



■ SHOULDER & ELBOW

Open elbow arthrolysis for post-traumatic elbow stiffness

AN UPDATE

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Post-traumatic elbow stiffness is a disabling condition that remains challenging for upper limb surgeons. Open elbow arthrolysis is commonly used for the treatment of stiff elbow when conservative therapy has failed. Multiple questions commonly arise from surgeons who deal with this disease. These include whether the patient has post-traumatic stiff elbow, how to evaluate the problem, when surgery is appropriate, how to perform an excellent arthrolysis, what the optimal postoperative rehabilitation is, and how to prevent or reduce the incidence of complications. Following these questions, this review provides an update and overview of post-traumatic elbow stiffness with respect to the diagnosis, preoperative evaluation, arthrolysis strategies, postoperative rehabilitation, and prevention of complications, aiming to provide a complete diagnosis and treatment path.

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Introduction

Post-traumatic elbow stiffness (PTES) is a well-known complication of elbow trauma; it causes upper limb disabilities and severely affects daily activities, mainly due to the formation of heterotopic ossification (HO)¹ and soft tissue adhesion and contracture.² A loss of 50° in the arc of motion can cause up to 80% loss of function.³ Treatment goals for PTES involve regaining a stable, painless elbow with functional range. Generally, conservative therapy such as static or dynamic splinting is the first choice within six months after trauma.⁴ Thereafter, surgery can be performed if the patient is dissatisfied with the range of movement (ROM) and desires to improve function. There are three main operating methods for PTES: arthroscopic release, open elbow arthrolysis (OEA), and arthroplasty. Among these, though more complex release can be performed with greater experience, arthroscopic release is usually only considered for simple elbow stiffness;⁵ total elbow arthroplasty may be considered in less active and older patients only if no other treatment options are available.⁶ Therefore, OEA is still the commonest operative method for PTES.

In 1944, Wilson⁷ first reported treatment of PTES caused by supracondylar fracture of the humerus by capsule excision. In the following 70 years, significant improvements have occurred in OEA.⁸⁻¹⁰ A systematic review of 637 patients showed a mean increase of 51° in ROM and a 23% rate of complications after OEA; however, the treatment regimen and efficacy varied.⁸

Due to poor understandings of the treatment principles, nonstandard surgical procedures and insufficient prevention of complications for some surgeons, the therapeutic effect of OEA is often unsatisfactory. As Morrey¹¹ noted, “loss of joint motion is a common complication of elbow trauma. Dealing with post-traumatic elbow stiffness is a challenging task for the orthopaedic surgeon”. Therefore, in this article, we review the complete diagnosis and treatment path of OEA for treating PTES, including diagnosis, preoperative evaluation, arthrolysis strategies, postoperative rehabilitation, and prevention of complications.

Definition and diagnosis

Based on a 3D optical tracking technology, functional elbow motion necessary for

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contemporary and modern tasks such as using a cellular telephone or keyboard is wider than the traditional “double 100°” reported by Morrey.³ Currently a ROM of approximately 120° in flexion and extension and 140° in forearm rotation arc (FRA) are required.¹² Further functional improvement is also needed if patients cannot complete the actions required by their occupation or interests, even if the above range is met. Therefore, the existing definition of elbow stiffness (flexion < 120°, extension > 30°, or rotation < 45° in either direction¹³) should be updated to “range of elbow motion or rotation not meeting patient needs in entertainment, work, and daily life”.

When a patient reports with PTES, injury history and limited elbow mobility are the main complaints. Injuries include elbow dislocation, fractures (such as distal humerus, olecranon, radial head, and terrible triad injury), brain trauma, and burns. Limited mobility manifests as restricted elbow extension or flexion, and pronation or supination. Additional symptoms commonly include pain and neurological symptoms (sensory and motor dysfunction); less commonly, muscle atrophy, osteoporosis, and joint degeneration are seen.

