대한소아재활발달의학회 2021년 춘계연수강좌

Surgical intervention of neonatal brachial plexus injury

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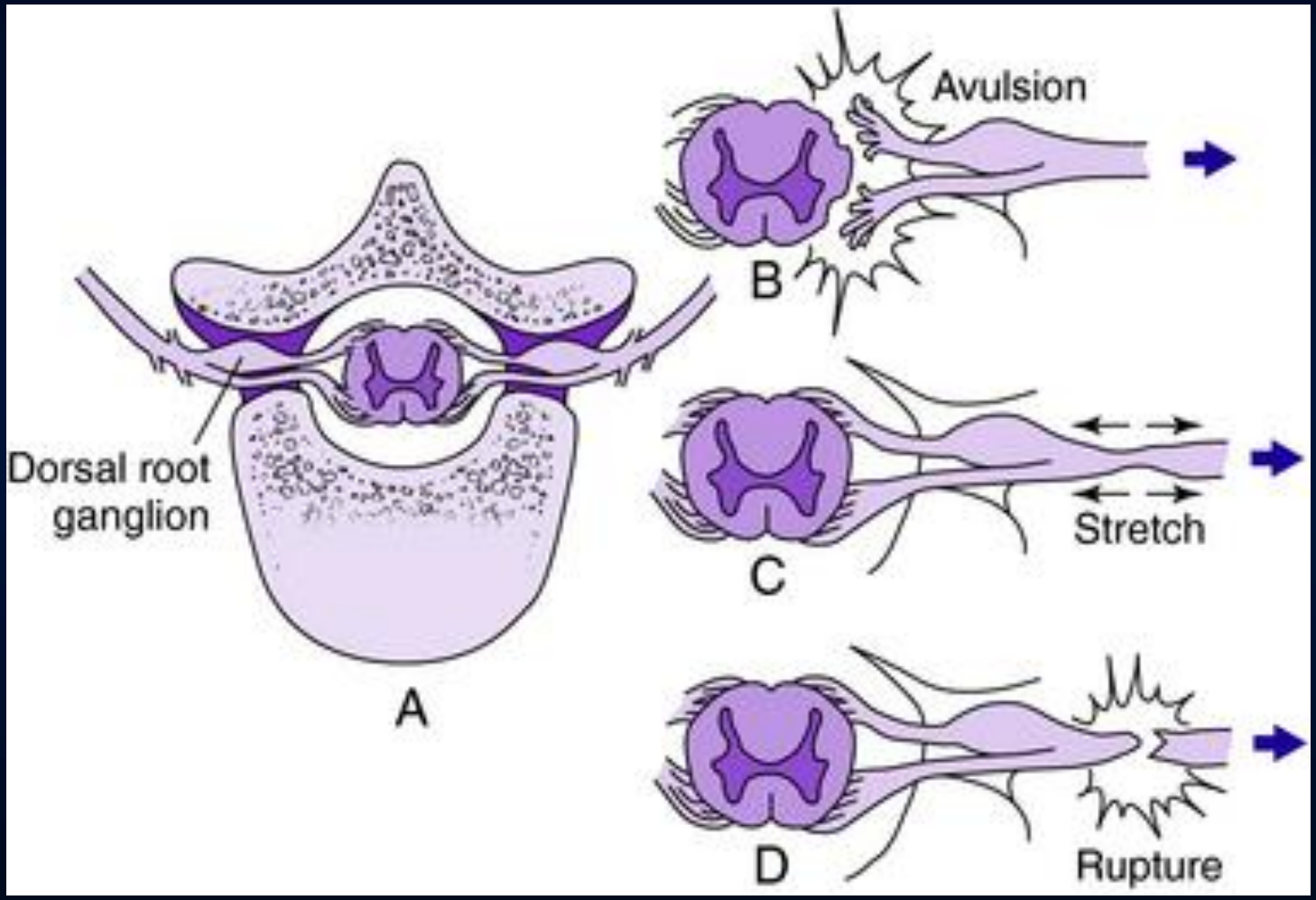
정형외과

Types of surgery

- Microsurgical procedures
  - ✓Nerve graft
  - ✓Nerve transfer
- Secondary procedures
  - ✓Tendon transfer
  - ✓Muscle transfer
  - ✓Arthrodesis

Types of injury



Timing of nerve surgery

- Gilbert and Tassin (Chirurgie, 1984)
  - ✓Indication; Absence of biceps function by 3 months
  - ✓Poorer shoulder outcome at 5 years and increased likelihood for secondary procedures

Natural history

- Smith et al. (JBJS-Am, 2004)
  - ✓170 patients
  - ✓28 patients had no biceps function at 3 months
    - ➢13 of C5-6 > all regained at 6 months
    - ➢ 5 of C5-7 > 3 regained at 6 months
    - ➢10 of C5-T1 > 4 regained at 6 months
  - ✓Patients who regained biceps function before 6 months of age had better shoulder function

Natural history

- Water PM (JBJS-Am, 1999)
  - ✓49 patients; no biceps function at 3 months
  - ✓42 recovered biceps function at 6 months
  - ✓Patients who had recovery of biceps function between 3-6 months of age had similar shoulder function recovery who had microsurgical reconstruction

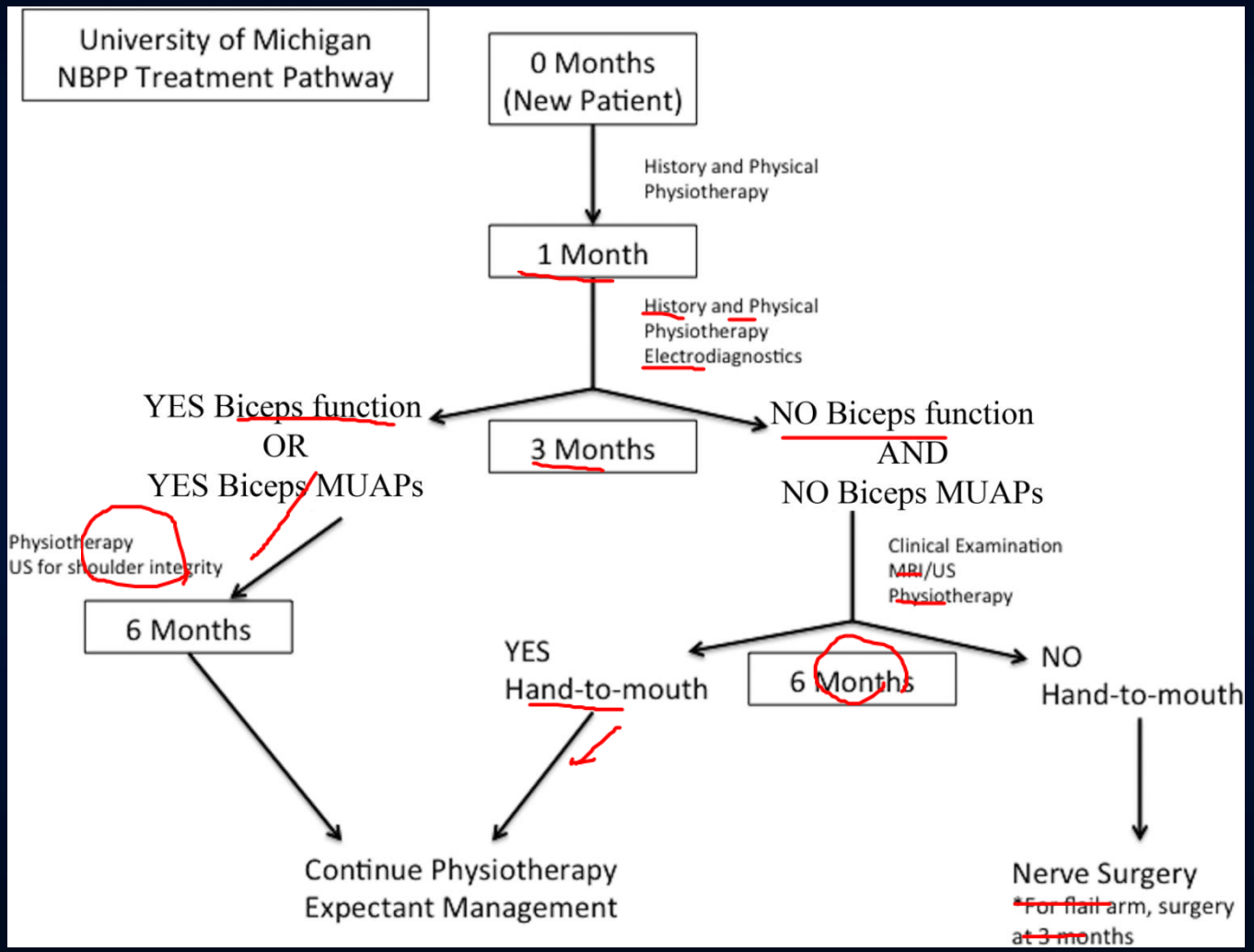
Timing of nerve surgery

- Water PM (JBJS-Am, 1999)
  - ✓Indication; Absence of biceps function by 6 months

MALLET[14] CLASSIFICATION BY MONTH OF RECOVERY OF BICEPS FUNCTION

	Global Abduction	Global External Rotation	Ability to Bring Hand to Neck	Ability to Bring Hand to Mouth
Natural history groups				
1 mo.	5.0	5.0	5.0	5.0
2-3 mos.	4.1	3.8	4.1	3.9
4 mos.	3.7	2.9	3.5	3.4
5 mos.	3.5	2.7	3.2	3.1
6 mos.	2.9	2.1	2.5	2.3
Microsurgical repair group	3.5	2.7	3.0	3.0

