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Paul W. Brand

An overview of the mechanical principles necessary for the treatment of disorders of the hand are presented. By means of length-tension curves, one can examine the capability of muscles available for tendon transfers. With demonstration of moment arm, one can determine how the force output of a muscle is used to move bones and joints.

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William P. Cooney

By reviewing principles of tendon transfer, new information on muscle force and excursion, and applied anatomy of the hand, tendon transfer for median nerve palsy can be chosen with a clearer understanding of the anticipated results. Reference to published data on muscle fiber length, muscle mass, and muscle tension potential provides accurate matching of the donor muscle to lost function of the "recipient muscle." Tendon transfer must restore muscle balance without exacting too great a cost from overall hand function.

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Hill Hastings II and Sandra Davidson

Tendon transfers for correction of clawing deformity in ulnar nerve palsy are only consistently successful in young ligamentously lax individuals. Correction of deformity is most inconsistent in the intrinsically stiff hands of older individuals. Correction of clawing is more difficult in the little finger than in the ring finger. While use of the flexor digitorum superficialis for intrinsic transfer simply corrects clawing deformity and restores synchronous finger flexion, grip strength will be further decreased by approximately 21 per cent, and total active range of motion by 7 per cent. Correction is best achieved by transfer of a wrist motor with tendon graft into index, middle, ring, and little digits, despite limitation of clawing to the ring and little digits. Pinch should be augmented by metacarpophalangeal joint fusion rather than by interphalangeal joint fusion. When combined with extensor carpi radialis brevis adductor plasty, pinch strength can be doubled.

Radial Nerve Palsy 179*Robert L. Reid*

The anatomy of the radial nerve; timing and types of tendon transfers to repair chronic loss; and author preference for type of transfer are discussed.

Tendon Transfers for Combined Nerve Injuries 187*William W. Eversmann, Jr.*

The patient with an upper extremity affected with multiple nerve injuries will require multiple surgical procedures for reconstruction by tendon transfer. Successful reconstruction will be based on a simple plan that adheres to the basic principles of tendon transfers, as well as the more detailed principles of combined nerve injuries. When completed, the reconstruction will only redistribute the few specific assets that are available and therefore cannot be expected to create normally functional hands.

Management of the Upper Extremity in Traumatic Tetraplegia 201*Charles P. Murphy and Robert G. Chuinard*

The management of the upper extremity in traumatic tetraplegia is complex and extremely important for the rehabilitation of the patient. The evolution of present management is reviewed. The evaluation and classification of the tetraplegic patient is discussed with general recommendations for treatment.

**Tendon Transfers About the Shoulder and Elbow
in the Spinal Cord Injured Patient..... 211***David P. Falconer*

Restriction of triceps function through tendon transfers in the spinal cord injured patient allows use of the arm for positioning and mobility, as well as placement of the hand for reach and grasp activities. Transfer of the posterior portion of the deltoid to the triceps aponeurosis, as developed by Moberg, is the principal means of restoring triceps function. Moberg's technique, as well as some alternative transfers that have evolved, are described in this article.

Surgical Reconstruction of the Upper Extremity in Cerebral Palsy 223*J. Leonard Goldner*

This article discusses surgical treatment of the upper extremity in cerebral palsy. Such treatment should provide a balanced grasp and release, a reasonable range of pronation and supination of the forearm, and should maintain sufficient strength for hand function.

Tendon Transfers in Muscle and Tendon Loss..... 267*Lawrence H. Schneider*

Tendon transfer is a useful tool in instances of muscle loss or irreparable tendon injury. The standard procedures developed for the application of tendon transfer in nerve injury must be followed. In addition, these cases, because of local soft tissue and bone injury,

will often require preparation prior to the actual tendon transfer. Attention to the details of treatment will prove rewarding to patient and surgeon.

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Robert D. Leffert and Gary M. Pess

Brachial plexus injuries result in severe functional deficits in the upper limb. The authors review a group of 74 patients with brachial plexus injuries who underwent 160 tendon transfer operations, as well as 94 additional procedures, in an attempt to augment lost function. Following evaluation of functional recovery, 58 per cent of the patients were rated Good, 34 per cent Improved, and 8 per cent Unimproved. The authors conclude that significant benefit can be obtained by peripheral reconstruction and tendon transfers in patients with brachial plexus injuries.

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Ralph Thomas Manktelow

With the aid of microneurovascular anastomoses, functioning muscle may be transferred to damaged extremities to provide useful function. The gracilis muscle has been particularly useful for the reconstruction of finger flexion or finger extension.

Tendon Transfers for Elbow Flexion 297

Peter J. Stern and Robert J. Caudle

This article reviews the causes of loss of elbow flexion. It outlines the necessary preoperative considerations for elbow flexorplasty. The techniques, advantages, and disadvantages of flexorplasty, including the Steindler, pectoralis major, triceps, sternocleidomastoid, and latissimus dorsi, are discussed.

Tendon Transfers in Surgery of the Rheumatoid Hand 309

Lennart G. Mannerfelt

Tendon transfer procedures are used in the reconstructive surgery of the rheumatoid hand in cases of tendon ruptures, deformities, and compression neuropathies with subsequent muscle atrophy. The prerequisites and essential principles for tendon transfers are discussed, including the following: 1) correction of contractures, 2) adequate power of the muscle, 3) sufficient amplitude, 4) straight line of pull, and 5) maintenance of the integrity of the muscle.

Timing of Tendon Transfers in Peripheral Nerve Injury..... 317

George E. Omer

The timing of tendon transfers is dependent upon the etiology and prognosis of the motor imbalance, the neurophysiologic problems for the patient, and the condition of the involved extremity. Tendon transfers should be done as soon as clinically indicated in order to restore functional activity and prevent the development of poor patterns of motion. Tendon transfers should be completed before cutaneous sensibility is restored, in order for the patient to use and interpret all sensory input with an associated re-education of sensi-

bility. The purpose of tendon transfers is not so much to gain strength as to gain the ability to place the involved extremity in position to fully use the remaining functional muscle-tendon units. Re-evaluation is as important as the surgical procedure in the final result.

**Strengthening of the Partially Paralyzed Shoulder Girdle
by Multiple Muscle-Tendon Transfers..... 323**

J. Leonard Goldner

Strength and stability of the shoulder girdle affect function of the entire upper extremity. Isolated muscle weakness may be compensated for by adjacent muscles; however, profound weakness of the deltoid muscle, for example, affects not only placement of the extremity, but also strength and endurance of the forearm and hand. Orthotic substitutes for weakened muscles are not successful. If the muscle weakness is nonprogressive and stable, then surgical treatment will improve glenohumeral stability, increase endurance, and provide more uniform strength for many activities of daily living.

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