Preoperative evaluations

ROM measurement. The universal goniometer, a simple and easy-to-use instrument with 360° scale (1° increments), is most used for elbow ROM measurement. One study described the three bony landmarks in detail: the lateral epicondyle (centres), the tip of acromion process (stationary arm points), and the middle portion of wrist (mobile arm points).¹⁴ The intraclass correlation coefficients for goniometric measurement of the elbow ranged from 0.945 to 0.973, indicating good reliability.¹⁴ The usual practice is to round the values to 5° steps up or down. Although this seems precise enough, a recent study showed that the accuracy of statistical tests performed on rounded ROM data is limited, referred to as “rounding error”, and they proposed a p-value (α) correction for tests on rounded ROM data.¹⁵

Imaging, laboratory, and electrodiagnostic examination. Radiographs are necessary to assess the joint anatomy, articular congruity, and presence and location of loose bodies, HOs, and osteophytes that may limit motion. Calculated tomography (CT) with 3D reconstruction is helpful for accurate localization of blocks and further detail of the articular surface. A recent study demonstrates that CT can also determine the path and spatial relationship to HO of the radial and median nerves at the elbow.¹⁶

Measurement of inflammatory markers, such as C-reactive protein and erythrocyte sedimentation rate, help detect infection or inflammatory conditions. Elevated serum alkaline phosphatase levels help predict the occurrence or recurrence of HO, especially in children.¹⁷

The presence of nerve compression can be confirmed by findings of sensory loss, motor weakness, or nerve hypersensitivity. Moreover, electromyography and nerve conduction velocity studies can be useful as confirmatory studies.¹⁸

Classification. Several classifications are used to describe elbow stiffness. The commonly used three-type Morrey’s classification¹⁹ allows better understanding of the cause: intrinsic components involve intra-articular adhesions, articular malalignment, and cartilage loss; extrinsic components involve capsular and ligamentous contracture and HO; in reality, most are a combination of both. Mansat’s classification²⁰ has four parts based on ROM (mild, ROM > 90°; moderate, 60° < ROM ≤ 90°; severe, 30° < ROM ≤ 60°; and very severe, ROM ≤ 30°). Recently, a new classification – the Fan’s classification, comprising four types of flexion-extension dysfunction (tethers alone, tethers with blocks, articular malformation, and bony ankylosis) and three types of forearm rotation dysfunction (contracture alone, radial head malunion or nonunion, and proximal radioulnar bony ankylosis), was introduced to specify and standardize the operative approaches and arthrolysis steps.²¹

Hastings and Graham²² divide elbow HO into three types: I, radiologically evident without functional limitation; II, radiologically evident with functional limitation, and subdivided into IIA (limitation of flexion-extension), IIB (limitation of pronation-supination) and IIC (limitation in both); and III, ankylosis. The Brooker classification²³ originally described for HO around the hip is also used for the elbow: I, islands of bone within the soft tissue; II, bone spurs extending from proximal or distal to the joint but with > 1 cm between the opposing surfaces; III, bone spurs with < 1 cm between the nearest opposing ends; and IV, ankylosis.²⁴

Functional scores. Multiple functional scores are reported for elbow function evaluation, such as American Shoulder and Elbow Surgeons-Elbow (ASES), Disabilities of the Arm, Shoulder and Hand Score (DASH), and Oxford Elbow Score.^{25,26} Among them, the Mayo Elbow Performance Index (MEPI), developed by Morrey²⁷ in 1992, is most widely used,²⁸ and includes elbow pain (45%), motion (20%), stability (10%), and daily function (25%; ability to comb hair, feed, perform personal hygiene tasks, on shirt and put on shoes), with a categorical rank of poor (0 to 59), fair (60 to 74), good (75 to 89), and excellent (90 to 100). Recently a new functional score, the Shanghai Elbow Dysfunction Score²⁹ (SHEDS), comprising three portions: elbow motion capacities (48%, eight-item daily activity form), elbow-related symptoms (42%, pain, nerve function, strength, and stability), and patient satisfaction level (12%), is the first validated system for elbow stiffness, with good reliability, validity, and sensitivity. A minimal clinically important difference (MCID) of 15 points in MEPI was reported for rheumatoid

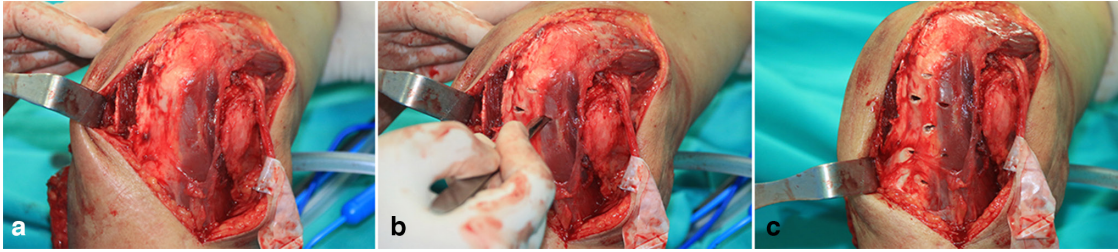


Fig. 1

Pie-crusting contracted triceps (tether release). Multiple stab incisions are made in the triceps tendon in the medial-to-lateral and distal-to-proximal directions via the medial approach.

arthritis after arthroplasty or synovectomy;³⁰ however, to our knowledge, there is no MCID in any functional score for elbow stiffness.

