Brachial Plexopathies And Proximal Mononeuropathy

Part II

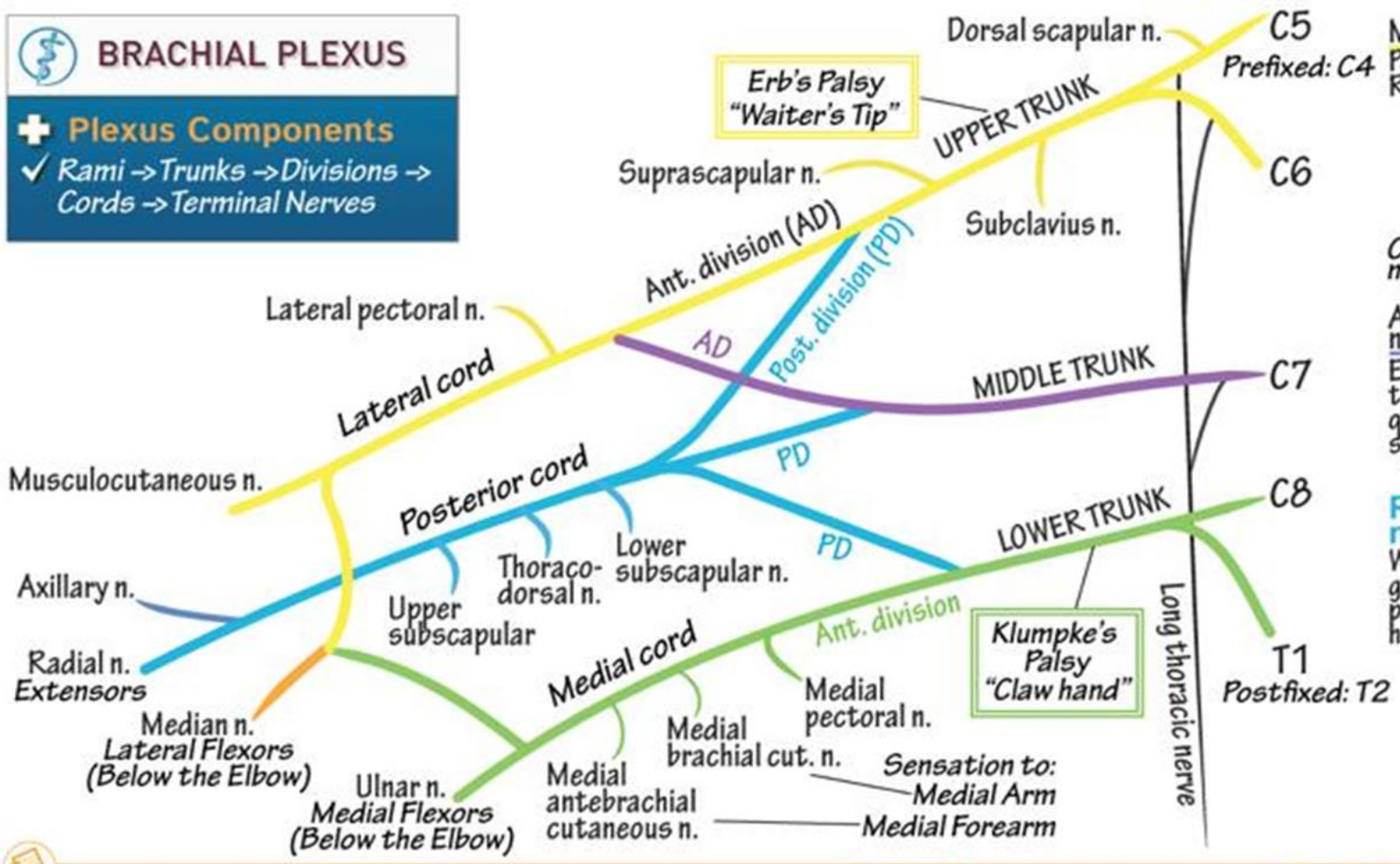
Dumitru, Chapter **19**

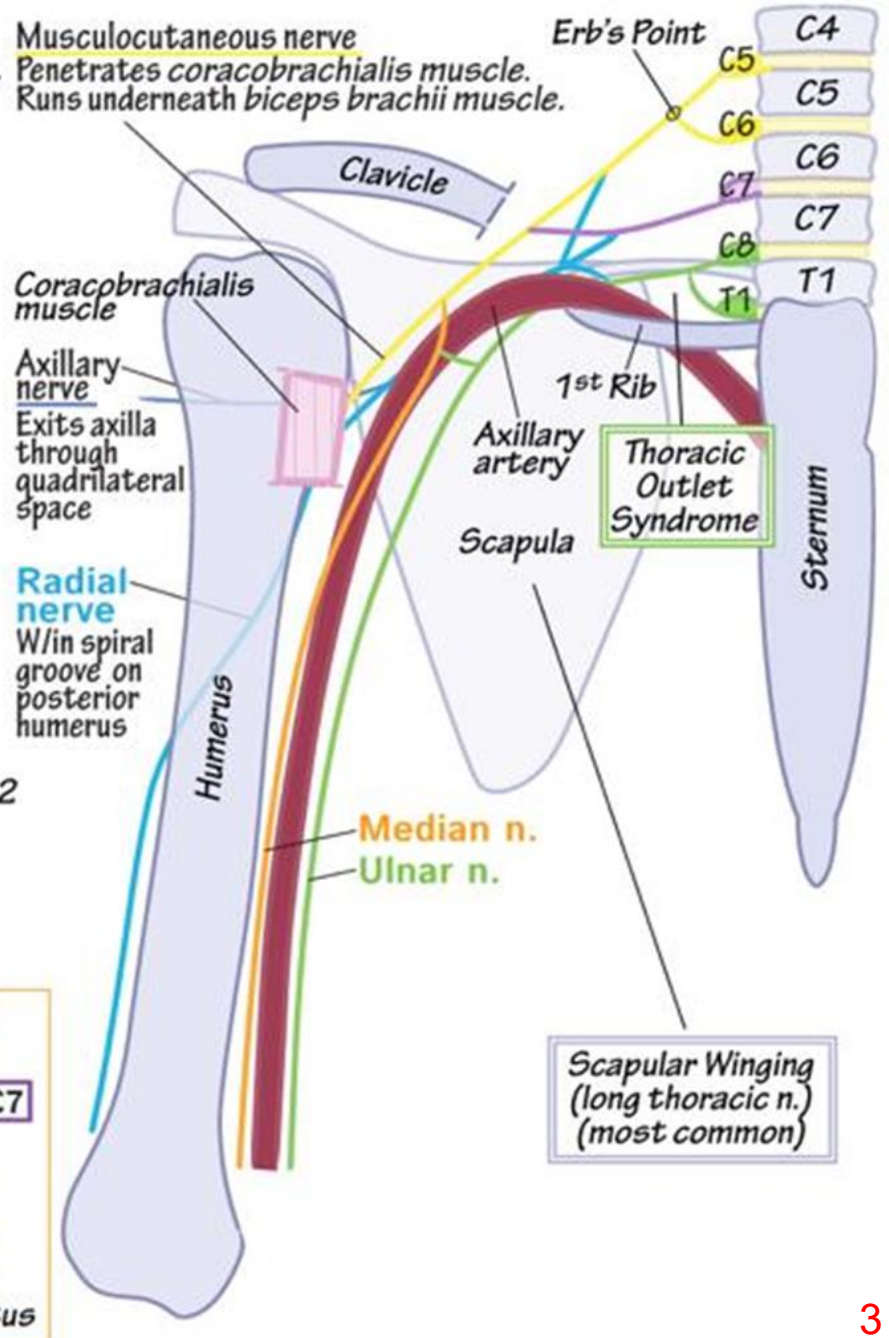
Regional Plexopathies and Nerve Injuries

BRACHIAL PLEXUS

Plexus Components

✓ Rami → Trunks → Divisions → Cords → Terminal Nerves





Musculocutaneous n. C5 C6 *Biceps b., brachialis, Coracobrachialis*	Upper subscapular C5 C6 *Subscapularis*	Dorsal scapular n. [C4] C5 *Rhomboids*
Axillary n. C5 C6 *Deltoid, Teres minor*	Thoracodorsal n. C6 C7 C8 *Latissimus dorsi*	Long thoracic n. C5 C6 C7 *Serratus anterior*
Lateral pectoral n. C5 C6 C7 *Pectoralis major (clavicular)*	Lower subscapular n. C5 C6 *Subscapularis, Teres major*	Subclavius n. C5 C6 *Subclavius*
Medial pectoral n. C8 T1 *Pectoralis major (sternal), Pec. minor*		Suprascapular n. C5 C6 *Supraspinatus, Infraspinatus*

Table 19-8. Scapular Winging Evaluation

Nerve	Long Thoracic	Spinal Accessory	Dorsal Scapular
Muscle	Serratus Anterior	Trapezius	Rhomboids
Scapula at rest	Winging	Less winging with prominent inferior angle	Winging with inferior angle prominent
	Medial translocation	Lateral translocation	Later translocation
	Inferior angle medially rotated	Inferior angle medially rotated	Inferior angle laterally rotated
	Apparent shoulder drooping because of rotation	True shoulder drop with prominent levator scapulae	
Accentuated by	Forward flexion*	Abduction	
Decreased by	Abduction	Forward flexion to 90°	Overhead elevation

* Protraction against resistance; also forward flexion to 45° below horizontal

Modified from Liveson JA, Spielholz NI: Peripheral Neurology: Case Studies in Electrodiagnosis. Philadelphia, F.A. Davis, 1979.