Flowchart of nerve surgery

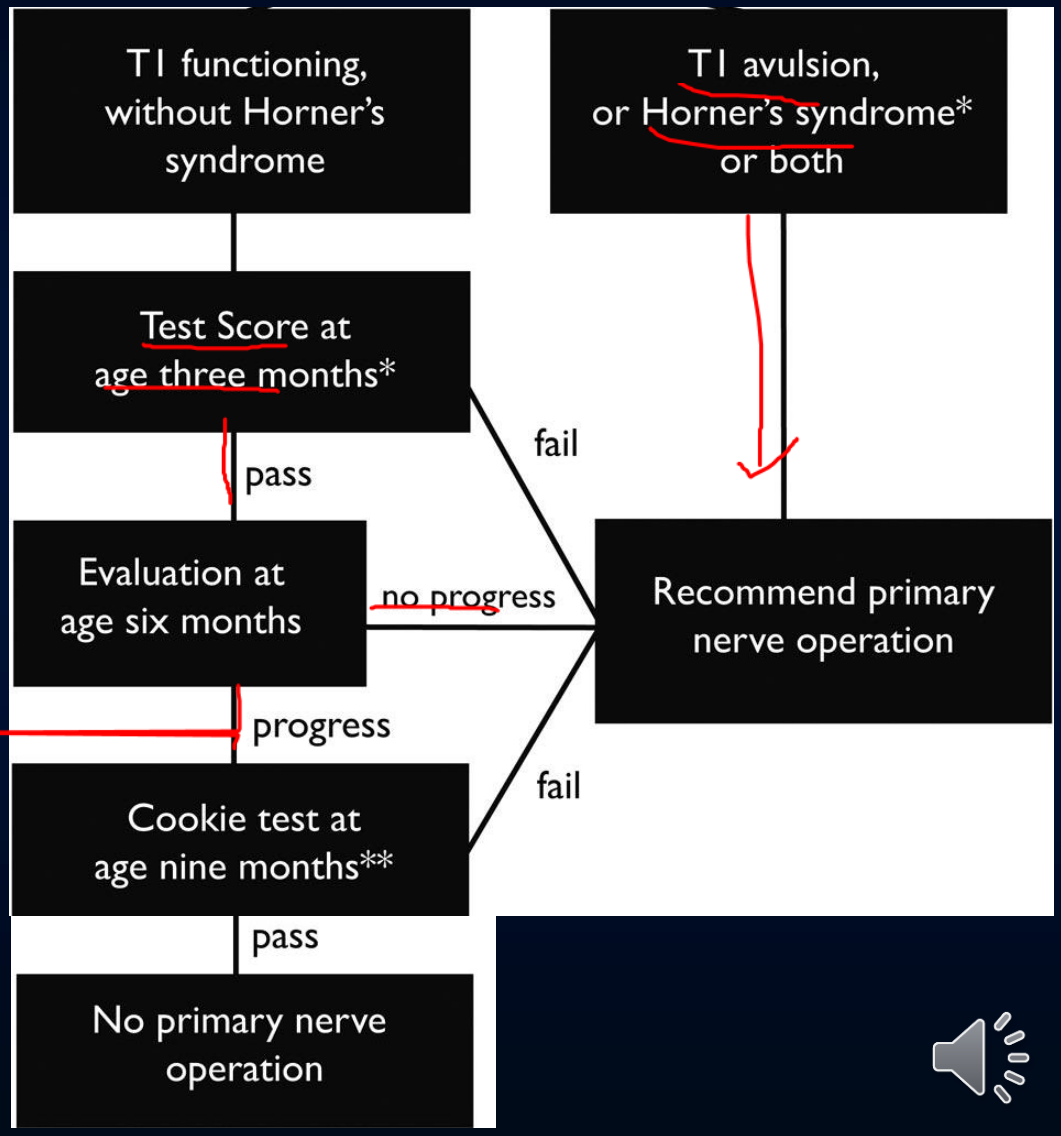


Wilson et al. Neurosurgery. 2013

Flowchart of nerve surgery

- Test score
  - ✓ Elbow flexion; 2점
  - ✓ Elbow extension; 2점
  - ✓ Wrist extension; 2점
  - ✓ Finger extension; 2점
  - ✓ Thumb extension; 2점
- 3.5점 이하 수술 고려

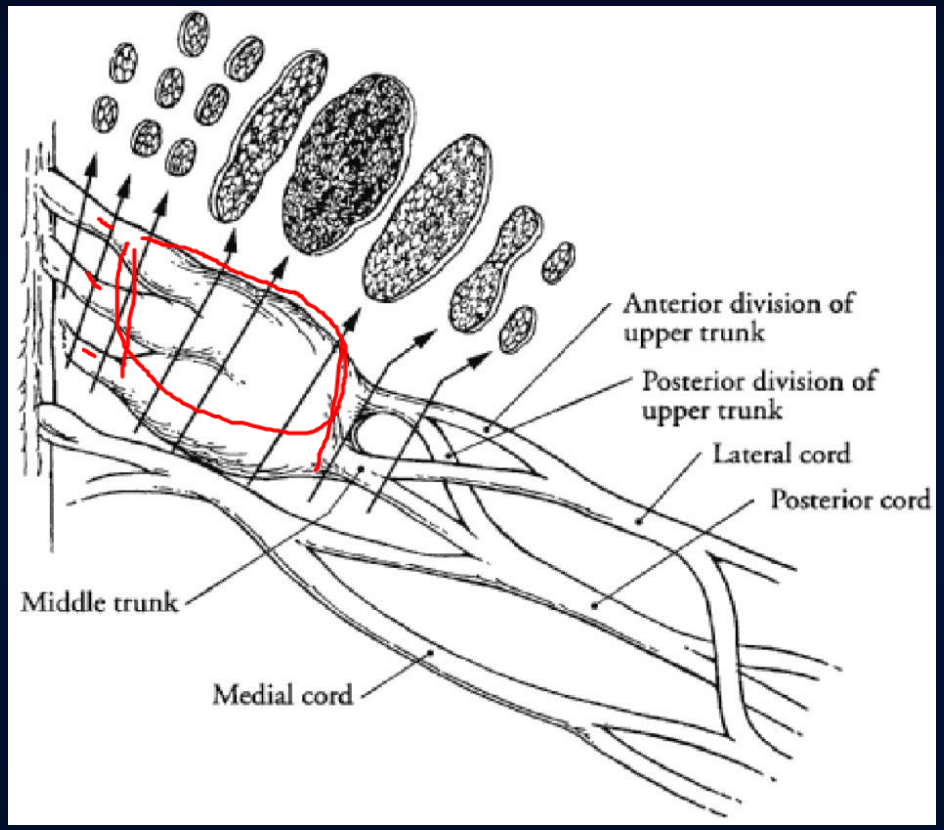
Borschel & Clarke. PRS. 2009

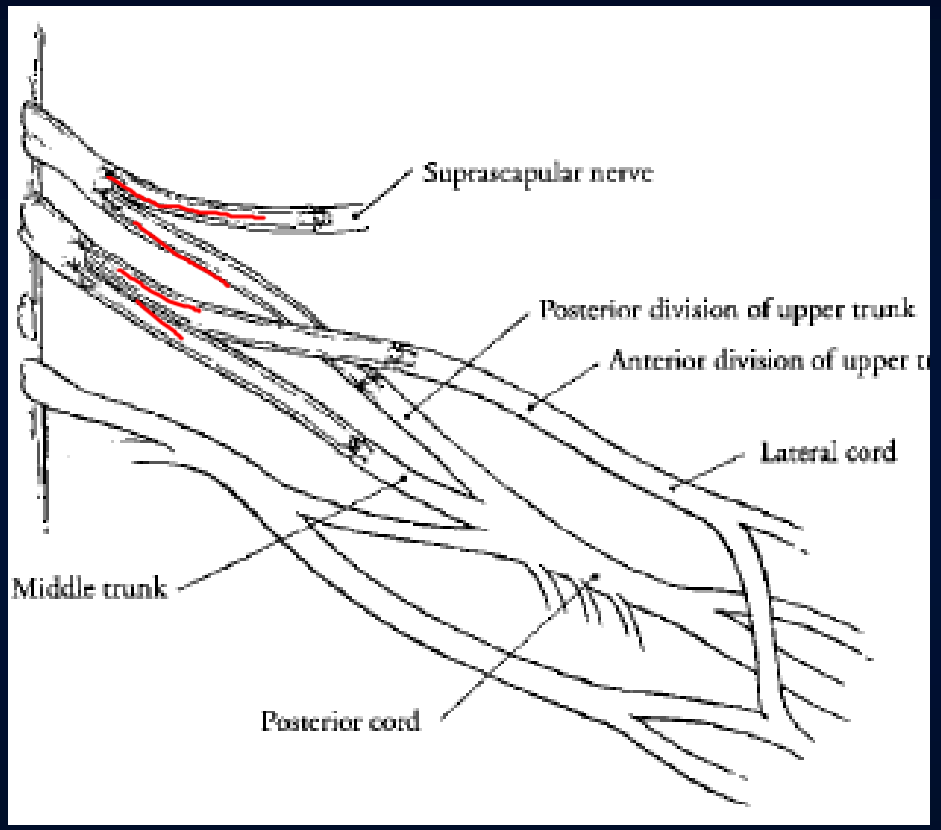


Preferred timing of nerve surgery

- Whole arm type or Horner syndrome
  - ✓No biceps function at 3 months of age
- C5-7 or C5-8
  - ✓No biceps function at 6 months of age
- Others
  - ✓No hand to mouth at 9 months of age

