Guest Editorial

Harnessing the Magic of Nerve Reconstruction for Restoring Function in Total Palsies (Dr A.K. Banerji Oration ISPNSCON 2024)

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The technique of nerve repair has been known for over a century. Closed traction injuries of the brachial plexus are commonly seen after road traffic accidents, particularly following falls off two wheelers. Most of these injuries, unfortunately, involve all five roots of the brachial plexus with disconnection of the brain and spinal cord from the upper limb. Restoration of function in the paralyzed upper limb depends upon reestablishment of the connection with the brain. Essentially, it means approximation of functioning nerves to the broken nerve ends. A large majority of such injured roots are avulsed from the spinal cord (intraforaminal or preganglionic lesions). Hence, one must depend upon nerve donors from outside the brachial plexus. The fact that the outcome of a nerve repair is not seen immediately cannot be ignored. The delay in appearance of any function is inevitable. In addition, the standard nerve transfers are known to be more reliable for proximal functions (rotator cuff, biceps, triceps, and pectoralis major) as the axons must grow over shorter distances before they reach their target muscles. In fact, function distal to the elbow is only seen when the proximal donor provides a large number of axons. In such circumstances, ruptured root stumps in the neck are valuable commodities.

Surgical Strategy

The inevitable delay in observing outcomes implies that the surgeon must plan reconstruction based on his or her knowledge of available techniques. The surgeon must be acquainted with all such nerve transfers and the anticipated outcomes. The patient's age and the delay from the accident are the most important parameters that influence the results. In general, nerve repairs do not provide consistent results at delays greater than 6 months and are not recommended after 9 months. Repairs close to the target muscles can be attempted at 6 to 9 months, particularly in younger patients (<30 years).

In dealing with total palsies, we consider restoration of elbow flexion a priority and choose to direct our best effort to achieve that goal. Reinnervation of the rotator cuff is essential for stabilization of the shoulder. For this, transfer of the spinal accessory nerve (divided distal to the branches to the upper trapezius) to the suprascapular nerve is preferred. In most cases (across age groups), the patient regains 30 to 45 degrees of abduction while standing. In fact, if the quality of the suprascapular nerve is not reliable (injury extending up to the notch) or the spinal accessory nerve is not functioning, shoulder fusion is planned for a later stage. Function distal to the elbow is limited to restoration of flexion of the wrist, fingers, and thumb. For this, the nerve donor must provide many axons. Ruptured root stumps in the neck must be identified. Presence of a strong Tinel sign (paresthesia in the sensory distribution of the C5–C6 roots on application of pressure at the posterior border of the sternomastoid) and some function in the serratus anterior point to the existence of such ruptures and warrant careful dissection medial to the phrenic nerve. The integrity at the foramina is confirmed by stimulation of the branches to the serratus anterior and examination of the cut section lateral to these branches. Traditionally, the ruptured stumps were bridged to the medial root of the median nerve below the clavicle using multiple cables of nerve grafts. Mobilization of the lower trunk by separation of the posterior division of the lower trunk and sectioning the pectoral branches allow direct approximation to the root stump. This involves meticulous separation of the lower trunk in the neck and dissection in the deltopectoral region. The superior outcomes achieved by these efforts have been signaled by Wang et al.[1] This is based on the concept that elimination of one suture line avoids the consequent loss of axons and time so that they arrive in greater numbers and at an earlier stage at the target muscles (less time for degeneration of the motor end plates). In an earlier publication (May 2013), Wang et al[2] popularized the

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use of the full C7 transfer by the prespinal route for direct approximation to the mobilized lower trunk. Our team validated the concept of achieving superior outcomes by direct C7 transfers in 2017.[3]

Extension of the fingers is essential for independent use of the hand. For this, transfer of the phrenic nerve to the posterior division of the lower trunk[4] was proposed. In our experience, this has proved to be the most reliable method of restoring triceps, but finger extension has remained elusive.

Secondary Operations

Full restoration of function in the completely paralyzed upper limb by nerve reconstruction alone is inconceivable. One must await a plateau in the functions at the shoulder, elbow, and hand. The patient is guided for daily repetition of actions to recruit each transfer for gradual strengthening of the target muscles. Eventually, we plan for secondary orthopaedic operations to try and improve the utility of the recovered muscles. Lack of external rotation at the shoulder is addressed by a derotation osteotomy of the humerus to enable the patient to place the hand on a table in front of him. Arthrodesis of the wrist has been found to augment the strength of the finger flexors. In addition, the distal radioulnar joint is fixed to keep the forearm in 20 to 30 degrees of pronation (functionally and cosmetically superior). In most cases, finger flexion is accompanied by a strong flexor carpi ulnaris that becomes redundant after wrist arthrodesis. This is harnessed by bridging the end of the tendon to the dorsum of the metacarpophalangeal joint of the thumb using a tendon graft passed along the thenar eminence.

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Conflict of Interest
None declared.

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