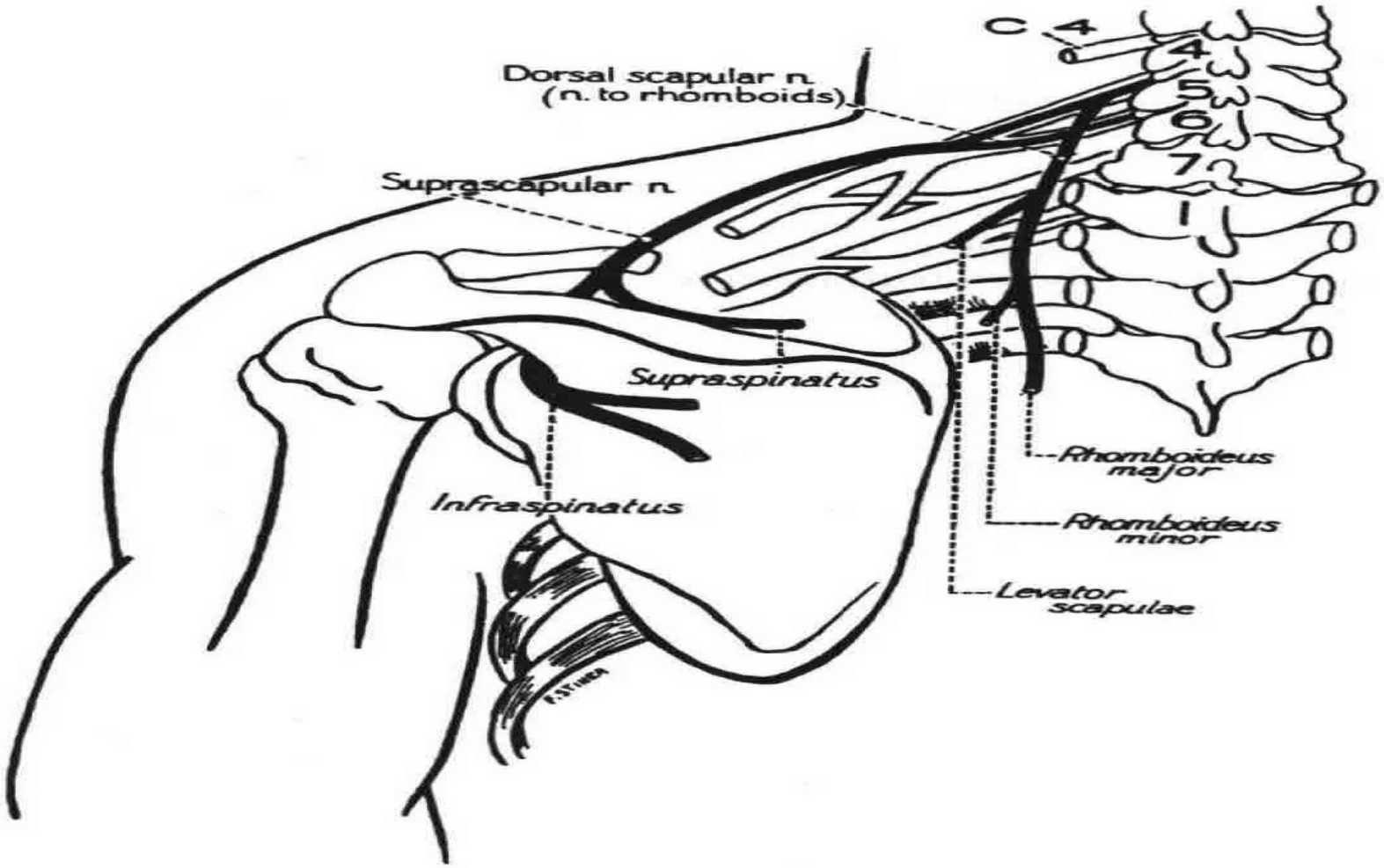


Figure 19-9. **Posterior aspect of the thorax.** The dorsal scapular and suprascapular nerves can be seen coursing to their respective muscles. The suprascapular nerve passes beneath the suprascapular notch (not depicted) as well as around the spinoglenoid notch, which are two potential areas of compromise. (From Haymaker W, Woodhall B: Peripheral Nerve Injuries: Principles of Diagnosis. Philadelphia, W.B. Saunders, 1953, with permission.)

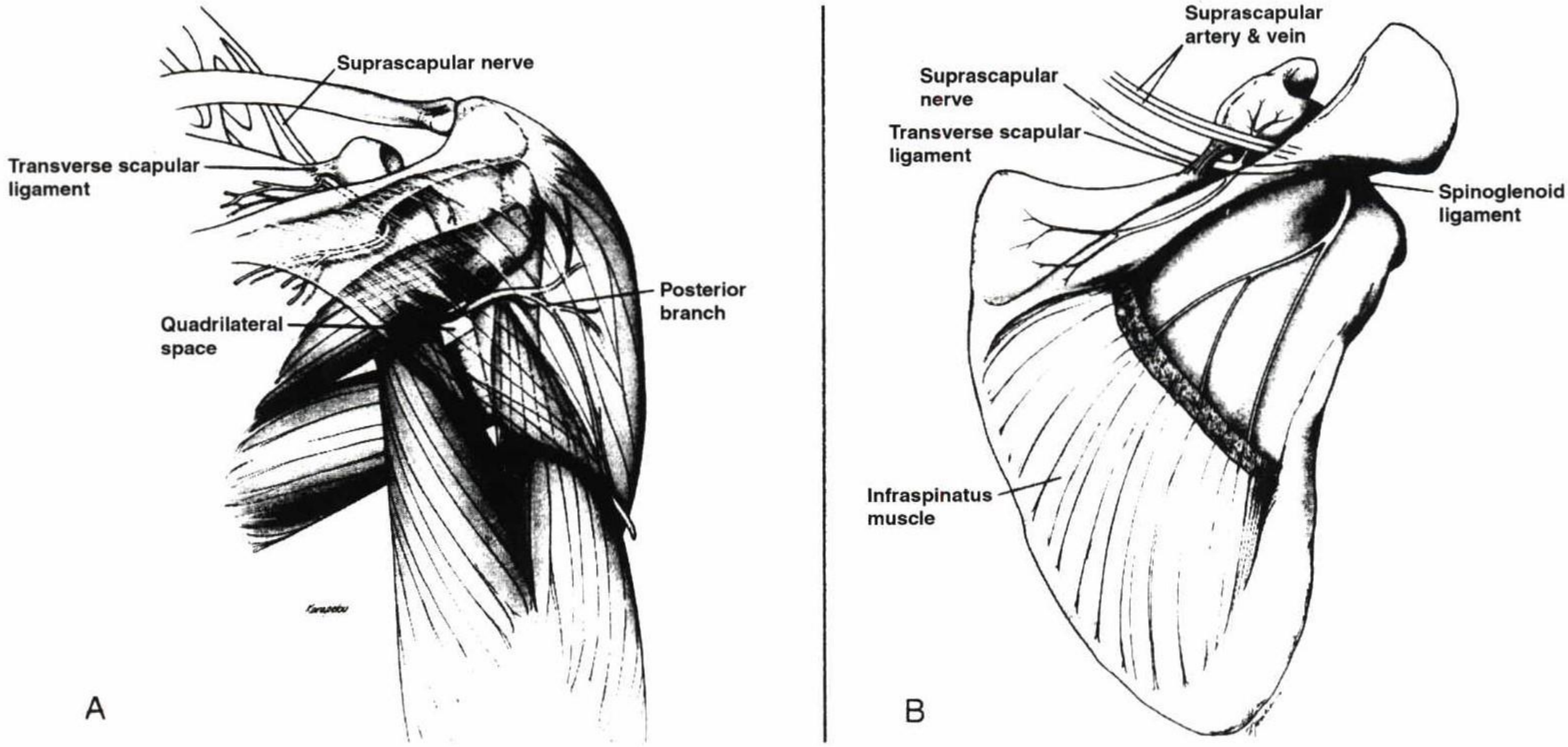


Figure 19-12. **Suprascapular and axillary nerve anatomy.** **A**, Suprascapular nerve traveling beneath the transverse scapular ligament and around the spinoglenoid notch. The axillary nerve is also shown to penetrate the quadrilateral space. **B**, Suprascapular nerve traversing the two fibro-osseous tunnels beneath the transverse scapular ligament and the spinoglenoid ligament. (Reproduced from McIlveen SJ, Duralde XA, D'Alessandro DF, Bigliani LU: Isolated nerve injuries about the shoulder. Clin Orthop 1994;306:54–63, with permission.)

