

Outcome of Longstanding Dislocated Elbows Treated by Open Reduction and Excision of Collateral Ligaments

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ABSTRACT

Aim: To study the long term result of open reduction of longstanding dislocated elbows with regard to stability, avascular necrosis of the distal humerus and degenerative changes of the joint.

Methods: Nine patients, aged between nine and 60 years (average 30 years) with longstanding posterior dislocation of the elbow underwent open reduction. The operative procedure featured a medial and lateral incision, excision of the capsule, fibrous adhesions and the collateral ligaments with no attempt to reconstruct the ligaments, as well as anterior transposition of the ulnar nerve. The procedure was performed on an average eight months after the injury (range 1.5 to 30 months).

Results: All elbows had improved flexion at follow-up which ranged from one to eleven-and-half years (average 48 months). The average arc of flexion improved from 11° to 87°. The average flexion at the elbow improved from 32° (range 20° - 50°) to 111° (range 85° - 140°). Younger patients with fractures of the articular surface of distal humerus had smaller gain in the range of motion. No patient complained of instability or had recurrence of dislocation. No patient developed avascular necrosis of the distal end of the humerus. The radiographs of the 60-year-old man at 11.5 years follow-up showed extensive degenerative changes of the joint but he still maintained a painless arc of flexion from 10° to 135°.

Conclusion: There was improvement in the range of motion and function in all nine patients. The elbows were stable despite excision of the collateral ligaments. There was no evidence of avascular necrosis. Patients with eight or more years of follow-up showed degenerative changes of the joint.

Keywords: collateral ligaments, dislocated elbow, excision of ligaments, open reduction, stability

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INTRODUCTION

Patients presenting late with an unreduced posterior dislocation of the elbow are still a problem in developing countries where socio-cultural factors may affect the medical care of traumatic injuries. The attendant problems including capsular and muscle contracture, widespread intracapsular adhesions and post-traumatic distortion of the articular surface have led to diverse opinions as to how best to treat the longstanding elbow dislocation. These have ranged from no treatment⁽¹⁾, to operative reduction alone^(2,3) or in conjunction with arthroplasty⁽⁴⁾. Other alternatives to restore the range of motion at the elbow, such as distraction or interposition arthroplasty are technically demanding, post-operative rehabilitation is lengthy and exacting, have a high complication rate, the results are unpredictable and may lead to instability at the elbow⁽⁵⁻⁷⁾. Whereas, open reduction requires no special equipment.

This article constitutes the author's personal series of nine patients with delayed presentation of elbow dislocation, treated by open reduction using combined medial and lateral approaches^(8,9). The capsule and fibrous adhesions along with the remnants of the collateral ligaments were excised. No attempt was made to reconstruct the ligaments. The post-operative rehabilitation was kept simple for compliance by the patients and to avoid defaults at follow-up.

Following the extensive surgical procedure, there were concerns about the stability of the elbow, avascular necrosis of the distal humerus and degenerative changes of the joint. The long term outcome is presented. Several authors^(3,8-11) who also advocated open reduction have not discussed these issues.

METHODS

Between January 1990 and December 2000, nine patients aged between nine and sixty years (mean 30 years) were seen with unreduced post-traumatic dislocations of the elbow. They all complained of inability to bend the elbow and consequently could not perform the usual activities of daily living. Pain was not a major complaint. There were six men and three women. Of the six men,

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Table I. Details of patients' characteristics.

Case	Age (yrs)	Sex	Side	Mode of Injury	Dominant limb	Displacement	Associated fractures	Duration of injury (months)	Pre-op range of motion (degrees)	Post-op range of motion (degrees)	Gain in motion (degrees)	Follow-up (Months)	Occupation
1	13	M	L	Fall from tree	No	Postero-lateral	None	3	30 - 35	35 - 100	60	42	Student
2	60	M	R	MVA	Yes	Posterior	None	2	20 - 25	10 - 135	120	138	Odd jobman
3	13	M	L	soccer	No	Postero-lateral	Chip from lateral condyle	9	40 - 50	45 - 90	35	96	Student
4	31	M	L	soccer	No	Postero-lateral	Chip from coronoid	30	-5 - 25	20 - 120	70	24	Fisherman
5	9	M	R	Fall from tree	Yes	Postero-lateral	medial condyle	12	30 - 50	20 - 95	55	36	Student
6	18	F	L	Fall from bicycle	No	Postero-lateral	None	12	30 - 35	20 - 85	60	24	Housemaid
7	50	M	L	Fall from ceiling	No	Postero-lateral	Radial head	2	10 - 20	10 - 140	120	36	Odd jobman
8	29	F	R	Fall at home	Yes	Postero-lateral	None	1.5	10 - 20	40 - 120	70	24	Housewife
9	47	F	R	Fall at home	Yes	Postero-lateral	None	1.5	20 - 30	20 - 120	90	12	Housewife

