Anatomy & terminology

Ernest W Johnson MD
Emeritus Professor
PM&R The Ohio State University

Stedman – 25th Ed.

extremitas (eks-trem'I-tas)

[L. fr. *extremus*, last, outermost] [NA]. Extremity; one of the ends of an elongated or pointed structure. Incorrectly used to mean Limb. See membrum.

LIMBS - *not extremities*

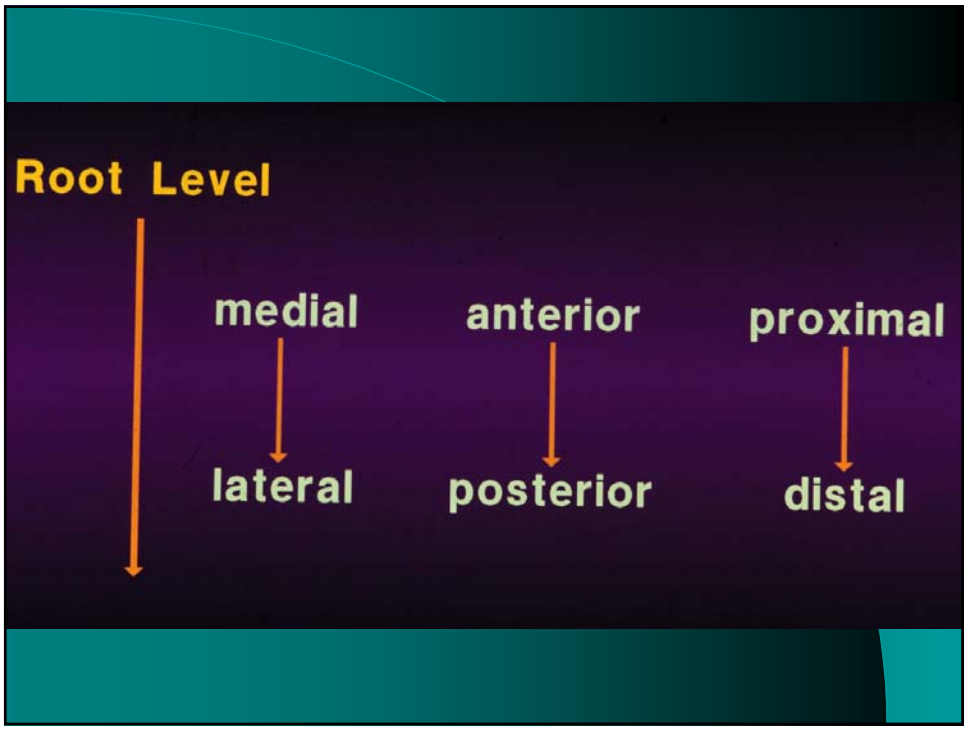
- Upper limb
  - Arm – shoulder to elbow
  - Forearm – elbow to wrist
  - Hand – this is end of limb

LIMBS – ***not extremities***

- Lower limb
  - Thigh – hip to knee
  - Leg – knee to ankle
  - Foot – all 26 bones

Where to explore muscles?

Use embryologic contours

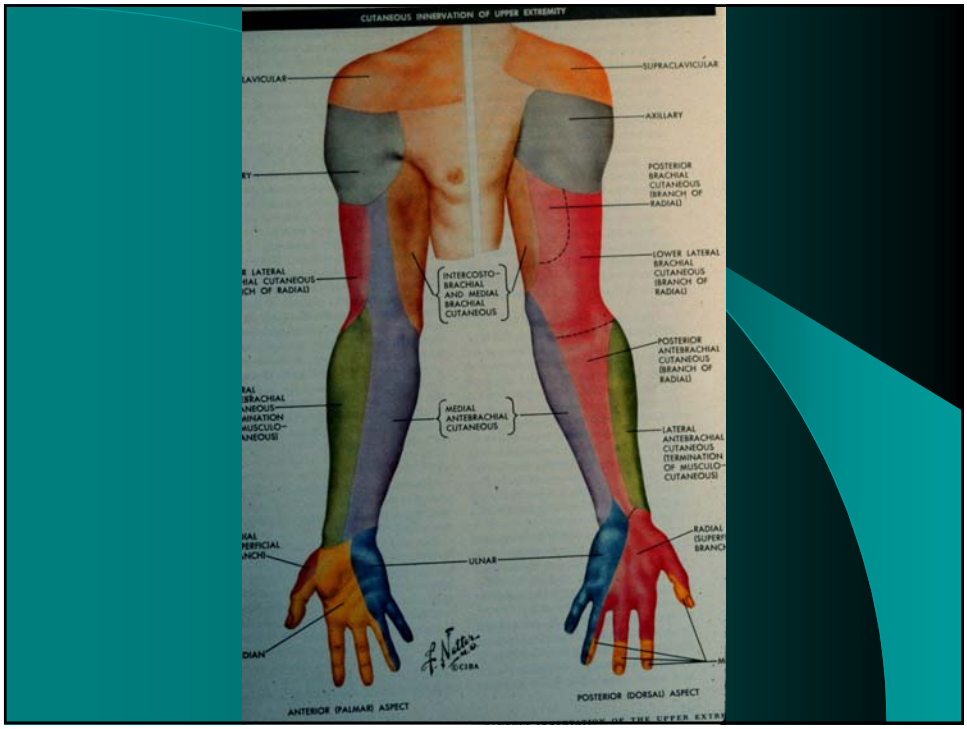


Upper limb - Motor innervation

- No C-7 below wrist
- C-6 below elbow – volar: pronator teres, dorsal – brachioradialis; supinator
- C-7 above elbow – triceps, anconeus,
- C-7 from trunk - acting on UL: latissimus dorsi, serratus anterior, pectoralis major
- Thenar – C8; hypothenar-T1

Upper limb – sensory innervation

- C-6 – digit 1
- C-7 - digit 2,3
- C-8 – digit 4,5
- T-1 – medial forearm



Lower limb – motor enervation

- Quadriceps and adductors – L 2-4
- L-4 below knee – ***only*** anterior tibial
- L-5 below ankle – ***only*** ext dig br
- Toes – S1 – S2: medial to lateral ie. Digit 1 to digit 5

Lower limb – sensory enervation

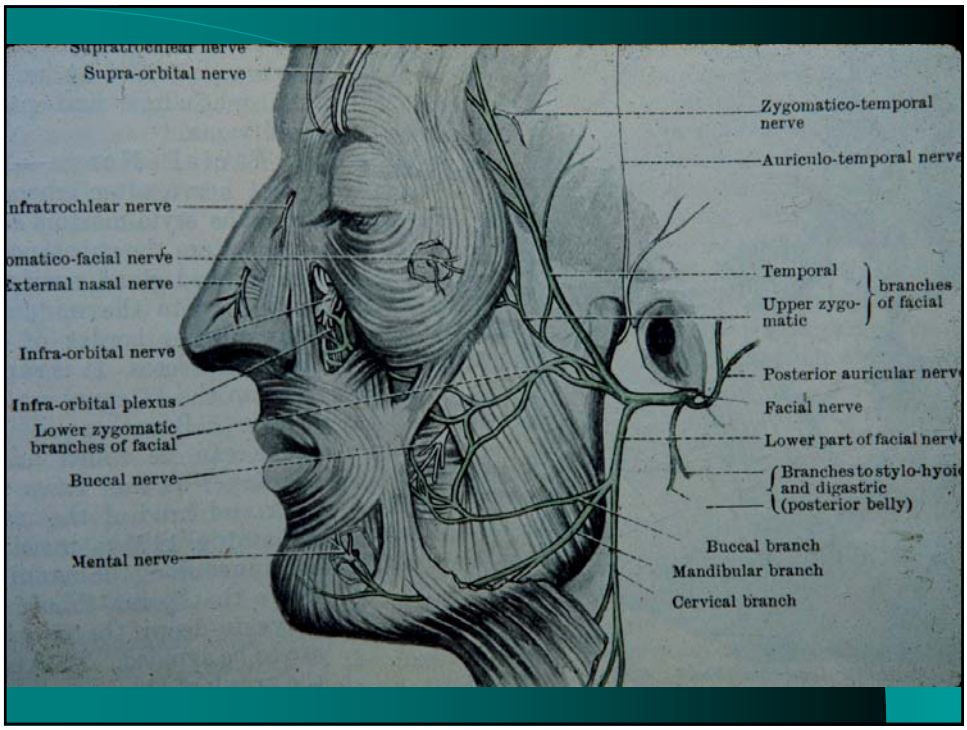
- L-2 to S-1 medial to lateral; anterior to posterior; proximal to distal
- L5 - dorsal medial foot
- S1 – dorsal lateral foot and sole