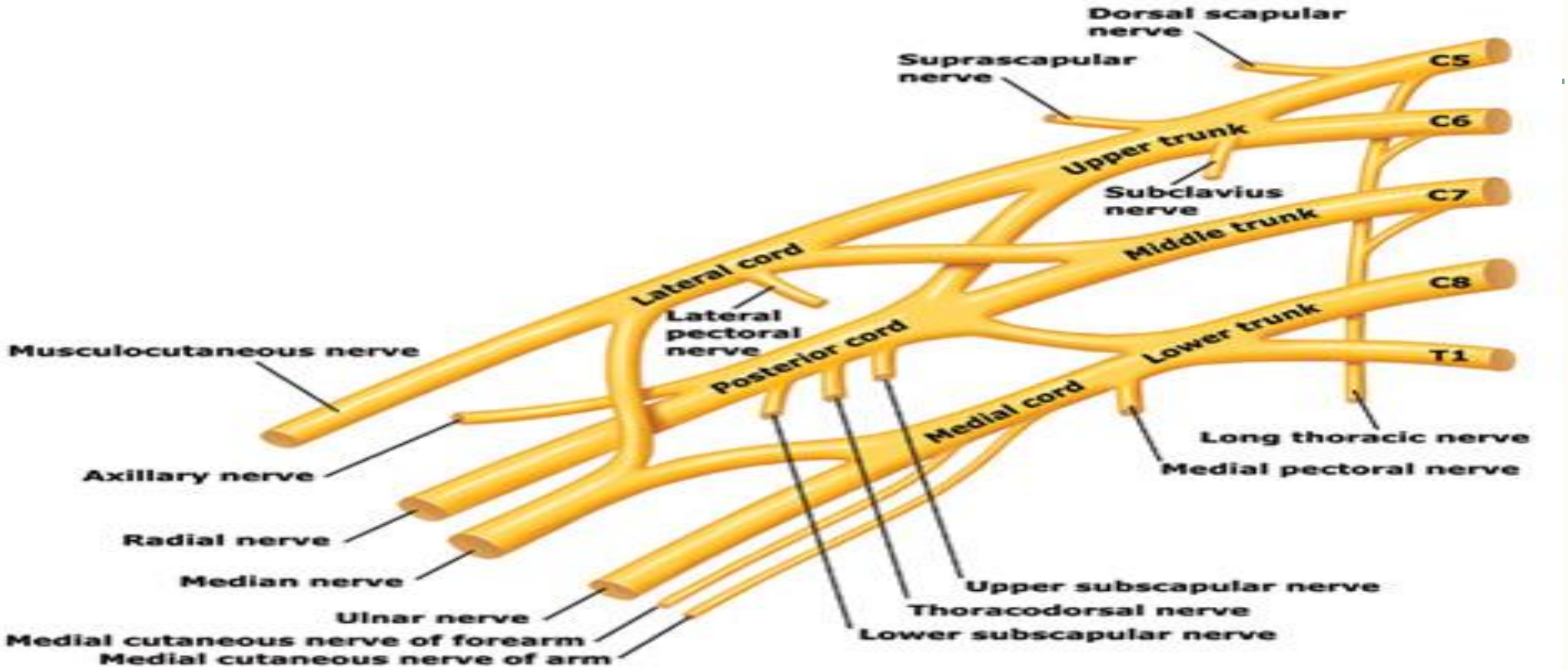
Infraspinatus denervation :

the most common lesion resulting only in infraspinatus denervation :

In the athlete :volleyball players ,exact mechanism :unclear but may involve the repeated overhand stress activities involved in this sport.

In the nonathlete, the most common reason reported in the literature for preferential infraspinatus denervation :cystic lesion in or about the spinoglenoid notch that can be visualized quite well by MRI.

Terminal Nerve Branches



Axillary Nerve

- Shoulder dislocations or surgical neck fractures of the humerus
- Severe blunt trauma
- gunshot wounds
- general anesthesia, sleeping with the arms raised superiorly
- neuralgic amyotrophy
- **SNAP** is not available,CMAP:Deltoid
- **Needle electromyographic:**
- Paraspinal, supra/infraspinatus, biceps brachii, pronator teres brachioradialis muscles are all quite useful
- deltoid and teres minor:Abnormal

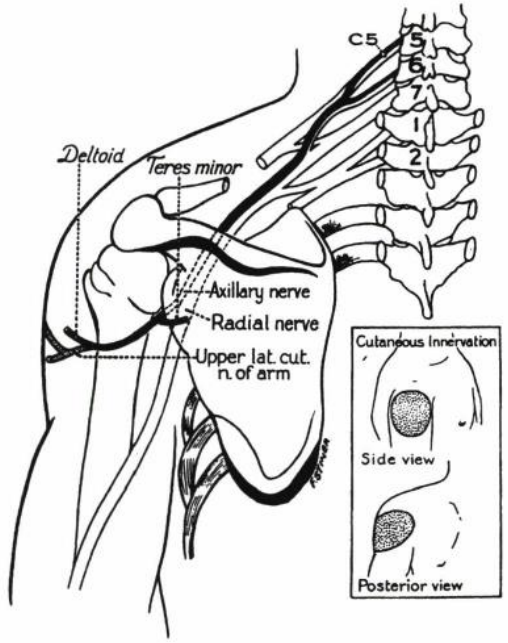


Figure 19-14. **Axillary nerve.** One of the terminal branches of the posterior cord is the axillary nerve. It supplies the teres minor and deltoid muscles and provides cutaneous sensation to the skin overlying the deltoid muscle (upper lateral cutaneous nerve of the arm).

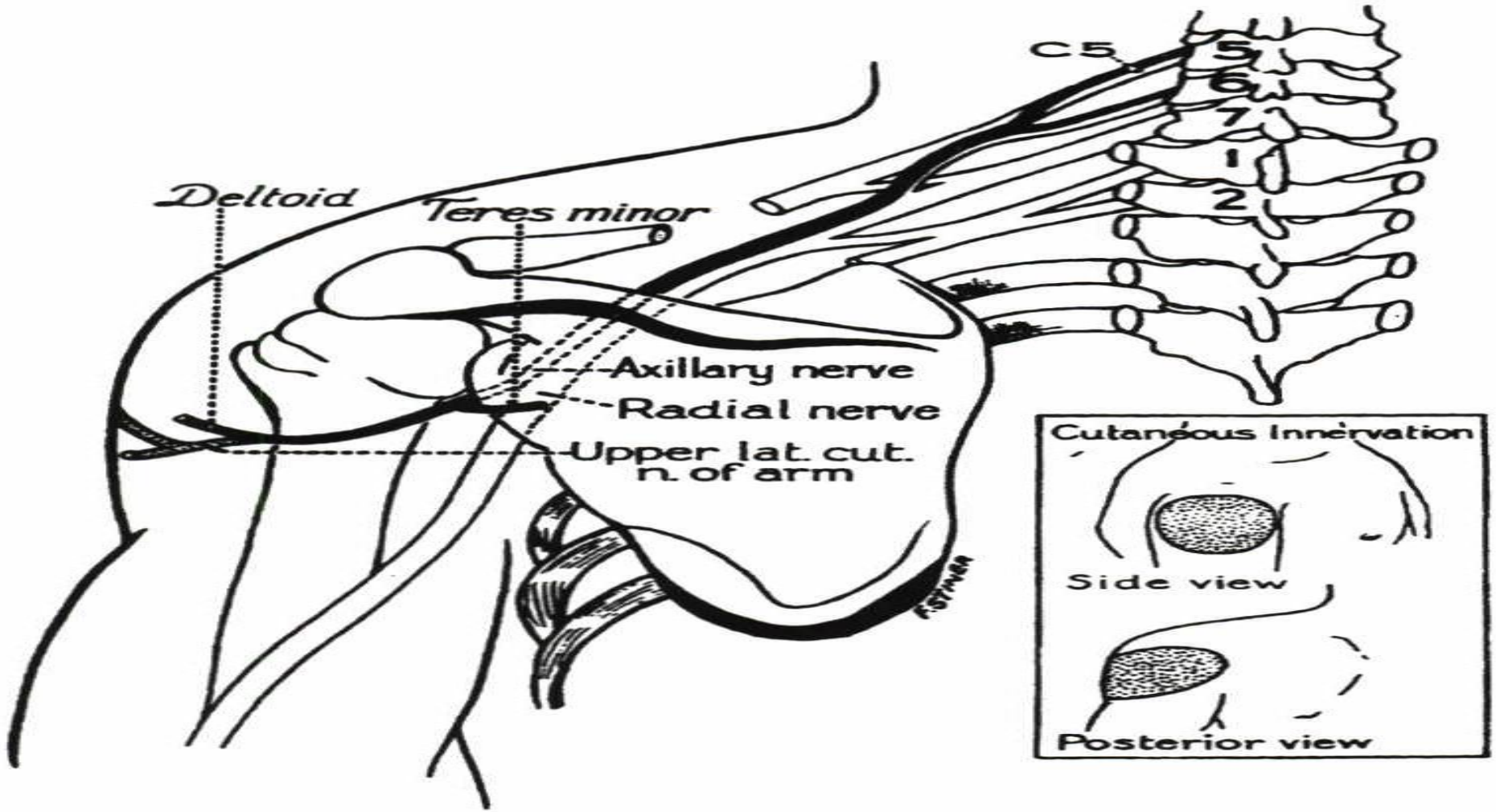


Figure 19-14. **Axillary nerve.** One of the terminal branches of the posterior cord is the axillary nerve. It supplies the teres minor and deltoid muscles and provides cutaneous sensation to the skin overlying the deltoid muscle (upper lateral cutaneous nerve of the arm). (From Haymaker W, Woodhall B: Peripheral Nerve Injuries: Principles of Diagnosis. Philadelphia, W.B. Saunders, 1953, with permission.)

Musculocutaneous Nerve.

- injury in isolation is relatively rare when compared to other peripheral nerves.
- Anterior dislocations of the shoulder
- neuralgic amyotrophy
- weightlifting, malpositioning during anesthesia, and traumatic arm extension
- The LAC may be injured secondary to *antecubital phlebotomy*
- LAC **SNAP:** small amplitude or absent
- **Biceps CMAP** : small amplitude or absent
- **Needle electromyographic** abnormalities in only in the three muscles innervated by this nerve
- If voluntary MUAPs are absent but a relatively good size CMAP can be obtained after 7-10 days following the injury, a conduction block is likely present.

