Central band reconstruction for the treatment of Essex-Lopresti injury: A novel technique using the brachioradialis tendon

Emmanuel P. Apergis, Panagiotis T. Masouros, Vasileios S. Nikolaou, George Arealis, George C. Babis

From the Orthopaedic Department, Red Cross Hospital of Athens, Greece


KEYWORDS: Essex-Lopresti; brachioradialis tendon; interosseous membrane; central band reconstruction; longitudinal radioulnar dissociation.

INTRODUCTION

Essex-Lopresti lesion or longitudinal radioulnar dissociation (LRUD) occurs when a high-energy force is axially applied on the forearm. It is characterized by fracture of the radial head, dislocation of the distal radioulnar joint (DRUJ) and rupture of the interosseous ligamentous complex (IOLC) (7). A high level of clinical suspicion is required in order to recognize the true extent of the injury since 75% of injuries can be missed on first presentation (34). Careful clinical and radiological examination of elbow and wrist should always be performed: Bilateral x-rays of the elbow, forearm and wrist are indicated and any DRUJ length discrepancies as well as shortening of the distance between radial tubercle and coronoid process must...
be evaluated. MRI and ultrasound can aid to the diagnosis by detecting IOLC tears (25). Finally, radius pull test (29) and the radius joystick test (30) can help to evaluate the integrity of IOLC intraoperatively.

The treatment of Essex-Lopresti lesion depends on time of diagnosis, extent of injury of IOLC and functional demands of the patient. Although reconstruction of the central band (CB) has been supported by many authors as an essential part of the treatment, there is no widely accepted technique. We present a novel technique for the reconstruction of the IOLC by rerouting the tendon of brachioradialis (BR).

**CASE PRESENTATION**

A 50-year old school teacher fell from a height of 10 ft (3 m) onto his outstretched left non-dominant hand. Initially, he was admitted in a district hospital with pain, swelling and limitation of elbow movement. Radiographic examination showed a comminuted radial head fracture (Fig. 1a). An above elbow backslab was applied and he was referred to our unit.

On presentation to our hospital, two days later, the limb was neurovascularly intact; elbow and wrist movements and DRUJ examination were painful. Radiographs of the whole forearm revealed proximal migration of the radius (Fig. 1b) and DRUJ subluxation (Fig. 1c). MRI of the forearm identified rupture of the IOLC (Fig. 1d). Hence, the diagnosis of an Essex-Lopresti injury was established.

![Fig. 1a. — Anteroposterior radiograph demonstrating the comminution of the radial head fracture](image)

**Fig. 1b. — Posteroanterior view of the wrist demonstrating the radioulnar discrepancy**

![Fig. 1b](image)

Restoration of all three components of the injury was proposed to the patient. On the fifth day from injury, under general anesthesia, the patient was positioned supine with the hand on an arm table. The difference in ulnar-variance was measured radiographically, using the radius pull test and was found +5 mm. A tourniquet (250 mmHg) was used and the procedure evolved in three stages:

a) The radial head was exposed through the posterolateral approach (Kocher). The comminution of the radial head precluded any attempt for ORIF; hence radial head replacement was performed in a standard manner (Bi-polar, SBI, rHead™ Recon). Post replacement, radioulnar length was restored and leveling of distal radioulnar joint was confirmed radiographically.

b) Dorso-ulnar approach to the DRUJ. Rupture of dorsal capsule was identified with avulsion of dorsal and volar distal radioulnar ligaments from their ulnar insertion. TFC was trapped between
central band reconstruction for the treatment of essex-lopresti injury

the seat of the ulnar head and the sigmoid notch (Fig. 2a). Release and reinsertion of TFC to the fovea using a bone anchor was performed. Then the dorsal capsule of the DRUJ was sutured.

c) Using a 10 cm longitudinal incision along the lateral forearm compartment the first dorsal compartment was released and the wide insertion of brachioradialis tendon was identified and detached with a bone block using a fine osteotome from its insertion on radial styloid. The tendon was freed-up from distal to proximal up to its musculotendinous junction, while taking care not to injure the superficial radial nerve (Fig. 2b). Radius was approached through the interval between the dorsal border of BR and ECRL muscle and subperiosteal dissection was carried out. At approximately 60% of the radius length, as measured from the radial...
A bone tunnel was created in an oblique fashion from radiodorsal to ulnovolar using drills with gradually increasing diameters (from 3.2 to 4.5 mm) (Fig. 2c). An additional 2 cm skin incision was made on the ulnar side at a point near the junction of the middle and distal thirds of the ulna. A unicortical oblique osseous hole was created on the radial border of the ulna using a 4.5 mm drill, and two separate smaller holes (2.8 mm) were created on the ulnar border of the ulna. The BR tendon was then rerouted in a distal oblique direction at an angle of approximately 21° to the long axis of the ulna. It was passed through the radius entering dorsal to IOLC and beneath extensor tendons. A Kelly hemostat was passed from distal ulna to proximal radius, grasped the incorporated bone block to the BR tendon and pulled back to the ulnar incision. Only the distal end of the BR tendon was fixed with a Bunnell stitch using a No 2 nonabsorbable suture: the bone block was readjusted and embedded into the osseous hole of the radial border of the ulna. Sutures were threaded through the two holes, tied over the bone bridge of the ulnar border of the ulna and tensioned with the forearm in neutral rotation (Fig. 2d). Pronosupination was assessed and the incisions were closed. At the end of the procedure, the DRUJ was transfixed with the forearm in neutral rotation with a 2 mm smooth K-wire (Fig. 3) (Fig. 4 a, b).

