

## TECHNIQUE

# Reattachment of the Ruptured Distal Biceps Tendon Using a Modified Anterior Approach

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## ■ HISTORICAL PERSPECTIVE

Distal biceps tendon ruptures may be the most common tendon rupture about the elbow, but they are still relatively rare. Fortunately, complete distal biceps tendon ruptures are easily recognized. The diagnosis is suggested by the history. The patient generally gives a history of a sudden "ripping," "tearing," "popping," or "electric shock" in the upper arm. The sensation generally occurs while the patient is resisting biceps flexion (such as lifting a heavy object), or resisting biceps supination (such as tightening a wrench). Occasionally the rupture will occur in the event of a direct blow to the anterior aspect of the upper arm (such as a slashing injury with a hockey stick). Clinically, the patient may notice proximal migration of the biceps muscle (Fig. 1). Within a few days, ecchymosis will generally develop about the medial aspect of the elbow. The ecchymosis is usually more prominent about the proximal medial aspect of the forearm than the distal aspect of the arm (Fig. 2). Clinically, complete distal biceps tendon ruptures are always associated with weakness of resisted biceps supination. They are not always associated with weakness of resisted biceps flexion. Depending on the amount of proximal migration, the biceps tendon may or may not be palpable in the antecubital fossa. If the tendon is palpable, it is usually a bit thickened. The thickening can be appreciated by comparing the involved tendon with the normal, uninvolved contralateral biceps tendon. Radiographs are not usually necessary if these findings are present.

A number of operations have been described to repair complete ruptures of the distal biceps tendon. The op-

erations can be grouped into nonanatomic and anatomic repairs.

The older operations tended to be nonanatomic. Concerns about injury to the vital structures in the region of the antecubital tunnel caused earlier surgeons to avoid the deeper dissections associated with an anatomic repair and to secure the ruptured distal biceps tendon to either the lacertus fibrosis or the brachialis (6,12). Although there is a dearth of objective data, the older literature suggests that a good result could be obtained by attaching the ruptured tendon to the brachialis muscle.

Most modern surgeons recommend anatomic reattachment. The differences in technique center around the number of incisions, the site of tendon reattachment, the fixation device employed, and the use of grafts. The initial approaches were anterior (4,8), but enthusiasm for this approach was dampened by the number of reported neurovascular complications (6,13). In 1961, Boyd and Anderson (3) reported a method of reattaching the distal end of the ruptured biceps tendon using two approaches. The anterior approach allowed for retrieval of the ruptured tendon. The tendon was passed posteriorly between the radius and ulna and retrieved through a second posterior incision. The tendon was reattached to the radial tuberosity by pronating the forearm. The Boyd and Anderson approach avoided the dangers of the deep dissection in the antecubital fossa but required dissection of the muscles off of the lateral aspect of the olecranon. A trap door was made in the tuberosity and drill holes made on its opposite hinge. Modifications of the Boyd and Anderson approach include approaching the tuberosity through a posterior muscle splitting incision and using a high-speed bur to make a trough (13). The development of suture anchors has rekindled interest in the anterior approach. Le Huec et al. (9), Lintner and Fischer (11), and Strauch et al. (14) used a single anterior incision and reattached the tendon end with suture anchors placed into

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**FIG. 1.** Proximal migration of the biceps muscle after a complete distal biceps tendon rupture.

the radial tuberosity. Both studies reported excellent results with no nerve injuries.

Most published series of distal biceps tendon ruptures are based on fewer than 10 to 15 patients (1,2,5, 10,12,13). Dobbie (6) reported on 51 cases performed by 34 different surgeons. Over the past 5 years, the senior author has had the opportunity to repair over 50 patients with distal biceps tendon rupture, using an anterior technique that was first demonstrated by the late Arthur A. Thibodeau, M.D.. This technique was modified as the senior author became more experienced. The technique is predictable, uses readily available equipment, and does not require special anchors. With this technique, occa-

sional transient paresthesias of the medial antebrachial cutaneous nerve have been noted, but the subjects have had no (major) neurovascular complications and no synostoses. All of the patients have been able to resume their former level of activity without modification.

