Compelling Hope
Center for Treatment of Paralysis and Reconstructive Nerve Surgery at Jersey Shore University Medical Center

Integration of Reconstructive Therapies to Improve Upper Limb Function

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Director of the Center for Treatment of Paralysis and Reconstructive Nerve Surgery
Peripheral Nerve Surgery
Applications

Peripheral Nerve Disorders
- Compression Neuropathy
- Facial Paralysis
- Phantom Limb pain
- Nerve Trauma

Spinal Cord Injury
- Tetraplegic hand
- Pressure sores
- Ventilator dependency
- Bladder dysfunction

Stroke
- Upper extremity paralysis
- Aspiration
Rehabilitative Surgery
Surgical Algorithm

- Nerve Repair
- Nerve Grafting
- Neurotization
- Tendon Transfer
- Tenodesis
- Joint Fusion
- Splinting
THE ELECTRIC GARAGE DOOR ANALOGY

- Outlet
- Wire
- Motor
- Chain
- Door
ADVANCES IN PERIPHERAL NERVE SURGERY

- Brachial Plexus Repair
- Facial Reanimation
- Prostate Grafting
- Foot Drop Surgery
- Nerve Transplantation
- Reanimation After Spinal Cord Injury
- Reanimation After Stroke
- Resensitization of the Buttocks
Peripheral Nerve Surgery

Return of function

Decrease in pain

Decrease in disability score
Central Nervous System vs. Peripheral Nervous System
Avulsion vs. Rupture
PERIPHERAL NERVOUS SYSTEM

Can Be Fixed

- Primary Repair
- Nerve Grafting
- Neurotization
- Tendon Transfer
- Free Muscle Flap
- Joint Fusion
THE TEXTBOOKS ARE WRONG.

DO NOT WAIT A YEAR.

IF NOT IMPROVED BY 3 MONTHS, THEY WILL NOT IMPROVE.

EMG AT 6-8 WEEKS.

REPAIR AT ABOUT 3 MONTHS.

ALLOWS FOR “SECOND SHOT” BEFORE ONE YEAR.
Brachial Plexus Repair
24 year old 5 months after motorcycle accident. C5, C6, C7, brachial plexus injury
After brachial plexus repair with nerve grafting
A 22 year old 6 months after a motorcycle accident. He has a brachial plexus injury (C5-C6)
Status post brachial plexus repair with nerve grafting
- It’s all about spare parts
- No need to prioritize
- Can’t go to The Home Depot
- Cadaver
- Living Related Donor
Tendon Transfer

“Tetraplegic Hand Surgery”
Trapezius to Deltoid
Pectorals to Biceps
Latissimus to Triceps or Biceps
Tendon Transfer

Table 65-1

<table>
<thead>
<tr>
<th>Sensibility</th>
<th>Motor*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No muscle below elbow suitable for transfer</td>
<td>Flexion of elbow, supination of forearm</td>
</tr>
<tr>
<td>1</td>
<td>Br</td>
<td>Flexion of elbow, supination of forearm</td>
</tr>
<tr>
<td>2</td>
<td>ECRL</td>
<td>Extension of wrist (weak or strong)</td>
</tr>
<tr>
<td>3*</td>
<td>ECRB</td>
<td>Extension of the wrist (strong)</td>
</tr>
<tr>
<td>4</td>
<td>PT</td>
<td>Wrist extension, pronation of forearm</td>
</tr>
<tr>
<td>5</td>
<td>FCR</td>
<td>Flexion of the wrist</td>
</tr>
<tr>
<td>6</td>
<td>Finger extenders</td>
<td>Extrinsic extension of the fingers (partial or complete)</td>
</tr>
<tr>
<td>7</td>
<td>Thumb extenders</td>
<td>Extrinsic extension of the thumb</td>
</tr>
<tr>
<td>8</td>
<td>Partial digital flexors</td>
<td>Extrinsic flexion of the fingers (weak)</td>
</tr>
<tr>
<td>9</td>
<td>Lacks only intrinsicis</td>
<td>Extrinsic flexion of the fingers</td>
</tr>
</tbody>
</table>

*BR, Brachioradialis; ECRL, Extensor carpi radialis longus; ECRB, Extensor carpi radialis brevis; PT, Pronator teres; FCR, Flexor carpi radialis.