Nerve graft


Anterior division of upper trunk
Posterior division of upper trunk
Lateral cord
Posterior cord
Middle trunk
Medial cord


Suprascapular nerve
Posterior division of upper trunk
Anterior division of upper t
Lateral cord
Middle trunk
Posterior cord

Guidelines

- C5,C6 rupture
  - ✓C5 – posterior division of upper trunk
  - ✓C6 – anterior division of upper trunk
- C5,C6 rupture, C7 avulsion
  - ✓C5 – posterior cord
  - ✓C6 – lateral cord

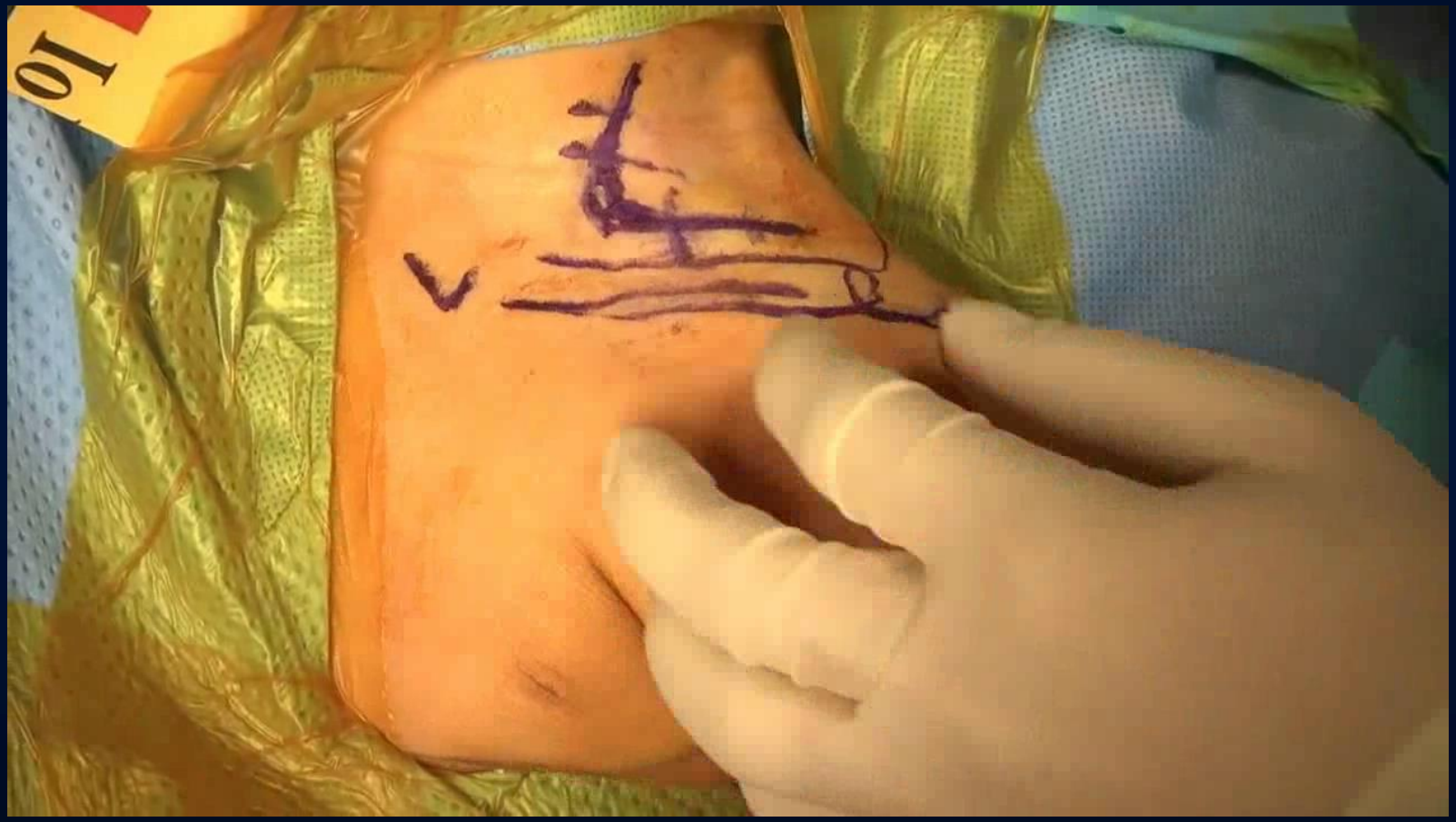
Guidelines

- C5,C6,C7 rupture, C8,T1 avulsion
  - ✓C5 – lateral cord
  - ✓C6 – medial cord
  - ✓C7 – posterior cord
- C5,C6 rupture, C7,C8,T1 avulsion
  - ✓C5 – posterior cord
  - ✓C6 – medial cord
  - ✓Intercostal transfer to lateral cord

Case

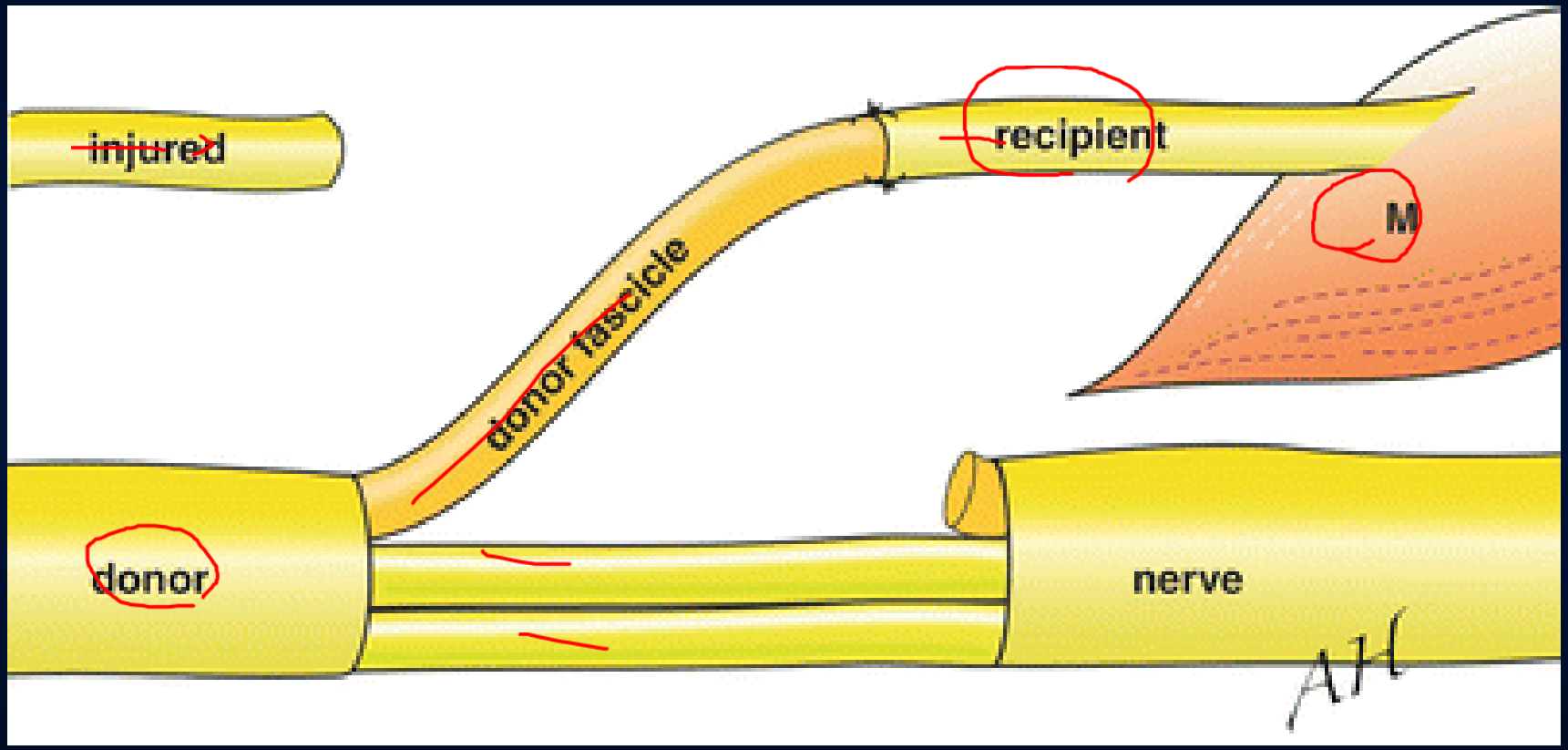
- F/ 6months
- Whole arm type; no muscle contracture at shoulder, elbow, wrist and finger
- EMG/NCV; Brachial plexus whole trunk injury
- MRI
  - ✓C5,C6; postganglionic
  - ✓C7,C8,T1; root avulsion