Arthrolysis strategies

Time point. The timing of OEA is important. Too early likely causes HO recurrence, while too late poses risks such as progressive soft tissue fibrosis, exacerbation of neurological symptoms, and secondary cartilage degeneration. Garland³¹ suggested six months for limb trauma, one year for spinal cord injury, and 1.5 years for brain trauma. Generally, HO maturity requires three to six months¹. One study found no significant difference in HO recurrence ($p = 0.942$) between early excision (mean six months after initial trauma) and control group (23 months).³² No significant differences with respect to ROM ($p = 0.067$), MEPI ($p = 0.350$), and complications (all $p > 0.05$) were found among early (six to ten months), median (11 to 20 months), and late (> 20 months) release groups.³³ Thus, if imaging shows maturity, and there are no symptoms like pain, swelling, or local tenderness, early arthrolysis can be performed within six to ten months.

Approach. There are several approaches for OEA, including anterior,³⁴ posterior,³⁵ lateral,²⁰ and medial.³⁶ The preferred approach depends on prior elbow incision, location, and extent of HO and need for ulnar nerve decompression. The anterior approach is not advocated due to the high risk of neurovascular injury. An isolated medial or lateral approach may not be sufficient for extensive HO. A single posterior or combined medial-lateral approach is most common. The posterior approach with elevated broad medial and lateral skin flaps can provide extensive surgical exposure through a single incision, but postoperative haematoma or seroma may develop due to the space under the flaps. Traction across the posterior wound during flexion may interfere with rehabilitation and even cause wound-healing complications. O'Driscoll³⁷ advocates the combined medial-lateral approach to avoid haematoma and enable early postoperative exercises with fewer wound-healing problems. The combined approach is also supported by the Fan's classification²¹ (depicted above), in which the lateral approach

for anterior tethers and blocks, and medial approach for posterior tethers and blocks.

Release step. Generally, the factors affecting elbow mobility can be divided into tethers and blocks. Posterior tethers (e.g. thickened posterior capsule and contracted triceps) or anterior blocks (e.g. HO, free body in the radial fossa, and osteophyte around coronoid) can cause flexion loss. Similarly, anterior tethers or posterior blocks may cause extension deficiency. Release steps are generally similar for various kinds of PTES. For tethers, release and excision of scarred or ossified soft tissue in the anterior/posterior elbow is indicated in the lateral/medial approach; for blocks, clearing HO, scar, osteophyte, or loose body in the anterior/posterior elbow is recommended from a lateral/medial approach.²¹

Medially, the triceps is elevated off distal humerus, and the posterior bundles of medial collateral ligament are resected to expose the posterior elbow for debridement. The posterior capsule is resected if a contracture has formed as a posterior tether. Excision of HO and clearance of the olecranon fossa under direct visualization are performed to remove blocks. A 5 mm to 10 mm shortened olecranon tip osteotomy is performed when osteophytes have formed around the olecranon to achieve more extension. A pie-crusting triceps release (Figure 1, as a tether factor) is sometimes performed to improve flexion contracture.³⁸

Laterally, the extensor origins of brachioradialis and extensor carpi radialis longus are elevated from the lateral epicondyle to expose the anterior elbow for debridement. As an anterior tether, hypertrophic anterior capsule excision is performed. HO is excised (Figure 2, as a block factor), and the radio-humeral joint and coronoid fossa are cleared under direct visualization to remove blocks. If present, osteophytes on the tip of the coronoid are removed to improve flexion.