#### ■ INDICATIONS/ CONTRAINDICATIONS

The indications for the surgical repair of complete distal biceps tendon ruptures are cosmetic or functional. The cosmetic deformity is associated with proximal migra-

**FIG. 2.** The ecchymosis develops after 3 or 4 days and is usually more prominent distally than proximally.





**FIG. 3.** The skin incision does not need to cross the antecubital fossa. The longer distal incision provides enough exposure. The shorter proximal incision is used with delayed repairs when the tendon cannot easily be retrieved.

tion of the tendon and its associated muscle belly. If the tendon is not completely detached, or if it tethers distally, there may not be much of a cosmetic deformity. The functional indications have to do with weakness of both supination and elbow flexion. Surgical repair improves both strength and endurance (1,2,13). Improvement is seen more with supination than elbow flexion. If supination is not crucial, the patient may elect to avoid surgery and, instead, work on strengthening the secondary elbow flexors.

### ■ TECHNIQUE

The patient is placed supine on the operating room table with the arm abducted and resting on the hand table. The surgeon sits on the medial aspect of the arm. A tourniquet is placed high on the upper arm; a sterile tourniquet is usually not necessary. The arm is exsanguinated and the tourniquet inflated.

An extensile incision is made along the anterior edge of the flexor pronator muscle mass (Fig. 3). The incision

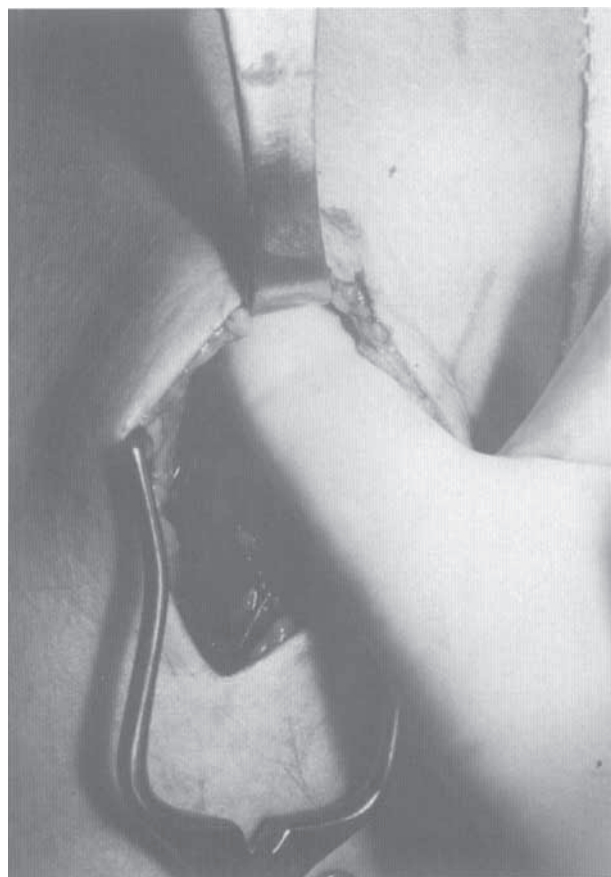
begins just distal to the antecubital fossa and extends distally for a distance of three or four fingerbreadths. The incision is carried sharply through the forearm fascia. If seen, the medial antebrachial cutaneous nerve should be protected. Dissection continues between the neurovascular bundle and the extensor muscles. If the tendon has not retracted proximally, it will be seen deep to the lacertus fibrosis and anterior to the brachialis muscle (Fig. 4). The lacertus fibrosis may need to be divided to facilitate the exposure and repair. If the tendon has not retracted, it will be surrounded by a thickened sheath that is generally filled with serosanguinous fluid. Opening the sheath will release the fluid and expose the ruptured end of the distal biceps tendon. If the tendon is not visible, then proximal dissection is necessary. Sometimes the tendon can be visualized by inserting army-navy retractors proximally. If the tendon cannot be visualized, it can sometimes be retrieved by digital dissection; inserting a finger proximally can sometimes free up a ruptured tendon that is usually resting on the anterior medial aspect of the brachialis muscle (Fig. 5). If this does not work,