Approach



Graft

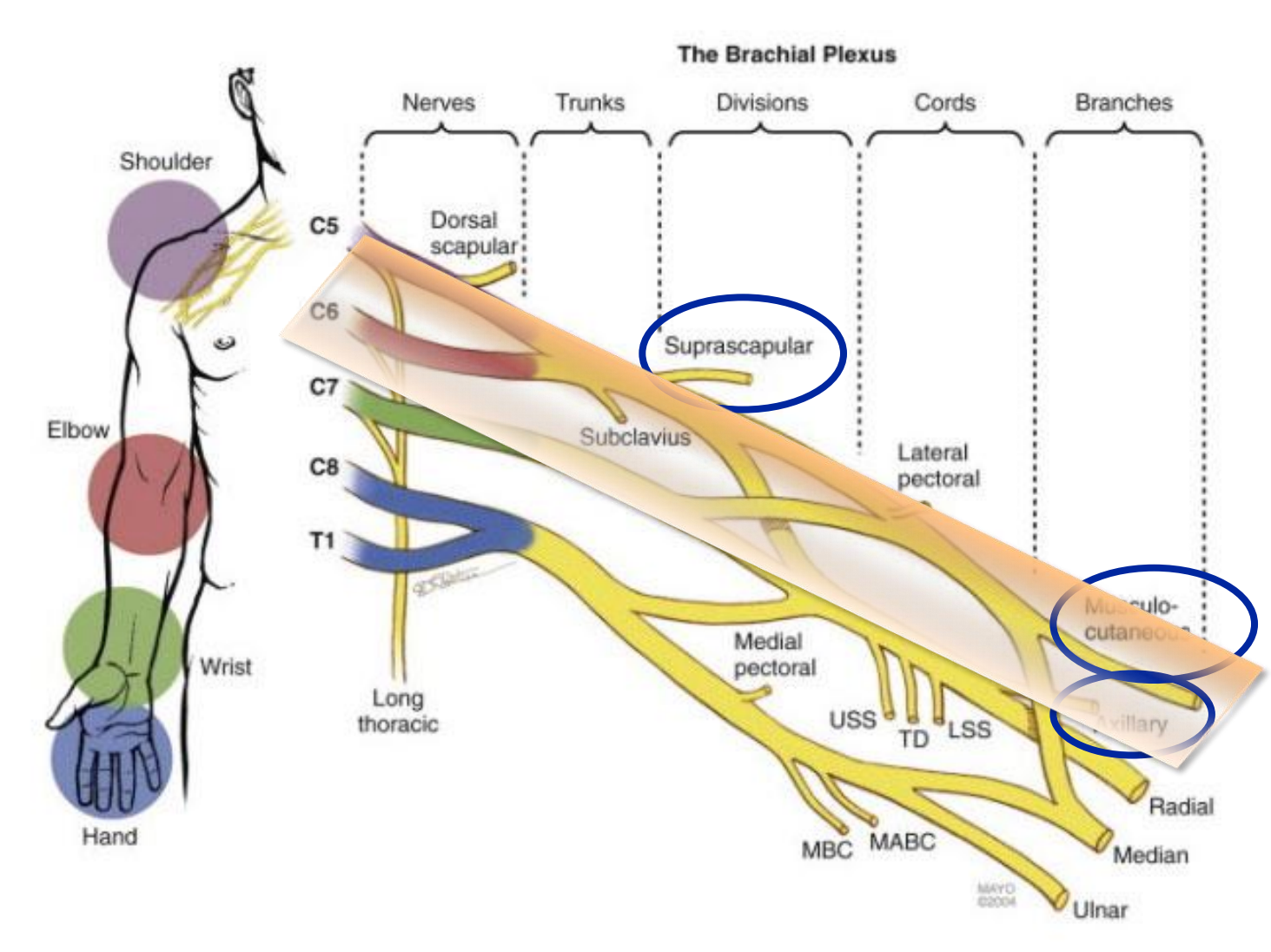
Nerve transfer



Nerve transfer

- Indications
  - ✓Root avulsion; proximal nerve stump is injured or unavailable
  - ✓Distance to target muscle is too far