Rotational stiffness caused by an abnormal proximal radioulnar joint can be managed in the same OEA (Figure 3); otherwise, separate treatment is recommended, if the stiffness is caused by forearm interosseous membrane, distal radioulnar joint, and wrist joint. Scars and adhesions around the radial head and annular

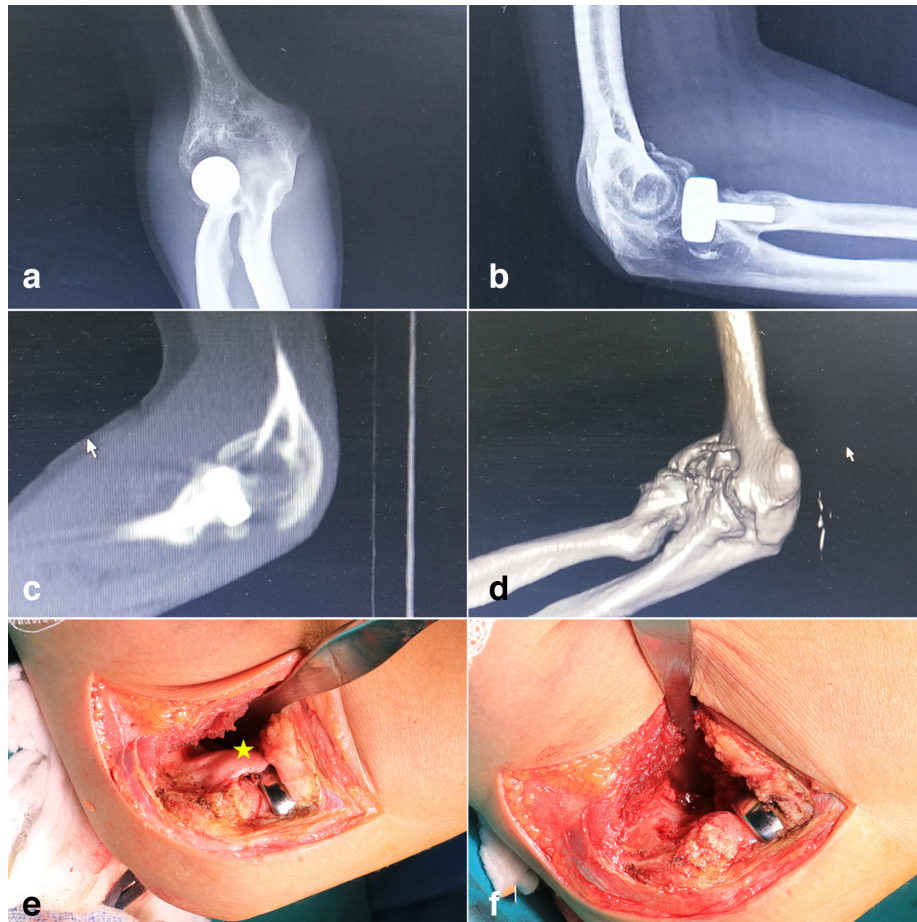


Fig. 2

Anterior ectopic bone excision (block removal). a,b) Radiograph, c) sagittal view of calculated tomography (CT), and d) 3D CT reconstruction show heterotopic ossification (HO) in the anterior elbow. e) An irregularly shaped HO (*, yellow) originated from distal humerus can be seen in the anterior elbow from the operative field. f) The ectopic bone is excised under direct visualization intraoperatively.

ligament are the primary causes, and contracture release is performed. Approximately half of the patients have rotational loss due to periradial head HO,³⁹ which should be managed. Reconstruction is performed for radial head malunion or nonunion limiting rotation after elbow trauma, including prosthetic arthroplasty and head resection.⁴⁰

Outcomes. Figure 4 is an example of a 37-year-old woman with limited ROM after elbow trauma, who was treated by OEA and had regained ROM at follow-up. A systematic review involving 637 patients reported a mean preoperative and postoperative ROM after OEA of 52° and 103°, respectively, with an average increase of 51°.⁸ Table I summarises OEA outcomes in the last five years (from 2016 to 2020), including (increased) ROM and FRA, and functional scores.^{21,41–54} To our knowledge, the largest case series of OEA in the English literature was in 2016 from the Shanghai Sixth People's Hospital involving 260 patients.⁵⁴ The mean ROM was 39° preoperatively and 117° at follow-up, with an increase of 78°. The clinical centre also reported medium-term outcomes (> 5

years) of OEA with hinged external fixation for 49 severe PTES.⁴⁷ Their satisfactory results showed significant improvements in ROM (from 27° preoperatively to 131° postoperatively), MEPI (54 to 95 points, 100% of good-excellent rate), and DASH (48 to 8 points). A novel technique, olecranon osteotomy-facilitated elbow release (OFER) procedure, was introduced in 35 patients; the mean ROM increased to 110°, with an improvement of 77°, and DASH score decreased to 11 points.⁵⁰ However, almost of them were grade III and IV. In the future, high-level evidence-based clinical research is needed.