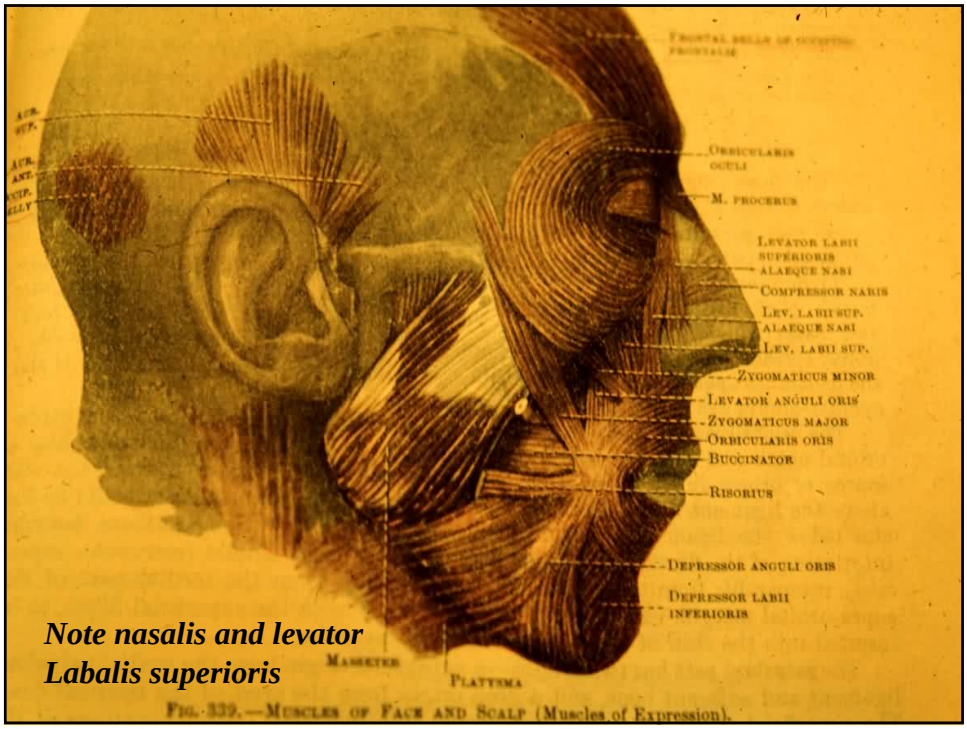
Trunk – sensory enervation

- Clavicle – T2
- Nipple – T4
- Xiphoid – T6
- Costal margin – T8
- Umbilicus – T10
- Inguinal ligament – T12

Facial muscles

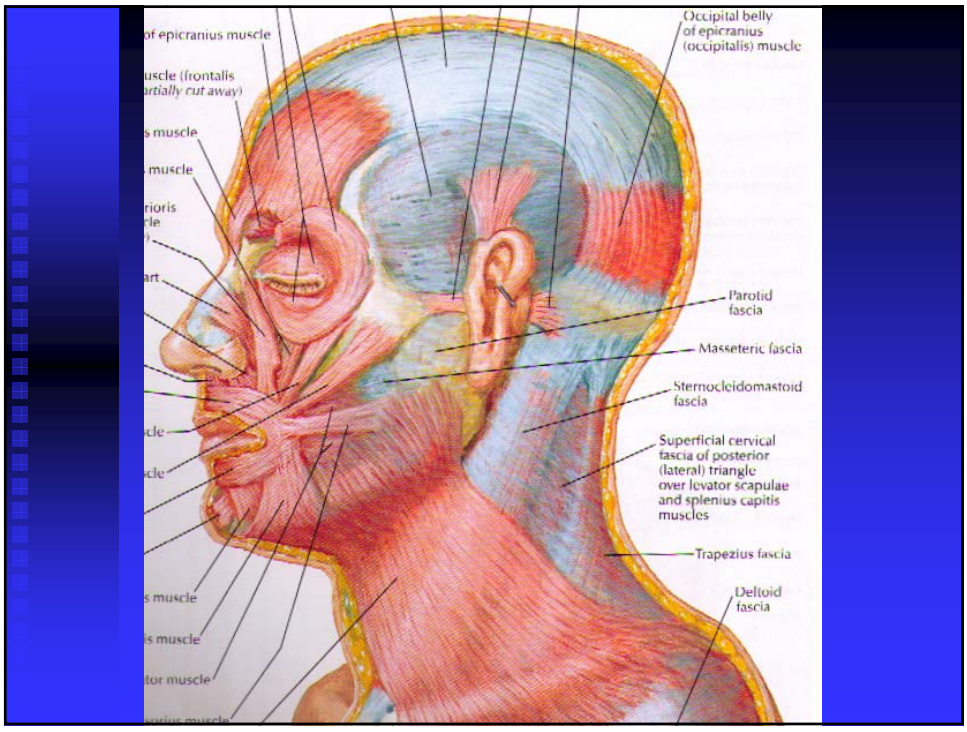
- Posterior auricular is innervated by 1st branch after stylomastoid foramen
- Examine 4 branches
  - Frontalis
  - Orb oculi
  - Nasalis
  - mentalis





Note nasalis and levator Labalis superioris

Fig. 339.—Muscles of Face and Scalp (Muscles of Expression).

