Clinical Aspect of Peripheral Nerve Injuries

Mechanisms of injury

- 1. Traction
- 2. Transection
- 3. Mixed

Clinical Outcome

- Dependent on:

1. Preservation of conduit
2. Time since injury.

   Axonal regeneration ~1 mm/day

   >1 year – limited recovery.

   > 2 years – no recovery.

Medical Research Council motor grading scale

Grade	Muscle status
0	No contraction
1	Flicker of contraction
2	Active motion, gravity eliminated
3	Active motion against gravitys
4	Active motion against resistance
5	Normal strength

Modified Sunderland Classification

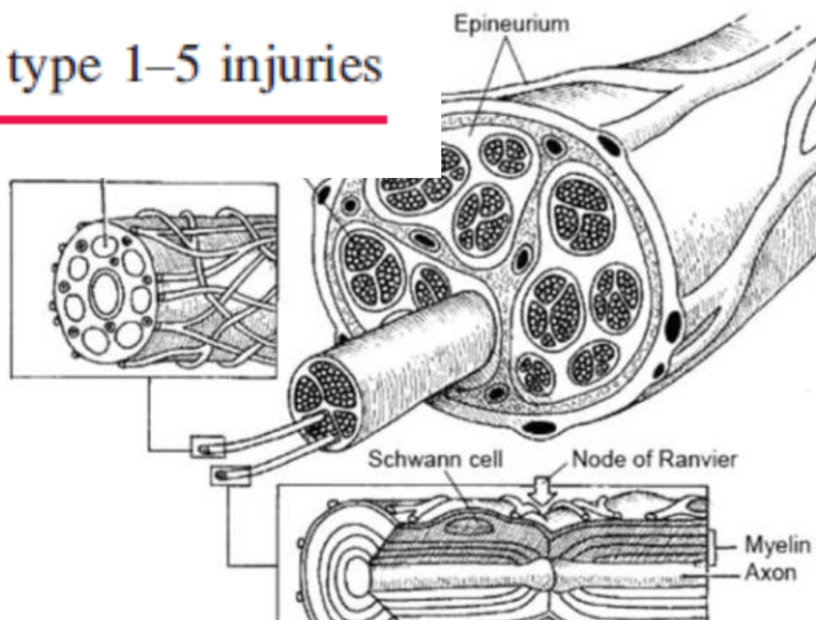
Spontaneous recovery > surgery

TABLE 1. *Degrees of Nerve Injury*

Degree	*Injury*
1	Conduction block; resolves spontaneously
2	Axonal rupture with intact basal lamina
3	Axonal and basal lamina rupture; some scar; perineurium intact
4	Complete scar; perineurium ruptured; epineurium intact; "neuroma incontinuity"
5	Complete transection
6	Combination of normal nerve and type 1–5 injuries

Variable spontenous recovery

no recovery without surgical intervention



Time frame for intervention

- **Sharp transection**
- Repair within 3 days

- **Blunt transection**
- Repair after 3 weeks.
- Allow time for macerated, crushed tissue to reveal itself and retract. Graft defect

- **Traction** – neuroma in situ
- Oberve 3 months

Management

- Electromyographic studies (4 weeks and 3 months) after injury are helpful in determining the degree of injury and in tracking recovery.
- Observation for 3 months is recommended after closed traction nerve injuries (observe for spontaneous recovery.
- Early exploration (2 weeks) is recommended for open injuries with nerve lacerations or transections.

Management

- Surgical intervention:

1. Transected nerve : immediate tension free repair
2. Concomitant wound exploration
3. Poor spontaneous recovery.

Natural history vs surgical intervention

- Stretch injury : monitor recovery
  a) Lack vs Progressing Tinel's sign
  b) Pre vs post ganglionic injury
  c) Complete vs ncomplete injury
  d) Infraclavicular injuries often lacks spontaneous recovery

TABLE 2. *Principle Criteria for Transfer Donor Nerves*

Principles of motor nerve transfers	*Principles of sensory nerve transfers*
1. Donor nerve near target motor end-plates	1. Donor nerve near target sensory receptors
2. Expendable donor nerve	2. Expendable noncritical donor nerve
3. Pure motor donor nerve	3. Pure sensory donor nerve
4. Donor-recipient size match	4. Donor-recipient size match
5. Donor function synergy with recipient function	5. Side-to-end (terminolateral) repair if necessary; end-to-end repair is preferable
6. Motor reeducation will improve function	6. Sensory reeducation will improve function

Adapted with permission from Mackinnon SE, Novak CB. Nerve transfers. New options for reconstruction following nerve injury. *Hand Clin.* 1999;15:643–666.