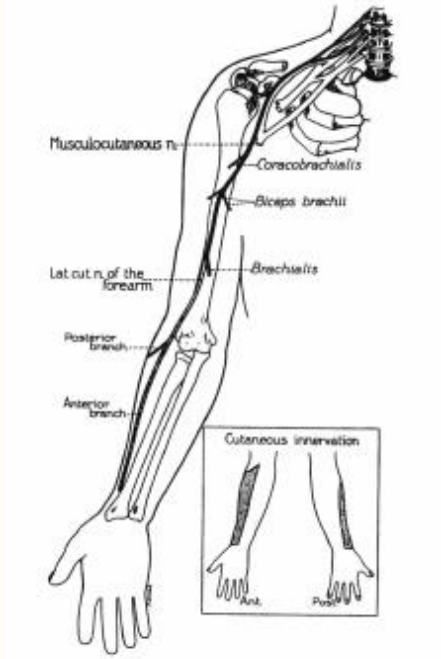


Figure 19-15. **Musculocutaneous nerve.** This nerve is the termination of the lateral cord and supplies the coracobrachialis, biceps brachii, and brachialis muscles. It terminates as the lateral antebrachial cutaneous nerve which splits into two cutaneous branches to supply the radial aspect of the forearm. (From Haymaker W, Woodhall B:

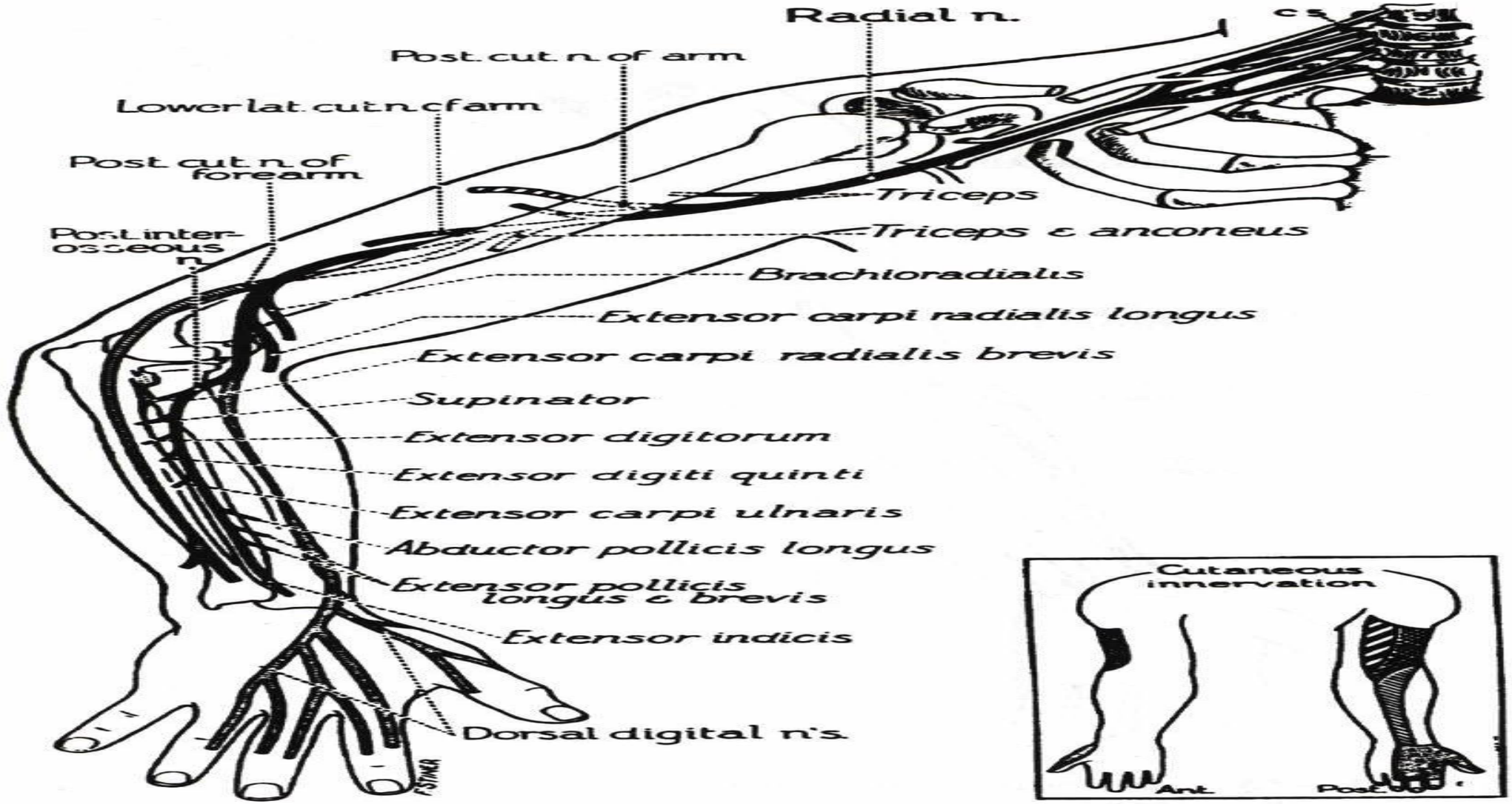


Figure 19-16. **The course and muscular innervation of the radial nerve.** In the axilla and proximal arm the triceps muscle is innervated and three sensory branches originate. The sensory branches can be of assistance in localizing a lesion at or proximal to the spiral groove. Note the sequence of muscles innervated and correlate this diagram with table 19-1. (From Haymaker W, Woodhall B: Peripheral Nerve Injuries: Principles of Diagnosis. Philadelphia, W.B. Saunders, 1953, with permission.

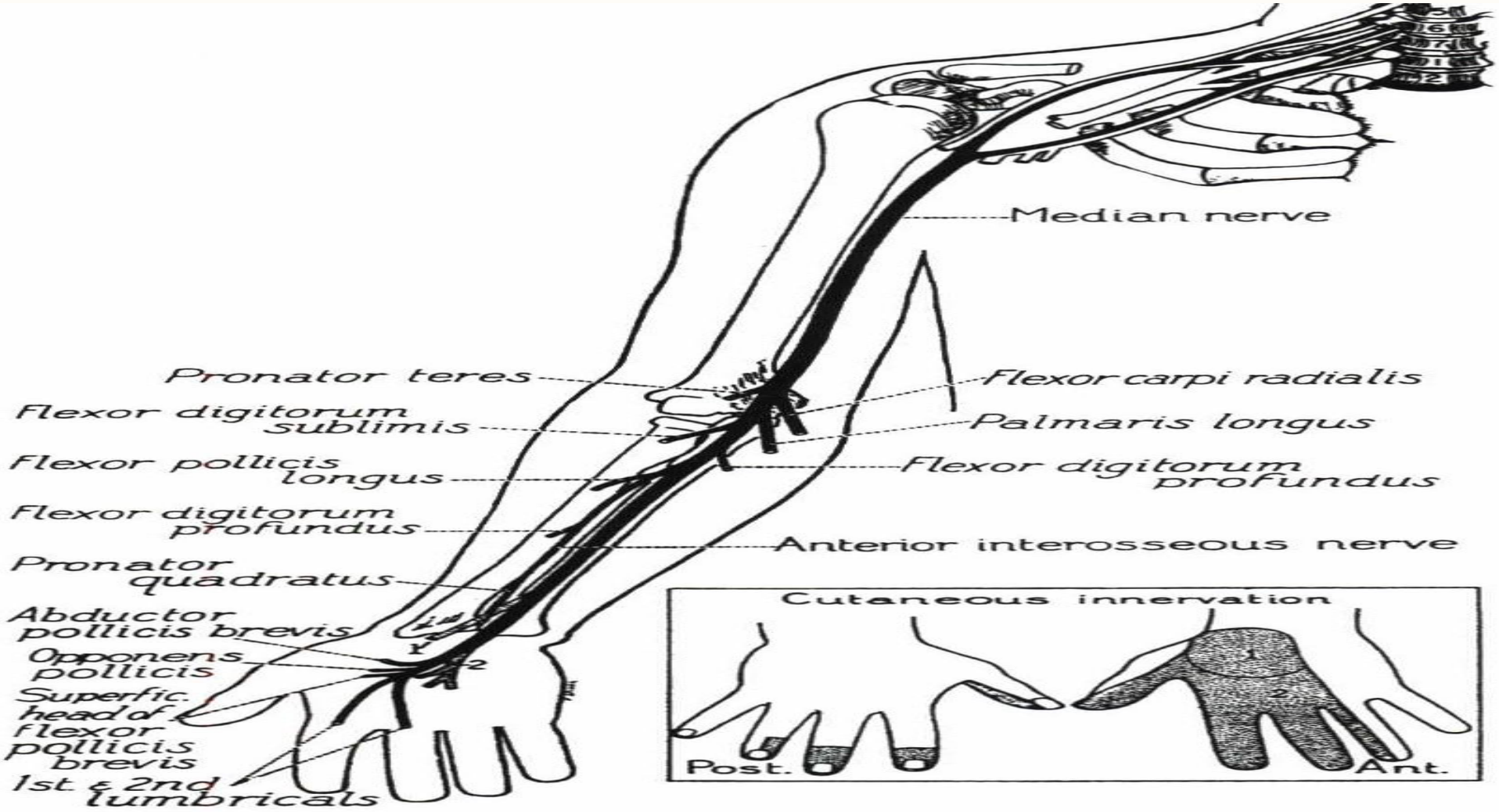


Figure 19-17. **The course and innervation of the median nerve.** There are no muscular or cutaneous branches arising from the median nerve in the axillary region or arm. The first branch originating from the median nerve is to the pronator teres in the proximal forearm. Note the sequence of muscles innervated and compare this diagram to Table 19-1. (From Haymaker W, Woodhall B: Peripheral Nerve Injuries: Principles of Diagnosis. Philadelphia, W.B. Saunders, 1953, with permission.)

