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Commentary

Carotid sheath route: Is it the solution for the problems of the pre-spinal route?

The treatment of complete brachial plexus injuries remains a challenge to all surgeons engaged in microvascular and microneural reconstruction. These are young individuals affected by the loss of control of the entire upper limb. Over the past five decades, experience has been gained in various techniques to restore function in the paralysed arm. However, consistent results have been reported only with proximal muscles. Thus, one can reasonably expect to restore the ability to place the arm in space. The utility of these primitive movements (shoulder abduction through the reinnervated supraspinatus and deltoid, adduction from the pectoralis major and elbow function from the biceps and brachialis) is improved by simple orthopaedic operations. However, the complex functions distal to the elbow remain elusive. This is, largely, due to the paucity of sources of donor axons. The possibility of borrowing a nerve from the opposite normal brachial plexus was introduced 30 years ago and represented a remarkable leap of faith. This idea of harnessing a root that was completely intact without producing significant deficit appeared to be the answer to the problem of restoring strength in the fingers. Although the original authors had described the use of the full C7, fear of producing a deficit in the donor limb deterred most other surgeons from following them. The literature is strewn with reports of the use of half the C7 root bridged with vascularised or non-vascularised nerve grafts to the paralysed upper limb. The strength of finger flexion is unsatisfactory and is achieved in a sporadic manner at best. In this scenario, the report by Wang Shufeng in 2013 sought to oppose several ideas that were considered as gospel. For the first time, flexion and extension of the elbow and fingers could be restored and a patient with a flail upper limb could reach out, grasp, and release an object independently (without the help of the opposite normal hand). The most important aspects of this strategy were direct repair of the donor and recipient nerves for the C7, phrenic and spinal accessory nerves. Wang sought to surmount this wide gap of the opposite C7 and the lower trunk on the paralysed side by passage of the C7 along a pre-spinal route and by mobilisation of the lower trunk by sacrifice of some proximal branches. This produced strong flexion of the wrist and fingers (the ulnar nerve was not sacrificed) that could be readily re-educated so that the patient could activate the function without forced manoeuvres of the donor limb. This was reported in an astounding 60% of operated patients. The veracity of these claims has been confirmed in our own experience with this technique.

However, the pre-spinal route has proved to be a strong deterrent for wide diffusion of the method. The length of the C7 harvested has often been inadequate to cross the midline. Hence, the repair has to be performed at a very inconvenient location. That affects the quality of the repair. In addition, injury to important vital structures could be responsible for complications that are not seen with the use of nerve grafts passed along a subcutaneous tunnel across the chest.

Colleagues in China and Taiwan have described alternatives to the pre-spinal route.

Doshi and Bhat have proposed a method that appears simple to execute and allows a repair at a site that is readily accessible. The direct passage from the intervertebral foramen to the subcutaneous plane through the carotid sheath is an innovation that is very appealing. The technique combines simplicity of execution with the security of not affecting any important structure. The mobilisation of the lower trunk follows the steps that have been described previously. The site of the lesion affects the length of the segment of the C8T1 roots that had to be trimmed. That could limit the utility of this new method. Wang, too, has referred to this as a hindrance to achieving direct approximation behind the oesophagus. In addition, passage anteriorly instead of the transverse

direction could lead to a loss of length of the C7. The anterior division of the lower trunk may not always reach the midline at the suprasternal notch and might necessitate skeletal shortening.

Experience with nerve grafting of the opposite C7 (full root) to the ipsilateral lower trunk has shown that there is a remarkable difference when the ends are approximated directly. One has to overcome the hesitation to repair with the limb in the adducted position. The true utility of the C7 transfer can be realised only in this manner. The carotid sheath route is an exciting new prospect that, I expect, would encourage more surgeons to venture forward in the quest of restoring prehension in these young patients with complete brachial plexus injuries. I must congratulate Dr. Piyush Doshi and Dr. Yogesh Bhat for leading the way.

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