Brachial plexus injuries

1. C5C6 distribution

- Low incidence of avulsion
- Spontaneous recovery sometimes
- Good result with direct repair, supplemented with neurotisation

Brachial plexus injuries

2. C5,C6,C7 distribution

- More avulsion than C5C6C7 injuries
- Less frequent spontaneous recovery
- Variable loss of wrist /finger movement
- Moderate outcome result

Brachial plexus injuries

3. C5 through to T1

- Poorest outcome
- 50% some usable shoulder and arm function
- Often graft repair from a single root (often C5), supplemented with neurotisation

Brachial plexus injuries

4. Combined Suprascapular and Axillary nerves stretch injury

- Relatively common. Associated with shoulder dislocation
- Suprascapular portion – often improves with time
- Axillary portion requires exploration and repair

Brachial plexus injuries

5. Cord injuries

- Repair of

  lateral cord (& branches) - good result

  posterior cord (& branches) – good result

  median cord (& branches) – poorer

Surgical Exploration

- Neuroma in situ
- - after 3 months
- if NAP present → neurolysis
- If NAP (nerve action potential) -→ resect and graft defect

- Transected nerve -→ nerve graft or nerve transfer

Surgical aims – Shoulder Stabilisation and elbow function

	Shoulder stabilisation	External Rotation	Elbow flexion	Elbow extension
Neurotisation	Suprascapular N , Axillary N	Suprascpular N	Musculocutaneous N	Branch to long head of Triceps
Muscle transfer	Trapezius , (Sternoclavicular) pectoralis major	Latissimus Dorsi		-