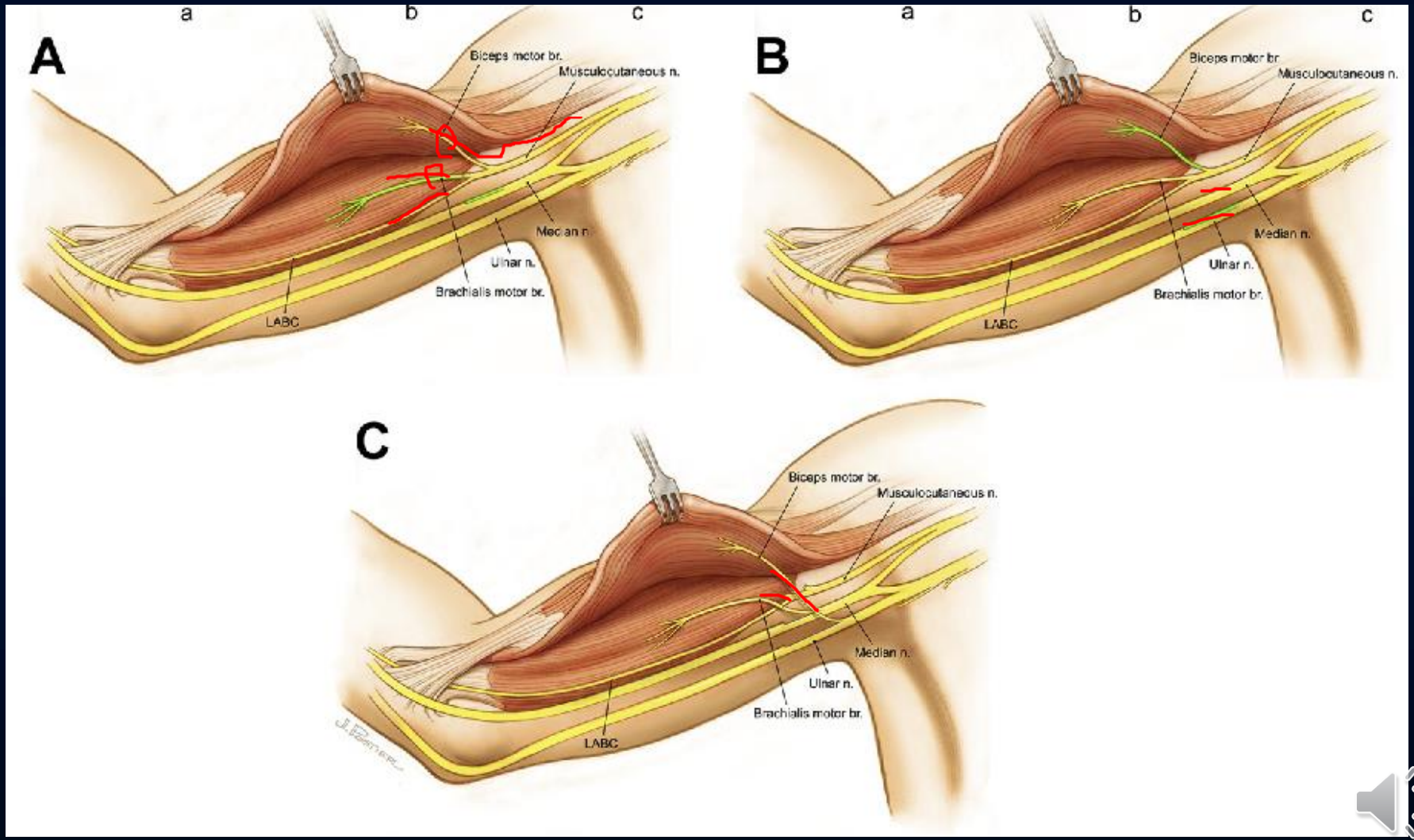
Upper trunk BPI



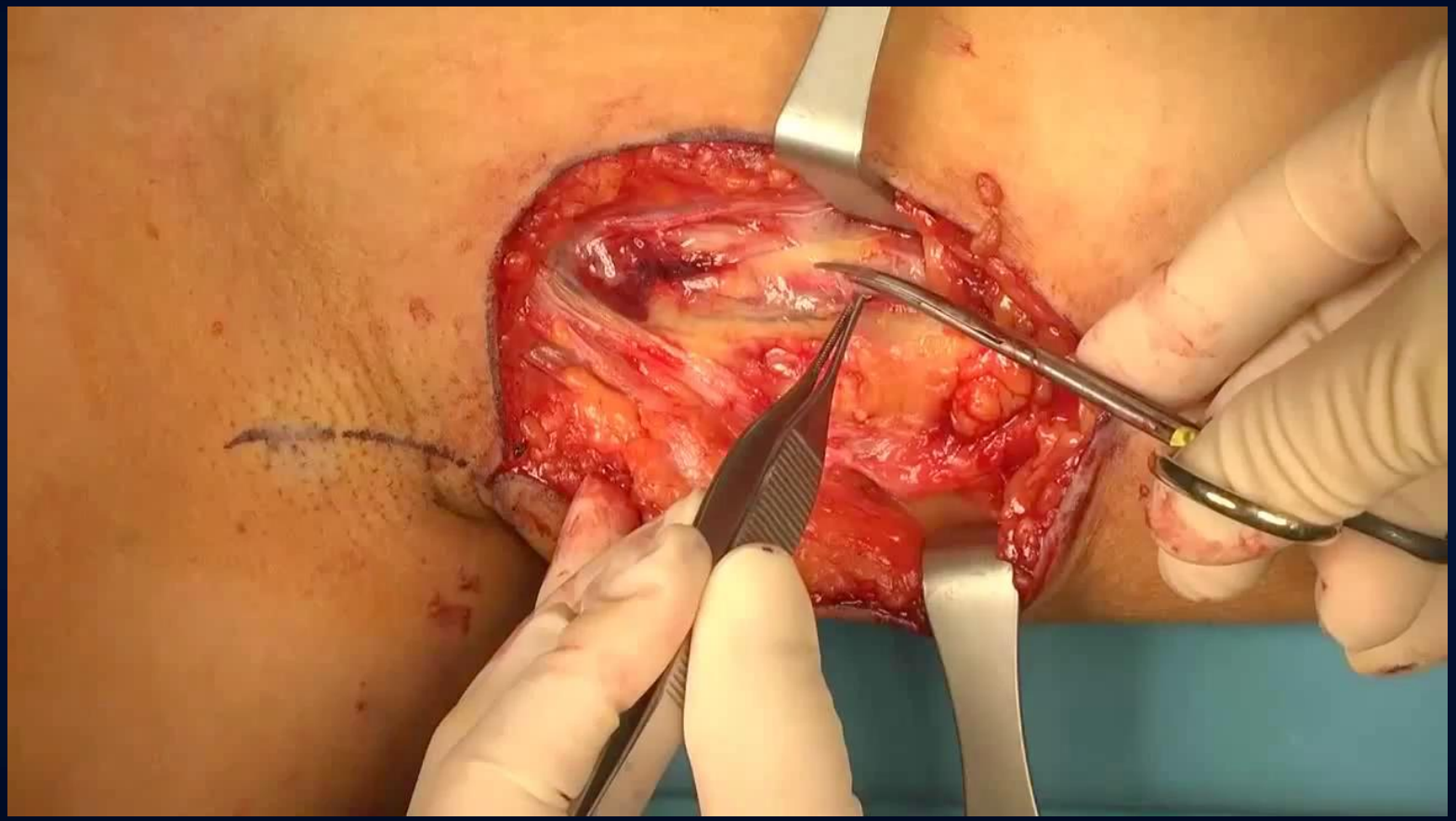
Nerve transfer in upper trunk injury

- Elbow flexion
  - ✓A fascicle of ulnar nerve to branch of brachialis
  - ✓A fascicle of median nerve to branch of bicpes
- Shoulder abduction
  - ✓Branch of triceps to deltoid branch of axillary nerve
- Shoulder external rotation
  - ✓Spinal accessory nerve to suprascapular nerve