Postoperatively, the patient was placed in a sugar-tongue splint in neutral forearm rotation for 5 weeks after which the splint and the K-wire were removed and forearm and wrist motion initiated. Weight bearing activities were restricted for 6 additional weeks.

**Pearls and Pitfalls**

- It is crucial to re-establish the length of the radius before starting the CB reconstruction. If needed, an ulnar shortening osteotomy may precede.
- When mobilizing the BR tendon, it is important to recognize and protect the superficial branch of the radial nerve by retracting it medially. It becomes subcutaneous at a mean of 8.5 cm proximal to the radial styloid, emerging in dorsal

---

*Fig. 2c.* — The brachioradialis tendon graft passing through the oblique bone tunnel created to the radius, from an ulnovolar to radiodorsal direction (arrow).

*Fig. 2d.* — Through a 2 cm ulnar incision the tendon graft embedded into the osseous hole created to the radial border of the ulna and sutured over two small holes created to the ulnar border of the ulna.

*Fig. 3.* — X-ray of the forearm at the end of the procedure.
The wider proximal aspect of the tendon could be trimmed or folded with stitches to produce a uniform tendon graft.

The graft should be placed in (20°-24°) angle with respect to the long axis of the ulna replicating the anatomy of the native CB, while a more horizontal orientation may have an adverse effect on the range of rotational movements. Slight inaccuracy in the proximal - distal direction may be less significant (1,4,16,17).

RESULTS

A close clinical follow-up examination was carried out in the first months (1, 3 and 6 months) and then annually until 44.9 months (3.68 years). ROM and grip strength were electronically measured with E-link (Biometrics, Gwent, UK), using the other hand as control. The patient was already pain-free 3 months after the operation with no DRUJ instability. He had a functional ROM of 8°-125° degrees flexion/extension of the elbow and 150° pronosupination, which improved further to 0 to 133° flexion/extension, 85° supination and 80° pronation at 9 months. Wrist flexion was 68° and extension 81°. Grip strength was measured in kilograms with the dynamometer set at five positions of which the mean value was based on three trials for each grip strength position. At final follow-up, average grip strength was 32 kg, reaching 96.3% of the contralateral side.

Upper limb function was measured using the Disability of Arm, Shoulder and Hand (DASH) outcome questionnaire (13) and was found 18.3. Elbow function was evaluated using the Mayo Elbow Performance Score (MEPS) (18) and was found 100. Wrist function was 100 and was measured using the modified Mayo wrist score (2).

All of the above measurements indicate a good to excellent function. Radiographic examination of the elbow at the final follow-up showed a well-fixed distal stem and bone resorption (stress shielding) immediately beneath the implant collar (Fig. 5 a,b).

Assessment of sequential postoperative x-rays revealed that bone resorption beneath the implant collar started at 5 months post-surgery and was

Fig. 4. — Schematic drawing demonstrating the reconstruction using brachioradialis tendon rerouting technique

direction between the BR and extensor carpi radialis muscles (24).

Fluoroscopy can aid to mark precisely the appropriate location for bone tunnels creation in order to attain the required orientation of the graft.

In order to avoid iatrogenic fracture during ulnar tunnel creation, drill bits for the opposite cortex should not exceed 2.8 mm in diameter and diverge as much as possible. Prophylactic plating, although proposed by some surgeons, is not routinely recommended (20).
completed in one year. Since then it remained unchanged. The ulnar variance measured -2 mm, did not change with clenched fist views and was equal to the contralateral healthy wrist.

