CONTENTS

Dedication **ix**

Preface **xiii**
Susan E. Mackinnon and Christine B. Novak

Nerve Transfers in the Forearm and Hand **319**
Justin M. Brown and Susan E. Mackinnon

In the forearm, vital and expendable functions have been identified, and tendon transfers use these conventions to maximize function and minimize disability. Using similar concepts, distal nerve transfers offer a reconstruction that often is superior to reconstruction accomplished by traditional grafting. The authors present nerve transfer options for restoring motor and sensory deficits within each nerve distribution on the forearm and hand.

Nerve Transfers for Brachial Plexus Reconstruction **341**
Stephen H. Colbert and Susan E. Mackinnon

Brachial plexus injuries result in devastating loss of function for patients and present incredible challenges for peripheral nerve surgeons. Recently, nerve transfers have produced superior results compared with traditional interposition nerve grafts for brachial plexus reconstruction. The authors present a review of current surgical options for treatment of partial and complete adult brachial plexus injuries using nerve transfers.

Nerve Transfers in Brachial Plexus Birth Palsies: Indications, Techniques, and Outcomes **363**
Scott H. Kozin

The advent of nerve transfers has greatly increased surgical options for children who have brachial plexus birth palsies. Nerve transfers have considerable advantages, including easier surgical techniques, avoidance of neuroma resection, and direct motor and sensory reinnervation. Therefore, any functioning nerve fibers within the neuroma are preserved. Furthermore, a carefully selected donor nerve results in little or no clinical deficit. However, some disadvantages and unanswered questions remain. Because of a lack of head-to-head comparison between nerve transfers and nerve grafting, the window of opportunity for nerve grafting may be missed, which may degrade the ultimate outcome. Time will tell the ultimate role of nerve transfer or nerve grafting.

Nerve Transfer with Functioning Free Muscle Transplantation **377**
David Chwei-Chin Chuang

In this article, the author focuses on functioning free muscle transplantation (FFMT), an advanced microneurovascular technique indicated in patients who have an advanced injury with a major brachial muscle or muscle group loss or denervation and in whom no locally available or ideal musculotendinous donor unit exists. FFMTs have been successfully applied clinically in cases involving adult brachial plexus palsy, obstetric brachial plexus palsy, facial palsy, severe Volkmann's ischemia, and severe crushing and traction injuries of the forearm or arm with major muscle loss. As the author notes, FFMT is a new challenge for the reconstructive surgeon. He outlines the eight major principles for nerve transfer with FFMT, basing his conclusions on the more than 333 patients who received FFMT between 1995 and 2005 in his hospital.

Contralateral C7 Transfer in Adult Plexopathies **389**
Julia K. Terzis, Zinon T. Kokkalis, and Epaminondas Kostopoulos

In the current study, a retrospective review of 56 patients with posttraumatic root avulsion brachial plexus injuries who underwent contralateral C7 transfer using the selective contralateral C7 technique is presented. The intraoperative findings of the involved brachial plexus, the surgical technique of preparation of the donor C7 nerve root, and the various neurotization procedures are reported. The surgical outcomes as well as the potential adverse effects of the procedure are analyzed. We conclude from this study that the selective contralateral C7 technique is a safe procedure that can be applied successfully for simultaneous reconstruction of several different contralateral muscle targets or for neurotization of cross chest nerve grafts for future free muscle transplantation.

Measuring Outcomes in Adult Brachial Plexus Reconstruction **401**
Keith A. Bengtson, Robert J. Spinner, Allen T. Bishop, Kenton R. Kaufman, Krista Coleman-Wood, Michelle F. Kircher, and Alexander Y. Shin

The focus of this article is on evaluating the various outcome measures of surgical interventions for adult brachial plexus injuries. From a surgeon's perspective, the goals of surgery have largely focused on the return of motor function and restoration of protective sensation. From a patient's perspective, alleviation of pain, cosmesis, return to work, and emotional state are also important. The ideal outcome measure should be valid, reliable, responsive, unbiased, appropriate, and easy. The author outlines pitfalls and benefits of current outcome measures and offers thoughts on possible future measures.

Rehabilitation Following Motor Nerve Transfers **417**
Christine B. Novak

Cortical mapping and relearning are key factors in optimizing patient outcome following motor nerve transfers. To maximize function following nerve transfers, the rehabilitation program must include motor reeducation to initiate recruitment of the weak reinnervated muscles and to establish new motor patterns and cortical mapping. Patient education and a home program are essential to obtain the optimal functional result.

Cortical Plasticity Following Nerve Transfer in the Upper Extremity **425**
Dimitri J. Anastakis, Martijn J.A. Malessy, Robert Chen, Karen D. Davis, and David Mikulis

With increasing clinical experience, peripheral nerve surgeons have come to appreciate the important role that cortical plasticity and motor relearning play in functional

recovery following a nerve transfer. Neurostimulation (transcranial magnetic stimulation), and neuroimaging (functional MRI, structural MRI, magnetoencephalography) measure different aspects of cortical physiology and when used together are powerful tools in the study of cortical plasticity. The mechanisms of cortical plasticity, according to current and widely accepted opinions, involve the unmasking of previously ineffective connections or the sprouting of intact afferents from adjacent cortical or subcortical territories. Although significant strides have been made in our understanding of cortical plasticity following nerve transfer and during motor relearning, a great deal remains that we do not understand. Cortical plasticity and its manipulation may one day become important contributors to improve functional outcome following nerve transfer.

Optimizing Skeletal Muscle Reinnervation with Nerve Transfer **445**
Samuel C. Lien, Paul S. Cederna, and William M. Kuzon, Jr

Denervation as a consequence of nerve injury causes profound structural and functional changes within skeletal muscle and can lead to a marked impairment in function of the affected limb. Prompt reinnervation of a muscle with a sufficient number of motion-specific motor axons generally results in good structural and functional recovery, whereas long-term denervation or insufficient or improper axonal recruitment uniformly results in poor functional recovery. Only nerve transfer has been highly efficacious in changing the clinical outcomes of patients with skeletal muscle denervation, especially in the case of proximal limb nerve injuries. Rapid reinnervation with an abundant number of motor axons remains the only clinically effective means to restore function to denervated skeletal muscles.

End-to-Side Nerve Repair: Review of the Literature and Clinical Indications **455**
Linda T. Dvali and Terence M. Myckatyn

End-to-side (ETS) nerve repair, in which the distal stump of a transected nerve is coapted to the side of an uninjured donor nerve, has been suggested as a technique for repair of peripheral nerve injuries where the proximal nerve stump is unavailable or a significant nerve gap exists. Full review of the ETS literature suggests that sensory recovery after ETS repair results in some, but not robust, regeneration. Sensory axons will sprout without deliberate injury. However, motor axons only regenerate after deliberate nerve injury. Experimental and clinical experience with ETS neurorrhaphy has rendered mixed results. Continued research into ETS nerve repair is warranted. ETS techniques should not yet replace safer and more reliable techniques of nerve repair except when some, but not good, sensory recovery is appropriate and a deliberate injury to the donor motor nerve is made.

Nerve Fiber Transfer by End-to-Side Coaptation **461**
Hanno Millesi and Robert Schmidhammer

To bring some light into the ongoing controversy concerning end-to-side coaptation in brachial plexus surgery, the authors organized a symposium in 2006 titled *How To Improve Peripheral Nerve Surgery.* The authors sought the participation of experienced surgeons and researchers who had made personal contributions to the field. This article contains information collected at this symposium and presents the authors' clinical results and ideas illustrating the potential of nerve fiber transfer by end-to-side coaptation.

Erratum **485**

Index **487**