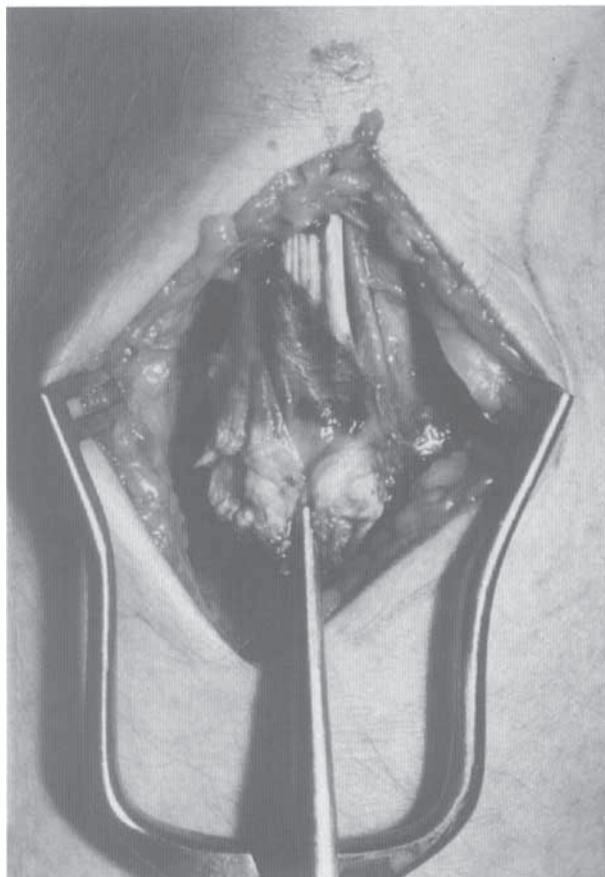
**FIG. 4.** The ruptured biceps tendon resting over the neurovascular bundle and between the flexor and extensor muscle masses. Note the medial antebrachial cutaneous nerve behind the Army-Navy retractor.

then a second extensile incision is made just proximal and medial to the antecubital fossa. A two- to three-fingerbreadth incision is more than adequate to expose the ruptured distal biceps tendon.

Once the tendon has been exposed, a Kocher clamp is placed at the ruptured end and traction applied for a few minutes to regain any available length (Fig. 6). The repair is performed with #5 nonabsorbable suture threaded through Keith needles. The repair is begun near the musculotendinous junction with the Bunnell technique. The needles should be passed simultaneously to avoid cutting or piercing the suture material. The senior authorities obtain at least three or four separate passes with the Keith needles. Small cuts on the medial and lateral aspect of the distal end of the ruptured tendon allow the Keith needles to be passed out of freshly debrided tendon while still maintaining a grasp with the Kocher clamp (Fig. 7). Once the needles and suture have been passed through the distal stump, the residual tendon, still held firmly in the Kocher clamp, can be safely divided. Unless the Keith needles are swagged onto the suture, it is wise to keep small clamps on the ends of the #5 nonabsorbable



