IC 11: Distal Motor and Sensory Nerve Transfers: A Changing Paradigm

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Overview

Following complex upper extremity peripheral nerve injury, motor and sensory recovery can be less than optimal. Distal nerve transfers can provide a source of motor and/or sensory innervation closer to the target end organ thus providing quicker recovery and optimizing motor and sensory outcome. Postoperative rehabilitation including sensory and motor reeducation is necessary to ensure that functional outcome is maximized.

Classification of Nerve Injury

<table>
<thead>
<tr>
<th>Degree of Injury</th>
<th>Tinel’s Sign Present</th>
<th>Recovery</th>
<th>Rate of Recovery</th>
<th>Surgical Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Neurapraxia</td>
<td>No</td>
<td>Complete</td>
<td>Up to 12 weeks</td>
<td>None</td>
</tr>
<tr>
<td>II Axonotmesis</td>
<td>Yes</td>
<td>Complete</td>
<td>1” per month</td>
<td>None</td>
</tr>
<tr>
<td>III</td>
<td>Yes</td>
<td>Varies *</td>
<td>1” per month</td>
<td>None or Neurolysis</td>
</tr>
<tr>
<td>IV Neuroma</td>
<td>Yes but no advancement</td>
<td>None</td>
<td>None</td>
<td>Nerve repair, graft or transfer</td>
</tr>
<tr>
<td>V Neurorritmesis</td>
<td>Yes but no advancement</td>
<td>None</td>
<td>None</td>
<td>Nerve repair, graft or transfer</td>
</tr>
<tr>
<td>VI Mixed Injury (I to V)</td>
<td>Some fascicles (II, III)</td>
<td>Some fascicles (II, III)</td>
<td>Depends on degree of injury (I – V)</td>
<td>Neurolysis, nerve repair, graft or transfer</td>
</tr>
</tbody>
</table>

* Recovery can vary from excellent to poor depending on the amount of scarring and the sensory versus motor axon misdirection to target receptors

Advantages of Nerve Transfers
- Directs a large number of axons to denervated muscle quickly
- Uses a source of nerve in close proximity to the denervated muscle
- Provides faster and superior muscle reinnervation

Surgical Indications and Management
- For motor nerve deficits:
  - Use an expendable motor nerve
  - Use a donor nerve that is close to the motor end plates of the target muscle
  - Make sure there are a large number of donor motor nerve axons
  - Motor reeducation is more straightforward if the donor innervated muscles are synergistic to the target innervated muscles
- For sensory nerve deficits:
  - Use a donor sensory nerve that innervates an a non-critical area
  - Use a pure sensory nerve
  - Use a size-matched donor nerve

Specific Examples
I. For reinnervation of a radial nerve or isolated posterior interosseus nerve injury - partial median to radial nerve transfer
II. For high ulnar nerve injury –
- Motor nerve transfer: anterior interosseous nerve to deep motor branch of the ulnar nerve at level of distal forearm
- Sensory nerve transfer: 3rd webspace sensory nerve to ulnar border of hand

- Use above nerve transfers in conjunction with FDP side-to-side tendon transfers
III. For high median nerve injury – need to restore pronation:

- Motor nerve transfer: Use motor nerves to ECRB, FCU or FDS as donor nerve to nerve to pronator teres
IV. Distal Sensory Transfers
Rehabilitation following Nerve Transfer

Early Post-operative Management
- Early range of motion is important to decrease adhesions
- Postoperative dressing is removed 2 to 3 days following surgery
- Protect repair site: typically 7-10 days
- Following immobilization; regain and maintain full passive range of motion

Late Stage Rehabilitation - Sensory & Motor Reeducation
- Alteration in cortical mapping following nerve injury
- Following reinnervation, regain cortical area by increasing the sensory/motor input
- Motor reeducation: need to increase muscle strength and central mechanisms controlling motor function
- Nerve to nerve transfer – requires motor re-education similar to that required with tendon transfers
- Biofeedback more useful than muscle stimulation

Motor Reeducation for Distal Motor Nerve Transfers
- To facilitate relearning, begin on unaffected side
- Initially need to contract muscle from donor nerve to achieve a contraction in the recipient muscle. Aim for control and initiation of muscle contraction
- Be aware of co-contraction of antagonist muscles
- Biofeedback – visual and audio
- Begin in gravity assisted or gravity eliminated positions and progress to exercises against gravity and progressive resisted exercises
- Dissociate target muscle from donor muscle contraction
- Strengthen uninjured muscles weakened from disuse (i.e. scapular muscles)
References

Also see: http://nervesurgery.wustl.edu/Pages/default.aspx