss of movement gained at operation, which is mandatory in all cases [1,2,10,20, 23]. The success of treatment is dependent on patient's understanding and willingness to comply with a rigorous postoperative protocol [7,8,19]. Our policy was to keep the patients hospitalized for two weeks to start and supervise painless physiotherapy under the effect of a regional brachial plexus block. We did not use the continuous passive motion machine (CPM). After discharge from the hospital, physiotherapy was continued for at least three months or till ROM became stabilized. Mittal [6] proposed keeping the patients hospitalized for a few days to start and then supervise the physiotherapy of the operated elbow and for a better pain control. Streubel and Cohen [8] proposed that prolonged in-hospital CPM with the use of an indwelling regional block catheter may be warranted in cases of severe contractures. The use of CPM is controversial. Many authors reported the use of CPM for variable periods in their postoperative rehabilitation program [2,8,21]. Others did not use it with a comparable outcome [1,6,10,11]. The

duration of physiotherapy is variable in the literature. It varies from three months up to 12 months or till a plateau in ROM is reached [6,11].

Although manipulation under anesthesia have been recommended for the management of the stiff elbow, it may be most indicated for recurrent elbow stiffness after surgical release. Reported complications with this procedure include transient ulnar neuritis and the potential for ligament disruption and fracture [8,24]. Arthroscopic arthrolysis has become a current practice for treating post-traumatic stiff elbow, with consistent results. However, this is a technically complex procedure for surgeons. It should preferably be indicated in cases of less severe contracture (ROM > 80° and extension deficit <40°), with no significant bone lesions to be resected [25]. Hinged elbow fixator, is recommended when collaterals are disrupted during the contracture release [6].

Conclusions

Elbow stiffness is a frequent and disabling complication after trauma to the elbow. Surgical release is indicated if conservative treatment failed to achieve the functional range of movement. Correct patient selection, clear understanding of the pathological anatomy, careful attention to surgical technique with preservation of the elbow stabilizers, and structured postoperative rehabilitation are paramount to achieve a sustained optimal outcome.

Conflicts of interest: None declared.

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