Good efficacy can also be achieved in patients with flexion-extension or rotation ankylosis. Massachusetts General Hospital evaluated 18 patients who had surgical release of complete bony ankylosis and found an average increase of 95° in ROM.⁵⁵ The mean Broberg and Morrey scores were 81 points, with a good-excellent rate of 61%. Shanghai Sixth People's Hospital showed a mean improvement of 112° in 41 patients.⁵⁶ The mean MEPI were 84 points and the good-excellent rate is 83%. Sapienza University of Rome reported 12 patients with

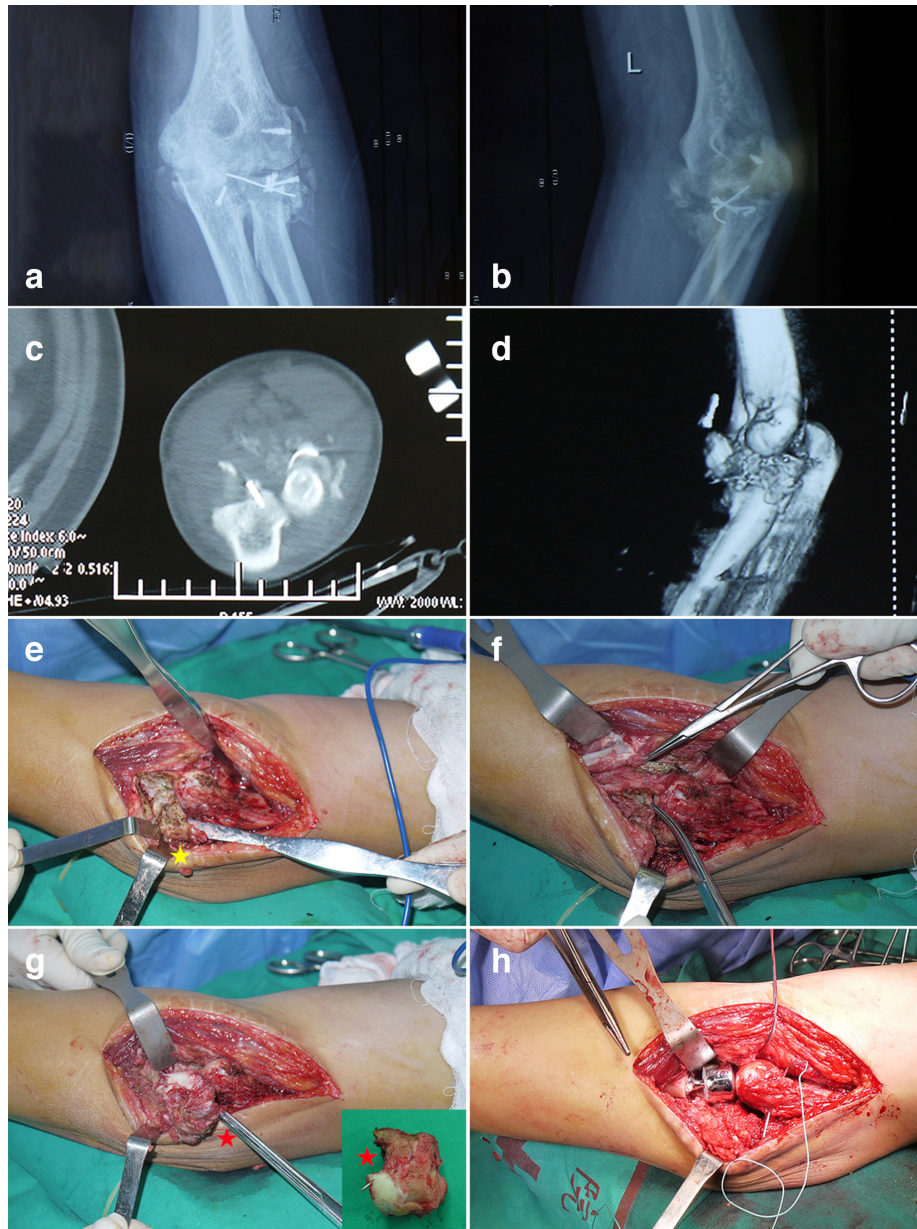


Fig. 3

Rotational function reconstruction. a, b) Radiograph, c) horizontal view of calculated tomography (CT), and d) 3D CT reconstruction show heterotopic ossification (HO) around the malformed radial head. e) An irregularly shaped HO (*, yellow) can be seen around the lateral side of annular ligament and radial head from the operative field, and f) is excised under direct visualization intraoperatively. g) The post-traumatic malformed radial head (*, red) can be seen from the operative field, and h) radial head arthroplasty is performed.

