Medial pectoral nerve transfer

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Dr. Wellons and his colleagues\(^6\) report convincing evidence that medial pectoral nerve (MCN) to musculocutaneous nerve (MCN) transfer can improve elbow flexion in infants with birth brachial plexus injury.\(^6\) They performed the MPN transfer procedure in a relatively large number of patients and achieved excellent surgical outcomes. Their results corroborate those previously reported by Blaauw and Sloof\(^4\) and make a strong case for MPN as a donor nerve that can be used in brachial plexus reconstruction for birth injury. The present report will serve as a valuable reference for many years. I commend the authors for their significant contribution to the treatment of birth-related brachial plexus injury.

Some aspects of their report and the use of this particular MPN transfer in infants warrant discussion. As the authors indicate, infants with C8–T1 injury would not be candidates for the nerve transfer procedure because the MPN receives output from C8–T1 nerve roots. Potential candidates are infants with C5–6 or C5–7 injury. In these infants, surgical treatment should be aimed to maximize improvement of both shoulder and elbow function and should be undertaken before 12 months of age. Patients with persistent limited shoulder abduction, arm external rotation, and elbow extension/flexion suffer from life-long disabilities, and they develop fixed shoulder and elbow joint deformities that cannot be corrected. Unless infants show shoulder abduction greater than 90°, the limited shoulder abduction in infancy will lead to worsening shoulder abduction due to increased shoulder adductor contractures. These patients cannot carry out arm movements that require concomitant shoulder movement. Orthopedic procedures for the fixed deformities coupled with muscle weakness do not restore full shoulder and elbow function. For example, rotational osteotomy at a later age can reposition the arm in more external rotation but does not increase the total arc of motion of the arm. Fixed elbow flexion deformities cannot be fully corrected with surgeries. Shoulder subluxation/dislocation and resulting late shoulder deformities cannot be prevented in many patients. Thus, one should not rely on palliative orthopedic procedures later in childhood. Instead, one should employ a broad brachial plexus reconstruction before the patient reaches 12 months of age.

When planning a type of brachial plexus reconstruction for C5–6 or C5–7 injury, one should remember favorable surgical outcome of resection of neuroma and nerve grafts, sometimes combined with C-4-suprascapular nerve neurotization. Gilbert and colleagues\(^5\) reported shoulder abduction of more than 90° in 81% of 241 infants with C5–6 repairs and 76% of 81 infants with C5–7 repairs. Such good improvements were also observed in elbow flexion and extension. We have reported similar outcomes.\(^1\) In contrast, the MPN transfer improves only elbow flexion but does not help improve elbow extension and shoulder function. If infants older than 6 months cannot flex their elbow against gravity but can abduct their shoulder more than 90°, the MPN transfer would be a good option. However, I have not seen persistent weakness confined to the biceps in our patients, nor am I aware of reports of such cases in

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Editorial

See the corresponding article in this issue, pp 348–353.
infants. In other words, persistent elbow flexion weakness is always associated with shoulder abduction weakness.

A report by Belzberg et al. helps clarify the utility of MPN transfer for the treatment of birth-related brachial plexus injury. In a survey of experienced surgeons in many countries, the authors presented the case of an infant who suffered a traumatic birth injury and at 5 months of age exhibited 20° of shoulder abduction, 45° of elbow flexion against gravity, and Grade 3/5 supraspinatus and infraspinatus muscle strength. Of 49 respondents, 14 said they would not operate and 35 said they would. Of the 35 surgeons who would operate, 17 would do resection of the neuroma with or without C-4-suprascapular nerve transfer. Some surgeons said they would perform partial resection of the neuroma without nerve grafts or perform external neurolysis first followed by various nerve transfers later. A pertinent finding is that only a single surgeon chose to do the MPN-MCN transfer. The survey points to the use of multiple surgical approaches to management of birth-related brachial plexus injury as well as rare utilization of MPN transfer for treatment of C5–6 birth injury. In our center, we have not performed the MPN transfer in any patient, but we have performed radial nerve-axillary nerve transfer in 3 patients and C-4-suprascapular nerve transfer in many patients to improve shoulder abduction.