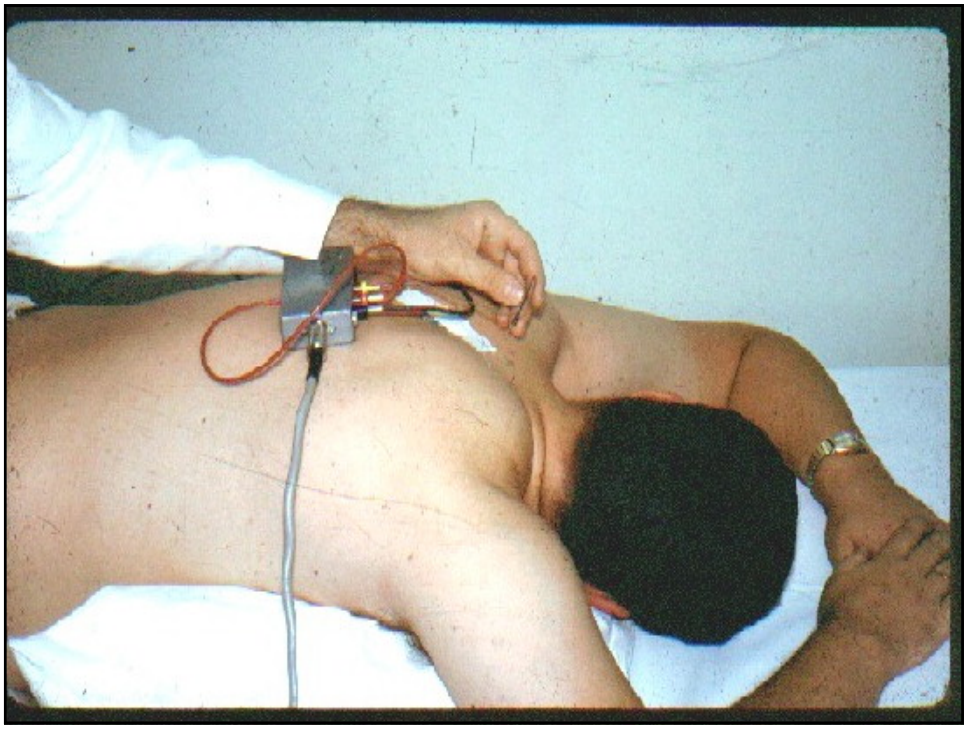


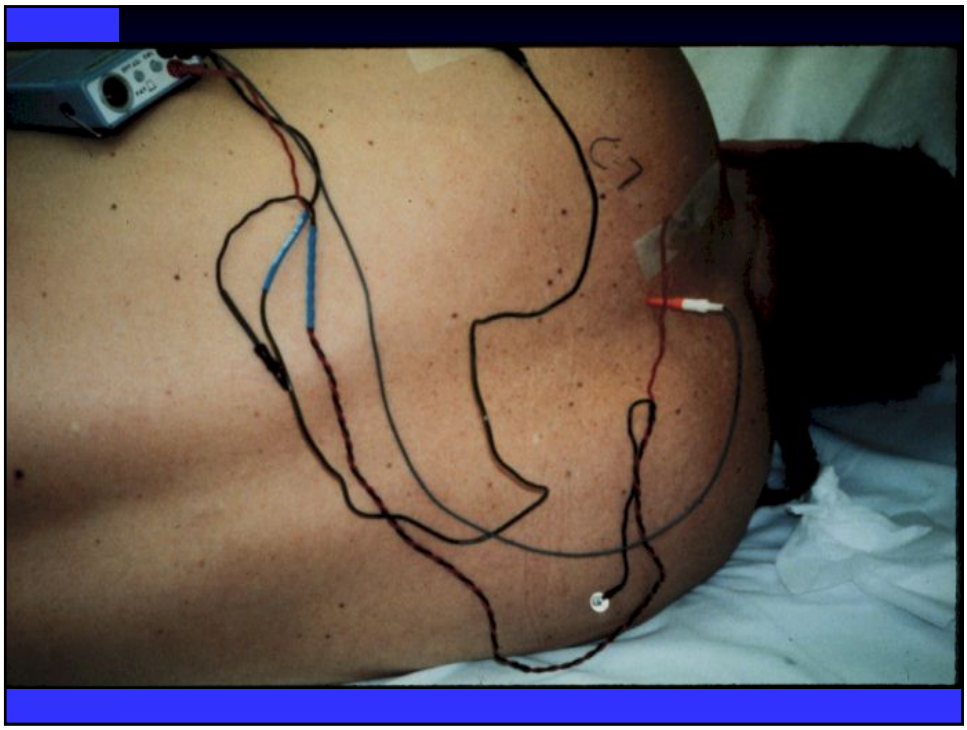
Surface recording around mouth or cheek – NO! NO! NO!

- Will record the underlying massiter or other 5th cranial nerve innnervated muscles
- It is impossible to limit stimulus external to stylomastoid foramen to 7th cranial nerve

Posterior neck muscles

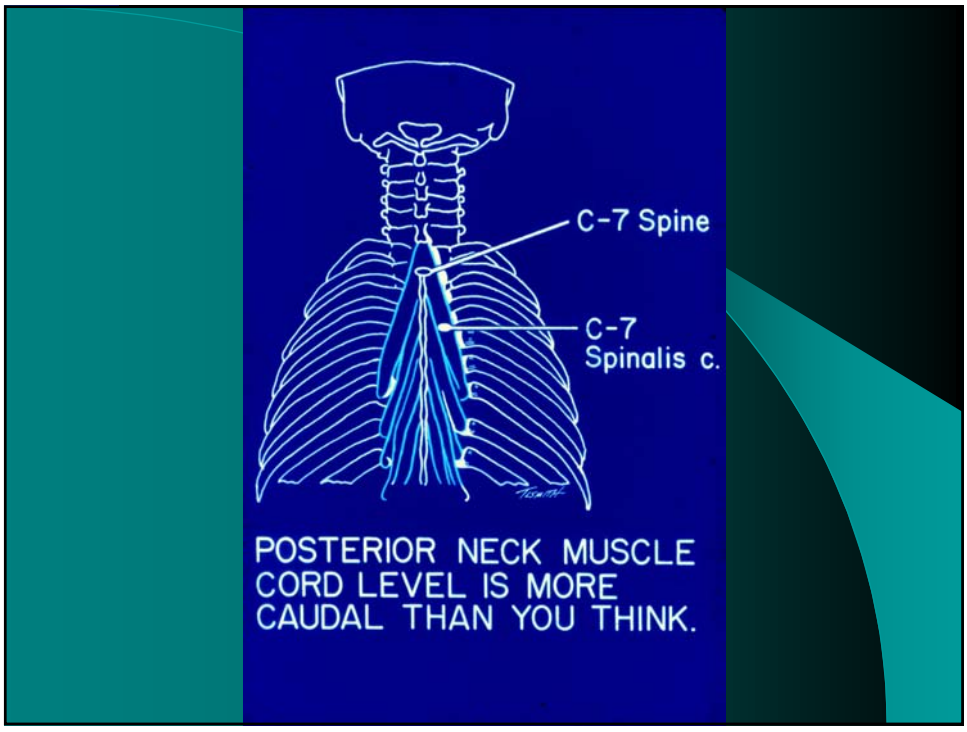
- Cervical root enervation (of posterior primary muscles) is much more ***caudal*** than you think!
- C-6 level is caudal to tip of C-7 spinous process
- C-7 is top of scapula
- C-8 is mid-scapula

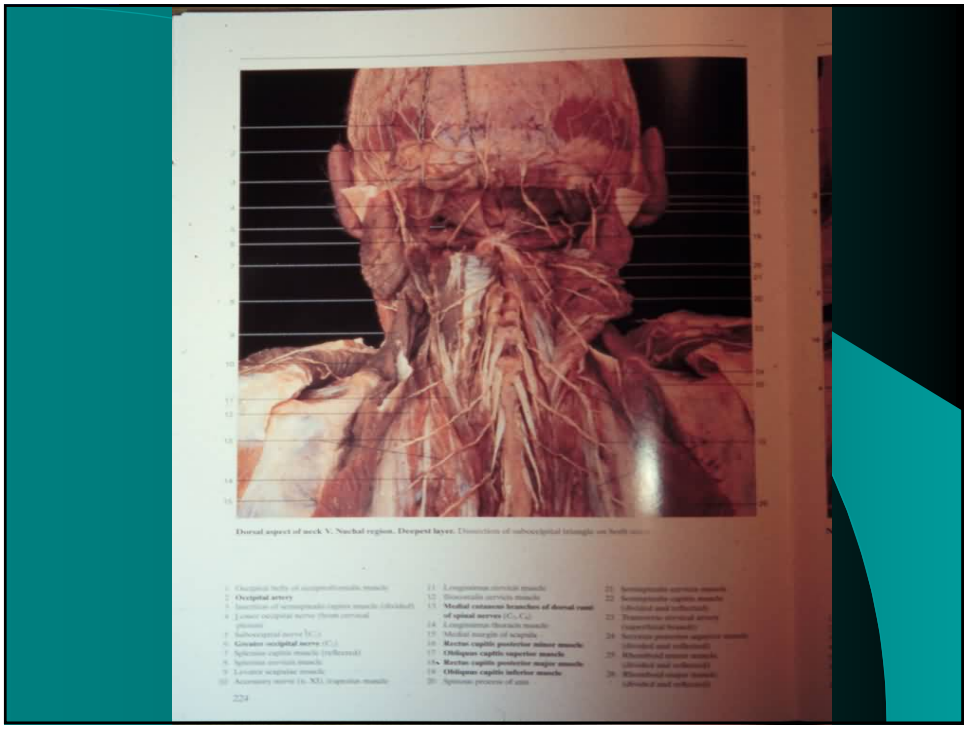



C7

WHERE TO INVESTGATE

- POSTERIOR PRIMARY RAMI
- **MORE CAUDAL THAN YOU THINK!**
  - ***C-6 is 1-2 CM CAUDAL TO TIP OF C-7 SPINOUS PROCESS***
  - ***C-7 is at TOP OF MEDIAL SCAPULA***
  - ***C-8 is at MID SCAPULA***