DISCUSSION

When treating an Essex-Lopresti lesion, it is paramount to address all the injured components in order to restore both the longitudinal stability and the transverse stability of the forearm bones: The radial head should be preserved if amenable to repair; otherwise a metallic prosthesis is indicated. Open reduction of the DRUJ, in conjunction with direct TFCC repair and DRUJ pinning are also well-established procedures (1,5). Finally, the central band has to be reconstructed so that normal load distribution is re-established. Otherwise excess force transmission through the radiocapitellar joint will eventually lead to implant instability, arthritis and pain (36). When treating delayed cases, it is crucial to evaluate whether the proximal radial migration is reducible or fixed. If it’s reducible, then radial head replacement and DRUJ reconstruction and pinning, constitute the usual practice. If it’s fixed, leveling of the radioulnar joint must precede, either with an ulnar shortening osteotomy or by using a distraction device as a one or two stage procedure (1,4).

While chronic instability is clearly the absolute indication for CB reconstruction, the procedure can also be used for active patients in the acute phase. There is strong evidence suggesting the low healing potential of the CB (1,12,16). Reasons being: interposition of forearm musculature and high ratio of collagen to elastin content (19). Although suture repair of the CB has been described (23,26) there is no data to suggest that this is any better than allowing the IOLC to scar once a normal radioulnar relationship has been restored (32). As a result, a reconstruction procedure must be considered.

Sellman et al. (28) were the first to investigate the biomechanical effect of replacing the radial head and reconstructing the IOLC with a polyester cord in a cadaveric study in 1995. They demonstrated that reconstruction of IOLC alone could restore forearm stiffness by 94%. Many procedures have been described since then for the reconstruction of the IOLC.

We can classify them into one of three types depending on the graft used:

a. Local graft from the injured forearm: single or double band flexor carpi radialis (FCR) tendon (22,33), pronator teres (4,17), palmaris longus (33).

b. Graft harvested from a healthy region: bone-patellar-bone (BPB) tendon (1,16), or hamstrings/semitendinosus tendon (31).

c. Synthetic materials or allografts: Mini Tight Rope and suture-button constructs (6,11,14), Achilles tendon allograft (32) and anterior tibialis allograft (20).

Teiwani et al. (33) compared three tendon autografts for the reconstruction of the CB in radial head deficient cadaveric forearms: palmaris longus (PL), FCR and BPB tendon. They concluded that the BPB tendon could prevent proximal migration of the radial head more effectively than the other grafts, while none was capable to restore normal mechanics of the forearm. Marcotte and Ostermann reported good functional outcomes in a clinical series of 16 patients using BPB tendon for the treatment of an Essex-Lopresti lesion, but they underlined donor site morbidity as a major concern. 25% of the patients complained about knee pain and the authors suggested the use of a BPB allograft (1,16). Promising results have been reported using
central band reconstruction for the treatment of essex-lopresti injury

Micromotion of the BR tendon through the osseous tunnel of the radius during elbow flexion allows the graft to act as a dynamic stabilizer, more than a static one, at least in the early postoperative phase. This may protect the graft from excessive loads, until a biological incorporation has occurred. In the late post-op period, no motion of the graft through the radius tunnel is anticipated, thus providing a rigid construct. Yet, the transformation of the tendon graft into ligament and the integration of the tendon graft into the osseous tunnels have to be further investigated by biomechanical studies.

Advantages of our technique merit to be mentioned are: BR tendon is an autograft and the results rely on biological incorporation of the graft, ensuring long-term stability as opposed to synthetic constructs. When compared to the BPB tendon, the use of a local graft with an insignificant functional impact on elbow movements minimizes donor site morbidity. Moreover, the fixed length of BPB tendon and the difficulty in appropriate tensioning are additional limitations. The rerouting of the pronator teres tendon is an attractive alternative, but its technical difficulties and the proximity of the median nerve have reduced its reproducibility.

Finally, our technique pioneers dynamic stability with only one fixation point of the graft required. Regardless of the graft type, the reconstruction of the CB is technically demanding and requires careful preoperative planning and surgical expertise. Appropriate graft orientation and tensioning are the keys to having a favorable outcome. The optimal position of the forearm, in which the graft should be tightened, remains to some extent controversial: While some authors claim that the CB is significantly shorter in supination, Moritomo et al have shown, that the CB demonstrates isometric properties during forearm rotation suggesting a neutral position to tighten the graft. Most surgeons prefer to tension it in neutral rotation or slight supination.

Our technique has shown that the BR tendon can safely be used as a local graft for IOLC reconstruction. Further clinical and biomechanical studies are necessary to evaluate the efficacy of the technique.
REFERENCES


32. **Stabile KJ, Pfaeffle J, Saris I, Li ZM, Tomaino MM.**

33. **Tejwani SG, Markolf KL, Benhaim P.**

34. **Thomason K, Burkhart KJ, Wegmann K, Muller LP.**

35. **Tirrell TF, Franko OI, Bhola S, Hentzen ER, Abrams RA, Lieber RL.**

36. **Tomaino MM, Pfaeffle J, Stabile K, Li ZM.**

Acta Orthopædica Belgica, Vol. 85 - 1 - 2019