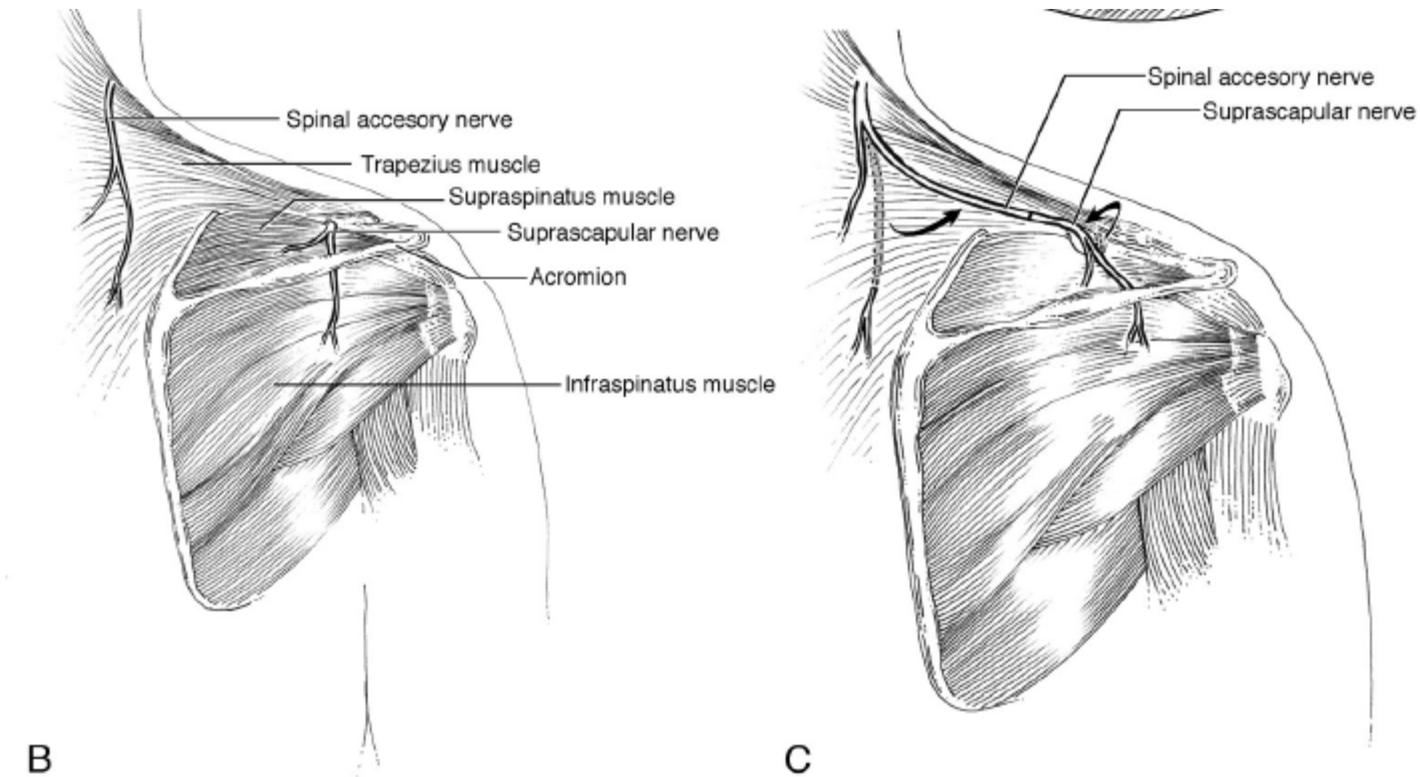
Surgical aims

<table>
<tr><td></td><td>Hand -
restore protective sensation</td><td rowspan="3">Deafferentation Pain

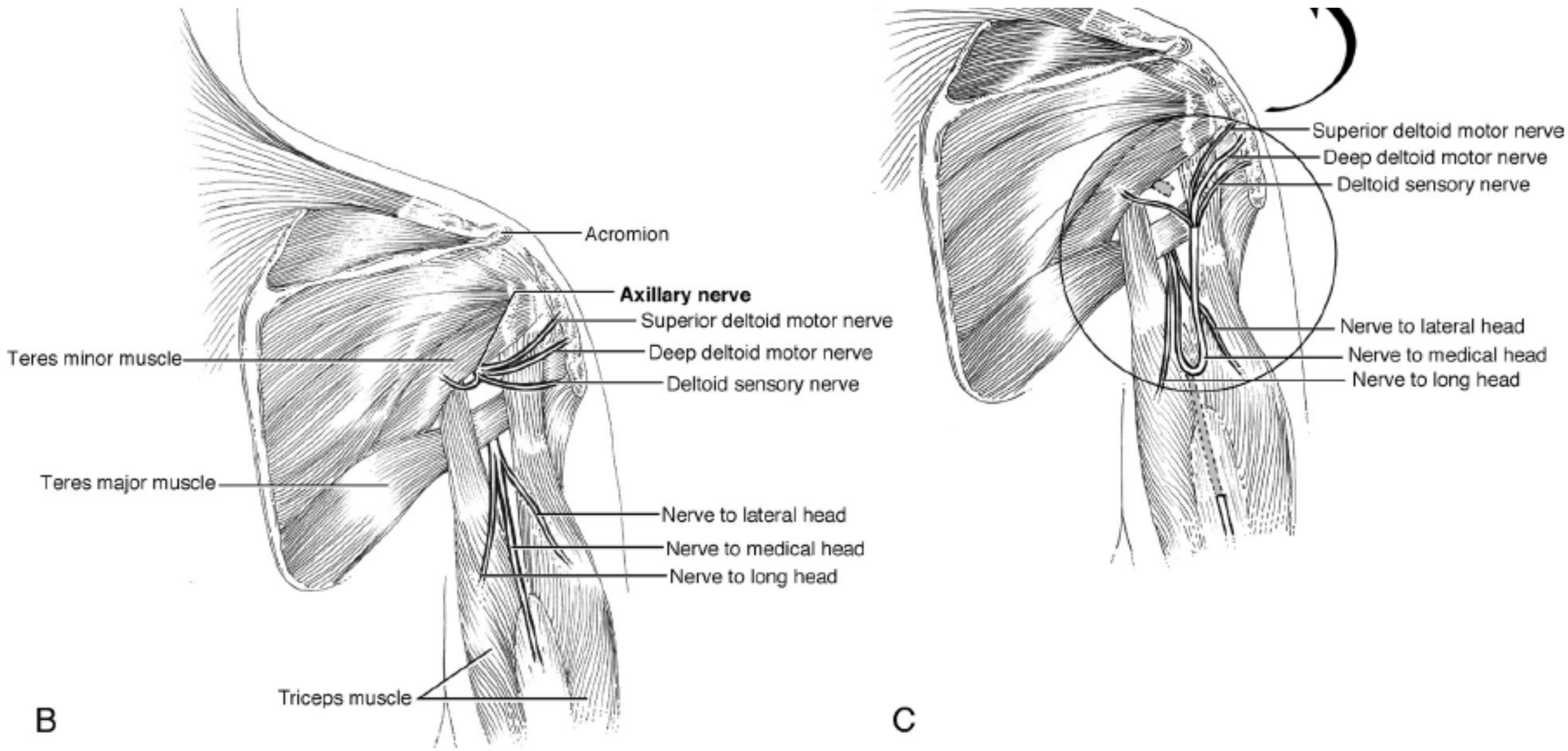
-Intractable
-“continous,burning, compressing pain”