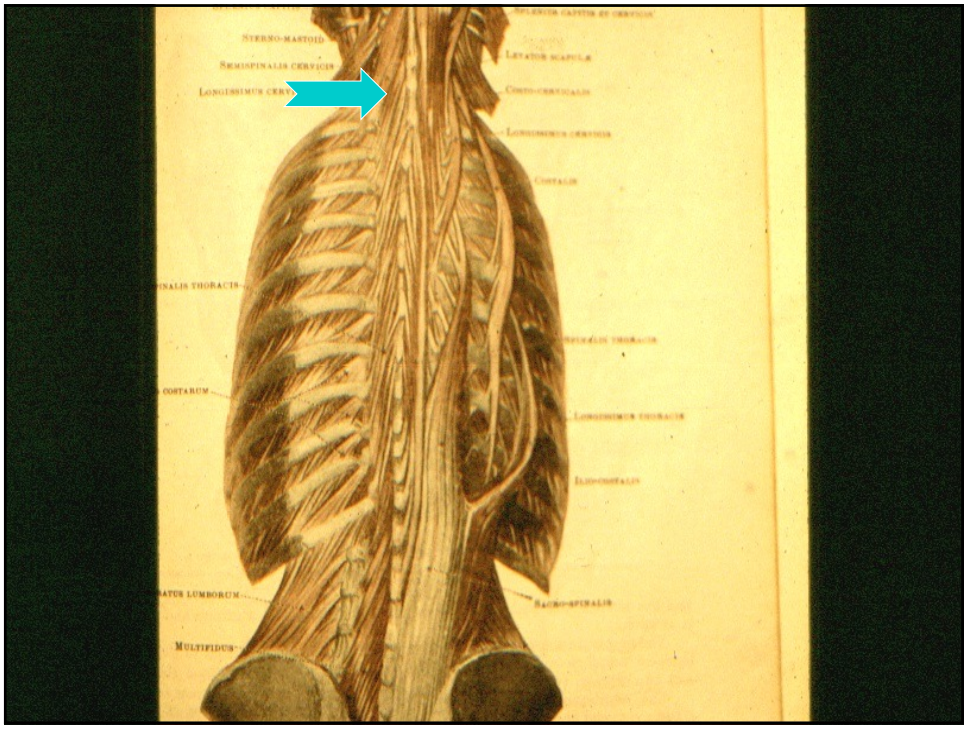




Dorsal aspect of neck V. Nuchal region. Deepest layer.

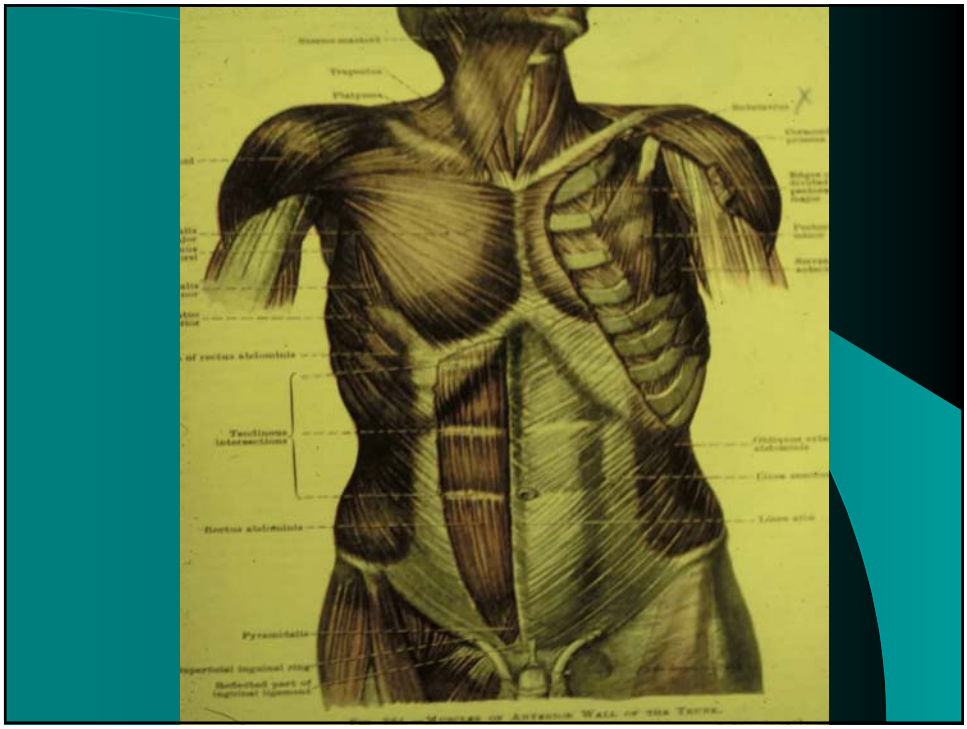
Note arrow at C-6 myotome

Also see course of muscles supplied by posterior primary rami



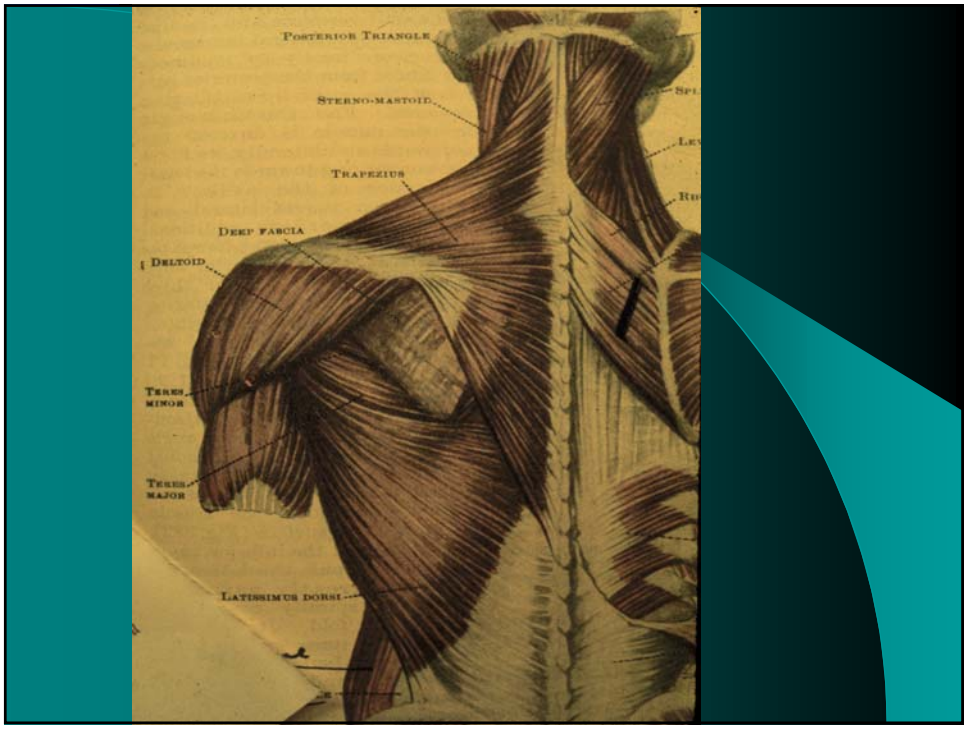
Pectoralis major

- All branches of brachial plexus are available when exploring this muscle
  - C5,6 – upper portion (clavicular)
  - C7,8T1 – lower portion (sternal)