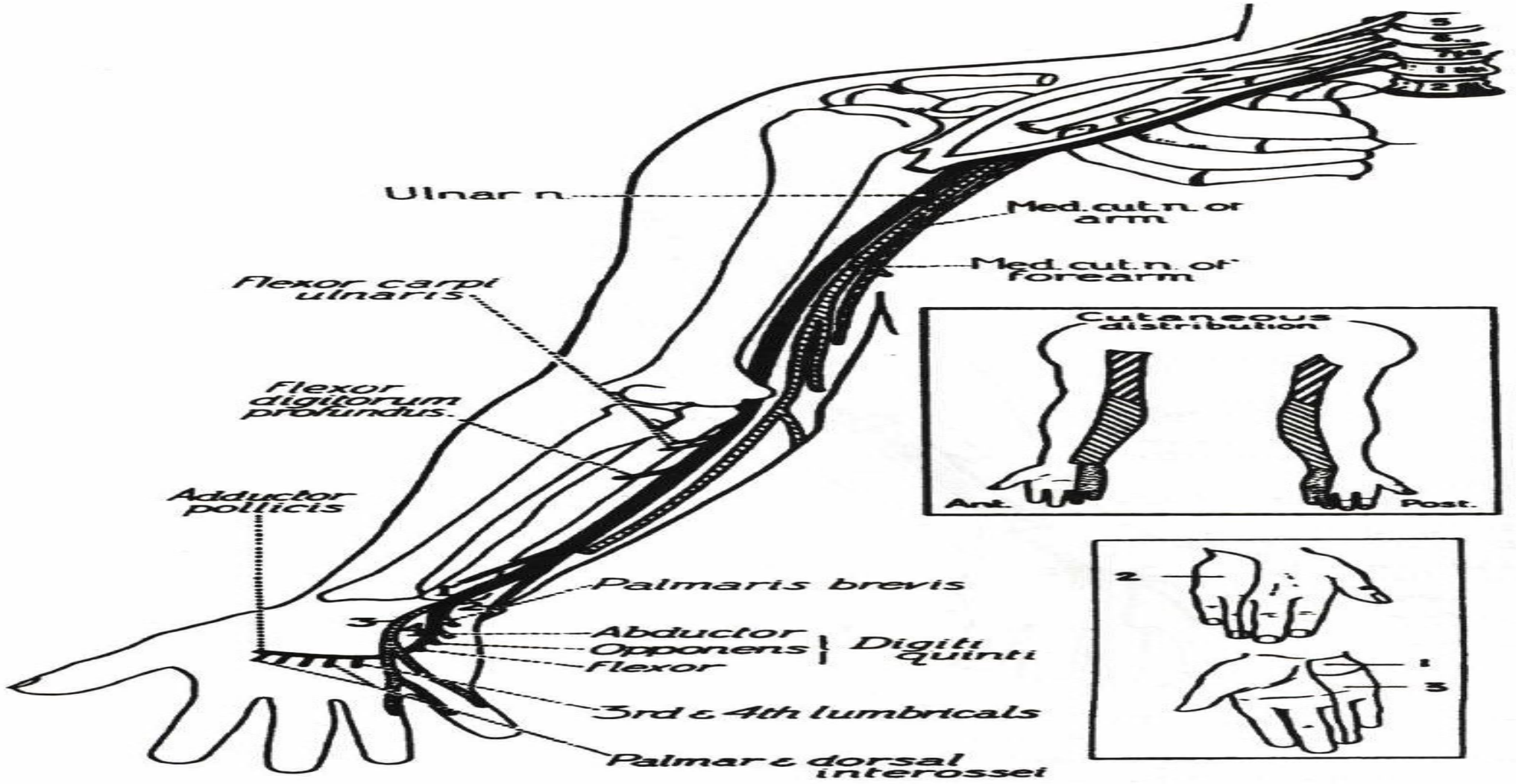


Figure 19–18. **The course and innervation of the ulnar nerve.** Like the median nerve, the ulnar nerve does not generate any motor or cutaneous branches in the arm. The cutaneous branches of the medial cutaneous nerves of the arm and forearm are depicted. (From Haymaker W, Woodhall B: Peripheral Nerve Injuries: Principles of Diagnosis. Philadelphia, W.B. Saunders, 1953, with permission.)

- بیمارآقای 52 ساله، با شکایت درد شدید و نقطه ای در مدیال اسکاپولای چپ ازحدود ۴۰ روز پیش
- در معاینه اسپورلینگ در سمت چپ مثبت
- قدرت پروگزیمالها نرمال
- اکستانت دست چپ ۳/۵ چپ
- ابداکشن شست و انگشتان ۳/۵ چپ
- رفلکسها نرمال

Sensory NCS

Nerve / Sites	Rec. Site	Onset Lat ms	Peak Lat ms	NP Amp µV	PP Amp µV	Segments	Distance mm	Velocity m/s
R Median - Digit III (Antidromic)								
Wrist	Dig III	3.02	3.75	14.0	20.8	Wrist - Dig III	140	46
Mid palm	Dig III	1.46	2.03	9.0	22.3	Mid palm - Dig III	70	48
L Median - Digit III (Antidromic)								
Wrist	Dig III	3.07	3.80	21.4	22.0	Wrist - Dig III	140	46
R Ulnar - Digit V (Antidromic)								
Wrist	Dig V	2.50	3.39	17.9	15	Wrist - Dig V	110	44
6	Dorsum	2.55	3.33	17.7	22.0			
L Ulnar - Digit V (Antidromic)								
Wrist	Dig V	2.50	3.33	11	15.3	Wrist - Dig V	110	44
R Radial - Anatomical snuff box (Forearm)								
Forearm	Wrist	1.98	2.55	13.9	17.9	Forearm - Wrist	100	51
L Radial - Anatomical snuff box (Forearm)								
Forearm	Wrist	2.08	2.76	16.6	21.7	Forearm - Wrist	100	48
R Medial antebrachial cutaneous - Forearm (Elbow)								
Elbow	Forearm	2.24	2.71	6.3	9.0	Elbow - Forearm	140	63
Elbow	Forearm	2.24	2.76	6.7	7.3			
L Medial antebrachial cutaneous - Forearm (Elbow)								
Elbow	Forearm	2.19	2.66	4.7	5.8	Elbow - Forearm	140	64

Motor NCS

Nerve / Sites	Muscle	Latency ms	Amplitude mV	Segments	Distance mm	Lat Diff ms	Velocity m/s
L Median - APB							
Wrist	APB	3.65	7.5	Wrist - APB	70		
Elbow	APB	7.66	6.9	Elbow - Wrist	210	4.01	52
R Median - APB							
Wrist	APB	4.01	9.9	Wrist - APB	70		
Elbow	APB	7.97	9.4	Elbow - Wrist	210	3.96	53
L Ulnar - ADM							
Wrist	ADM	3.80	6.8	Wrist - ADM	70		
B.Elbow	ADM	7.60	5.7	B.Elbow - Wrist	220	3.80	58
A.Elbow	ADM	9.84	5.6	A.Elbow - B.Elbow	110	2.24	49
R Ulnar - ADM							
Wrist	ADM	3.54	7.6	Wrist - ADM	70		
B.Elbow	ADM	8.54	6.6	B.Elbow - Wrist	270	5.00	54

F Wave

Nerve	Fmin ms
L Ulnar - ADM	31.46
R Ulnar - ADM	29.43

EMG

EMG Summary Table											
			Spontaneous					MUAP			Recruitment
Muscle	Nerve	Roots	IA	Fib	PSW	Fasc	H.F.	Amp	Dur.	PPP	Pattern
R. Deltoid	Axillary	C5-C6	N	None	None	None	None	N	N	N	N
R. Biceps brachii	Musculocutaneous	C5-C6	N	None	None	None	None	N	N	N	N
R. Flexor carpi radialis	Median	C6-C7	N	None	None	None	None	N	N	N	N
R. Extensor digitorum communis	Radial	C7-C8	N	None	None	None	None	N	N	N	N
R. First dorsal interosseous	Ulnar	C8-T1	N	None	None	None	None	N	N	N	N
L. Biceps brachii	Musculocutaneous	C5-C6	N	None	None	None	None	N	N	N	N
L. Deltoid	Axillary	C5-C6	N	None	None	None	None	N	N	N	N
L. Flexor carpi radialis	Median	C6-C7	N	None	None	None	None	N	N	N	N
L. Extensor digitorum communis	Radial	C7-C8	2+	4+	3+	None	None	1-	2+	2+	
L. First dorsal interosseous	Ulnar	C8-T1	2+	4+	3+	None	None	N	2+	2+	Discrete
L. Triceps brachii	Radial	C6-C8	1+	None	None	None	None	N	N	N	N
L. Flexor pollicis longus	Anterior interosseous	C7-C8	2+	3+	3+	None	None	N	2+	2+	Discrete
L. Extensor indicis proprius	Radial	C7-C8	3+	3+	3+	None	None	N	2+	2+	Discrete
L. Abductor pollicis brevis	Median	C8-T1	2+	2+	2+	None	None	N	2+	2+	Discrete
L. Brachioradialis	Radial	C5-C6	N	None	None	None	None	N	N	N	N

- Severe pregangelionic lesion of left c7-8 roots with evidence of active denervation

- نکته:
- درسته ما گزارش میکنیم اما کمی هم باید به فکر مواردی مثل پلکسوپاتی ایدیوپاتیک یا موارد دیگه هم باشیم، چون با سطح دیسک هم لول نبود و با ام ار ای بیمار از نظر سمت درگیری مطابقت نداشت.


