CASE REPORT

Ulnar Nerve Reconstruction With a Basilic Vein Tributary Graft: A Practical and Easily Replicable Technique With Favourable Outcomes

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ABSTRACT

A young gentleman presented with a closed fracture of the left radius and an open fracture of the left ulna complicated with segmental loss of the ulnar nerve measuring 1.5cm. After thorough debridement and stabilization of the bone injuries, the ulnar nerve gap was bridged with an autologous venous graft harvested off a tributary of the basilic vein that served as a nerve conduit. At 18 months post-surgery, sensori-motor function of the patient's left ulnar nerve was nearly fully restored, indicative of successful reconstitution of the ulnar nerve using a basilic vein tributary vein graft.
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INTRODUCTION

Reconstitution of nerves using grafts have been well-documented in prior studies. The gold standard for reconstruction of nerve defects involve utilization of tension free autologous nerve grafts, however, studies to search for alternatives with similar or better outcomes have always been mooted. The use of autologous vein grafts as conduits to reconstruct nerve defects have been found to be a useful option with favourable outcomes. The authors present a successfully managed case of ulnar nerve reconstitution using a practical and easily replicable method with favourable outcomes at 18 months after surgery.

CASE REPORT

A 20-year-old gentleman presented to the Emergency Department with a closed fracture of the left radius and an open fracture of the left ulna, following an awkward fall while playing "sepak-takraw". "Sepak-takraw" is a traditional sport commonly played in South-East Asia akin to volleyball but played with the feet. Acrobatics such as overhead kicks are employed to volley a rattan ball over a net to score points. Due to these acrobatics, maneuvers to prevent falls using outstretched upper limbs are common, inadvertently leading to upper limb injuries such as that seen in this case.

The patient presented within an hour of his injury with a deformed left forearm. An open wound measuring 2x1 cm over the ulna border of his forearm was seen. He had reduced sensation over the ulnar nerve distribution, with a subtle ulna claw deformity of the left hand. Radial and median nerve function was intact in addition to a normal distal circulation status. Plain radiographs of the left forearm revealed fractures of the mid-shaft region of left radius and ulna [Figure 1(a)].

After administration of intramuscular tetanus toxoid and intravenous cefuroxime, his wound was irrigated, dressed and his left forearm placed in an above elbow backslab. Consent was taken that included the possibility of an autologous nerve graft or vein graft harvest to address the possible ulnar nerve injury. He underwent emergency wound debridement and exploration of the forearm in addition to dynamic compression plating of his left radius and ulna within the same day of presentation [Figure 1(b)].

Intraoperative findings noted that the wound at the ulnar border of the left forearm was in communication with the ulna fracture site. The proximal ulna bone fragment had buttonholed through the flexor carpi ulnaris muscle, narrowly missing the ulnar artery. There was a 1.5cm segment of the ulnar nerve which was transected (held by a sleeve of epineurium) at the proximal third of ulnar bone [Figure 2(a)]. Taking advantage of the abundance of basilic vein tributaries at the vicinity of the surgically extended wound, a basilic vein tributary vein graft measuring 3 cm was harvested. Care was taken to ensure that the harvested vein was turned inside out to ensure tubolization of the nerve was unimpeded. The vein graft and epineurium of the ulnar nerve ends were apposed tension free using 9-0 Prolene sutures [Figure 2(b)]. Post-operatively, the patient was placed in an anti-ulna claw splint and started on oral vitamin B-complex supplements. Range of motion exercises of the digits and the wrist were taught and supervised by physiotherapists and occupational therapists to ensure compliance and favourable outcomes.

Both fractures healed without complications within 2 months of surgery [Figure 1(c)]. At 4 months post-surgery, a nerve conduction study done showed absence of ulnar sensory nerve action potentials (SNAPS) with normal conduction velocity (CV), while electromyography showed absence of compound muscle action potential (CMAPS) but normal distal motor latency (DML) of ulnar nerve. At 6 months post-surgery, he had complete resolution of his ulna claw hand deformity with good flexor digitorum profundi function at his left ring and little fingers. The travelling Tinel sign was also noted at the tip of his little finger at this point in time. The numbness over the tip of his left little finger continued to improve and sensation was found to be normal at 18 months post-surgery as evidenced by his Semmes-Weinstein monofilament test which recorded a score of ≤2 in addition to a normal nerve conduction study. Most significantly, muscle power of all muscles innervated by the left ulnar nerve fully recovered with an MRC grade of 5. Fromment and Wartenburg signs were negative, and Quick DASH score was 0 at the latest follow up, indicating excellent hand function outcomes. Grip strength measured with JAMAR dynamometer was 80 lbs. The patient has been able to return to his normal daily activities without any deficits experienced in his left upper limb.