three were students, two were odd job men and one was a fisherman. Of the three female patients, two were housewives and the third was a housemaid. All patients were right-handed and had a unilateral closed dislocation. The left elbow was affected in five patients and the right in the other four. Two patients were injured while playing soccer, two had fallen from a tree, two had falls at home, one had a fall from the roof, one had a fall from a bicycle and the oldest patient, the 60-year-old man, had a fall from a motorcycle. All patients had prior treatment by a traditional practitioner.

The flexion contracture at the elbow was on an average of 20° (range 10° to 40°) but Case 4 had hyper-extension of 5°. Further flexion at the elbow was severely limited in all nine patients and none could flex the elbow beyond 50° (Table I). The arc of flexion was on an average 11° (range 5° to 30°). No patient had any neuro-vascular deficits on clinical examination.

The radiographs showed postero-lateral dislocation in eight elbows and the ninth had only posterior displacement. Four patients had associated fractures. Case 3 had a small osteo-cartilaginous fragment from the lateral condyle of the humerus, Case 4 had a small osseous fragment from the tip of the coronoid process, Case 5 had a fracture of the medial condyle of the humerus and Case 7 a Type II (Mason) fracture of the radial head. There was no evidence of heterotopic ossification in any patient in spite of the massage and manipulation by the traditional healer.

All patients were otherwise in good health and were not on any regular medication. No prophylactic medication was prescribed for the prevention of heterotopic ossification. The average delay between the original injury and the operation was eight months (range 1.5 to 30).

Operative technique

Open reduction was performed on all nine patients using a combined medial and lateral approach. A 15 cm longitudinal incision was made on the lateral side, centred over the lateral epicondyle. The radial nerve was isolated and protected. The lower end of the humerus was freed of all adhesions and the coronoid as well as olecranon fossae were cleaned of all soft tissues. In all cases the articular cartilage of the distal humerus had lost its smoothness and sheen. In Case 1, there was a one centimetre square area with loss of full thickness of the articular cartilage which exposed the subchondral bone on the medial side of the lateral condyle. In Case 4, which had remained dislocated for 30 months, the articular surface was flattened and had lost its smooth contours.

The torn lateral capsule was excised clearing the bone of all soft tissues. It was difficult to identify the remnants of the torn collateral ligaments and no attempt was made to repair or reconstruct the ligaments. Next, the articular surfaces of the radial head and the olecranon were cleared of fibrous tissue.

Similarly, a 15 cm longitudinal incision was made on the medial side, centred over the medial epicondyle. The ulnar nerve was identified and was mobilised for about 15 cm, taking care to protect the branches to the flexor carpi ulnaris. At the end of the operation, the nerve was transposed anteriorly in the subcutaneous tissue plane. The medial intermuscular septum was divided to avoid sharp angulation in its course. Any remaining adhesions were excised completely leaving the distal end of the humerus devoid of soft tissues. The median nerve, the brachial artery and flexor muscles were protected anteriorly during the dissection.

With the articular surfaces mobilised, attention was then directed to the associated fractures. It was difficult to determine the exact location or origin of the small chip fractures especially in long standing dislocations as the articular surfaces were covered with fibrous tissue and adhesions. In those circumstances when the small fragments could not be reduced accurately or their origin could not be located they were excised as in Cases 3 and 4. The fragments were only fixed when it could fit anatomically with the articular surface. In Case 5, the medial condyle fragment of the humerus was realigned and fixed with a 1.6 mm Kirschner wire. In Case 7, the fracture of the radial head was fixed with a screw.