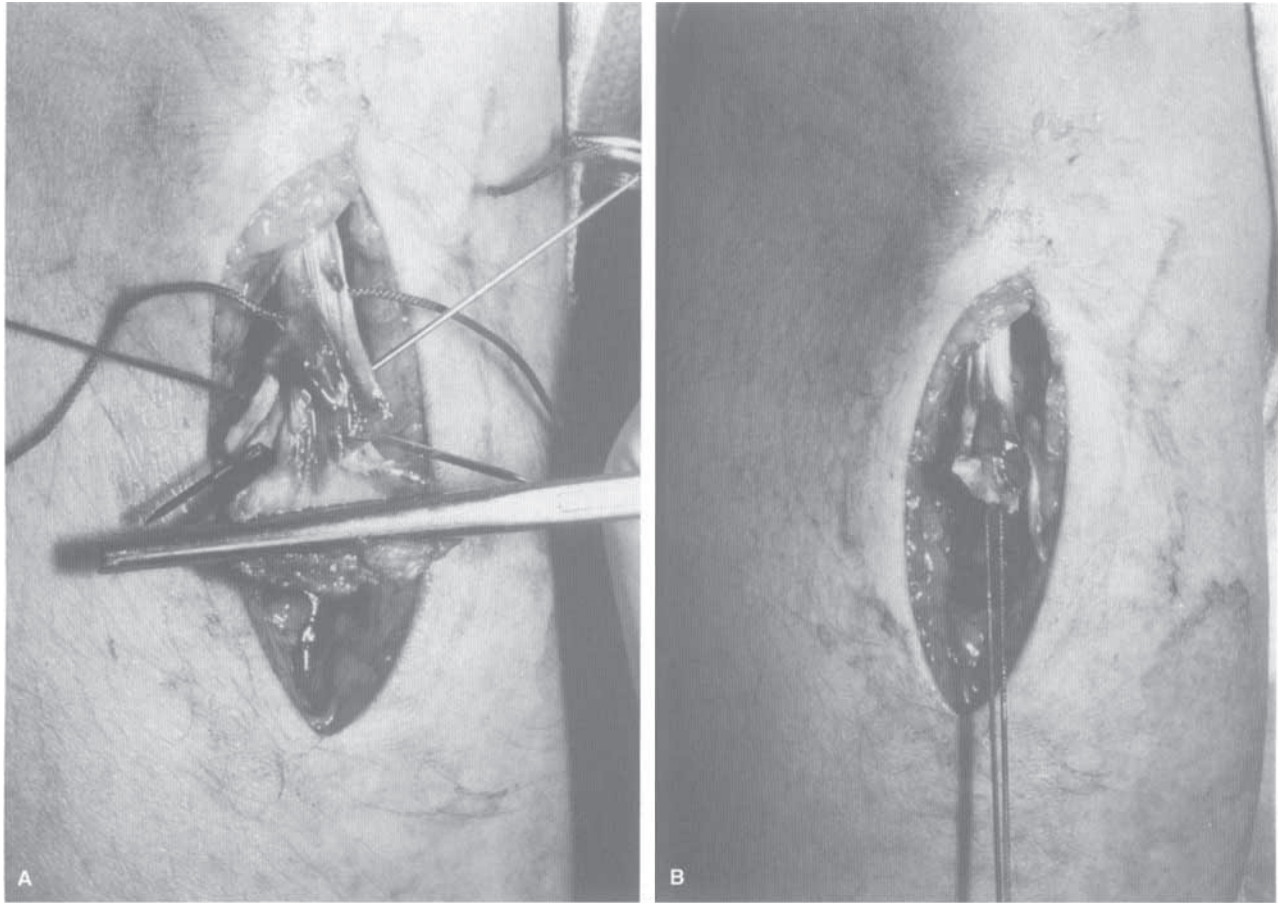
**FIG. 5.** The surgeon's finger is inserted proximally and medially. Sometimes serosanguinous fluid will be expressed as the tendon is encountered.



**FIG. 6.** The tendon is retrieved by grasping the end of the ruptured tendon. During the suture weave, the Kocher clamp is placed transversely just proximal to the ruptured end.

suture to prevent the needles from sliding off. If the repair was performed through a proximal incision, the suture and needles need to be passed deep to the skin bridge and retrieved in the distal (working) incision. The Keith needles and suture ends are then wrapped in towels and set aside to prevent accidental puncture.

The next step is exposure of the radial tuberosity. If the tendon sheath is still visible, a Kelly clamp can be passed down the sheath to the tuberosity. Slow careful dissection around the clamp will eventually expose the radial tuberosity. Frequently, however, the tendon sheath is not visible. The tuberosity can be safely exposed by dissecting lateral to the midline and close to extensor muscle mass. Generally, two or three veins need to be ligated. A branch of the recurrent radial artery often needs to be ligated. Once the vessels are ligated, a blunt-tipped Cobra retractor can be placed around the medial aspect of the radial neck. The Cobra retractor is crucial to the exposure as it protects the medial neurovascular structures. If the dissection is lateral to the midline, the median nerve will generally not be seen, while dissection



