

# Tendon Transfers for Combined Peripheral Nerve Injuries



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## KEYWORDS

• Tendon transfer • Combined • Nerve • Injury • Palsy • Median • Ulnar • Radial

## KEY POINTS

- Tendon transfers for combined nerve injuries have significant limitations due to available muscle tendon units, scarring, and the significant rehabilitation required.
- Surgical reconstruction must be individualized with a focus on restoring functional goals.
- The suggestions in this article should only be considered as a rough guide, because some may be reasonable and others not in a given patient.

## INTRODUCTION

Combined peripheral nerve injuries present a unique set of challenges to the hand surgeon when considering tendon transfers. Typically they result from severe trauma to the upper extremity and can be associated with significant injuries to soft tissue, bone, and vascular structures.<sup>1</sup> Muscle and tendon injuries requiring repair may both worsen motor deficits and limit the number of viable tendons available for transfer. Significant scar formation can complicate reconstruction due to adhesion formation, increasing the difficulty of establishing a reasonable path for tendon rerouting. In addition, the accompanying sensory deficits are often more severe than single nerve injuries with profound loss of both protective and fine sensation, making function not simply a matter of repositioning and muscle transfer.<sup>1,2</sup>

These sensory deficits have been suggested as the most critical factor in determining overall hand function.<sup>1,3,4</sup> Protective sensation of pain and temperature is lost as well as the ability for the hand and digits to identify their place in 3-dimensional

space (proprioception). There is a close association between motor function and sensation, and abnormal patterns of motor activity can worsen these sensory deficits.<sup>3</sup> It has been suggested that tendon transfers should be completed before attempts to improve sensation,<sup>1</sup> although they can be combined in one sitting for the convenience of the patient if the tendon transfer rehabilitation is not compromised. The restoration of sensation can be attempted through direct nerve repair, nerve grafting, nerve transfer, and skin and tissue transplants to key areas of sensation, including the radial and ulnar borders of the thumb, radial border of the index, and ulnar border of the hand.<sup>1,5-7</sup> Unfortunately, in many cases of combined peripheral nerve injuries, if return of sensation is not anticipated, tendon transfers are not indicated.<sup>1,2</sup>

The general principles of tendon transfers have been well described earlier in this issue as well as elsewhere<sup>2,8-10</sup>; however, there are specific considerations related to combined nerve palsies. Donor muscle tendon units (MTUs) (**Table 1**) must be of normal or near normal strength (at least 4/5),

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**Table 1**  
Muscle tendon unit abbreviations

Abbreviation	Muscle Name
ADM	Abductor digiti minimi
APB	Abductor pollicis brevis
BR	Brachioradialis
ECRB	Extensor carpi radialis brevis
ECRL	Extensor carpi radialis longus
ECU	Extensor carpi ulnaris
EDC	Extensor digitorum communis
EDM	Extensor digiti minimi
EIP	Extensor indicis proprius
EPL	Extensor pollicis longus
FCR	Flexor carpi radialis
FCU	Flexor carpi ulnaris
FDP	Flexor digitorum profundus
FDS	Flexor digitorum superficialis
FPB	Flexor pollicis brevis
FPL	Flexor pollicis longus
PL	Palmaris longus
PT	Pronator teres

have similar excursion, and preferably act in phase with the recipient tendon. Tendon transfers rely on the redundant action of multiple tendons, making some tendons expendable for donors without loss of function. In the case of combined nerve injuries, there are typically fewer options for transfer because of fewer tendons of shared function that are expendable as well as associated injuries to tendon or muscle bellies. Careful preoperative planning must be performed to make the most of remaining MTUs (Table 2). Before considering transfer, tissue equilibrium should be complete with wounds and fractures healed, and full passive range of motion should be achieved. In addition to tendon transfers, joint arthrodesis should be considered in certain cases, more so with combined nerve injuries than single nerve injuries, both to improve function and to provide additional tendons for transfer.

Particularly in combined nerve injuries, the goal of tendon transfer is to restore function rather than replace specific muscle groups.<sup>1,9</sup> It is important for the surgeon to establish the goals of care with the patient, with the understanding of both parties that it will not be possible to re-create a

**Table 2**  
Anatomic deficits, reconstructive goals, and available muscle tendon units for transfer in combined peripheral nerve injuries

Combined Nerve Injury	Anatomic Deficits	Reconstructive Goals	Available MTUs for Transfer
Low median-ulnar	All hand intrinsic	<ul style="list-style-type: none"> <li>• Key pinch</li> <li>• Thumb opposition</li> <li>• Treatment of clawing</li> <li>• Coordinated MP and IP joint flexion</li> </ul>	<ul style="list-style-type: none"> <li>• Radial innervated muscle groups (BR and all extensors)</li> <li>• PT, FCR, FPL, FDS, FCU, PL</li> </ul>
High median-ulnar	<ul style="list-style-type: none"> <li>• All hand intrinsic</li> <li>• External finger flexors</li> <li>• Finger flexors</li> </ul>	<ul style="list-style-type: none"> <li>• Key pinch</li> <li>• Thumb opposition</li> <li>• Finger flexion for simple grip</li> <li>• Treatment of clawing</li> <li>• Coordinated MP and IP joint flexion</li> </ul>	Radial innervated muscle groups (BR and all extensors)
High ulnar-radial	<ul style="list-style-type: none"> <li>• Hypothenar muscles</li> <li>• Ulnar intrinsic</li> <li>• Finger and wrist extensors</li> <li>• Ulnar half of FDP</li> </ul>	<ul style="list-style-type: none"> <li>• Wrist extension</li> <li>• Finger and thumb extension</li> <li>• Thumb adduction</li> <li>• Ring and small finger flexion</li> </ul>	<ul style="list-style-type: none"> <li>• PT, FCR, PL, FDS</li> <li>• Radial half FDP</li> </ul>
High median-radial	<ul style="list-style-type: none"> <li>• All wrist MTUs except FCU</li> <li>• All extrinsic finger flexors and extensors</li> <li>• Thenar muscles except adductor pollicis and deep portion FPB</li> </ul>	<ul style="list-style-type: none"> <li>• Thumb opposition</li> <li>• Mass action grip</li> <li>• Thumb and finger extension</li> </ul>	<ul style="list-style-type: none"> <li>• FCU after wrist arthrodesis</li> <li>• Ulnar half FDP</li> <li>• Hypothenar muscles</li> </ul>

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