The joint was then reduced and held in 90° of flexion by 1.6 or 2 mm Kirschner wire passed from the humerus, across the joint, into the radius. Care was taken to prevent the ulnar nerve from being trapped between the articular surfaces during reduction of the elbow joint. In Case 4, the contracture of the triceps tendon prevented the elbow flexion to 90°. Through a separate short posterior mid-line incision the triceps tendon was lengthened at the myo-aponeurotic junction by two transverse incisions made one to one and half centimetres apart. The aponeurosis was not repaired. Wounds were closed in usual manner, a suction drain was inserted and the elbow was placed in a long arm plaster of Paris posterior splint.

Rehabilitation

Four to five weeks after surgery the Kirschner wire was removed and active self mobilisation exercises were started under supervision of a physiotherapist. Passive and forcible movements were avoided. Whenever the elbow was painful or swollen, mobilisation was temporarily discontinued. No splints of any kind were used. The elbow was supported in a tri-angular sling, which was discarded by the patients of their own accord, generally after six to eight weeks. Supervised physiotherapy was discontinued at 12 to 14 weeks and patients were allowed free functional use of the elbow.

All patients were reviewed at follow up, which ranged from one to 11.5 years (average 48 months). Patients were assessed for pain, stability, the range of flexion-extension at the elbow, ulnar nerve deficit, heterotopic ossification and return to pre-injury occupation. The range of flexion-extension movement was measured using a mechanical goniometer placed on the lateral aspect of the elbow with its axis centred over the lateral epicondyle. The ulnar nerve was evaluated clinically. The stability of the elbow was assessed clinically by performing the valgus-varus stress in 20° to 30° of flexion and was compared with the uninjured side. The instability was graded as mild, moderate or severe as described by Morrey⁽⁵⁾. Antero-posterior and lateral radiographs of the elbow were made to check that the elbow had remained reduced and to look for any heterotopic ossification. Radiographs were taken regularly to document any avascular or degenerative changes of the elbow.

RESULTS

The average follow-up was 48 months (12 range 138 months). All wounds healed primarily. There was no incidence of pin track infection or neurovascular complications either transient or permanent.

Range of motion: All patients had improved flexion at the elbow. The patient with the longest duration of the dislocation, i.e. 30 months, could flex the elbow to 120°. However the three younger patients, all of them students, had less increase in flexion. Post-operatively, the average flexion contracture increased from 20° to 24°. In Case 4, the preoperative hyperextension of 5° was changed to a 20° flexion contracture. The average maximum flexion at the elbow improved from 32° (range 20° to 50°) to 111° (range 85° to 140°). The average arc of motion increased from 11° to 87°.

Cases 3, 4 and 5, with intra-articular fractures of the ulno-humeral articulation, had on an average 53° increase in the arc of motion as compared to 80° in the other five patients without fractures. However, Case 7, with the radial head fracture had 120° improvement. When all four cases were combined in the fracture group then the average improvement increased to 70°. The difference was not significantly different from the non-fracture group.

Younger patients i.e. under 20 years, had 54° improvement in the arc of motion as compared to 94° in patients over 20 years. This was statistically significant (p value >0.01). The oldest patient had retained a painless range of motion from 10° to 135° at eleven-and-half years, although his latest radiographs showed gross degenerative changes (Fig. 1). No patient had any loss in the range of motion over the years.

