

Brachial Plexus Injuries and Reconstruction



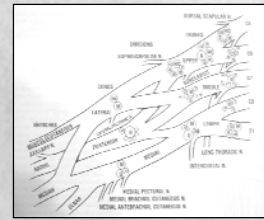
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Curtis National Hand Center
2010

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Questions Only

Anatomy of the Plexus CTQ

- Roots
- Trunks
- Divisions
- Cords
- Nerves



Direct Branches: Long Thoracic & Dorsal Scapular

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Brachial Plexus Injuries

- Anatomy
- Classification of injuries
- Adult and Obstetrical
- Radiation injury
- Brachial Neuritis

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Classification of Injuries

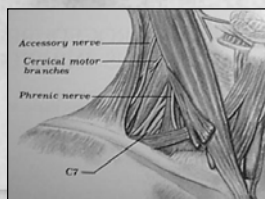
- Open Injuries
- Closed (Traction)
- Obstetrical Palsy
- Radiation



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Anatomy of the Plexus

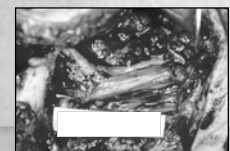
- Roots C5 through T1
- Begins distal to the scalenes CTQ
- Prefixed and Postfixed



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Open Injuries

- Penetrating Trauma
- Gunshot Wound
- Chain saw
- Iatrogenic



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Closed Injuries

- Forceful separation of head and shoulder
- Soft tissue separation
- Motorcycle or motor vehicle accident
- Post anesthetic: lateral deviation of head with arm abducted

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Horner's Syndrome

- Ptosis
- Myosis
- Anhidrosis



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Patient Evaluation

Acute

- Stabilize the patient
- Assess vascularity of the extremity
- Cervical spine injury
- Await wound healing

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Radiographs

- Cervical Spine
- Shoulder
- Chest xray
- Clavicle
- Ribs



Fractures allow greater separation of the plexus from the extremity ie worse prognosis CTQ

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Patient Evaluation

Subacute

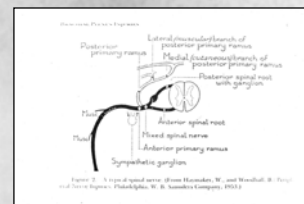
- Supraclavicular swelling and tenderness
- Winging of the scapula
- Horner's Syndrome
- Motor and sensory exam of the extremity



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Preganglionic vs Postganglionic

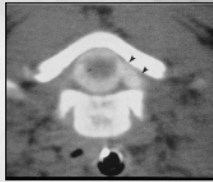
- Dorsal Root Ganglion
- Root avulsion Nonrepairable CTQ



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Imaging of the Plexus

- Myelogram: wait 6 wks
- CT myelogram: BEST
- MRI: easiest



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“FOR SOMEONE WHO
HAS NOTHING A LITTLE
IS A LOT”

Sterling Bunnell M.D.

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Electromyography

- Helpful to define level of injury
- Wait 3 weeks from injury
- Fibrillation potentials
- Posterior cervical musculature indicative of a root avulsion
- Obstetrical Palsy: Over estimates recovery and rare to see denervation CTQ

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Goals of Treatment CTQ

- Elbow flexion
- Shoulder stabilization
- Shoulder adduction
- Sensation distal to the elbow
- Wrist and digital motion



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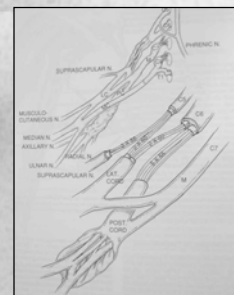
Somatosensory Potentials

- May be more helpful than electromyography
- Noninvasive
- Useful intraoperatively

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Surgical Treatment Options

- Repair
- Grafting
- Neurolysis
- Neurotization



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Sunderland's Grades of Nerve Injury

- I: Neuropraxia (loss of conductivity)
- II: Axonotmesis (axonal loss of continuity)
- III: Axonotmesis with endoneural rupture
- IV: Loss of continuity of nerve but not ruptured entirely
- V: Neurotmesis (total rupture)

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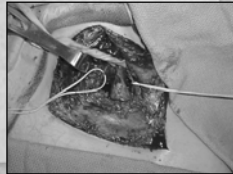
Direct Nerve Repair

- Open injury
- Obstetrical palsy
- Rarely possible in closed injury

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Surgical Indications

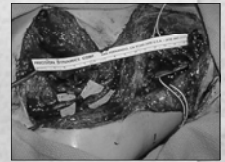
- Sharp laceration
- No recovery
- Child
- Significant sensory deficit
- Postganglionic lesion
- Positive tinell's



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Nerve Grafting

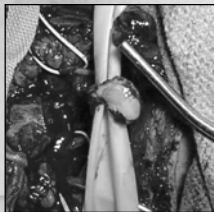
- Good proximal stump
- Upper and Middle trunks
- Neuroma-in-continuity that does not transmit
- Make graft 15% longer than needed to accommodate shoulder movement
- Sources: Sural, Antebrachial cutaneous, Ulnar



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Surgical Contraindications

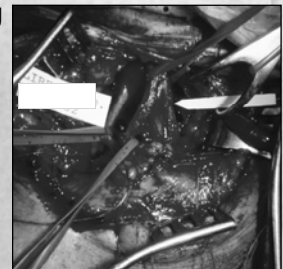
- Greater than two root avulsions
- Sensory-motor dissociation
- Greater than 45 years old