*O refers to cutaneous afferent impulses, Cu refers to cutaneous afferent impulses and is equated with residual static two-point discrimination of less than 12 to 15 mm.

*Caution: It may not be possible to determine the strength of the ECRB without surgical exposure.
<table>
<thead>
<tr>
<th>Group</th>
<th>Donor</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>BR</td>
<td>ECRL</td>
</tr>
<tr>
<td>1</td>
<td>BR</td>
<td>ECRL Thumb Tenodesis</td>
</tr>
<tr>
<td>2</td>
<td>BR</td>
<td>FPL</td>
</tr>
<tr>
<td>3</td>
<td>Stage I extensor tenodesis</td>
<td>Stage II Zancolli Lasso ECRL-FDP BR-FPL</td>
</tr>
<tr>
<td>4</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>5</td>
<td>Stage I BR-Extensors</td>
<td>Stage II ECRL-FDP PT-FPL</td>
</tr>
<tr>
<td>6</td>
<td>EPL</td>
<td>EDC</td>
</tr>
<tr>
<td>7</td>
<td>FDP</td>
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<tr>
<td>8</td>
<td>FDP</td>
<td>FDP</td>
</tr>
<tr>
<td>9</td>
<td>Lasso</td>
<td></td>
</tr>
</tbody>
</table>
Joint Fusion

Thumb Fusion
Shoulder Fusion
Wrist Fusion
Finger Fusion
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Nerve Surgery
The Future
Spinal Cord Patients

Treat Spinal Cord Patients Like Bilateral Brachial Plexus Patients
Spinal Cord Injury

• Spastic vs. Flaccid Paralysis
• Need to create flaccid paralysis
• Botox/Phenol
• Rhizotomy
• Motor Neurectomy
• Tendon Release
• Tendon Lengthening
Spinal Cord Injury

- Need for Functioning Donors
- Nerve donors above the lesion
- Muscle donors for tendon transfers
- Free muscle donors
- Sacrifice contralateral side?
Spinal Cord Paralysis

• Level of Injury
• Cranial nerves always spared
• Cervical plexus always spared
Spinal Cord Paralysis

- Prioritize Function
- Arm Abduction
- Tricep
- Bicep
- Wrist Extension
- Finger Extension/Flexion
- Individualize for Patient
Spinal Cord Injury Timing

- Need to let injury evolve
- Need to maximize therapy
- Need to maintain existing function
- Motor end plates do not degrade
- Spasm must be balanced
- Can take advantage of two-stage procedures
Spinal Cord Injury

- Trapezius to Deltoid Transfer
- Neurotization from spinal accessory nerve
- Nerve to levator scapulae
- Nerve to sternocleidomastoid
- Latissimus to bicep
- Latissimus to tricep
Spinal Cord Injury Hand Surgery

- Minimize Spasticity
- Maximize passive range of motion
- Maximize active range of motion
- Tendon Lengthening
- Joint Stabilization/Joint Fusion
- Splinting Static/Dynamic
- Tendon Transfer/ Tenodesis Effect
- Neurotization
Rehabilitative Surgery
Surgical Algorithm

Nerve Repair
Nerve Grafting
Neurotization
Tendon Transfer
Tenodesis
Joint Fusion
Splinting

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Elegance

Simplicity
Spinal Cord Patients

Reinnervate Buttocks to Prevent Pressure Ulcers
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Stroke Patients
Treat Stroke Patients Like Brachial Plexus Injuries
Stroke

- We can’t fix the problem…but we can restore some function
The Treatment of Spinal Cord Paralysis and Stroke
Restoring Sensibility to the Buttocks of Paraplegic Patients
Aiding in Controlled Urination in Paraplegics
Reinnervation of the Diaphragm for Ventilator Dependent Patients
Repair of Incisional Hernias in Multiply-Operated Patients
THANK YOU

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