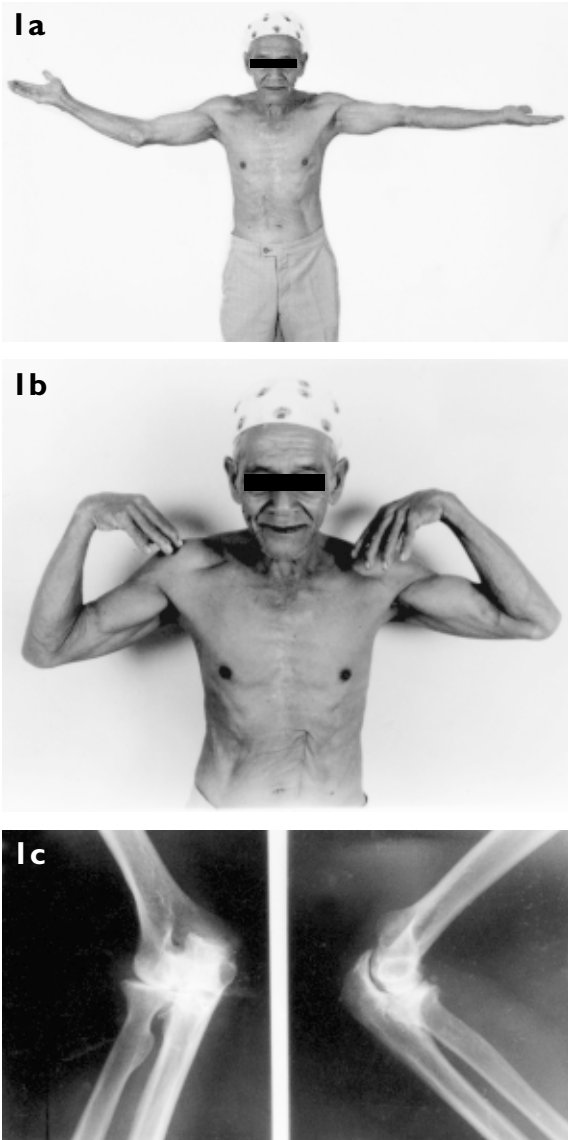


Fig. 1 Case 2. (a, b) Clinical photographs of a 60-year-old man show the range of flexion - extension at the right elbow that is preserved after eleven-and-half years following open reduction. (c) AP and lateral radiographs of the right elbow, at eleven-and-half years after open reduction, show gross degenerative changes but the patient still retained a painless range of motion.

Pain: Two patients had occasional discomfort after prolonged use. However, pain did not interfere with sleep in any patient. None required medication for pain relief. Three patients who were students returned to school. The fisherman was back at work after four months and the two odd job men resumed their work after few months. The oldest patient, Case 2, retired soon after surgery because of age. All three female patients resumed their household chores.

Cases 2 and 3, who were seen at 11.5 and eight years respectively after the surgery had gross degenerative changes as seen on the latest radiographs. Both had retained the range of motion at the elbow and did not complain of pain. Case 3 was working as a waiter in a restaurant.

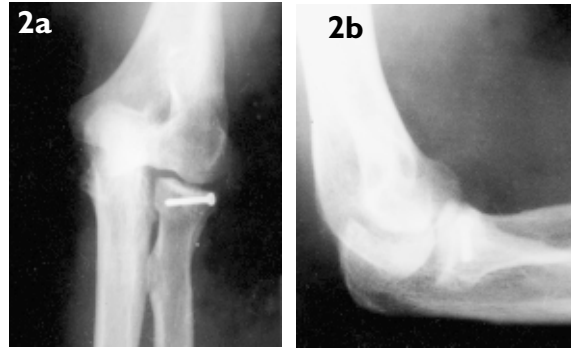


Fig. 2 Case 7. (a) AP and (b) lateral radiographs of the left elbow of a 50-year-old man taken three years after open reduction. The radial head fracture, Mason type II, was fixed with a screw. There is suggestion of subluxation of the elbow.

Stability: All nine patients had from no laxity to less than 5° laxity when tested by the valgus-varus stress test with the elbow in 20° to 30° of flexion⁽⁵⁾. The pivot shift test to exclude the postero-lateral instability as described by O'Driscoll⁽¹²⁾ could not be performed accurately as all patients had some flexion contracture. No patient complained of instability at the elbow and all returned to their pre-injury occupation. No patient had recurrence of dislocation. The plain radiographs of Case 7 at three years follow-up suggested subluxation of the elbow (Fig. 2) but a computed tomography (CT) with three dimensional reconstruction did not show any subluxation (Fig. 3).

Minor spicules of heterotopic bone were seen on nearly all radiographs at follow-up. However, no patient had symptoms. The bone was not excised. No patient had avascular necrosis of the distal end of the humerus.