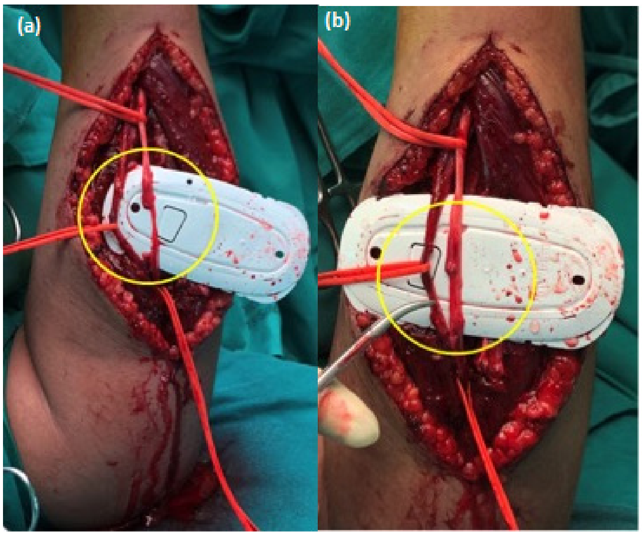

Figure 2: (a) Intra-operative image demonstrating the near total transection of the ulnar nerve held in place by a sleeve of epineurial tissue (area within yellow circle). (b) Intra-operative image demonstrating complete bridging of the transected ulnar nerve segment using the basilic vein tributary vein graft (area within yellow circle).

DISCUSSION

Peripheral nerve injuries occur in approximately 3% of upper limb trauma and are associated with penetrating injuries or displaced fractures (1). If treated unsuccessfully, these injuries may lead to debilitation of function. This has led to an unwavering search for an ideal method to repair or reconstitute nerve in order to restore form and function.

In general, the principle of a nerve repair is to achieve a tension-free, end-end repair (1). However, this principle is not always applicable, especially with nerve injuries

