I have no financial relationships relevant to this presentation.
Objectives

- Participants will be provided with a brief overview of the anatomy of the brachial plexus.

- Participants will understand the difference between nerve graft and nerve transfers and how it relates to rehabilitation techniques.

- Participants will learn activation techniques for 3 common brachial plexus reconstructions.

- Participants will understand the progression of exercises.
Outline

Surgical Interventions

• Brief anatomy Review
• Surgical Procedures
• Healing Process

Formulating a Treatment Plan

• What you need to know from the Surgeon
• Restrictions
• Timing for Interventions
• Activation Techniques
• Therapy Progressions
• Managing Patient Expectations
The Brachial Plexus
The Muscles

BRACHIAL PLEXUS - FULL DISTRIBUTION

C5
Dorsal scapular CS
(Rhomboïds, levator scapulae)
Nerve to subclavius C5,6
Suprascapular C5,6
(Supra/infraspinatus)

C6
Lateral pectoral C5,6,7
(Pectoralis major/minor)
Musculocutaneous

C7
Coracobrachialis

C8
Long head biceps

T1
Short head biceps
Brachialis

Lateral cutaneous nerve of arm

MEDIAL CORD

Medial pectoral n
(pectoralis maj/min)
Medial cutaneous n
of arm
Medial cutaneous n
of forearm

ULNAR

Elbow joint
Flexor carpi ulnaris
do Flexor dig profundus
Dorsal cutaneous branch
do 1/2 digits
Superficial terminal br
(1/2 digits nail beds)
Palmar cutaneous branch
(hypothenar skin)
Weis, if radioulnar
joints, I/O membrane
Flexor carpi radialis
Flexor digitorum
Superficialis
Flexor pollicis brevis
Palmaris longus
Palmar cutaneous
branch

MEDIAN

Median n
Pronator teres
1/2 Flexor dig profundus
Pronator quadratus
Wris, inf radioulnar
joints, I/O membrane
Flexor pollicis brevis
Flexor digitorum
Superficialis
Abductor pollicis brevis

POSTERIOR CORD

Upper subscapular
(Subscapularis)
Thoracodorsal
(Latissimus dorsi)

LOWER SUBSCAPULAR
(Subscapularis/teres major)

RADIAL

Post cut n of arm
Lower lat cut n of arm
Post cut n of forearm
Triceps
Brachialis (twig)
Anconeus
Brachioradialis
Ext carpi radialis longus

SUPERFICIAL RADIAL

Dorsum of hand & 3 1/2 digits
(not nail beds)

POSTERIOR INTEROSSEOUS N
Supinator
Extensor carpi radialis brevis
Extensor carpi ulnaris
Extensor digitorum
Extensor digiti minimi
Extensor indicis
Extensor pollicis longus
Extensor pollicis brevis
Abductor pollicis longus

DEEP TERMINAL BRANCH

Wrist joint
Flexor digiti minimi
Abductor digiti minimi
Opponens digiti minimi
4 palmar interossei
2 lumbricals
1st lumbrical
2nd lumbrical

3 1/2 digits, palmar skin
& nail beds

MUSCLES

SKIN

Joints

NAMED NERVES
Robert Taylor Drinks Cold Beer

Brachial Plexus (schematic)

- Long thoracic
- Dorsal scapular
- Suprascapular
- Lateral pectoral
- Musculocutaneous
- Median
- Medial pectoral
- Ulnar
- Radial
- Axillary
- Thoracodorsal
- Subscapular (Upper/Lower)

Roots Trunks Divisions Cords Branches
Two Main Surgical Procedures

Nerve Grafts

Nerve Transfer
Science of Healing

- Nerve repair = 3-6 weeks to regain enough strength to tolerate mobilization

- Tendon Transfers = 6 weeks to heal

- Axonal regeneration = “1 mm per day” or 1” per month”.
Prior to Surgery

- Full assessment
- Focus on joint protection
- Range of Motion
- No e-stim
- Gravity eliminated exercises
- Strengthen uninvolved muscles
Formulating Your Treatment Plan Following Surgery