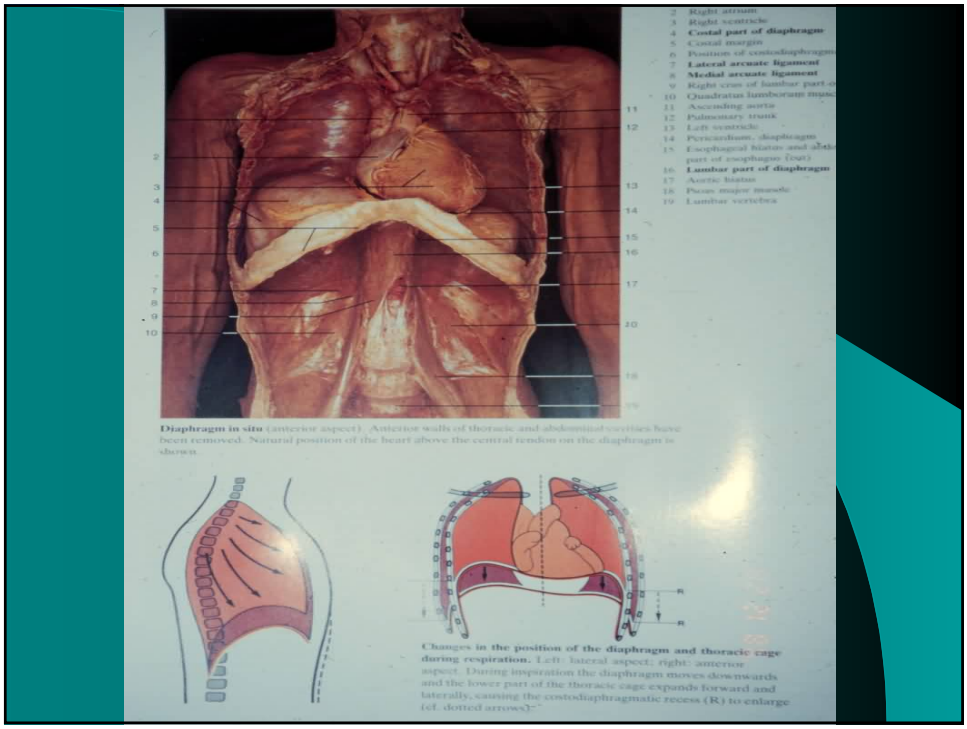
Posterior thorax

- Infraspinatus is accessible for surface recording (NB. For C-6 radiculopathy)
- Rhomboids accessible for needle EMG
- XI cranial nerve can be stimulated
- Upper trapezius accessible from surface recording and needle EMG



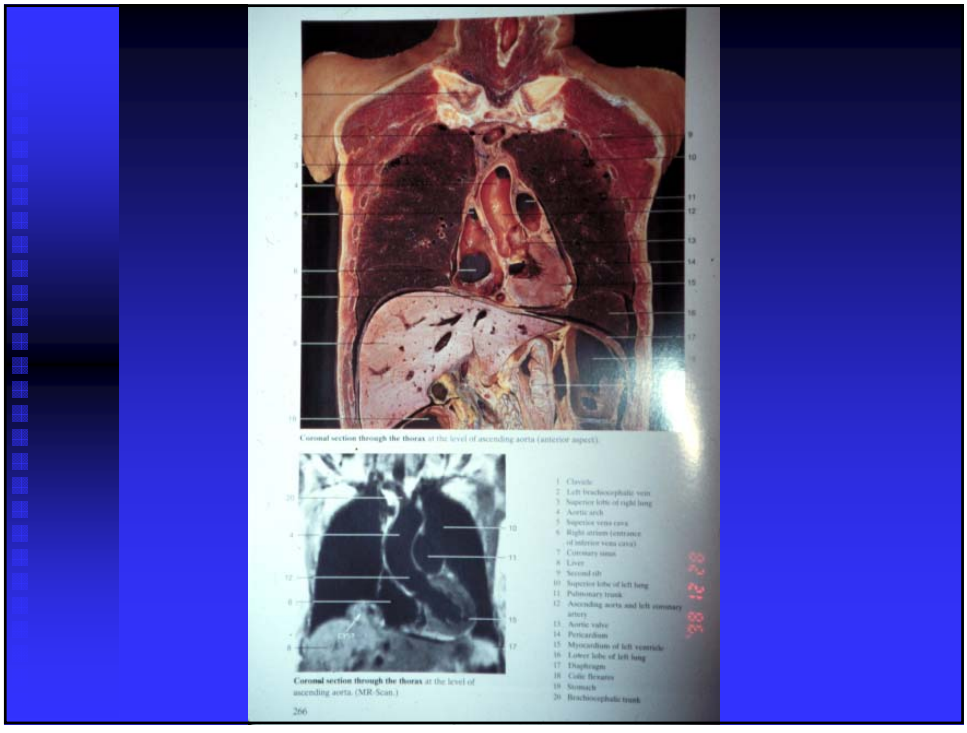
Diaphragm

- Accessible
  - Midline under xiphoid
  - Lateral – 10-11 ribs (after expiration)
  - Posterior – level of L-1 thru paraspinals
  - Ant-lat superiorly under rib cage



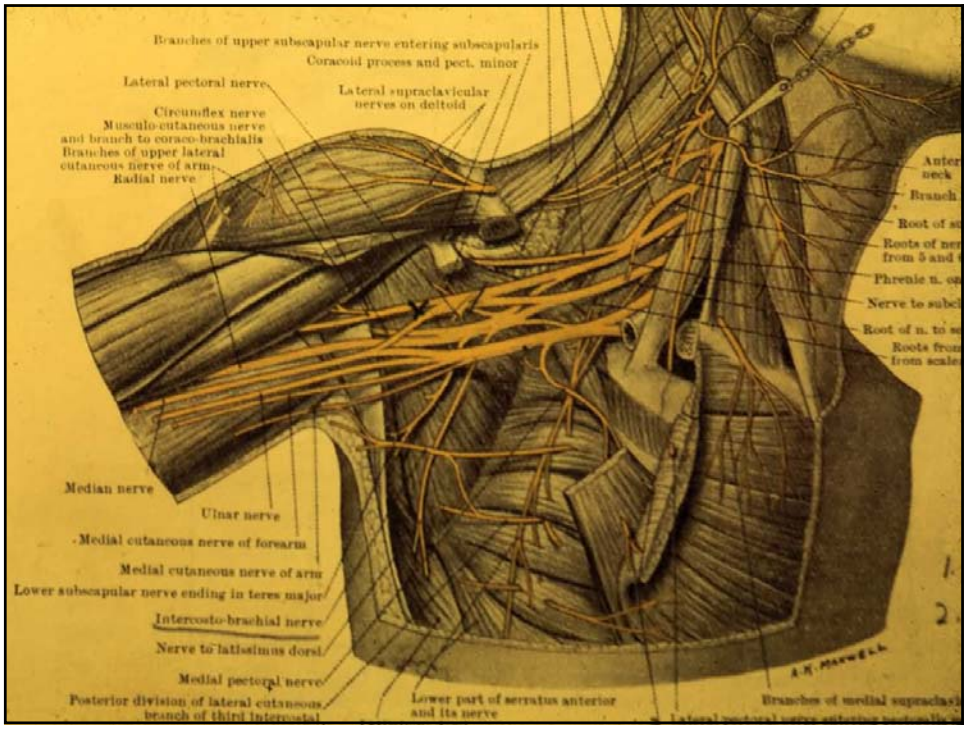
Diaphragm in situ (anterior aspect). Anterior walls of thoracic and abdominal cavities have been removed. Natural position of the heart above the central tendon on the diaphragm is shown.