Which group of infants with birth brachial plexus injury would benefit from MPN transfer? Blaauw and Slooff employed the MPN transfer in 25 infants. All of their patients had upper root avulsions, and they described the pectoral nerve transfer as “part of an extended brachial plexus reconstruction, involving transfer of the accessory nerve to the suprascapular nerve (20 cases) and/or direct repair of upper roots to improve shoulder function.” I agree with Blaauw and Slooff that the MPN transfer would benefit infants who suffer C5–6 or C5–7 root avulsion and the MPN transfer should be combined with other brachial plexus reconstruction. When infants have good hand and wrist function but a flaccid shoulder and elbow, improved elbow flexion after the MPN transfer would help them significantly. On the other hand, if only the MPN transfer is performed on infants who have limited shoulder abduction or elbow extension, the patients will be deprived of a chance to benefit from other brachial plexus repair procedures. The shoulder function will be left to spontaneous recovery.

If Dr. Wellon and colleagues gave information regarding pre- or postsurgical elbow extension in their patients, it would help understand long-term efficacy of the MPN-MCN transfer. If we improve only elbow flexion in the presence of weak triceps in infants, the patients eventually develop elbow flexion deformities because of unbalanced elbow flexion and extension. As mentioned above, fixed elbow flexion deformity is not amenable to surgical correction. Elbow flexion deformity may help hand-to-mouth movements but limit other functions. Thus, whenever there is a way to improve triceps function at the time of brachial plexus reconstruction, one should perform the operation. Dr. Wellon and colleagues did not use intraoperative electrical stimulation to identify the MPN. Since the MPN transfer will be used only infrequently, surgeons would benefit from using intraoperative electrical stimulation to identify this nerve. Branches from the pectoral nerves form a loop running from the lateral pectoral nerve to the MPN. This plexiform arrangement can make it difficult to distinguish between the medial and lateral pectoral nerves. Additionally pectoral muscle contraction with direct stimulation allow identification of the proximal and distal stumps of the severed donor nerve. The stumps of the severed donor nerve that exhibit no pectoral muscle contraction with electrical stimulation are proximal stumps and should be transferred.

References


Response

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We appreciate the time Dr. Park has given to our paper. His knowledge of the salient literature is broad, his personal series of brachial plexus reconstruction is impressive, and his commitment to improving the lives of children suffering from these injuries is commendable. His comments during the review process helped us to better clarify the intended message of this publication.

It is clear that Dr. Park believes that improvement of shoulder abduction is impossible in the setting of a persistent inability to flex the elbow. There is, however, a subpopulation of our cohort whose shoulder abduction improved to 90° while still unable to flex the elbow and bring the hand to the mouth. We determined that these 10 patients were beyond the benefit of surgical intervention for either the suprascapular or axillary nerves and therefore performed MPN to MCN neurontization only. Worthy to note is that in those children who did undergo an SSN neurontization for the absence of recovery of shoulder abduction, we considered obtaining
90° of active motion to qualify as success. An evaluation of recovery of shoulder function or an overall review of our institutional experience was not the goal of our paper. Our intent was to examine the postoperative incidence of hand-to-mouth function in children who had undergone MPN to MCN neurotization for persistent elbow flexion weakness. As we continue to gain experience, it is likely that we will review the surgical results of neurotization procedures for shoulder abduction in a later publication.

While we feel that the anatomy of the ansa pectoralis and the lateral and medial pectoral nerves lends itself to a relatively straightforward intraoperative identification, we also use gentle direct motor stimulation of the nerve in order to observe for pectoralis muscle contraction. We did not feel it necessary to monitor either of the pectoral muscles, however, for compound muscle action potentials. The utility of intraoperative monitoring is unclear. As our practice evolved, we began to incorporate monitoring more into each procedure, particularly into the evaluation of root integrity for consideration of proximal donor sites for sural nerve grafts.

While we feel that this approach has led to acceptable outcomes and content patients at follow-up, we are certainly willing to continue to re-examine our approach to pediatric brachial plexus injury. Again, we are most appreciative of Dr. Park’s experience and contributions to the subject. In truth, the field continues to evolve due in most part to the multidisciplinary nature of peripheral nerve surgery (neurosurgery, orthopedics, and plastic surgery), and the surgeon who is able to reevaluate personal presumptions is more likely to have continued successful outcomes. (DOI: 10.3171/2008.12.PEDS08370)

Reference