RADIAL NERVE INJURIES

Orthoses, Nerve repairs and transfers, Tendon transfers

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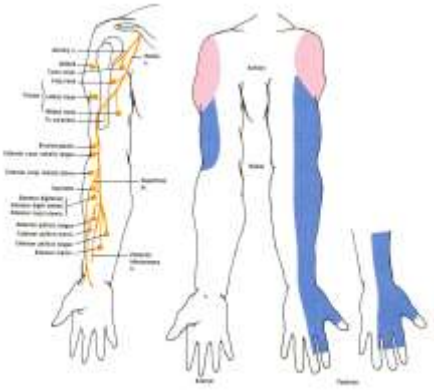
Learning Objectives

- Identify treatments appropriate while waiting for nerve function to return
- Understand prerequisites helpful for the variety of functional orthoses choices for radial nerve palsy
- Define three surgical managements for radial nerve palsy
- Identify effective training strategies for return of motion following surgeries to restore function following radial nerve palsy

Radial Nerve : Most frequently injured UE peripheral nerve

- Low:
  - PIN: ECRB, supinator, digit extrinsic extensors, ECU, APL
  - DSRN:Dorsal radial hand
- Intermediate (humeral fx): loss of ECRL
- High (proximal to pectoralis insertion) loss of: Triceps, Anconeus, BR



Remaining function

- Gravity assisted elbow extension
- Biceps and brachialis-Elbow flexors
- Biceps-forearm supination
- APB-thumb abduction
- PIP and DIP extension-intrinsics

Patient deficits impacting function Differential evaluation

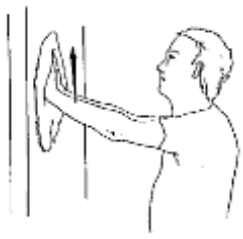
- Impaired motor function and planning
- Impaired sensation
- Changes to sensorimotor cortex
- Maladaptive compensatory movements- whole body
- All impacting function

Patient deficits
Differential evaluation

- MT unit shortening (flexors)
- Joint stiffness/contracture
- MT unit elongation (extensors)
- Impaired proprioception and sensation
- Secondary deficit of decreased grip/pinch strength
- Include in pre operative treatment

Waiting for return of function in radial nerve musculature

- Prevent/treat secondary tissue shortening and joint stiffness



Waiting for return of function in radial nerve musculature

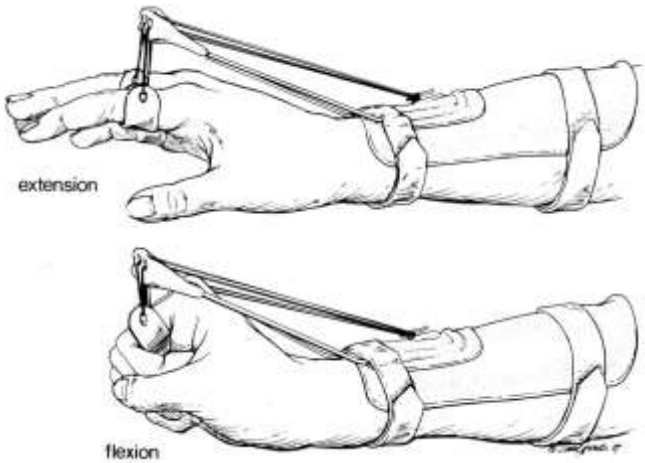
- Patient education
- GMIT
- Neuropathic pain
- Neural mobility
  - Tension in one location, release in another

Waiting for return of function in radial nerve musculature

- Functional performance: imagery
- Uninvolved joint, entire limb function
- Pre-transfer/repair training/motor learning aptitude
  - Acquisition, Retention, Transfer, Efficiency

Orthotic intervention

- Patient and tissue specific
- Prevent contractures/MT unit shortening/overstretch to denervated muscles
- Function/comfort-compensatory orthoses.
- Limit maladaptive compensatory movement patterns



Developed by J. Colditz

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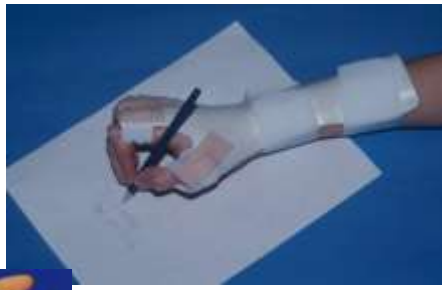

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Surgical options when recovery of function does not occur

Nerve repair

- Wait and see (3-4 mos.) from initial injury
- 12-18 month time period for re-innervation for humeral level injuries
- Motor end plates have limited time frame for re-innervation
- End to end repair or nerve graft required