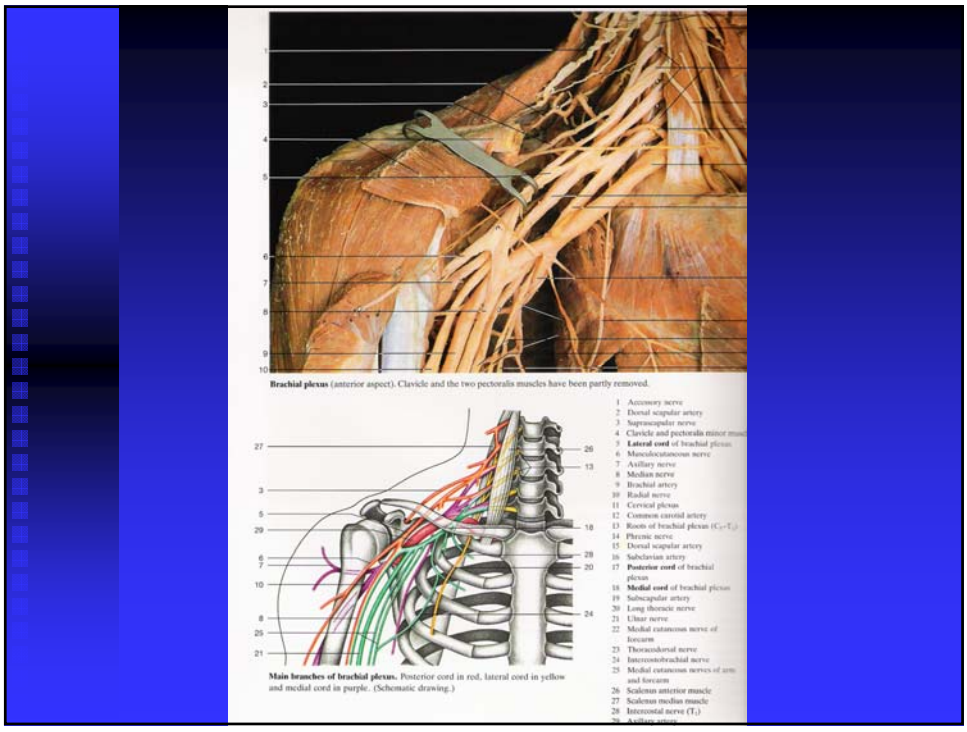
Changes in the position of the diaphragm and thoracic cage during respiration. Left: lateral aspect; right: anterior aspect. During inspiration the diaphragm moves downwards and the lower part of the thoracic cage expands forward and laterally, causing the costodiaphragmatic recess (R) to enlarge (cf. dotted arrows).



Coronal section through the thorax at the level of ascending aorta (anterior aspect).

Coronal section through the thorax at the level of ascending aorta. (MR-Scan.)


Branches of upper subscapular nerve entering subscapularis
Coracoid process and pect. minor
Lateral pectoral nerve
Lateral supraclavicular nerves on deltoid
Circumflex nerve
Musculo-cutaneous nerve and branch to coraco-brachialis
Branches of upper lateral cutaneous nerve of arm
Radial nerve
Median nerve
Ulnar nerve
Medial cutaneous nerve of forearm
Medial cutaneous nerve of arm
Lower subscapular nerve ending in teres major
Intercosto-brachial nerve
Nerve to latissimus dorsi
Medial pectoral nerve
Posterior division of lateral cutaneous branch of third intercostal
Lower part of serratus anterior and its nerve


Brachial plexus (anterior aspect). Clavicle and the two pectoralis muscles have been partly removed.
Main branches of brachial plexus. Posterior cord in red, lateral cord in yellow and medial cord in purple. (Schematic drawing.)
1 Accessory nerve
2 Dorsal scapular artery
3 Suprascapular nerve
4 Clavicle and pectoralis minor muscle
5 Lateral cord of brachial plexus
6 Musculocutaneous nerve
7 Axillary nerve
8 Median nerve
9 Brachial artery
10 Radial nerve
11 Cervical plexus
12 Common carotid artery
13 Roots of brachial plexus (C5–T1)
14 Phrenic nerve
15 Dorsal scapular artery
16 Subclavian artery
17 Posterior cord of brachial plexus
18 Medial cord of brachial plexus
19 Subscapular artery
20 Long thoracic nerve
21 Ulnar nerve
22 Medial cutaneous nerve of forearm
23 Thoracodorsal nerve
24 Intercostobrachial nerve
25 Medial cutaneous nerves of arm and forearm
26 Scalenus anterior muscle
27 Scalenus medius muscle
28 Intercostal nerve (T1)

Brachial plexus – Upper Trunk

- C5,6 spinal nerves
  - Motor – deltoid, biceps, infraspinatus,
  - Sensory
    - Axillary n –sensory (lateral shoulder)
    - Digit 1 (C-6)
    - Lat antebrachial cutaneous nerve

Brachial Plexus– middle trunk

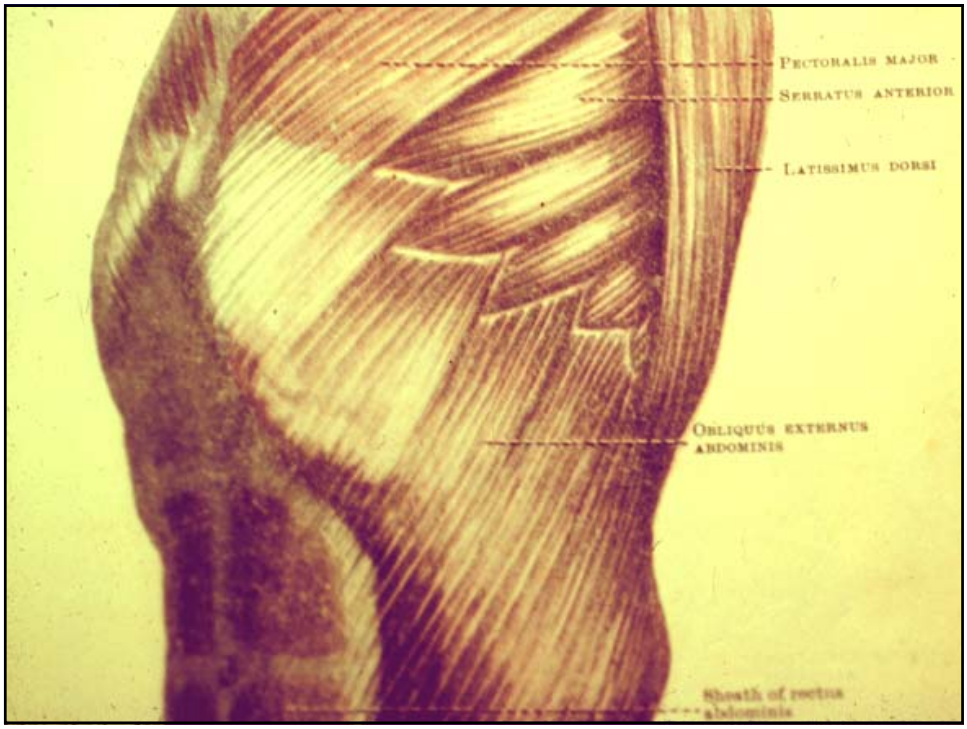
- C-7 spinal nerve
  - Motor – triceps, lat dorsi, serr ant, flex carp rad,
  - Sensory
    - Digit 2,3
    - Post antebrachial cutaneous nerve

Brachial plexus - Lower trunk

- C-8;T-1 spinal nerves
- Motor – triceps; hand intrinsics
- Sensory
  - Digit 5
  - Medial antebrachial cutaneous nerve

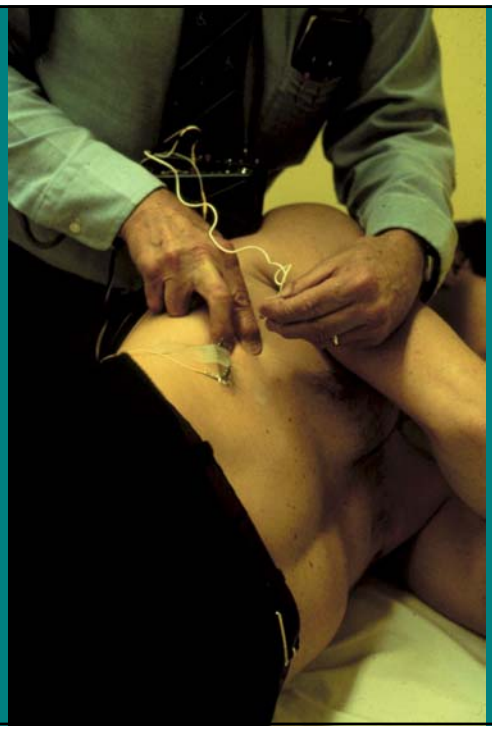
Serratus anterior

Access it electromyographically at its origin


Pectoralis major
Serratus anterior
Latissimus dorsi
Obliquus externus abdominis
Sheath of rectus abdominis