-Neurotisation reduces pain by half (but not in the painfully debilitating group – requires DREZ)</td></tr>
<tr><td>Neurotisation</td><td>•To ulnar nerve
•To lateral cord contribution to the median nerve</td></tr>
<tr><td>Muscle transfer</td><td>Gracilis to
•Finger flexion/exension
•Intrinsic hand muscle</td></tr>
</table>

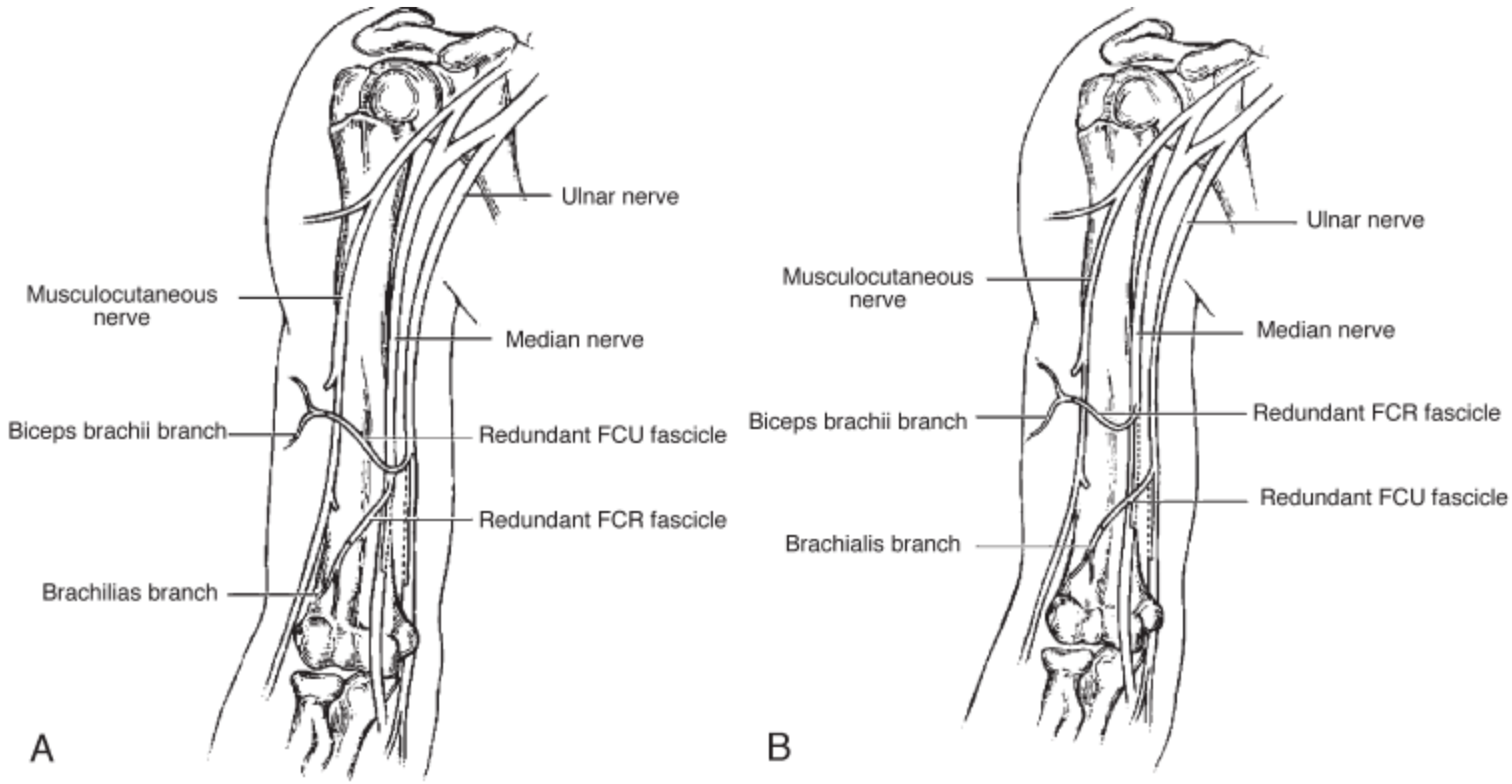
Nerve transfer – Spinal accessory to Supraspinatus N.