Nerve Repair Referral Details

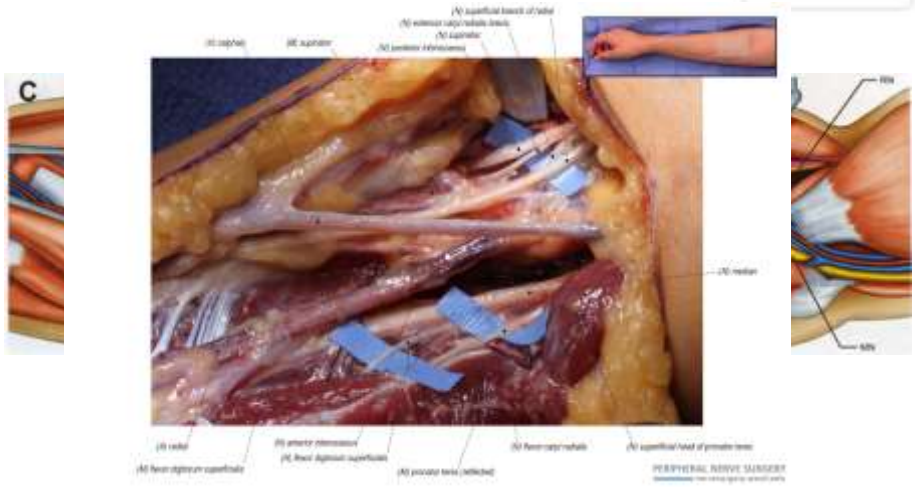
- Tension on repair?
- Nerve graft?
- Simultaneous tendon transfers?

Nerve Repair: Post Op

- Resting orthosis(may need to include elbow)
  - 3 weeks
- Functional orthosis and pre op therapy until re innervation of motors is noted
- Therapy intervention (discussed with nerve transfers)

Nerve Transfer (motor and sensory)

- Transfer innervated nerve/fascicles to a denervated nerve to provide re innervation to target motor fibers or sensory end organs
- Perform closer to end organ-allows earlier re innervation than nerve repair/ graft at injury site
- Avoids surgery in prior scarred areas, can perform before achieving tissue equilibrium distally
    - Moore AM, Novak CB: Advances in nerve surgery, JHT 2014



Nerve Transfer (motor and sensory)

- Doesn't require muscle amplitude/excursion changes that tendon transfers require
- Synergistic muscle actions from donor and recipient nerves preferred

Example of nerve transfer: median to radial

- FDS nerve to ECRB nerve
- FCR nerve to PIN nerve
- LABC nerve to RSN nerve
- May supplement with tendon transfer: PT to ECRB
  - Davidge KM et al: Median to radial nerve transfers for restoration of wrist,finger,thumb extension, JHS (AM) 2013
  - Tung TH, Mackinnon SE: Nerve Transfers: indications, techniques and outcomes, JHS (AM) 2010
  - Garcia-Lopez A. et al: Nerve transfers from branches to FCR and PT to reconstruct the radial nerve, JHS (AM) 2014

Nerve Transfer Referral Information

- Tension on transfer?
- Nerve graft used?
- Simultaneous tendon transfer?

Nerve Transfer: Post operative considerations

- 7-10 days protective orthosis: proximal/distal ROM, neuropathic pain control.
- If concomitant tendon transfer: protection of transfer requires additional immobilization time (4 weeks)
  - Novak CB: Rehabilitation following nerve transfers, Hand Clinics 2008
  - Novak CB, von der Hyde RL: Evidence and techniques in rehabilitation following nerve injuries, Hand Clinics 2013
  - https://youtu.be/5Vm16opyS4g

Nerve Transfer: Early re-ed

- Observe muscle twitch in re innervating musculature around 3-4 mos. post op
- Isometrically resist donor motor and assist transferred motor
- Short range
- High rep, low load, avoid fatigue
- Some of the same facilitation techniques as for tendon transfers

Task based intervention

- Is task: serial, discrete or continuous
- What is the environment
- Skill level:
  - Early-cognitive, novice
  - Middle-associative
  - Late-expert, automatic

Task based intervention

- Schedule for practice
  - Massed: greater practice than rest, forced use
  - Distributed: practice is spread out, greater rest
  - Random: Several different tasks. Better for learning, Not helpful for complex skills, helpful to transfer to a new task
  - Blocked: one task is repeated. Better for performance and retention

Task based interventions

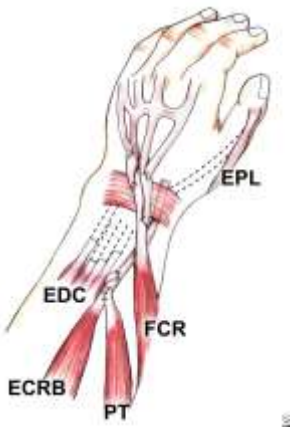
- Break task into parts
  - Practice each step of a sequence separately OR
  - Practice the task with one body part at a time
- Put the parts together
  - Forward: 1, 1and 2, 1,2, and 3. Less errors
  - Backward: 3, 2 and 3, 1,2 and 3

Late phase

- Patterning
- Resist once range is effective
- Simultaneous tendon transfer may impact strengthening time frame

Tendon transfers: wrist/digits

- PT to ECRB
- FCR/FCU/FDS III to EDC (EIP, EDM)
- FDS IV to EIP and EPL
- PL to EPL
- Varies if PIN only or also loss of ECRL
- Complications: inadequate tension, rupture, attenuation, adhesions, nerve injuries