Serratus anterior

- Most EMG'ers don't where to explore
  - Needle electrode between fingers which are placed in adjacent intercostal spaces
  - Recording electrodes along lateral chest
  - (C5.6.7) – Long thoracic nerve of Bell



Serratus Winging

- Long thoracic nerve of Bell compromise
- C-5,6,7 radiculopathy
- Recognition
  - Wings ***medially***
  - Winging made worse by shoulder forward flexion

Trapezius winging

- Causes
  - Local compromise of XI cranial N eg. Biopsy
  - Sacrifice of XI in radical neck surgery
- Symptoms and signs
  - Shoulder pain and weakness of shoulder abduction
  - Shoulder complex moves forward and downward
  - Scapular winging ***aggravated by shoulder abduction***

Trapezius winging

- Wings ***laterally***
- Winging is aggravated by shoulder abduction

SNAP's in upper limb

- C-6 – digit 1
- C-7 – digit 2,3
- C-8 – digit 5
- Median nerve – digit 1,2,3,4(1/2)
- Ulnar nerve – digit 4(1/2),5

CV ulnar nerve across elbow

- Must do study with elbow flexed (70 degrees)
- Proximal conduction is ALWAYS faster
- Note the amplitude (reduced- if block)
- Include SNAP of digit 5

Measurement	Elbow Straight	Elbow Flexed 70°
Above to below elbow	14 cm	17 cm
Conduction Velocity		
Across elbow	47 m/s	57 m/s
Above elbow to wrist	52 m/s	62 m/s
Below elbow to wrist	56 m/s	———

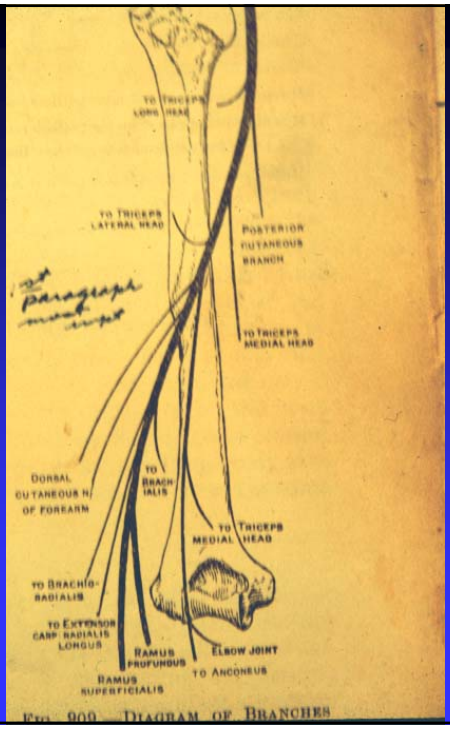
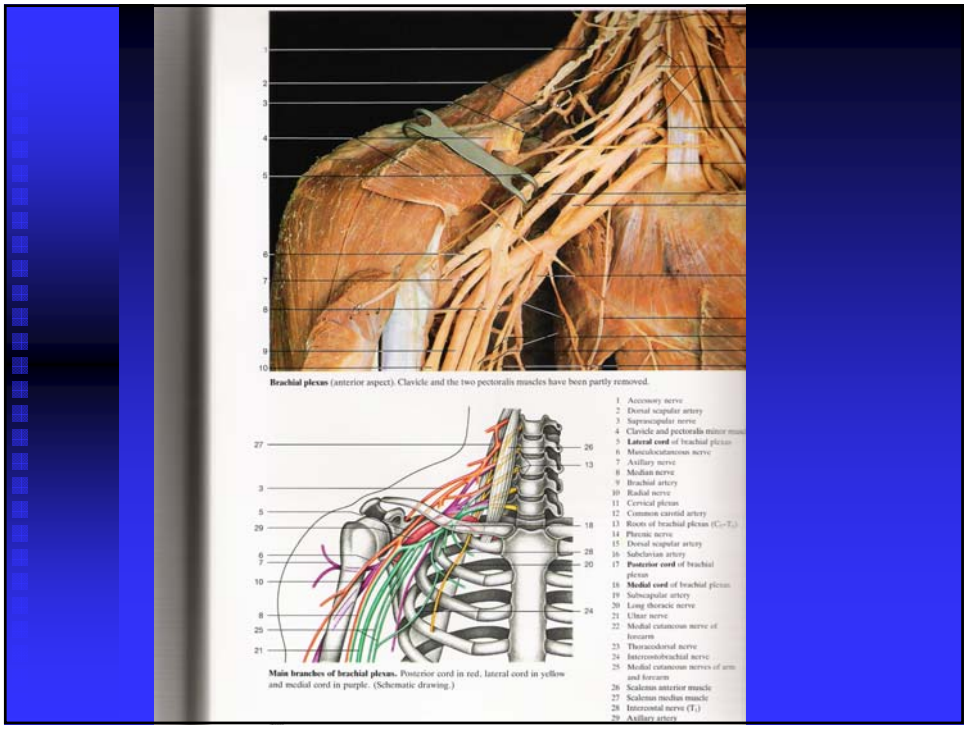
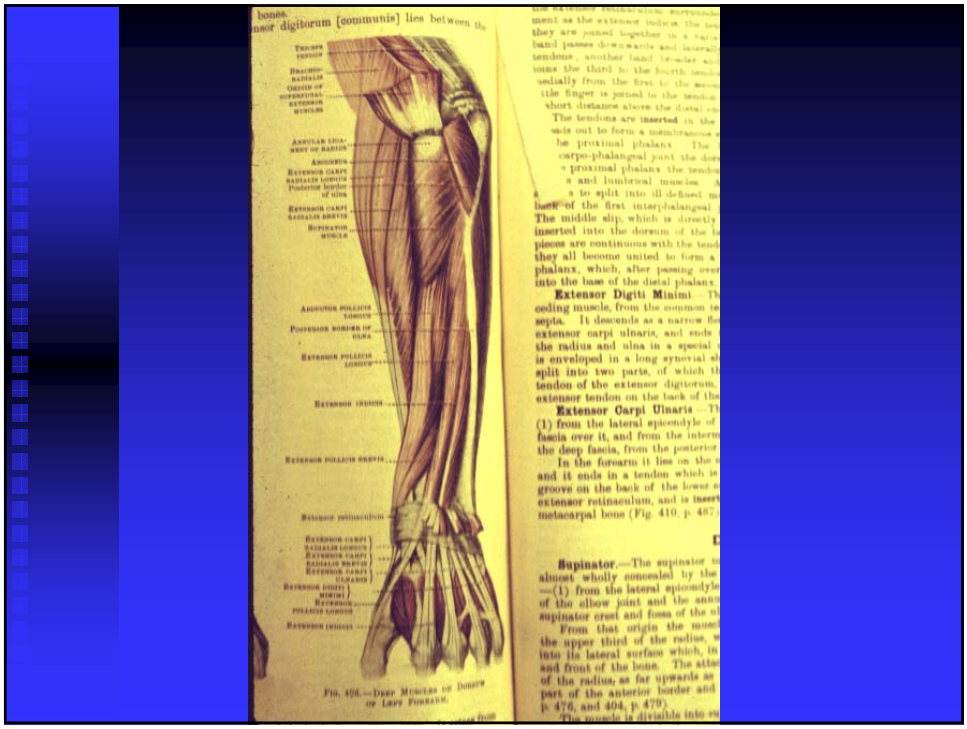


FIG. 900.—DIAGRAM OF BRANCHES



Brachial plexus (anterior aspect). Clavicle and the two pectoralis muscles have been partly removed.