Nerve to Triceps transferred to Axillary N.



Transfer to Musculocutaneous N



Transfer to Ulnar N

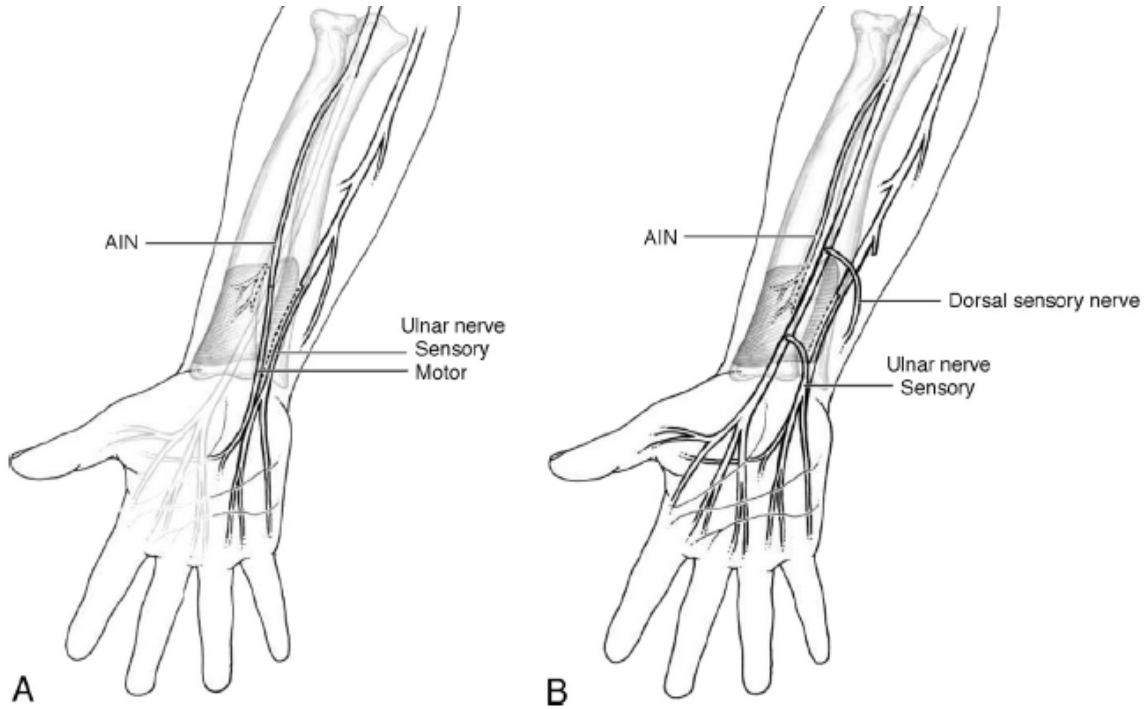


FIGURE 4. Nerve transfers to restore ulnar motor function. A, The distal branch of the AIN to the pronator quadratus is transferred to the deep motor branch of the ulnar nerve in the distal forearm. B, The sensory portion of the ulnar nerve and the dorsal sensory ulnar nerve are transferred end-to-side to the median nerve in the distal forearm. Reprinted from the Journal of the American Society for Surgery (Journal of Hand Surgery), 4, Weber RV, Mackinnon SE, Nerve transfers in the upper extremity, 200–213, © 2004, with permission from Elsevier.

Transfer to Radial N.