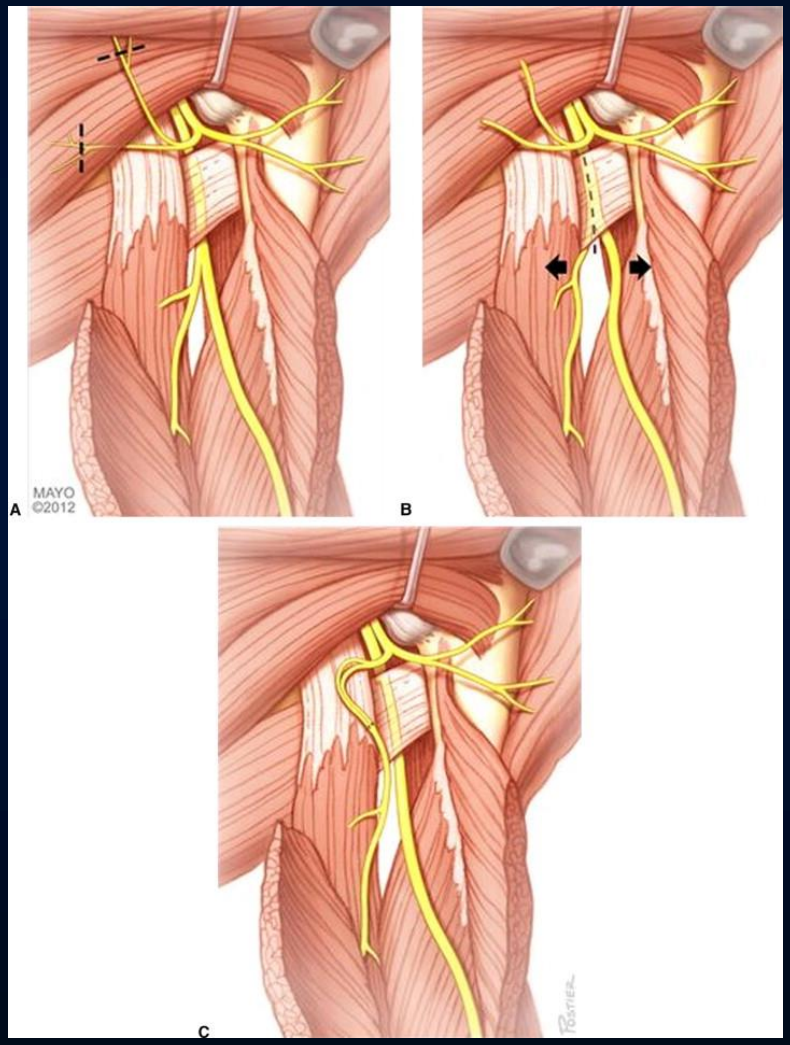
Double Oberlin's procedure

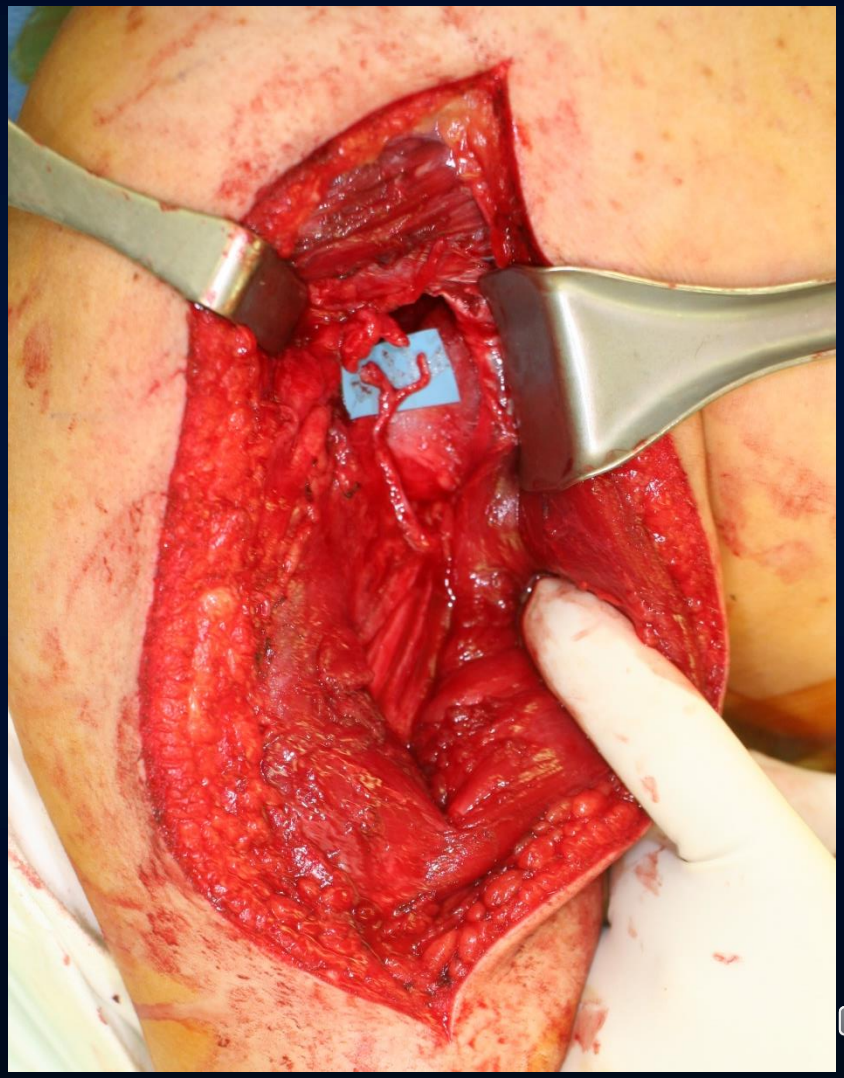


Double Oberlin's procedure

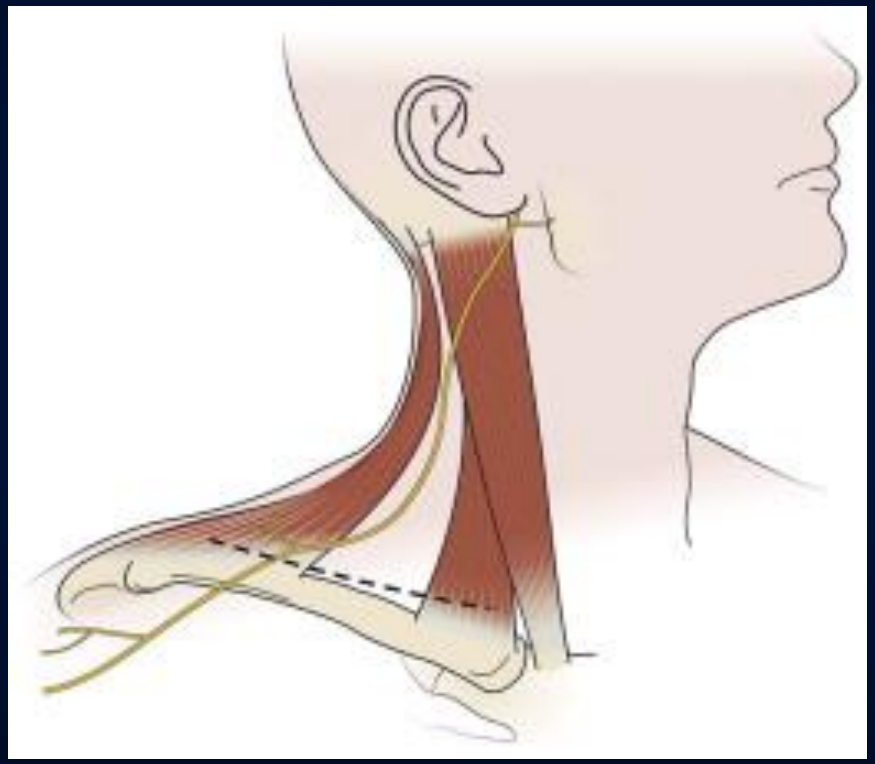


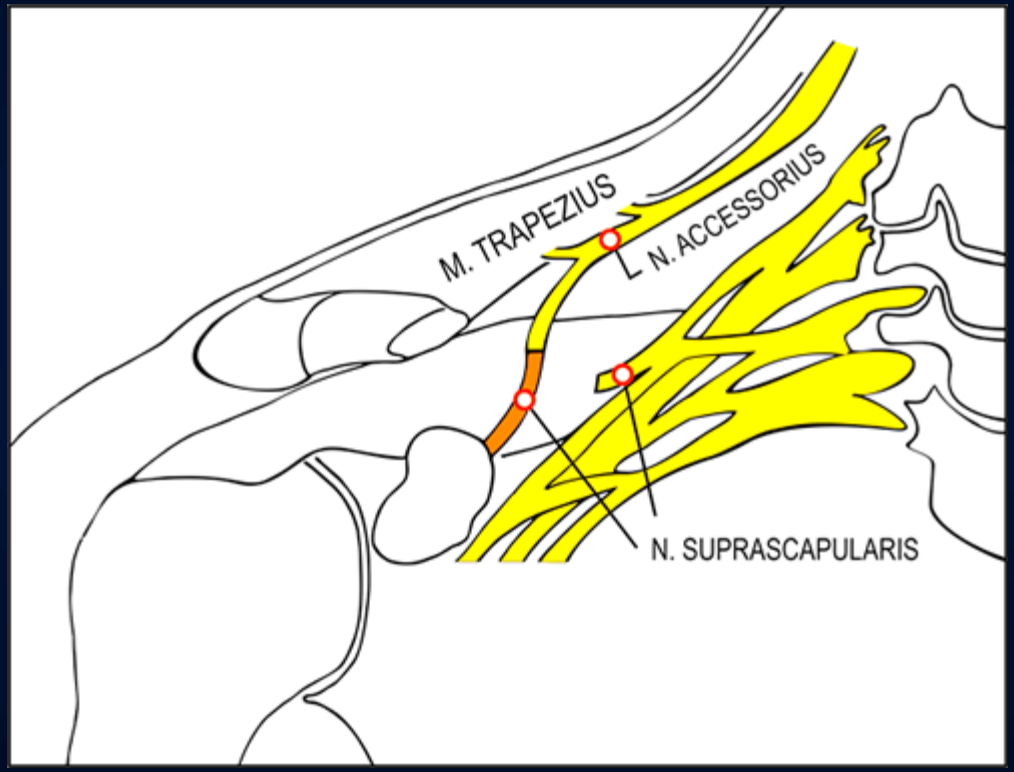
Triceps br to axillary nerve transfer



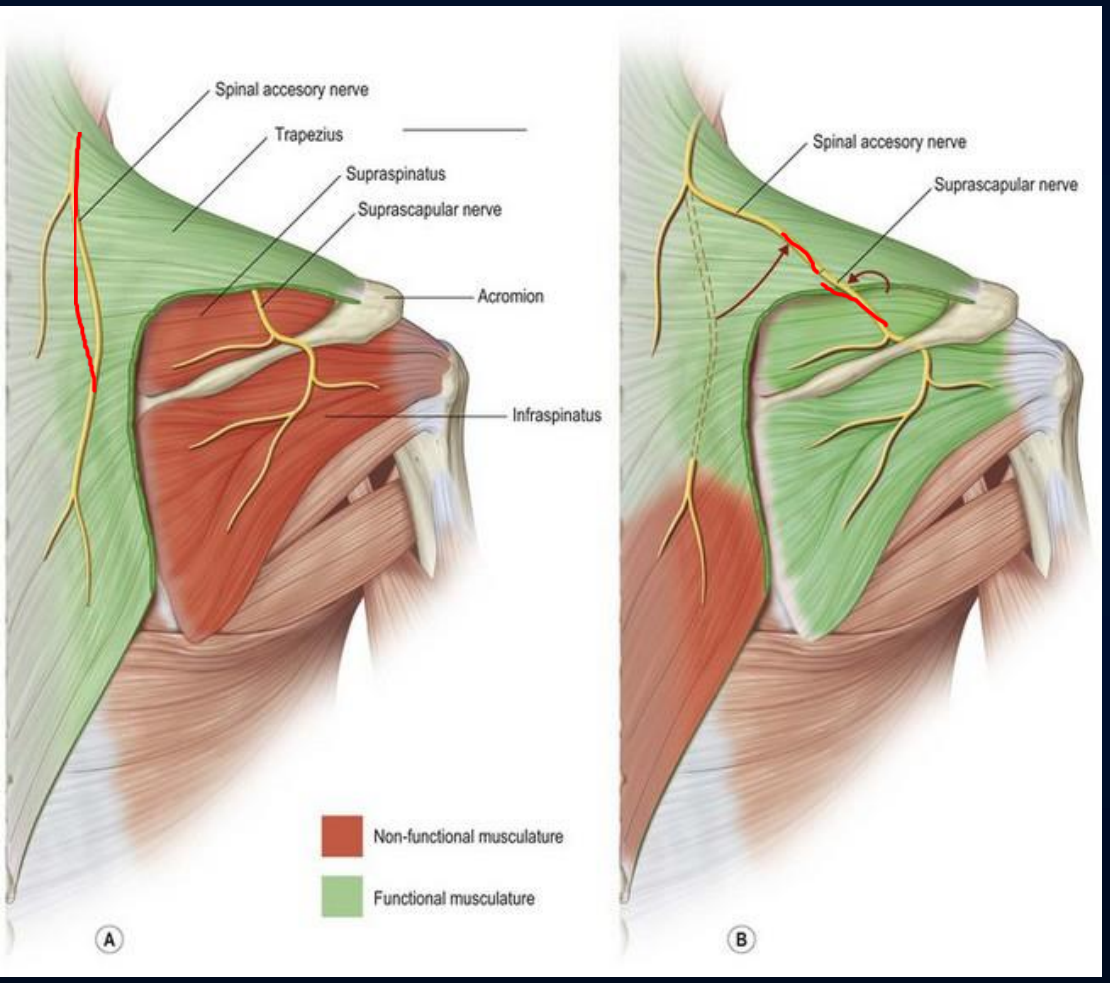


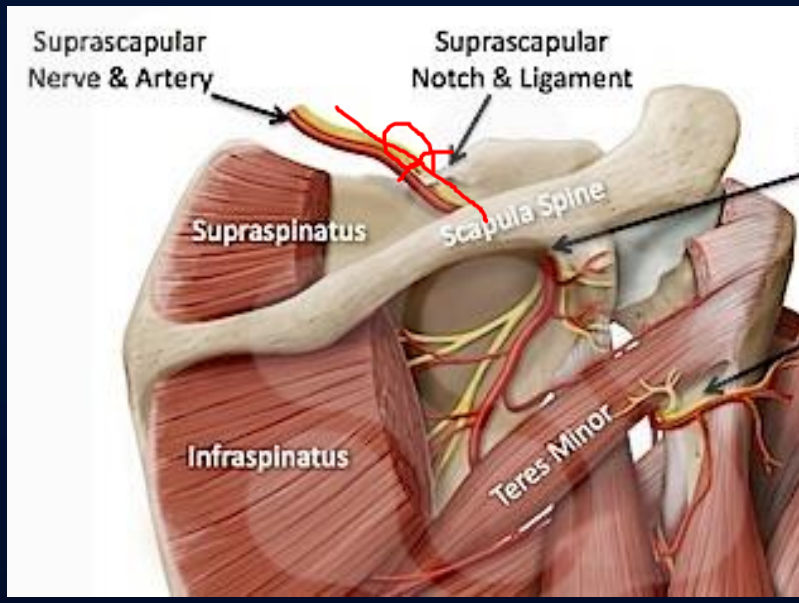
Anteior SAN to SSN transfer



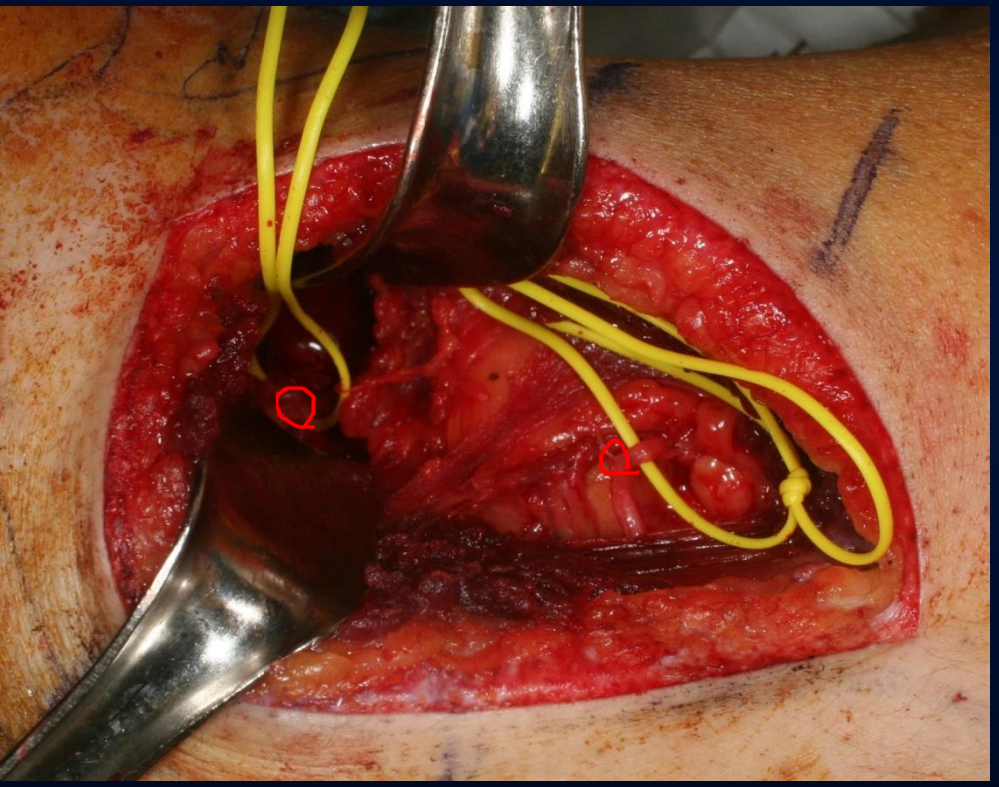


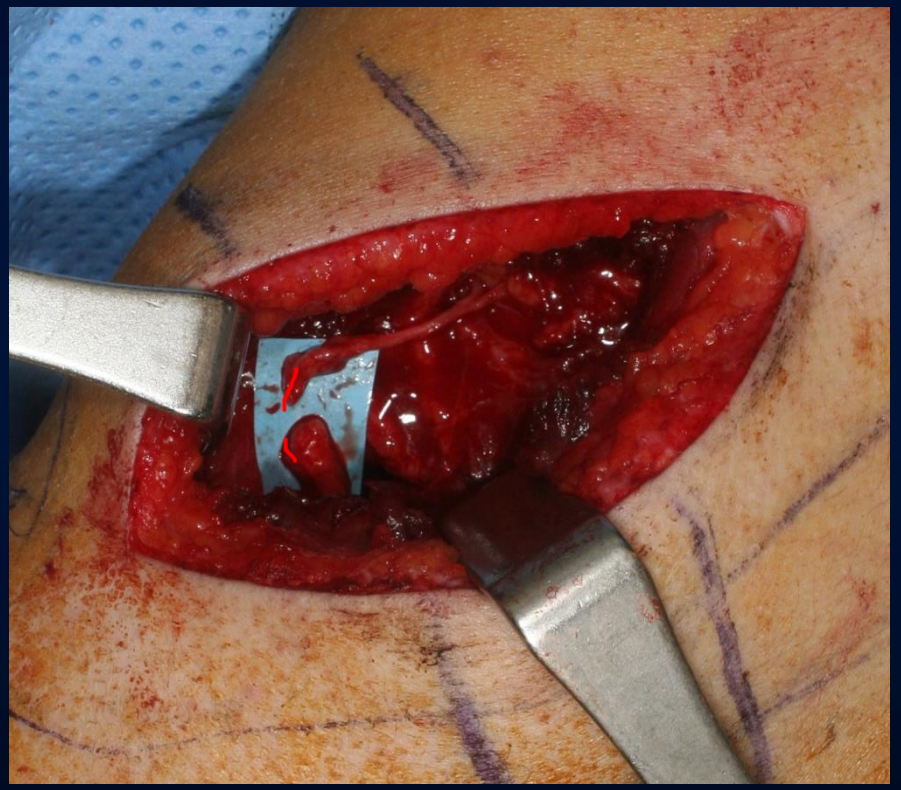
Posterior SAN to SSN transfer





Posterior SAN to SSN transfer





C5-T1 avulsion BPI

- Donor nerve
  - ✓Intercostal nerve; lateral cord
  - ✓Spinal accessory nerve; suprascapular nerve
  - ✓Contralateral C7

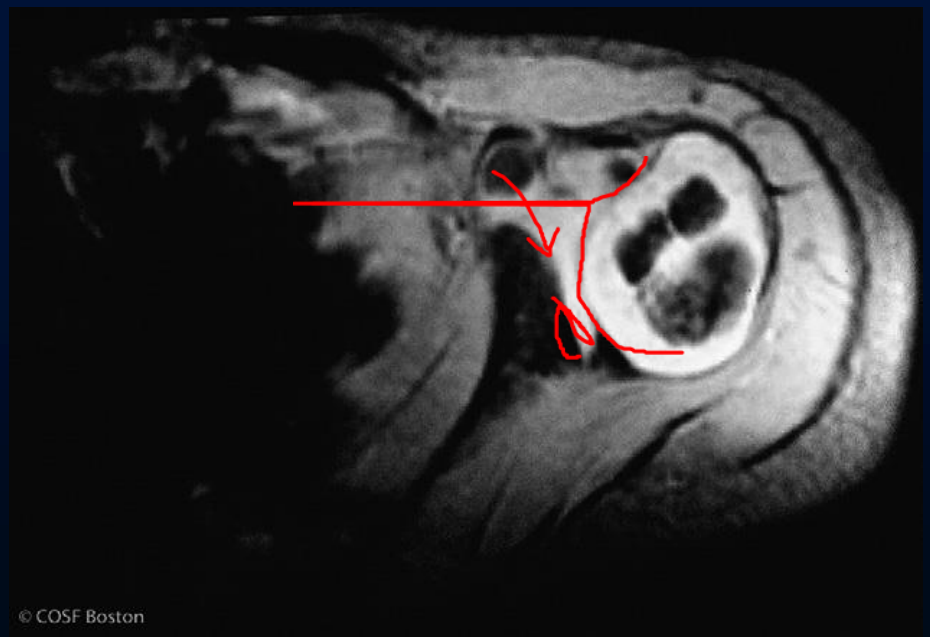
Intercostal nerve transfer

Secondary procedures

- Muscle imbalance around the joint
- This cause the joint contracture and bony deformity
  - ✓Shoulder
  - ✓Elbow

Shoulder