- How long to immobilize
- Protective orthosis?
- Starting PROM
- Movement Restrictions
- Expectations
- Donor used will dictate activation process
Get the Scoop

• Read surgical report

• Ask questions

• Repair will guide the breakdown of individual movement challenges
Thorough Evaluation

- Determine what is working, what is not
- Routine PROM, AROM
- MMT
- If saw patient prior to surgery…….
Activation Techniques
Three Top Targets

- Shoulder flexion/abduction
- Elbow flexion
- External rotation
Triceps to Axillary
Shoulder flexion/abduction

• Triceps branch to axillary nerve
  – What does the triceps branch of radial nerve do?
  – What does the axillary nerve do?

• Axillary branch
  Shoulder forward flexion and abduction

• Triceps branch
  Use any muscle that extends
  • Axillary branch
Who to Recruit

- Think elbow/wrist, thumb, finger extension to move the shoulder in abduction and forward flexion
- Triceps and wrist extension strengthening
Gravity Eliminated Strengthening
Shoulder Abduction
Triceps to Axillary Assist
Shoulder Flexion-Gravity Eliminated
Shoulder Flexion
Ulnar to Musculocutaneous
Elbow Flexion

- Ulnar nerve branch to musculocutaneous
- What does the ulnar nerve branch do?
- What does the musculocutaneous do?

Ulnar branch
Use any muscle innervated by the ulnar nerve
- Key pinch
- Ulnar deviation of wrist

Musculocutaneous nerve
Elbow Flexion
Who to Recruit

• Think key pinch and wrist ulnar deviation to flex the elbow.
Biceps Strengthening
Spinal Accessory to Suprascapular
External Rotation

- Spinal Accessory to Suprascapular

- What does the spinal accessory branch do?

- What does the suprascapular nerve do?

  Spinal Accessory
  Turning head to opposite side w/extension and shrugging
  Suprascapular
  External rotation
Who to Recruit

• This one is tricky
• Shrug shoulders and turn head away from involved arm while looking up.
External Rotation
External Rotation/Mirror
External Rotation
Ext Rotation With Suspension
Exercise Progression

• Continue with pre-op exercises
  – PROM important
  – AROM and AAROM as tolerated
  – Palpation of muscle- can begin gravity eliminated strengthening

• Neuromuscular re-education techniques

• Pool therapy

• Advanced therapy techniques
Expectations

• Nerve transfers
  – Typically 70 to 90 MAX shoulder flexion
  – Elbow to 90-110 degrees
  – External rotation to neutral

• Nerve grafts
  – Used to bridge the gap
  – Typically no neuromuscular re-ed needed
Therapy Progression

• Activation Techniques
• Gravity eliminated positioning
  – maintain passive range of motion
  – avoid fatigue initially
  – add weight when reach a functional arc of motion GRAVITY ELIMINATED and continue to increase
  – When achieve AROM to above shoulder, begin anti-gravity strengthening
Modalities

- Tri-pull tape:
- E-stim
- Kinesiotape
- Suspension Exercises
- Pilates
Advanced Interventions
Biofeedback

• Facilitation
  – Electrodes placed on desired muscles to achieve activation
  – Sound response to activation

• Decrease co-contraction
  – Electrodes placed on co-contracting muscles
  – Goal is not to hear sound.
Bioness

- Wireless hand rehab system that delivers low-level electrical stimulation to activate the nerves that control the muscles in the hand and forearm
MyoPro
Managing Patient Expectations

- Repair does not equal 100% return
- Pain can still persist
- Recover is LONG & SLOW
- Therapy is teamwork, but ultimately their responsibility
- Psychosocial issues
- Long term management
A Word About Neonatal Brachial Plexus Palsy

- Long-term compensatory patterns
- Trigger points
- Ulnar neuropathies/carpal tunnel syndrome
- Posterior subluxation
  - Bicep tendon
  - Tight upper trapezius
- Overuse of uninvolved arm
References


• Nerve and Tendon Reconstruction: When and How


Questions?
Lynnette Rasmussen, OTRL

lraz@umich.edu