proximal radioulnar synostosis who underwent surgical resection, and found an average increase of 123° in FRA, with 89 points of MEPI and 100% of good-excellent rate.⁴⁵

OEA can effectively reduce elbow pain.^{21,46,47,50,57} In 81 patients from the Glasgow Royal Infirmary, the visual analogue score (VAS) decreased from 2.0 points preoperatively to 1.0 point at follow-up,⁵⁷ which was similar to the results from the Shanghai Sixth People's Hospital.²¹ The medium-term outcomes also showed a mean VAS of 2.5 points pre-operatively and 0.4 points at follow-up.⁴⁷ Life

qualities also improve significantly, as per the increased 36-Item Short Form Survey (SF-36).^{21,47,58}

Nerve management. Proper nerve management is vital during OEA. The ulnar nerve is prone to elongation, and is at high risk for dysfunction due to reasons such as increased elbow flexion after OEA; therefore, most authors advocate routine exposure and release in the medial approach. However, whether anterior transposition of the ulnar nerve should be performed remains controversial. Some authors suggest keeping it in-situ

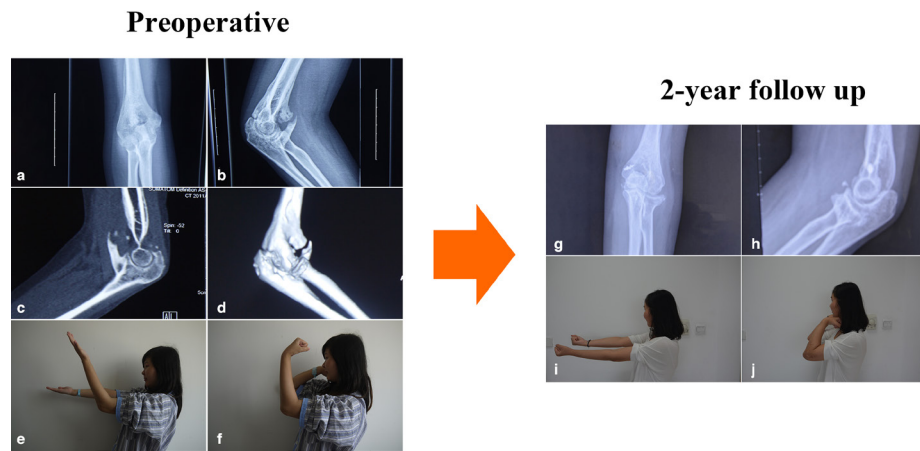


Fig. 4

An example of a 37-year-old woman with post-traumatic elbow stiffness treated with open elbow arthrolysis. a, b) Preoperative radiograph, c) sagittal view of calculated tomography (CT), and d) 3D CT reconstruction showed massive heterotopic ossification around the elbow. Before arthrolysis, the range of movement (ROM) was 35°, with e) extension of 50° and f) flexion of 85°. g, h) Radiographs at two-year follow-up showed no obvious blocks around the elbow, and the ROM recovered to 130°, with i) extension of 0° and j) flexion of 130°.

Table 1. Reported outcomes following open elbow arthrolysis within the last five years.