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Neurolysis

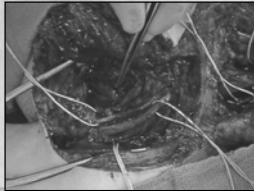
- Perplexus scarring
- Nerve in continuity
- Neuroma that transmit on stimulation



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Neurotization

- No proximal stump
- Less than 6 months from the injury
- Patient less than 30 years old



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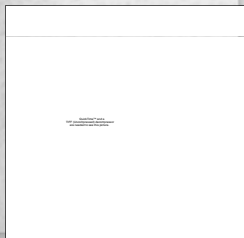
Results of Closed Treatment

- Best with low energy injury
- Infraclavicular better than supraclavicular
- 98% good or fair recovery

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Neurotization

- Intercostals II - VII
- Spinal Accessory
- Medial thoracic nerve
- Contralateral C7 root



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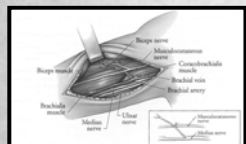
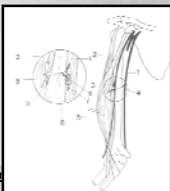
Ideal Patient

- Open Injury
- Less than 30 years of age
- Infraclavicular
- Nerve graft less than 3 months from the injury
- Neurolysis less than 6 months from the injury

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Distal Neurotization

- Oberlin: Branch of the Ulnar nerve to musculocutaneous
- MacKinnon: Oberlin plus median nerve branch to brachialis
- Transfer pronator teres motor branch to PIN



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Results

<u>Repair</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
Nerve Graft	58%	16%	26%
Neurolysis	64%	21%	14%
Neurotization	0%	1%	5%

Kanaya JHS 1990

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Results of Neurotization Combined Results

Source	Good	Fair	Poor
Spinal Accessory	34%	27%	39%
Intercostal:			
Musculotaneous	63%		37%
Radial	32%		68%

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Obstetrical Palsy

- Traction Injury
- Forceps Delivery
- Cephalopelvic Disproportion
- Rate Declining

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PAIN !!!!!

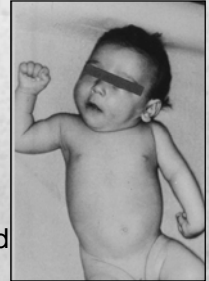
- 91% with 40 % severe
- Correlated with severity of injury
- Improved with recovery
- Improved with surgery ?

Bruxelle CORR 1988

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Obstetrical Palsy Diagnosis

- Asymmetrical arm movement
- Clavicle fracture
- Bony deformity
- Arm adducted and internally rotated



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Obstetrical Palsy



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Obstetrical Palsy Diagnosis

Erb's: Upper Trunk(C5 and C6)
 Klumpke's: Lower Trunks(C8 and T1)
 Complete: Entire plexus

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Mallet Classification



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Results of Surgery Gilbert CORR 1990

Hand Function:	83%
Hand Function with Neurotization:	30%
Intrinsic Function:	50%

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Natural History Tassin 1984

Complete Recovery: Motor function @ 1mo

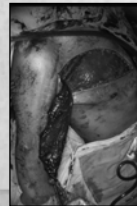
Good Recovery: Motor function @ 5 mo

Average Recovery: Motor function @ 3 mo

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Reconstruction Indications

- More than 18 months after the injury
- Functional Passive ROM
- Partial elbow lesion



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Surgical Indications Obstetrical Palsy

- No biceps function @ 3 - 6 months CTQ
- Total palsy and Horner's syndrome @ 2 months

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Reconstruction

- Shoulder: L'Episcopo Transfer
Humeral Osteotomy
Pect Transfer for winging
Axillary nerve reconstruction
Fusion
- Elbow: Steindler Flexorplasty
Pectoralis Transfer
Latissimus Transfer
Microvascular transfer
- Amputation

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Radiation Injury

- More than one year after radiation
- Vasovasorum replaced by scar
- Pain, parasthesia and progressive functional loss



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Brachial Neuritis:

- Acute atraumatic pain across top of shoulder and radiating down arm and up neck. Hours to weeks in duration.
- Muscle weakness and atrophy follow (starting within 2 weeks in 70%), originating with shoulder girdle and forearm
- Most often affected nerves: axillary (70%), suprascapular, long thoracic, musculocutaneous
- Sensory nerves mimic motor. Most often affected dermatomes are axillary and radial forearm.

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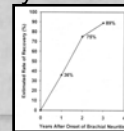
Radiation Injury

- 2/3 of patients have a flail arm
- Most with a Horner's syndrome
- Must rule out tumor recurrence
- NO improvement with neurolysis CTQ

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Brachial Neuritis:

- Observation
- PT will not speed recovery, but may maintain strength in unaffected muscle and maintain supple ROM
- Steroids not effective other than early pain relief- only one study.



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Brachial Neuritis: “Parsonage Turner Syndrome”

- 1.64 per 100,000
- M>F
- Bilateral in 1/3 (asymmetrical)
- Antecedent URI in 25%



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Summary

- Ideal patient for reconstruction has an open injury, infraclavicular lesion, and < 30yrs.
- Obstetrical BPI indicated for surgery if there is no function at 2mo or no biceps at 3-6mo.
- No surgery for Brachial Neuritis or Radiation injury

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The medial cord of the brachial plexus receives contributions from?

- A. All roots of the plexus
- B. Cervical roots 5,6
- C. Cervical roots 5,6,7
- D. Cervical roots 6,7,8
- E. Cervical root 8, thoracic 1

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