DISCUSSION

Limitation of motion at the elbow is a serious disability. Flexion from 30° to 130° is necessary to perform most activities of daily living⁽⁵⁾. Following open reduction the range of flexion improved in all elbows. The greatest improvement occurred within six months after the operation. Further improvement could be expected up to a year. Once improved, no patient had deterioration in the range of motion over the years. Improvement was less in patients with associated intra-articular fractures of the distal humerus, as also reported by other authors^(6,7,13). The patients over 20 years of age had greater improvement in the range of motion than the younger patients.

The combined medial and lateral approaches^(8,9) give excellent access for excision of fibrous adhesions as well as to fix the intra-articular fractures. It also helps to keep both the flexor and the extensor muscle groups intact for post-operative active mobilisation. Further the radial and the ulnar nerves could be isolated and protected. The posterior approach^(11,14)

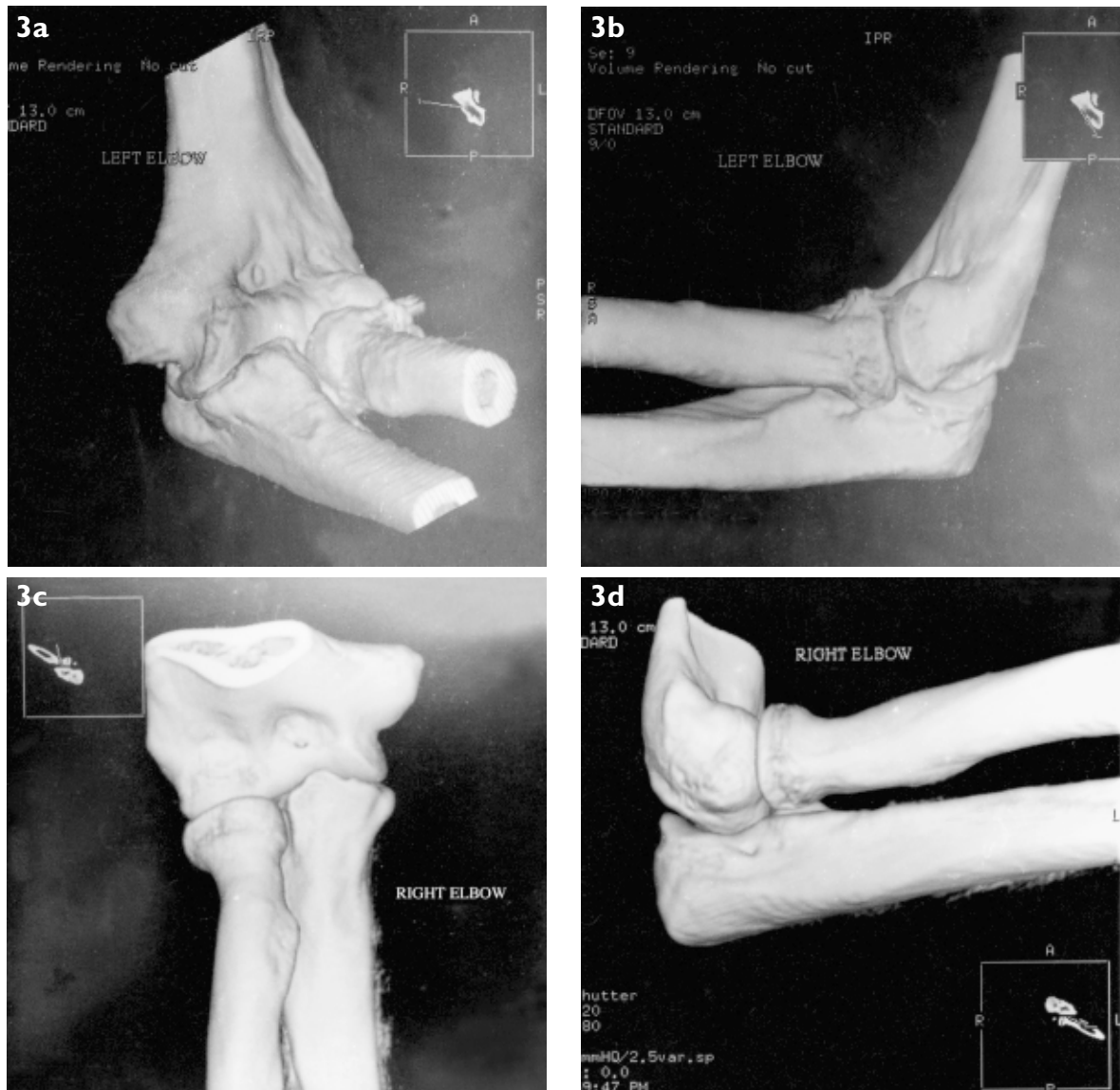


Fig. 3 Case 7. CT images with 3D reconstruction of both elbows done for comparison at 40 months after open reduction of the left elbow. (a, b) The left elbow, the injured side, is not subluxed. The ulno-humeral and radio-capitellum articulations appear congruent. The collateral ligaments were not reconstructed. (c, d) The right elbow is the uninjured side. The appearances of both the elbows are comparable.

though adequate for surgery on an anatomically intact or freshly injured elbow is not suitable for open reduction of a stiff unreduced elbow with grossly altered anatomy.

The collateral ligaments were torn, adherent, and difficult to identify and repair. Further, reconstruction of ligaments would add to the surgical dissection and tissue trauma, this could result in elbow stiffness. For immediate stability of the elbow, Kirschner wire fixation was used^(3,9,10). Later on, the anatomical shape of the olecranon and the trochlea, the intact radial head and the muscles around the joint maintain the stability⁽¹⁴⁻¹⁶⁾. Mehlhoff et al⁽¹⁶⁾ reported no gross instability in recently dislocated elbows treated by closed reduction. Further Josefsson et al⁽¹⁷⁾ reported no difference in the stability of the recently dislocated elbows irrespective of whether the collateral ligaments were repaired or not.