RAHIMI, ESMAEIL
AFR Azar Mehr C...
MR D13

- آقای ۶۰ ساله با ضعف اندام فوقانی راست از سه روز پیش بدنبال استفاده از elbow cruch
- ضعف در کل اندام حدود ۳از ۵
- اختلال حس نداره
- رفلکس ها کلا کاهش یافته
- دیابت از سالها قبل با کنترل نامطلوب در سالهای قبل که الان بهتره
- سایر اندامها قدرت نرمال

- علت استفاده از البو کراچ اگر قدرت سایر اندام ها نرماله؟؟
- ضعف در کل اندام؟؟ پروگزیمال و دیستال؟
- ضعف شروعش حاد بوده یا سیر پیشرونده داشته؟
- رفلکس کف پایی بیمار چطور بود؟

- زانوش پیچ خورده بود البو کراچ خودش ورداشته
- ضعف در کل اندام داشت هم پروگزیمال هم دیستال
- ضعف سه روز پیش ناگهانی بعد یه پیاده روی شروع شده
- رفلکس کف پایی فلکس
- رفلکسهای عمقی کلا کاهش

Sensory NCS

Nerve / Sites	Rec. Site	Onset Lat ms	Peak Lat ms	NP Amp µV	PP Amp µV	Segments	Distance mm	Velocity m/s
R Median - Digit III (Antidromic)								
Wrist	Dig III	3.18	4.01	10.7	16.6	Wrist - Dig III	140	44
L Median - Digit III (Antidromic)								
Wrist	Dig III	3.23	4.22	13.0	23.7	Wrist - Dig III	140	43
L Ulnar - Digit V (Antidromic)								
Wrist	Dig V	3.28	4.06	8.1	15.7	Wrist - Dig V	110	34
R Ulnar - Digit V (Antidromic)								
Wrist	Dig V	3.02	3.91	6.9	7.6	Wrist - Dig V	110	38
L Radial - Anatomical snuff box (Forearm)								
Forearm	Wrist	2.55	3.28	18.2	15.1	Forearm - Wrist	100	39
4	Wrist	2.19	2.81	18.0	12.6			
R Radial - Anatomical snuff box (Forearm)								
Forearm	Wrist	2.14	2.71	8.2	11.4	Forearm - Wrist	100	47
4	Wrist	2.19	2.76	8.7	11.5			
L Sural - Ankle (Calf)								
Calf	Ankle	2.92	3.59	2.7	2.4	Calf - Ankle	140	48
R Sural - Ankle (Calf)								
Calf	Ankle	2.81	3.39	3.8	3.8	Calf - Ankle	140	50
L Lateral antebrachial cutaneous - Forearm (Elbow)								
Elbow	Forearm	2.14	2.76	8.2	9.2	Elbow - Forearm	140	66
R Lateral antebrachial cutaneous - Forearm (Elbow)								
Elbow	Forearm	1.41	2.24	4.4	3.1	Elbow - Forearm	140	100

Sensory NCS

Nerve / Sites	Rec. Site	Onset Lat ms	Peak Lat ms	NP Amp µV	PP Amp µV	Segments	Distance mm	Velocity m/s
R Median - Digit III (Antidromic)								
Wrist	Dig III	3.18	4.01	10.7	16.6	Wrist - Dig III	140	44
L Median - Digit III (Antidromic)								
Wrist	Dig III	3.23	4.22	13.0	23.7	Wrist - Dig III	140	43
L Ulnar - Digit V (Antidromic)								
Wrist	Dig V	3.28	4.06	8.1	15.7	Wrist - Dig V	110	34
R Ulnar - Digit V (Antidromic)								
Wrist	Dig V	3.02	3.91	6.9	7.6	Wrist - Dig V	110	38
L Radial - Anatomical snuff box (Forearm)								
Forearm	Wrist	2.55	3.28	18.2	15.1	Forearm - Wrist	100	39
4	Wrist	2.19	2.81	18.0	12.6			
R Radial - Anatomical snuff box (Forearm)								
Forearm	Wrist	2.14	2.71	8.2	11.4	Forearm - Wrist	100	47
4	Wrist	2.19	2.76	8.7	11.5			
L Sural - Ankle (Calf)								
Calf	Ankle	2.92	3.59	2.7	2.4	Calf - Ankle	140	48
R Sural - Ankle (Calf)								
Calf	Ankle	2.81	3.39	3.8	3.8	Calf - Ankle	140	50
L Lateral antebrachial cutaneous - Forearm (Elbow)								
Elbow	Forearm	2.14	2.76	8.2	9.2	Elbow - Forearm	140	66
R Lateral antebrachial cutaneous - Forearm (Elbow)								
Elbow	Forearm	1.41	2.24	4.4	3.1	Elbow - Forearm	140	100

F Wave

Nerve	Fmin ms
L Ulnar - ADM	30.47
R Ulnar - ADM	32.50
L Tibial - AH	63.18

EMG Summary Table

Muscle	Nerve	Roots	Spontaneous					MUAP			Recruitment
			IA	Fib	PSW	Fasc	H.F.	Amp	Dur.	PPP	Pattern
R. Deltoid	Axillary	C5-C6	N	None	None	None	None	N	2+	2+	Discrete
R. Biceps brachii	Musculocutaneous	C5-C6	N	None	None	None	None	2+	2+	2+	Discrete
R. Flexor carpi radialis	Median	C6-C7	N	None	None	None	None	N	N	N	N
R. Extensor digitorum communis	Radial	C7-C8	N	None	None	None	None	1-	1-	N	Single
R. First dorsal interosseous	Ulnar	C8-T1	N	None	None	None	None	N	N	N	N

Conclusion:

All above findings are compatible with :

1- Moderate distal symmetric axonal sensory motor polyneuropathy

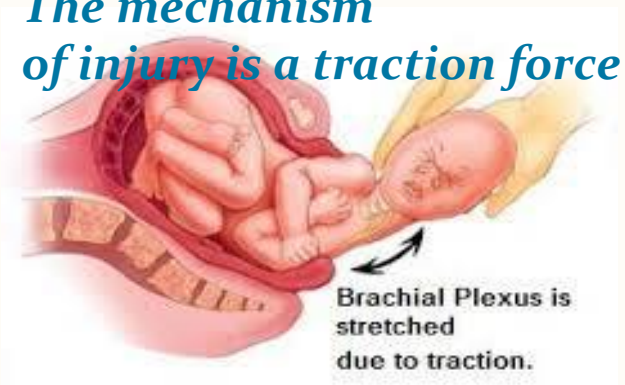
2- Moderate subacute right C5 root involvement

3- Right radial entrapment at mid humerus due to crutch palsy

However because it is too soon to judge on severity of lesion (3 days period) follow up EDX after 15 days is recommended.

Specific Brachial Plexus Disorders

1. Obstetrically related plexopathies:



- **There are three main types of injury to the brachial plexus incurred during the birth process:**

I. Upper trunk or C5/C6 spinal nerves (Erb's palsy)

II. Entire brachial plexus. second most common type of obstetric paralysis affects the entire plexus to varying degrees

III. C8/Tl nerve root avulsion (Klumpke's paralysis)

❖ Surprisingly, irrespective of the 3 types of injury, gross pain sensation is not diminished commensurate with the muscle weakness.

Risk factors:

1. *Heavy birth weight (approximately 4000--4500 g or greater) even in multiparous women*
2. *Long and hard labors*
3. *Mothers heavily sedated resulting in a sedated fetus with poor muscle tone*
4. *Breech presentation*
5. *Short mothers*

– **Protective factors:** *fetal growth restriction* and *prematurity*

Erb's palsy

- Traction injury to the **upper trunk** or the C5/C6 spinal nerves (most common type)
- The right upper limb is slightly more prone to injury secondary to the **common left occiput anterior presentation.**
- Both a **vertex and breech** presentation can result in **Erb's palsy.**
- **Forceps** are not a causative factor and may actually decrease the risk of plexopathy during breech delivery.
- There is paralysis or paresis of the *supraspinatus/infraspinatus, deltoid, biceps brachii, teres minor, brachioradialis, extensor carpi radialis longus/brevis, and supinator muscles.*
- Detection of **diaphragmatic , Rhomboids and serratus anterior** paralysis is suggestive of a **root avulsion** injury.

These patients typically lie with:

- **arms** *adducted and internally rotated* (unopposed pull of the sternal portion of the pectoralis major and latissimus dorsi muscles)
- **elbow** *extended*
- **forearm** *pronated* (unopposed triceps and pronator teres/quadratus muscles)
- **wrist/fingers** *flexed* (weak wrist extensors).

This posture is the so called "**waiter's tip position**"

Klumpke's paralysis

- A third and very rare type of plexus injury is Klumpke's paralysis, i.e., **C8/TI root avulsion**.
- These patients characteristically present with good shoulder girdle muscle function but **inability to grasp** with the hand.