Pre Operative considerations

- Supple PROM and soft tissue extensibility
- Strengthen donor musculature
- Sensory deficits persist

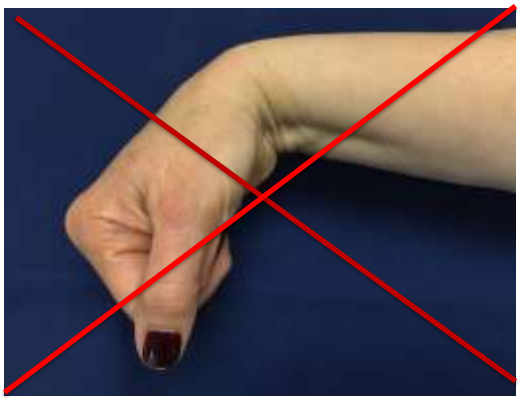
Referral details

- Specific transfers
- Quality of transfers-pulvertaft weave or side to side
- Tendon grafts needed
- Tension of the transfer

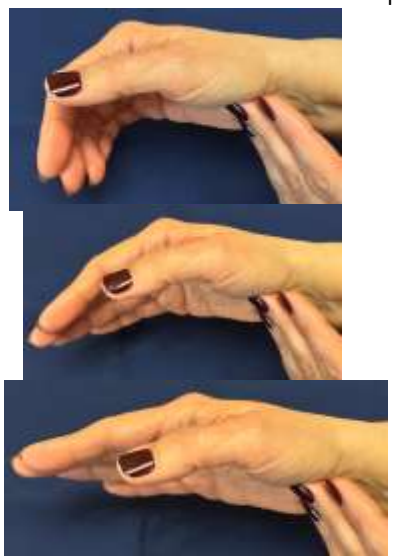
Tendon Transfer: Early phase

- Post operative orthosis: for 4 weeks. Long arm with elbow at 90 and wrist and fingers extended. IPJ's may be free.
- 4 Weeks: Perform original motion of donor, progress to the transferred motion. Synergistic transfers make the motor learning process easier.
- EAM programs: Activate transfer at end range and limit motion that would elongate the transfer

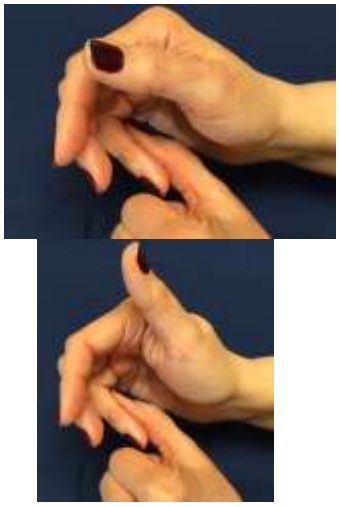
Avoid elongation of transferred muscle for 6-8 weeks..or longer



Resisted FCR for Digit Extension



Resisted FDS for Thumb Extension



Resisted opposite PT for wrist extension

Overflow from opposite limb

Strategies for re-education

- Minimize co-contractions-relax or contract antagonist to “feel” relaxation
- Simultaneous motion with transferred muscle and recipient muscle at the same time. Isometric contraction in neutral range
- Gradually eliminate transferred movements
- Brief exercise episodes only at first, successful reps
  - Schwartz, D: IN: Fundamentals of hand therapy, 2014

Strategies for re-education

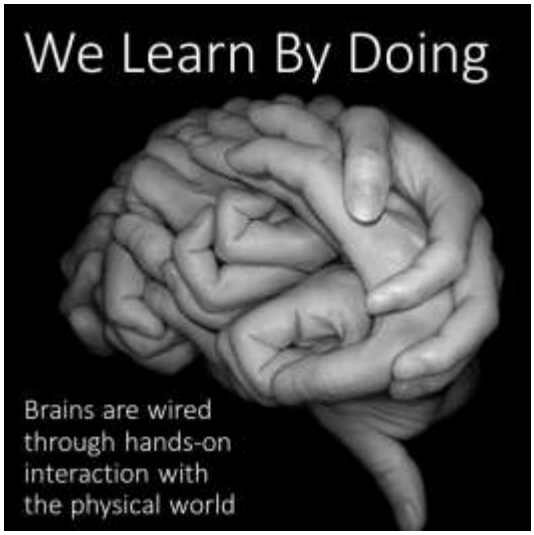
- Place and hold techniques
- Tapping, vibration
- Gravity-eliminated or gravity-assisted plane
- Perform desired motion on uninvolved limb-overflow
- Bilateral motion or activities
- Portions of functional tasks
- Biofeedback
- NMES (Neuromuscular Electrical Stimulation)??
  - Schwartz,D, IN: Fundamentals of Hand Therapy 2014

Strategies for re education

- Avoid composite motion which may elongate the transfer.
- Limit resistance until activation is effective

Some clinical images thanks to

- Karen Stewart-Pettengill MS, OTR/L, CHT



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