- M/C; internal rotation contracture
- Motor deficit beyond 6 months of age
  - ✓60-80% glenohumeral deformity



Shoulder

- Surgical indications
  - ✓Infantile dislocation
  - ✓Persistent internal rotation-adduction contracture despite extensive nonoperative management
  - ✓Limitation of abduction and external rotation with plateauing of neural recovery
  - ✓Progressive glenohumeral deformity

Infantile dislocation

- Within 18 months of age
- Arthroscopic or open release of anterior capsule and inferior glenohumeral ligament
- Partial subscapularis muscle lengthening
- Shoulder spica cast in the reduced position for 4 – 6 weeks

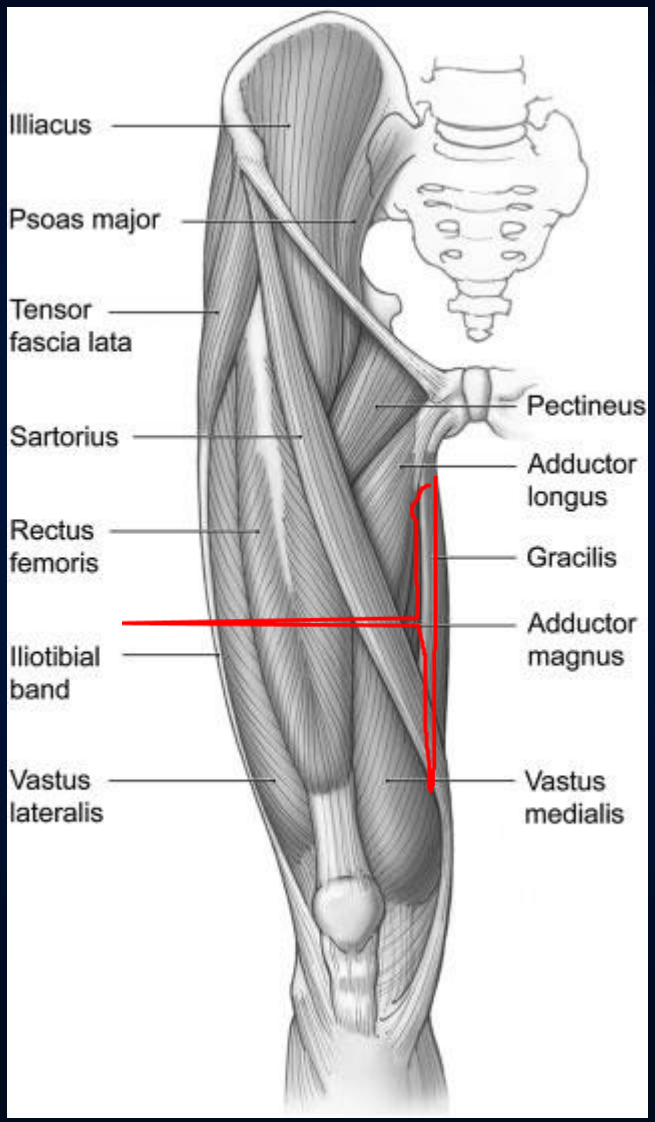
Persistent contracture

- 24 months of age 이후
- Arthroscopic or open release of anterior capsule
- ± subscapularis lengthening
- ± lattisimus dorsi and teres major tendon transfer to rotator cuff insertion