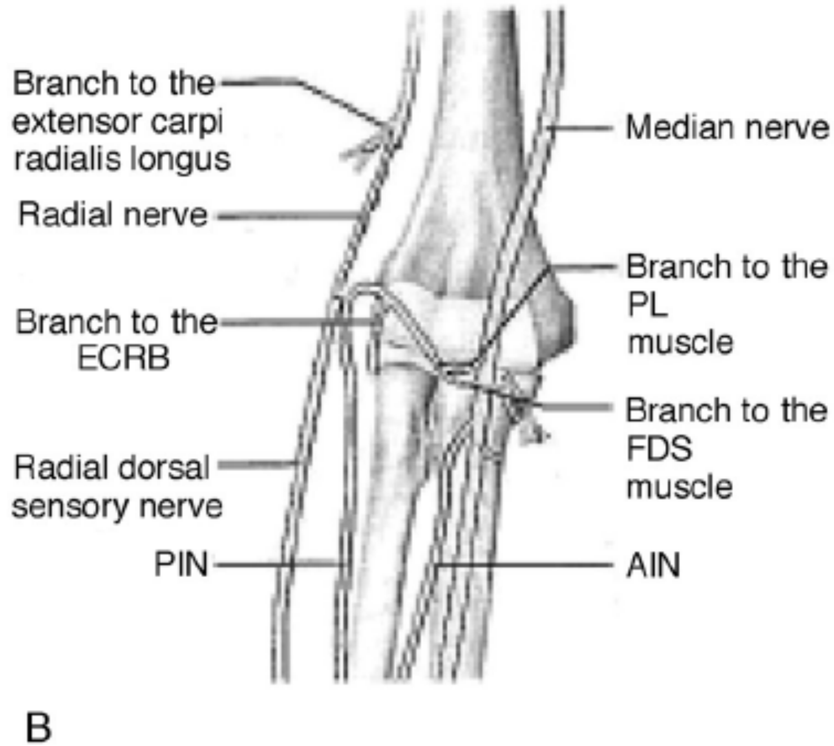
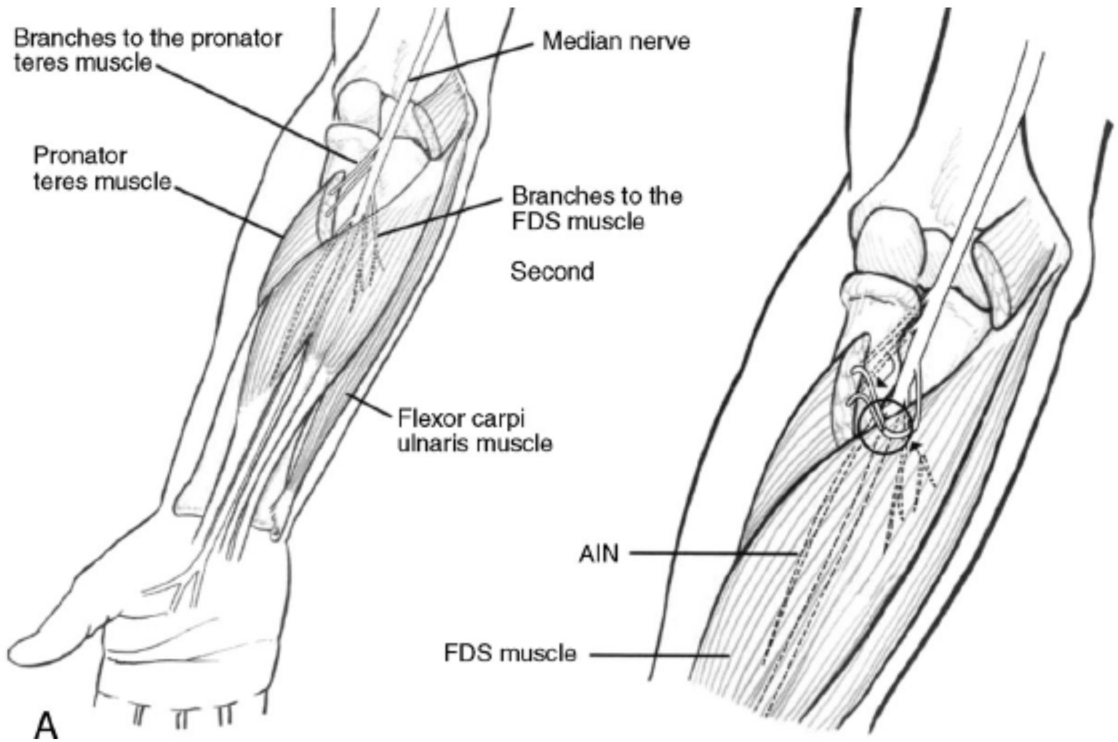


FIGURE 6. The PL and the FDS branches of the median nerve are transferred to the PIN and the ECRB branch of the radial nerve for restoration of wrist and finger extension. Reprinted from the Peripheral Nerve Surgery: Practical Applications in the Upper Extremity © 2006, with permission from Elsevier.

Restoring forearm pronation



Partial restoration of Median N hand sensation