Author	Year	Journal	Patients, n	Age, yrs	FU, month	FU ROM, °	Increased ROM, °	FU FRA, °	Increased FRA, °	FU functional scores, points
Guglielmetti ⁴¹	2020	<i>J Shoulder Elbow Surg</i>	15	35	6	108	41	134	21	MEPI: 77; DASH: 28 VAS: 3.9
Freibott ⁴²	2020	<i>J Shoulder Elbow Surg</i>	30	44	19	106	28	138	73	N/A
Zhang ⁴³	2020	<i>J Shoulder Elbow Surg</i>	61	40	27	112	84	154	46	MEPI: 87
Schemitsch ⁴⁴	2020	<i>Injury</i>	42	47	54	96	33	N/A	N/A	MEPI: 82, 77%*; DASH: 21
Sun ²¹	2020	<i>J Shoulder Elbow Surg</i>	216	37	18	118	78	128	52	MEPI: 91, 95%* VAS: 0.9
Giannicola ⁴⁵	2020	<i>J Shoulder Elbow Surg</i>	12	46	21	116	31	123	123	MEPI: 89, 100%*; m-ASES: 83; quick-DASH: 19
Kwak ⁴⁶	2019	<i>J Shoulder Elbow Surg</i>	31	40	33	96	44	N/A	N/A	MEPI: 80 VAS: 2.2
Sun ⁴⁷	2019	<i>Clin Orthop Relat Res</i>	49	36	69	131	104	145	30	MEPI: 95, 100%*; DASH: 8 VAS: 0.4
Brewley ⁴⁸	2019	<i>J Shoulder Elbow Surg</i>	21	41	39	98	54	N/A	N/A	MEPI: 84, 81%*
Haglin ⁴⁹	2018	<i>J Shoulder Elbow Surg</i>	103	45	15	112	52	139	36	N/A
Edwards ⁵⁰	2017	<i>J Bone Joint Surg Am</i>	35	40	37	110	77	N/A	N/A	DASH: 11 VAS: 1.4
Gundes ⁵¹	2017	<i>Acta Orthop Traumatol Turc</i>	77	35	44	110	65	180	10	MEPI: 85
Kruse ⁵²	2016	<i>J Shoulder Elbow Surg</i>	36	39	38	109	57	N/A	N/A	MEPI: 91 VAS: 0.4
Pettersen ⁵³	2016	<i>BMC Musculoskelet Disord</i>	43	47	41	106	56	139	19	MEPI: 85; quick-DASH: 20
Cai ⁵⁴	2016	<i>J Shoulder Elbow Surg</i>	260	37	14	117	78	N/A	N/A	N/A

*Excellent-good rate of MEPI

DASH, Disability of Arm Shoulder and Hand Questionnaire; FRA, forearm rotational arc; FU, follow-up; m-ASES, modified American Shoulder and Elbow Surgeons score; MEPI, Mayo Elbow Performance Index; N/A, not available; ROM, range of movement; VAS, visual analogue score.

to protect the concomitant vessels and reduce nerve stimulation and surgery time.⁵⁹ A study found that ulnar nerve function (Amadio score: 8.22 points, ulnar nerve symptoms: 8.1%) in the anterior subcutaneous transposition group was significantly better than that in the simple decompression group (7.62 points and 18.9%)

after OEA; the authors recommend anterior transposition in patients with preoperative ulnar nerve symptoms or preoperative flexion < 100°. ⁶⁰ Additionally, radial nerve exploration and release is necessary when the patient has severe extension deformity, long disease duration, childhood injury, extensive anterolateral HO, or preoperative

symptoms. The posterior interosseous nerve should be explored and protected when manipulating the radiohumeral and proximal radioulnar joint.

Internal fixator. The implant can be removed only if the time interval between the previous fixation and the index procedure is long enough to allow fracture union, and the preoperative radiographs and clinical symptoms show solid fracture union. To avoid iatrogenic fracture, the principle of “release first, removal next” (i.e. implant removal after complete release) should be followed.

Hinged external fixation. It remains controversial whether using hinged external fixation after OEA is effective. In a retrospective study of 42 patients with ROM $\leq 40^\circ$, the average ROM gain was 11° higher in patients treated with a hinge than those without;⁶¹ another study including 26 patients with very severe stiffness found an improvement in mean ROM from 16° preoperatively to 102° at follow-up.⁶² External fixation application has several advantages: maintaining elbow instability after complete release, protecting repaired collateral ligament, and fixing the elbow at the maximum flexion and extension positions to maintain the release effect and facilitate postoperative rehabilitation. A recent study selected the radial facet of the distal radius instead of the traditional middle ulna for distal pins.⁶³ The authors stated that this procedure can reduce the incidence of iatrogenic fracture during passive manipulation in rehabilitation as the distal radius is much thicker and stronger than the middle ulna. No broken ulna or radius was reported in their study. Along with daily rotation exercise, the final rotation recovery was not influenced, with a mean ROM of 126° and FRA of 153° .

Postoperative rehabilitation

Postoperative rehabilitation is aimed at preserving ROM obtained in surgery to achieve a satisfactory final outcome. Early mobilization after arthrolysis is important and the rehabilitation is routinely started on the first postoperative day. Splinting, continuous passive motion (CPM), and external fixation are the three popular selections.