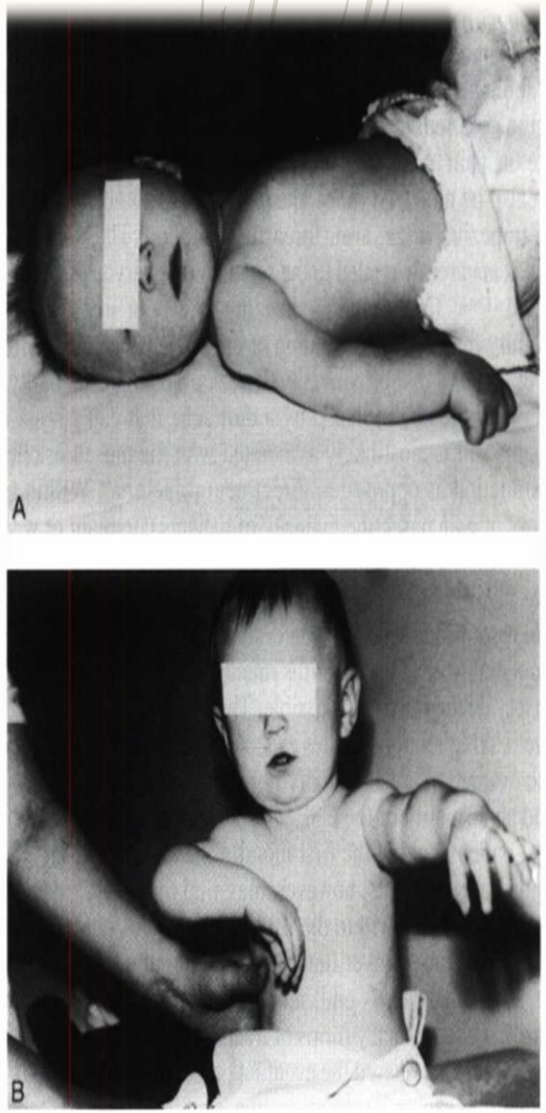


Figure 19-19. **Erb's palsy. A,** Typical presentation of an Erb's palsy with the affected arm in the so-called waiter's tip position. **B,** Spontaneous recovery of function at approximately 1 year of age

Recovery of Erb`palsy

- Several careful studies reveal that the majority of patients who **recover** significant functional use of the upper limb have good use of their
- *elbow, wrist, and finger extensors* use by **1.5 months**
- *deltoid and biceps brachii* muscles by **2 months**
- *external shoulder rotators* by **3 months**.

- Patients with the entire plexus involved always do worse than the Erb's type of paralysis. It is to be assumed that C8/Tl root avulsions do poorly regarding hand use.

- In addition to the history and physical examination, it is important to obtain **plain films** to investigate the possibility of associated *humeral or clavicular fractures as well as diaphragmatic paralysis.*
- The **electrodiagnostic** medicine consultation is most appropriately performed **4-6 weeks** following delivery and can be obtained serially **every 6-8 weeks** to observe for reinnervation if desired.

This fact emphasizes the importance of detecting voluntary motor units.

- The observation of voluntary motor units in any muscle obviates the need to compulsively look for spontaneous activity if the baby does not relax as is often the case.
- Voluntary motor unit detection signifies continuity between the anterior horn cell and its respective muscle, i.e., if a lesion is present the nerve pathway is not completely severed with the potential for improved function.
- It is important for practitioners to be aware that in approximately *one-third of "normal" full-term* and *one-half of neurologically intact premature infants* needle electromyographic examination can demonstrate potentials that cannot be distinguished from fibrillation potentials.
- These are normal findings and usually disappear by 3 months of age.

2. Neuralgic Amyotrophy:

This disorder is referred to by a multitude of terms:

- ***acute brachial neuropathy /plexitis/neuritis***
- ***idiopathic brachial plexopathy/plexitis/neuritis***
- ***Parsonage- Turner syndrome***
- ***shoulder girdle neuritis/syndrome***
- ***paralytic brachial neuritis***

- The majority of patients experience:
- an *acute onset of constant and rather intense sharp or throbbing pain*
- Shoulder abduction and rotation particularly **aggravate** the pain.
- Coughing or sneezing does **not aggravate** the painful symptoms.
- The duration of intense **pain** :several hours to approximately *3 weeks*.
- The intense quality of pain: **dull ache** that can persist for *Months***.**
- Within *two weeks of pain onset*, ……**weakness** involving the painful limb.

. Although the disturbance follows a pattern of peripheral nerves, the deficit is **mainly motor**. Slight, subjective sensory disturbances are possible.

Etiology

- ***trauma***
- ***surgery***
- ***infections***
- ***various innoculations***
- ***botulinum toxin A treatment for cervical or upper limb dystonia.***

These events have led to the impression that the disorder is primarily an **autoimmune disorder** with an associated inflammatory and/or ischemic component secondary to its usually acute presentation.

Improvement:

- Improvement is noted by most patients within the *first month* following symptom onset.
- About 36% of patients recover functionally within the **first** year,
- 75% by the **second** year's end,
- 89% by the end of the **third** year.

- Three main categories of insult can be recognized based on needle electromyography:

(I) **mononeuropathy**;

(2) **plexopathy**;

(3) **combined mononeuropathy and plexopathy.**

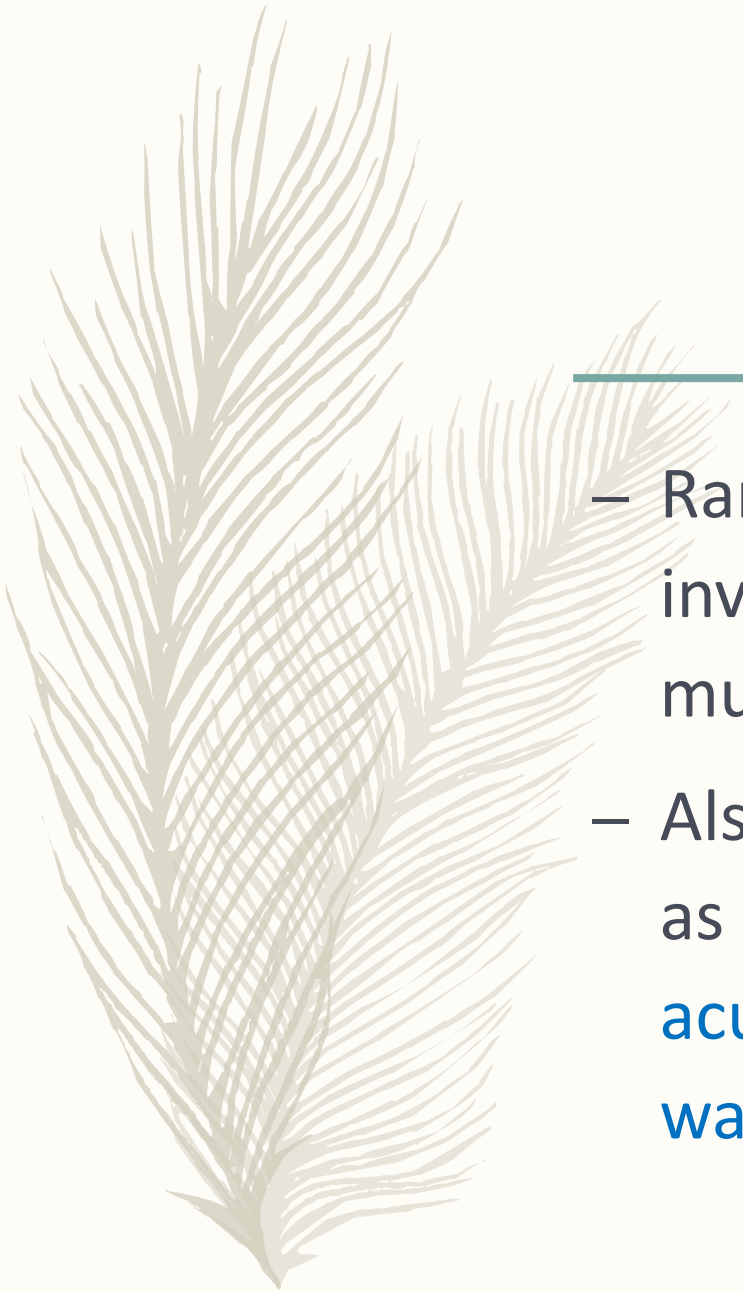
- The **most common pattern** of neuralgic amyotrophy appears to be either a single or multiple *mononeuropathy* primarily affecting:
- ***suprascapular***
- ***long thoracic***
- ***axillary nerves***
- ***Phrenic****(rare)*
- ***AIN*** *(rare)*

- An **autosomal dominant** form of hereditary neuralgic amyotrophy (*familial brachial plexus neuropathy*) with:

1. Recurrent,
2. Episodic,
3. Painful brachial neuropathies

- chromosome 17q24-q25.

❖ In addition to the typical clinical presentation of neuralgic amyotrophy, these individuals also display **mild dysmorphic features.**



- Rarely, multiple **cranial nerves (IX, X, XI, and XII**) can be involved, supporting the concept of a mononeuritis multiplex.
- Also, a variant of this disease may manifest preferentially as an isolated disorder of the *spinal accessory* nerve with acute unilateral suboccipital and neck pain followed by wasting and weakness of the trapezius muscle.

- **EDX:**
- **32%** of patients demonstrate abnormal **LAC** responses.
- **F-wave** determinations may be abnormal in these patients but are of minimal value in attempting to localize the lesion.
- Similar comments apply to the flexor carpi radialis **H-reflex** and **SEPs.**

- Needle EMG of affected muscle clearly reveals evidence consistent with Wallerian degeneration from *axonal loss*.