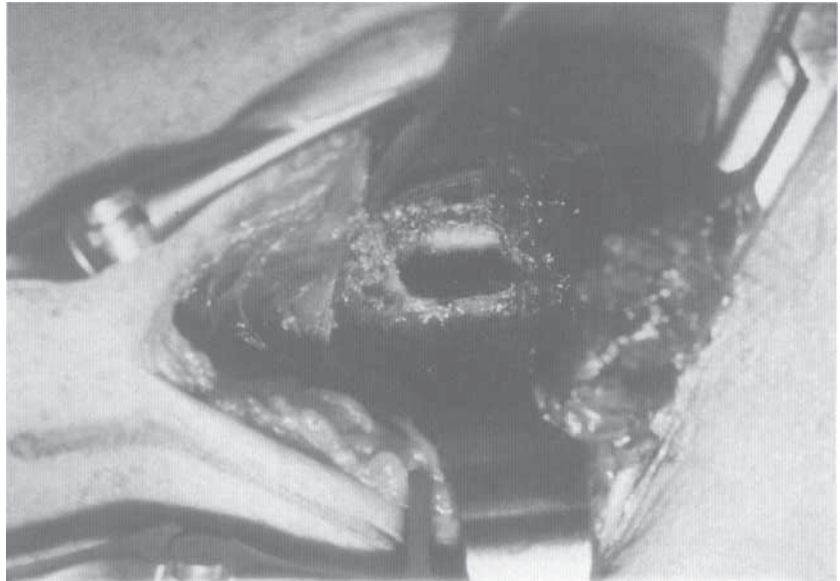
**FIG. 7. A:** The Keith needles are passed through partial cuts in the freshly divided biceps tendon. **B:** The tendon is completely transected after the needles have been retrieved.

medial to the midline will expose the median nerve. The forearm is supinated and the radial tuberosity visualized. There are generally shreds of tendon still attached to the tuberosity. Bursal and tendinous tissue is removed from the radial tuberosity with a rongeur. A trough is then made in the radial tuberosity (Fig. 8). The trough can be made with a power burr or with drill bits. Because burs generally come with small shanks, the senior author prefers to use drill bits. Before drilling, an awl is used to make two or three holes in a straight line over the tuberosity. The distance between the awl holes should approximate  $\frac{1}{4}$  inch, because this is usually the largest drill bit that can comfortably be inserted into the tuberosity. The awl holes are enlarged with the drill. The drill does not violate the posterior cortex. Any bridging bone between the holes can be removed with a rongeur, creating a trough that will comfortably contain the end of the ruptured distal biceps tendon. The biceps tendon will eventually be secured in the trough by making two holes in the posterior cortex.

The drill holes in the posterior cortex can be made

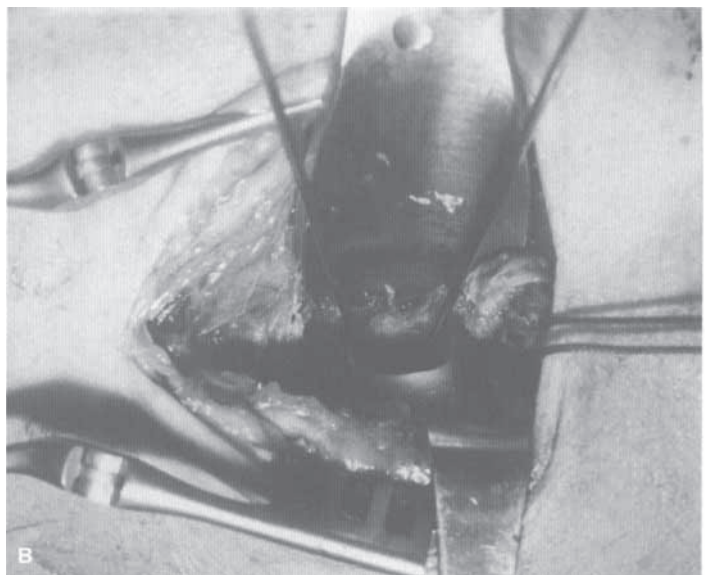
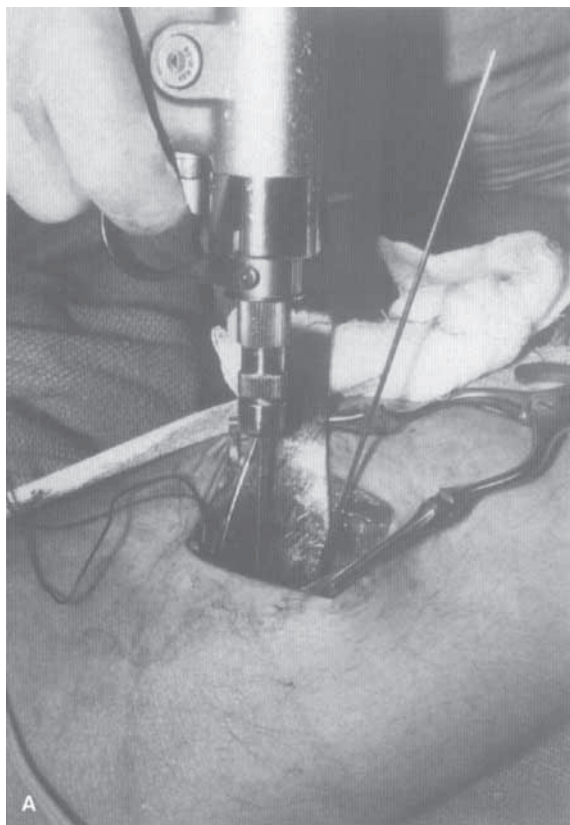
safely by palpating the posterior edge of the extensor muscle mass; this edge is one or two fingerbreadths anterior to the posterior edge of the subcutaneous proximal ulna. While maintaining a finger over the posterior edge of the extensor muscle mass, a hole is made in the posterior cortex. A 0.062 smooth Kirschner wire is used to make the hole while the arm is held in full supination. Directing the wire toward the posterior lateral edge of the proximal ulna will avoid injury to the more anterior posterior interosseous nerve. The Kirschner wire is left in place as a directional guide, and a similar wire is placed more distally, following the general direction of the first wire, but converging posteriorly (Fig. 9). The holes are generally placed proximally and distally in the posterior cortex to provide an adequate bony bridge. The Kirschner wires are removed, and a Keith needle is passed through each drill hole and pushed through the soft tissues posteriorly. A small incision is made over the protruding Keith needles, and the needles are retrieved (Fig. 10). The incision only needs to be large enough to allow retrieval of the sutures and tying of the knot. The needles