Splinting. Stretching produces plastic elongation of contracted tissue, which is based on viscoelastic properties of soft tissue including creep and stress relaxation.⁶⁴ The two main types are static progressive and dynamic splints. Previous studies have demonstrated no significant difference between the two protocols for PTES.⁶⁵ However, static progressive splinting is preferred for better toleration and shorter utilization periods; moreover, dynamic splinting is more likely to cause inflammation.⁶⁶ Generally, a three to four month period of splinting is enough, but adjustment is necessary for individual.

Continuous passive motion. The application of CPM device reduces intra-articular bleeding and periarticular oedema through a sinusoidal change of intra- and periarticular pressure;⁶⁷ however, its efficacy is still controversial. In one compared cohort of patients who received CPM device after

elbow arthrolysis versus those that did not use, no differences in ROM ($p = 0.56$) and MEPI ($p = 0.29$) were found.⁶⁸ This fact, plus changes in length of hospital stay, limited availability of portable machines and their difficulty of use, and problems with reimbursement, have restricted CPM application.

External fixation. The advantages and effectiveness of external fixation have been introduced in the preceding paragraph. Shanghai Sixth People's Hospital has introduced a three-step rehabilitation programme for external fixation after elbow arthrolysis.⁴⁷ In the first postoperative six weeks, patients are instructed to perform “active, assisted and passive” cycles of flexion-extension exercises (30 on the first day, increased by 30 per day until 300 were achieved) and forearm rotation exercises (at least twice daily) under close supervision by physical therapist or family members. The fixator is locked at the extreme position of elbow extension or flexion after each session of ROM exercise as well as in sleep. Generally, fixator removal is performed at six weeks in the outpatient operating room.

Prevention of complications

The complication rate of OEA is approximately 23%.⁸ The complications most reported are new-onset or exacerbated ulnar nerve symptoms, HO recurrence, and postoperative infection. Compared to treatment, prevention is key to reduce complications.

Ulnar nerve symptoms. Iatrogenic injury during surgery, increased nerve length, and intraneural pressure associated with improved ROM after OEA increase the risk of neuropathy and nerve palsy.⁶⁹ Prophylactic ulnar nerve decompression and transposition are indicated in cases of severe preoperative flexion deficiency. Careful release, blood vessel protection, and reduction of nerve stimulation during OEA are also important. One study reported 5% new-onset ulnar nerve symptoms without exacerbation after routine transposition during OEA; the authors also revealed that preoperative HO was an independent risk factor, especially on the medial side.⁵⁴

HO recurrence. Recurrent HO is the main reason for failed arthrolysis. Non-steroidal anti-inflammatory drugs (NSAIDs) and radiotherapy help prevent HO formation. The mechanism of NSAIDs is attenuating the bone morphogenetic pathway and reducing local inflammatory responses, and the commonest drug used is indomethacin.⁷⁰ Celecoxib, a selective cyclo-oxygenase-2 inhibitor, can also effectively inhibit HO formation after OEA.⁷¹ It has gained popularity because of the lower incidence of gastrointestinal side effects, while having similar efficacy as indomethacin.⁷⁰ Radiation can suppress the pluripotent mesenchymal cell from transforming into osteoprogenitor cells and osteoblasts.⁷² However, the overall effects of radiotherapy remain controversial and are supported by weak evidence:⁷³ the only randomized controlled trial was terminated before completion because of unacceptably high numbers

of adverse events; the only case-control study showed no efficacy; and only a few case series and reports showed positive results.

Post-operative infection. Long operation time, large surgical field, and local haematoma or seroma that may be inaccessible to systemically administered antibiotics, increase risk for infection. Local antibiotic delivery is suitable for wound infection prophylaxis because high concentrations are achieved directly at the wound site and systemic toxicity is limited.⁷⁴ One study found that local application of vancomycin powder can significantly decrease the infection rate following OEA (0% vs 6.5%, $p = 0.003$); no adverse effects were documented, showing a promising means to prevent post-OEA infection.⁷⁵

Summary

OEA can yield sustained improvement in elbow mobility, function, pain relief, and life quality. A clear understanding of the complete diagnosis and treatment path of OEA is paramount to achieving optimal results, from diagnosis, evaluation, operation, rehabilitation to prevention. Future research will need to focus on high-quality clinical evidence of treatment method and rehabilitation programmes.

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