Table 19-9. Neuralgic Amyotrophy[396,445]

Incidence	1.64 per 100,000 population
Male:Female ratio	2.4:1
Age	3 months–74 years
Antecedent or associated illness	About 45% of patients
Mode of onset	Rapid onset of pain/paralysis (paresis)
Initial symptom	Pain in 95% of patients
Weakness	Confined to shoulder girdle: 50% of patients confined to single peripheral nerve: 10% of patients Single nerves commonly affected: radial; long thoracic; axillary; suprascapular
Sensory deficit	Noted in about 67% of patients; most common: axillary and lateral antebrachial cutaneous
Laterality	Unilateral: 66% (right side: 54%); bilateral: 34%
Laboratory	Normal
Electrodiagnosis	Abnormal: helps to localize and follow disease progress

Thoracic outlet syndrome

- A collective term, describing a number of disorders attributed to compromise of *blood vessels* and/or *nerves* at any of several points between the *base of the neck and the axilla.*

Table 19-10. Thoracic Outlet Syndrome Classification

Vascular TOS

1. Arterial occlusion
   a. Major compromise
   b. Minor compromise
2. Venous occlusion
   a. Major compromise
   b. Minor compromise

Neurogenic TOS

1. Motor/sensory compromise (classic)
2. Disputed (atypical, droopy shoulder, combined neurogenic and vascular)

Major Arterial TOS

- Arise from an anatomic obstruction to arterial flow as the artery is compressed between the anterior scalene muscle and an anomalous cervical rib, protuberant supernumerary bony process, or fibrous bands connecting the C7 transverse process to the first rib.

1. Intimal damage to the artery
2. post-stenotic dilatation with:

A. Subsequent thrombus formation

B. Embolization.

- Limb ischemia and, if not recognized early enough, tissue necrosis, often necessitating amputation, are the end result.

Minor Arterial TOS

- The minor variations of this disorders are essentially the early manifestations of what may progress into the full-blown disorder with its profound clinical implications.
- Patients with the minor vascular compression syndrome can complain of vague upper limb pain and fatigue with decreased color and temperature of the affected limb.

Major venous TOS

- A spontaneous occlusion of the subclavian/axillary vein, located anterior to the anterior scalene muscle, can result in :
- Diffusely swollen and bluish limb that aches associated with dilated veins over the shoulder and upper chest.
- Often seen in young healthy persons after strenuous use of the upper limb such as
- manual labor or sports activities and is also referred to as "effort thrombosis.“

Minor venous TOS

- The minor type of venous TOS can present with similar but less pronounced symptoms to those noted above with particular limb positions predisposing to occlusion of the vasculature.
- It is important to keep in mind that many asymptomatic healthy individuals also have diminution or complete absence of the various pulses following one or all of the multiple clinical "TOS" test reported to "diagnose“ TOS.

True neurogenic TOS

Only patients presenting with **objective neurologic evidence** suggestive of *C8/T1 or lower trunk* neural compromise, such as:

- loss of sensation in the ulnar and/or medial brachial/antebrachial cutaneous nerves
- intrinsic (especially median-innervated) hand wasting
- electrophysiologic evidence consistent with a C8/T I root or lower trunk lesions

are considered to have **true neurogenic TOS**.

The majority of these individuals have a pronounced *cervical rib*.

- Patients who should be seriously considered to have true neurogenic TOS are usually but not always **young women** complaining of *pain* and *paresthesias* along the *medial aspect of the forearm and hand*.

- There is usually an associated complaint of progressive inability to use the hand with reduced dexterity and facility.

- The symptoms are typically *unilateral* and do *not always* involve the *dominant hand.*

NCS:

- A *normal median* **SNAP** should be obtained from *all three digits* supplied by the median nerve.
- A *reduced amplitude* and usually *normal latency ulnar* **SNAP** to the *fifth digit* is typically noted to ulnar stimulation at the wrist.
- The **CMAP** obtained from the *thenar* eminence with median nerve wrist stimulation is characteristically *reduced in amplitude* but *not in latency.*
- In particular, a *reduction or absence of the* **MAC** nerve should always be looked for in suspected neurogenic TOS.
- Nerve conduction studies of the *median* and *ulnar* nerves in the *forearm and arm are normal.*

- Essentially, the SEP does not add much to the simpler and routine nerve conduction studies and needle electromyography in most cases.“

- "root" stimulation did not add to the diagnosis but was confirmatory.

TOS

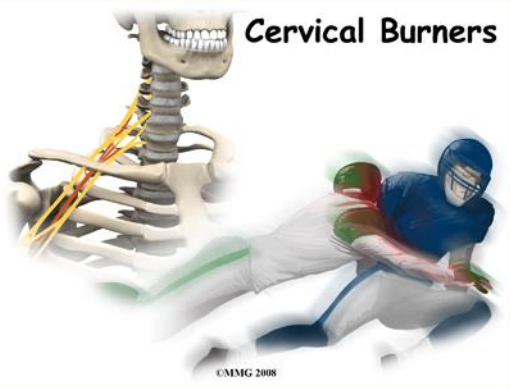
- **Needle EMG** findings are particularly dependent upon the severity and chronicity of the lesion.
- The *most common findings* in *long-standing* disorders are *obvious reductions in recruitment* (decreased numbers of motor units firing at rapid rates) with occasional large-amplitude long-duration MUAPs, although these may be of variable prominence.
- *Positive sharp waves and fibrillation* potentials are usually found in the APB and to variable degrees in the ulnar-innervated intrinsic hand muscles.

DDX TOS

1. Carpal tunnel syndrome.
2. Ulnar neuropathy at or about the elbow region
3. Cervical radiculopathy: Cervical paraspinal abnormalities may be quite helpful as TOS should have normal findings in this region.
4. Atypical motor neuron disorders : all SNAPs should be normal.
5. Syringomyelia
6. tumors of the supraclavicular region
7. multiple sclerosis

SPORTS-RELATED INJURIES (BURNERS/STINGERS)

- Burners or stingers usually present in *male* athletes significant physical contact or muscular stresses such as *football, hockey, basketball, or wrestling*.
- The athlete *immediately* complains of significant *pain* about the *shoulder and/or supraclavicular* region with associated pain and paresthesias *radiating* into the arm for a variable distance usually affecting the entire *arm/forearm/hand.*
- These persons usually quickly arise and begin shaking the affected limb



NEOPLASTIC PLEXOPATHIES

Neoplastic diseases affecting the brachial plexus are categorized into two forms:

(1) **primary** (2) **secondary.**

- **Primary brachial plexus tumors** : *less common* , usually benign.
- Typically arise from
- The *Schwann cell* (schwannomas, neurilemomas, neurinomas)
- The *neural sheath* (neurofibroma).
- **Secondary neoplastic disease** : *most common,* all types are malignant.
- The two major sources
- Primary or metastatic disease to the upper lobe of the *lung* (Pancoast or superior sulcus tumor),
- *Breast* tissue.

Pancoast tumor

- the brachial plexus is characteristically directly affected by a neoplastic process in the superior portion of the lung
- These patients are usually **male** and have a significant history of *cigarette smoking*.
- Patient who complains of pain about the shoulder region with some *radiation to the scapula*, muscle *wasting and weakness in the intrinsic hand muscles unilaterally (C8/TI distribution*), paresthesias along the *medial border of the forearm and hand*, and symptoms characteristic of Horner's syndrome.

Recurrent Neoplastic Disease or Radiation-Induced Plexopathy

Recurrent Tumor :

- *significant pain*
- *lower trunk*
- *Horner's syndrome*

Radiation :

- *No pain*
- *upper trunk*

- Patients who received *more than 6,000 rads* and experienced symptoms *within 1 year* were more likely to have **radiation** fibrosis of the plexus, but symptoms occurring later than 1 year could be due to either radiation or tumor.
- On the other hand, if the radiation dose was *less than 6,000 rads* and plexus symptoms occurred *within 1 year*, **tumor** is the more likely etiology.

- There is a suggestion that the documentation of *myokymic discharges* and *conduction block across the brachial plexus* favors a diagnosis of **radiation-induced plexopathy**, but further work is needed in this area.
- *Fasciculation* potentials are also commonly found but to a lesser degree than myokymic discharges.

- Fibrillation potentials can be quite common in both types of disorders.
- *Fibrillation* potentials are more commonly found in the *paraspinal* muscles in **radiation**-induced plexopathies than in neoplastic disease.

- *MUAP* changes are similar in both disorders suggesting *chronic axonal loss* with remodeling of the motor unit, i.e., large-amplitude long-duration potentials with reduced recruitment.

- There is a suggestion that *CMAP amplitude* may be more severely affected in **neoplastic** plexopathy.

- Alterations in the *median and ulnar SNAPs' amplitude* with no change in latency or conduction velocity is found more frequently in **radiation**-induced plexopathy.

- It is suggested that the *earliest finding* one may detect in **radiation**- induced plexopathy is a *diminution in SNAP amplitude*, particularly affecting the *median* nerve,

BACKPACK(rucksack) PARALYSIS

- Patients typically complain of a gradual onset of *weakness* to one of the upper limbs with variable amounts of numbness and paresthesias during the course of wearing the backpack/rucksack. The **weakness** characteristically affects the *shoulder girdle muscles* with altered **sensation** affecting the *arm or forearm*.

- Muscles typically affected include: *deltoid, biceps brachii, supraspinatus, serratus anterior*, and occasionally the *wrist extensors.*