**FIG. 8.** The trough in the radial tuberosity. Note the protection and visibility provided by placement of the Cobra retractor medially.



are then pulled through and traction applied to the sutures, bringing the tendon end into the bony trough (Fig. 11). While the elbow is flexed and supinated, the suture is tied. No attempt is made to dissect down to the posterior cortex of the radius. The suture is tied directly over

the posterior muscle mass. Most of the time, the tendon end will lie within the intramedullary cavity of the radius; sometimes the tendon end will rest at the entrance to the trough. Either position is acceptable and has not been shown to affect the clinical outcome.



**FIG. 9. A:** The Cobra retractor is medial; the self-retained retractor, distal. Note the relative convergence of the K-wires as they enter from opposite ends of the trough. **B:** Care is taken to insure an adequate posterior bony bridge.



**FIG. 10.** The Keith needles exit posteriorly between the posterior edge of the extensor muscles and the subcutaneous border of the ulna.

## ■ COMPLICATIONS

Fortunately, complications from distal biceps tendon repair are uncommon. Postoperative infections and tendon re-ruptures are rare. Irritation of the antebrachial cutaneous nerves can be avoided with appropriate skin incisions. Injuries to the radial nerve are typically transient but can be devastating (6,12). Sporadic cases of proximal radioulnar synostosis continue to be reported and seem to be more common with the two-incision technique (7,10, 13). Limiting soft tissue dissection and not exposing the ulna appear to reduce the risk of this complication. Heterotopic calcification continues to be a problem but may represent the chronic nature of the injury rather than surgical soft tissue damage (10).

## ■ REHABILITATION

Postoperatively, the arm is immobilized in a long arm splint with the elbow flexed and the forearm supinated. The arm is placed in a position that takes the tension off the repair; most elbows are placed in 60° to 90° of flexion. One week later, the splint is removed and the arm placed in a long arm cast in a similar position. The arm is immobilized for a total of 4 weeks. At 4 weeks, the patient begins range of motion exercises. The arm is then placed in a hinged brace with an extension stop at the degree of flexion noted at the 1-month visit. This extension stop is gradually decreased until full extension is reached. Isotonic and isokinetic strengthening exercises are begun at 6 to 8 weeks and resisted exercises at 2 months. Return to all activities is allowed 12 to 16 weeks after surgery.



**FIG. 11.** Traction on the sutures posteriorly pulls the tendon end into the trough. Position of the tendon end should be checked after the first knot is tied and before the suture is secured with multiple knots.

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