O'Driscoll et al⁽¹⁸⁾ described a spectrum of elbow dislocations ranging from instability to complete dislocation as a "circle concept". They further suggested that the medial collateral ligament is not always torn following the elbow dislocation. All the patients in this study had complete dislocation as confirmed at the operation and all had both the collateral ligaments torn. No attempt was made to reconstruct the ligaments. O'Driscoll et al⁽¹²⁾ further described a pivot shift test to exclude postero-lateral rotatory instability of the elbow. However, none of our patients regained full extension, therefore the test could not be accurately performed. No patient complained of instability of the elbow or had recurrent dislocation till the latest follow-up. Return to their pre-injury occupation was considered a good indicator of function and stability. The radiographs at follow-up of Case 7 suggested that the elbow was possibly subluxed, but this was not confirmed on the

CT-scan. Probably the appearance on the plain radiograph was due to inability to extend the elbow fully. The patient had retained nearly full painless flexion at the elbow, three years after the operation, and was working as a village mason.

Osteoarthritis following simple dislocations is rare^(17,19,20). Two patients with eight and 11.5 years follow-up developed gross degenerative changes. It is difficult to state whether the degenerative changes were due to the original injury or due to the surgery or both. The articular surface of the distal humerus was damaged to some extent in all patients. Perhaps with longer follow-up, other patients could also show degenerative changes.

Despite extensive soft tissue dissection and excision of the ligaments, no patient developed avascular necrosis of the distal end of the humerus. This was also noted by McKee et al⁽⁶⁾ when they reported the results of reconstruction of mal-union and non-union of intra-articular fractures of the distal humerus. Probably, the metaphyseal bone doesn't devascularise easily.

Heterotopic bone formation occurs commonly following extensive soft tissue injury or dissection around the elbow^(6,7,10). Indomethacin has been used for prophylaxis with inconsistent effect. In this study no specific prophylactic measures were used and no patient had functional impairment. However minor spicules of new bone formation were seen on nearly all radiographs.

CONCLUSION

Following open reduction of the longstanding dislocated elbow, improvement in the range of motion and function was obtained in all nine patients. This improvement was lasting. However, patients with associated intra-articular fractures had less improvement in the range of motion. The elbows were stable despite excision of the collateral ligaments. There was no recurrence of dislocation.

The two patients who had more than eight years of follow-up showed degenerative changes but they still retained a painless range of motion.

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