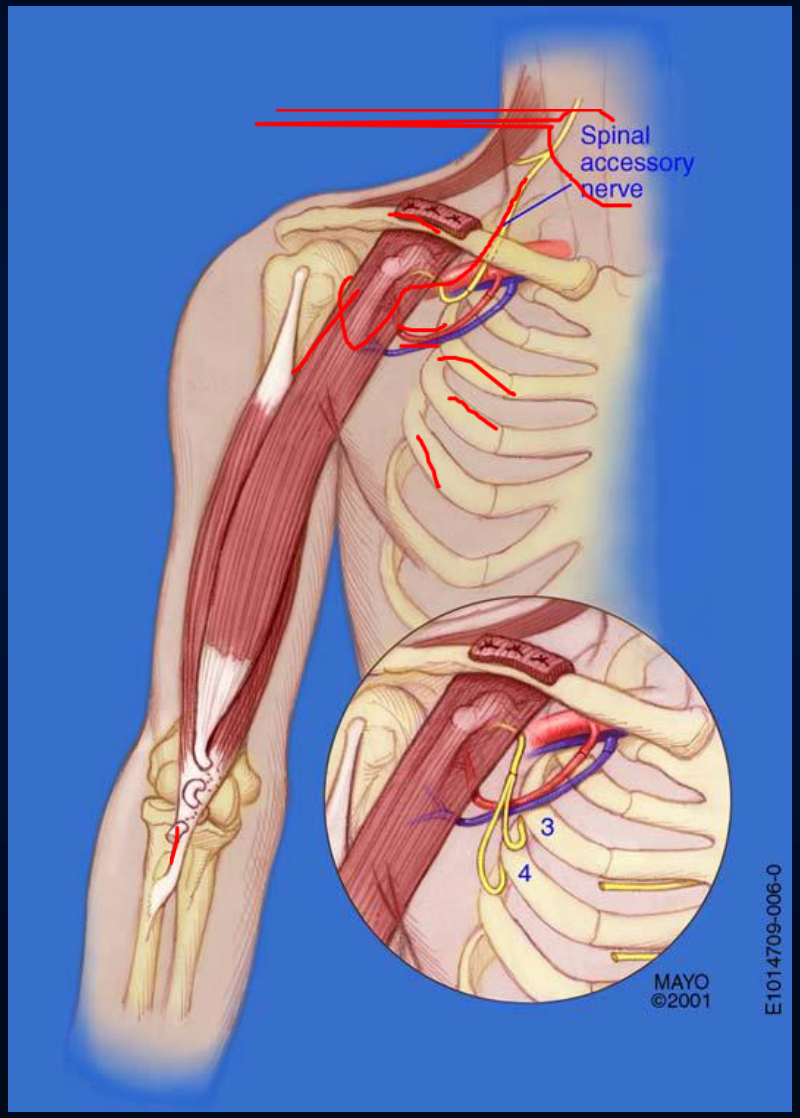
Elbow

- Surgical option for failed elbow flexion power
  - ✓Gracilis muscle flap
  - ✓Steinlder flexorplasty
  - ✓Regional tendon transfer; pectoralis major, lattisimus dorsi

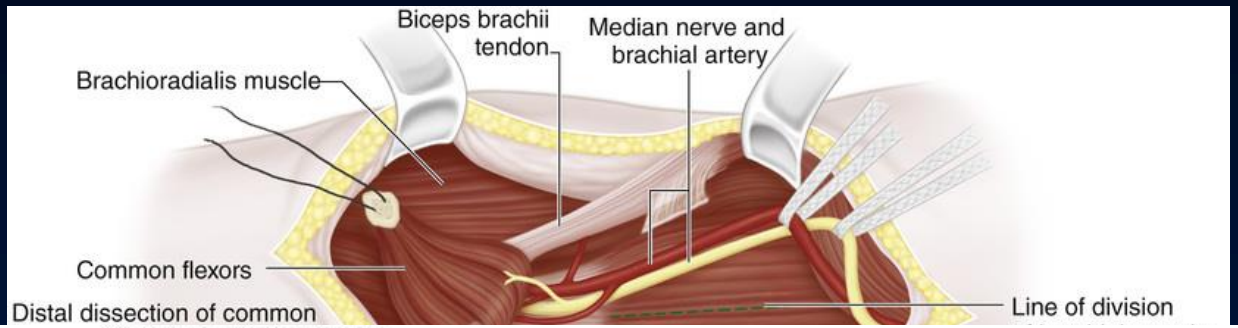
Gracilis muscle flap

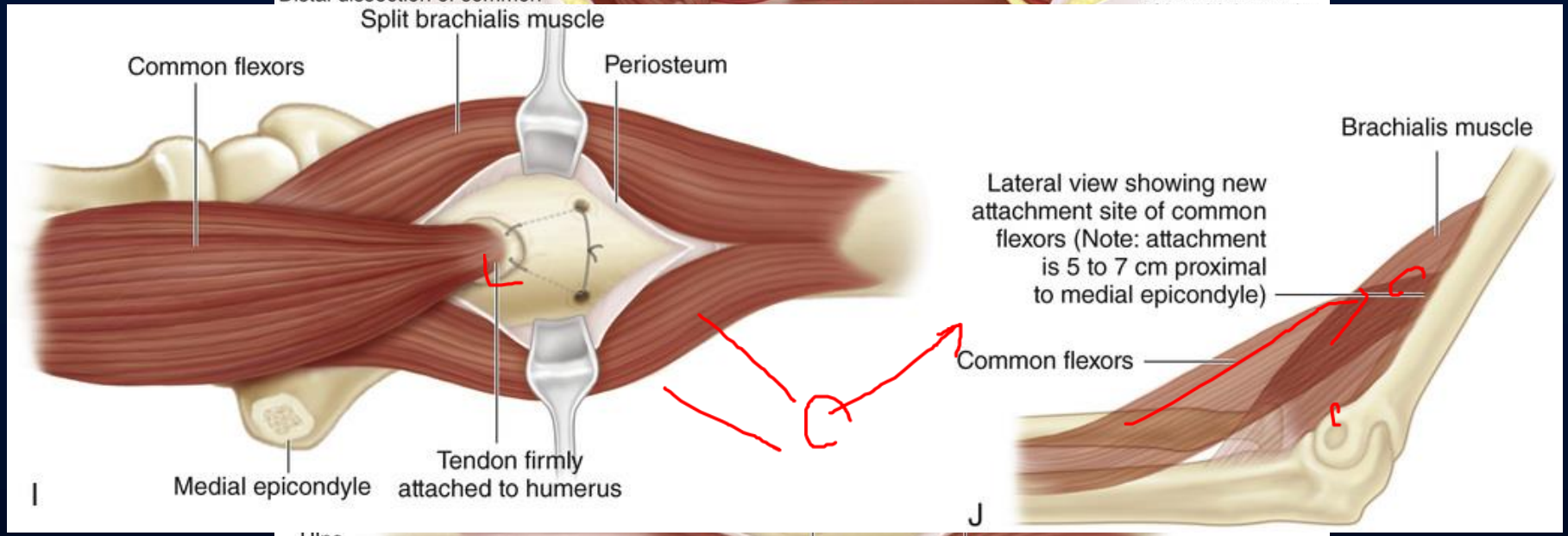


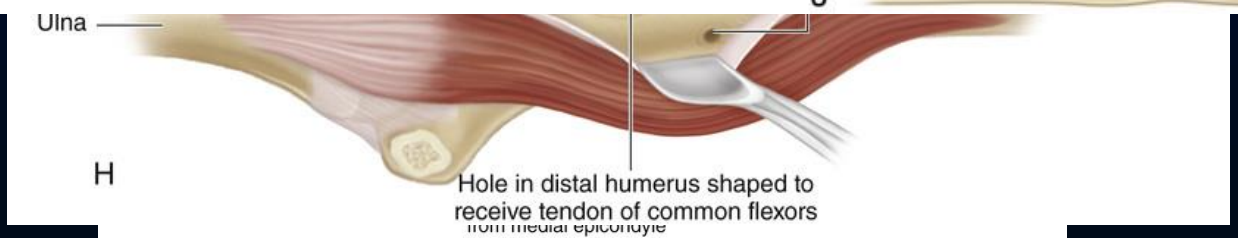
Gracilis muscle flap



Steindler flexorplasty







Summary

- Microsurgical brachial plexus reconstruction is necessary when biceps function is not recovered at 3 – 9 months of age
- Secondary procedures will be necessary when shoulder joint contracture or elbow flexion weakness is apparent during follow-up

Thank you for your attention