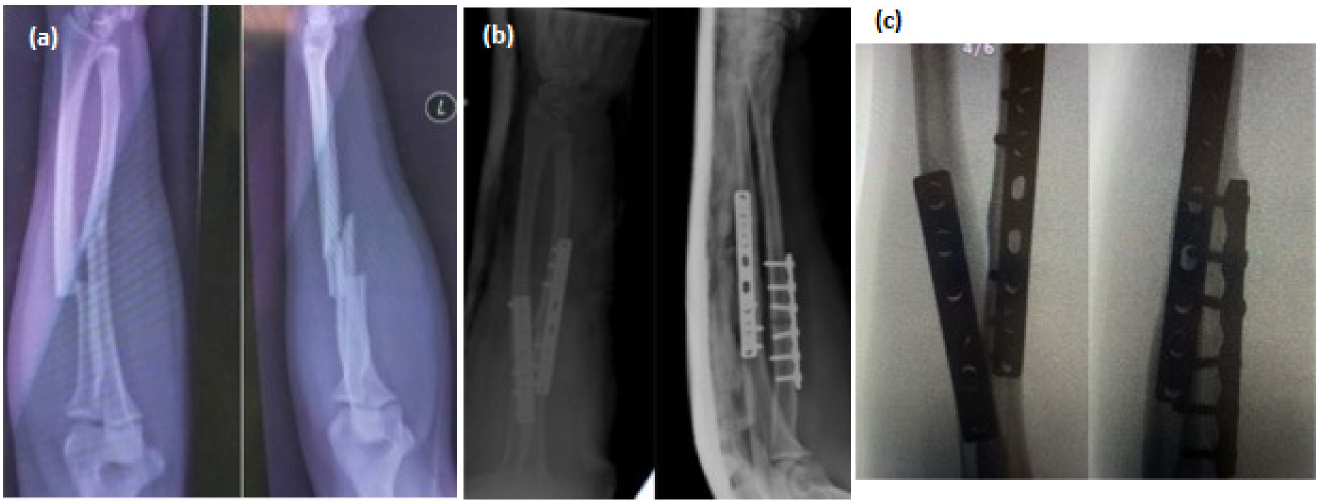

Figure 1: (a) Anterior-posterior and lateral plain radiographs of left forearm demonstrating midshaft fractures of both radius and ulna. The ulna fracture appears to have an oblique configuration with a sharp spike, possibly contributing to transection of the ulna nerve. (b) Anterior-posterior and lateral plain radiographs of left forearm after dynamic compression plating demonstrating restoration of bony anatomy that provides secure splintage for the vein graft conduit.(c) Anterior-posterior and lateral image intensifier images of the left forearm demonstrating successful union of the radius and ulna fracture 2 months post-surgery.

associated with sizeable gaps. In these situations, nerve reconstructive procedures would need to be considered. Options for nerve reconstruction include autologous nerve grafts, acellular allografts and conduits (2,4).

Conduits commonly described include pre-formed mesothelial tubes, silicone tubes, absorbable conduits and vein grafts (2). These conduits facilitate tubolization of the proximal and distal ends of a severed nerve. By using nerve conduits, this avoids the morbidity associated with autologous nerve grafting including neuroma formation at the donor site, scarring and permanent loss of function. In addition, with nerve autografts there is the possibility of mismatch of nerve and graft dimensions due to limited donor nerve availability (1).

An ideal conduit would need to be bio-compatible, non-immunogenic, bio-degradable, semi-permeable and of appropriate porosity to allow exchange of oxygen and nutrients. Conduits should be mechanically stable, while simultaneously possessing flexibility to prevent compression of the regenerating axons (2). The theoretical advantage of a vein graft conduit in comparison to other conduits is that it allows nerve regeneration guided by neurotrophism, and acts as a barrier to soft tissue ingrowth and axonal over-sprouting at the co-aptation site. This in turn reduces the risk of neuroma formation. Considering the many prerequisite properties needed to be an ideal conduit, vein grafts have been found to be a favourable option (5).

Historically, vein graft conduits have been reported to be successful in management of distal sensory nerve defects, particularly in nerve defects measuring 1cm to 3cm involving nerves within the hand (1,3,5). However, there is scarcity of literature regarding the application of vein graft conduits involving larger nerves of the forearm and their outcomes in relation to restitution of motor function.

In the case described, the basic principles of utilization vein graft conduits were applied. These included the identification of the extent of the nerve defect, debridement of the transected nerve ends, harvesting of a vein graft 50 percent longer than the nerve gap. Should a fracture be present concomitantly with the nerve defect, prior bony stabilization to provide secure splintage for the vein graft conduit must be done. The vein graft was turned inside out empirically to prevent the possible impediment of nerve sprouting by venous valves. The unique aspects of the case described were the use of a tributary of the basilic vein which was harvested within the extended wound that was required during debridement of the open fracture. These veins were found to be ample within the forearm and would be readily available for use as vein graft conduits, obviating the need for a distant donor site that may contribute to further morbidity. Although classical teaching mandates the use of a vein graft with a diameter measuring twice of that of the nerve, a vein of similar diameter to that of the nerve was used in this case with favourable outcomes. In addition to this, while most studies and reports focus on sensory restoration within digital nerves, near total restoration of sensori-motor function is seldom highlighted but was observed in this case. Furthermore, the successful use of a vein graft conduit to address an injured nerve within the forearm in comparison to a digital nerve indicates the immense potential of vein grafts conduits for management of injuries in larger nerves.

Taking into account these points and the successful outcome of this patient, the authors aim to highlight and add to the current compendium of possible techniques and outcomes in using vein graft conduits to reconstruct traumatic nerve defects.

CONCLUSION

In conclusion, despite autologous nerve grafts remaining as the gold standard for nerve repair, autologous vein grafts offer a good option for reconstruction of nerve defects within the forearm due to their abundance within the area of injury and relatively good outcomes as observed in the case described.

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