Main branches of brachial plexus. Posterior cord in red, lateral cord in yellow and medial cord in purple. (Schematic drawing.)



bones.
nsor digitorum [communis] lies between th

Fig. 406.—Deep Muscles of Dorsum of Left Forearm.

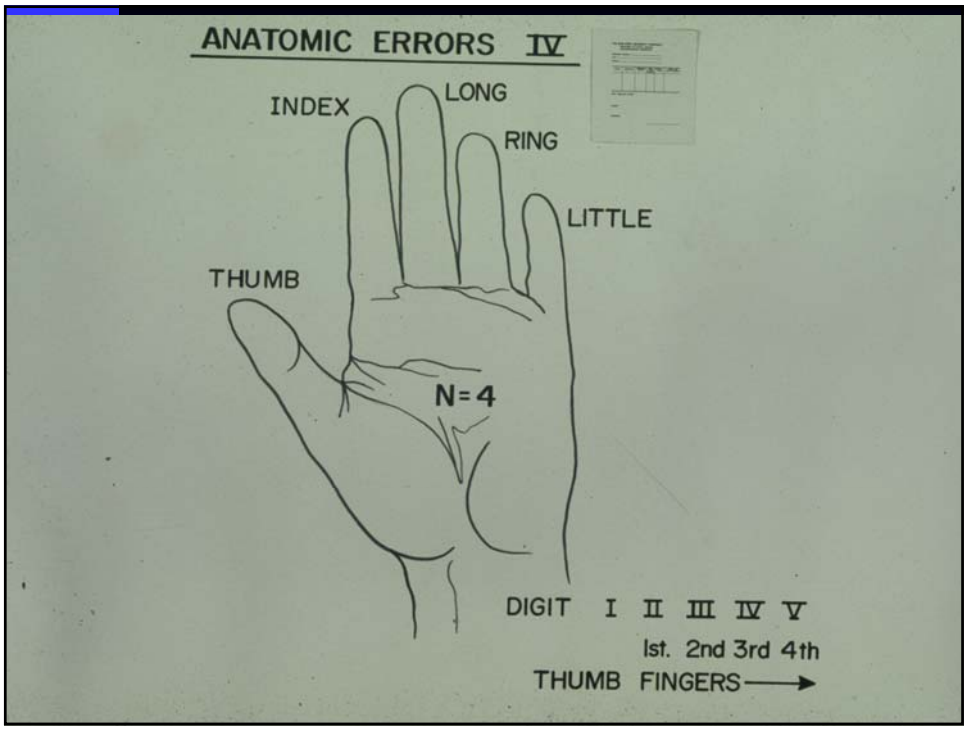
Extensor Digiti Minimi—Th
ceding muscle, from the common te
septa. It descends as a narrow fle
extensor carpi ulnaris, and ends
the radius and ulna in a special
is enveloped in a long synovial sh
split into two parts, of which th
tendon of the extensor digitorum,
extensor tendon on the back of the

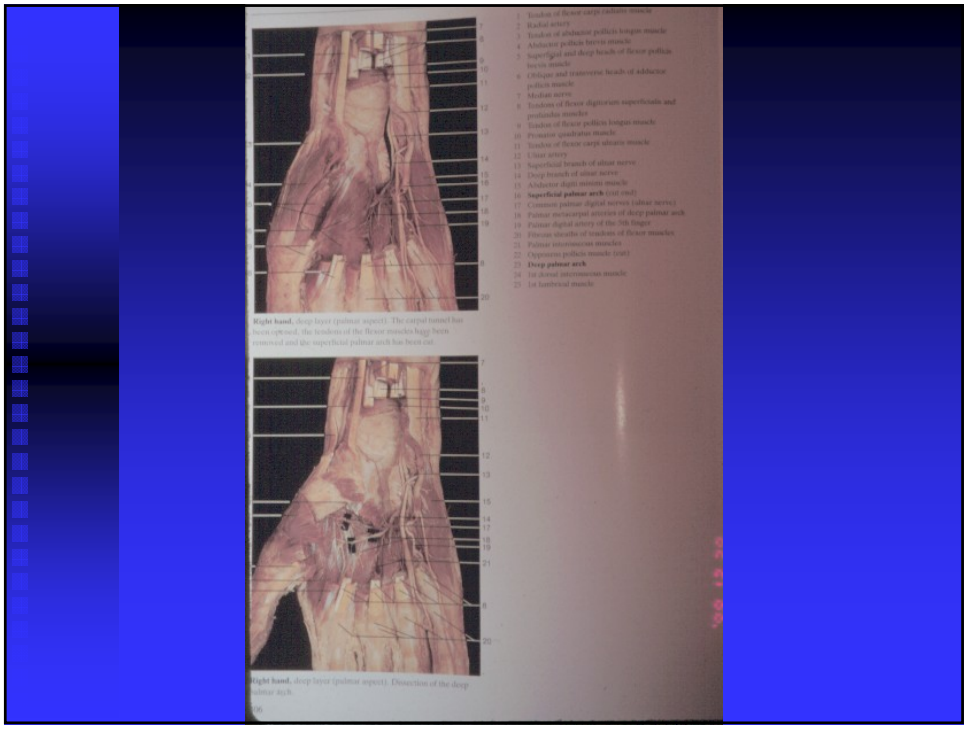
Extensor Carpi Ulnaris—Th
(1) from the lateral epicondyle of
fascia over it, and from the interm
the deep fascia, from the posterior

In the forearm it lies on the
and it ends in a tendon which is
groove on the back of the lower e
extensor retinaculum, and is insert
metacarpal bone (Fig. 410, p. 487

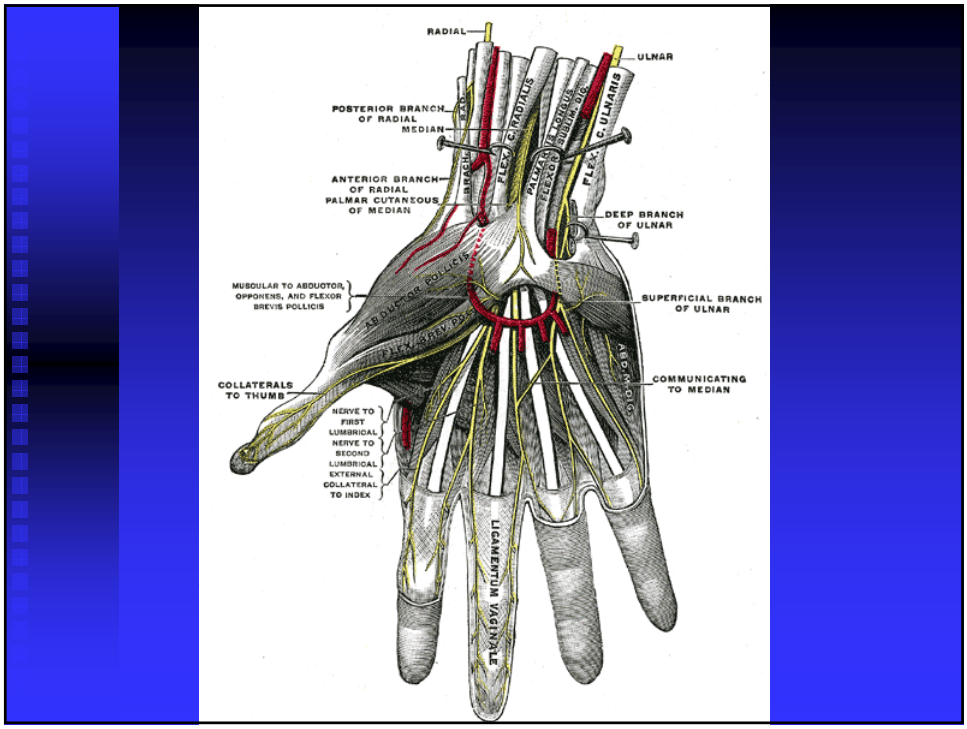
Supinator.—The supinator
almost wholly concealed by the
—(1) from the lateral epicondyle
of the elbow joint and the annu
supinator crest and fossa of the u

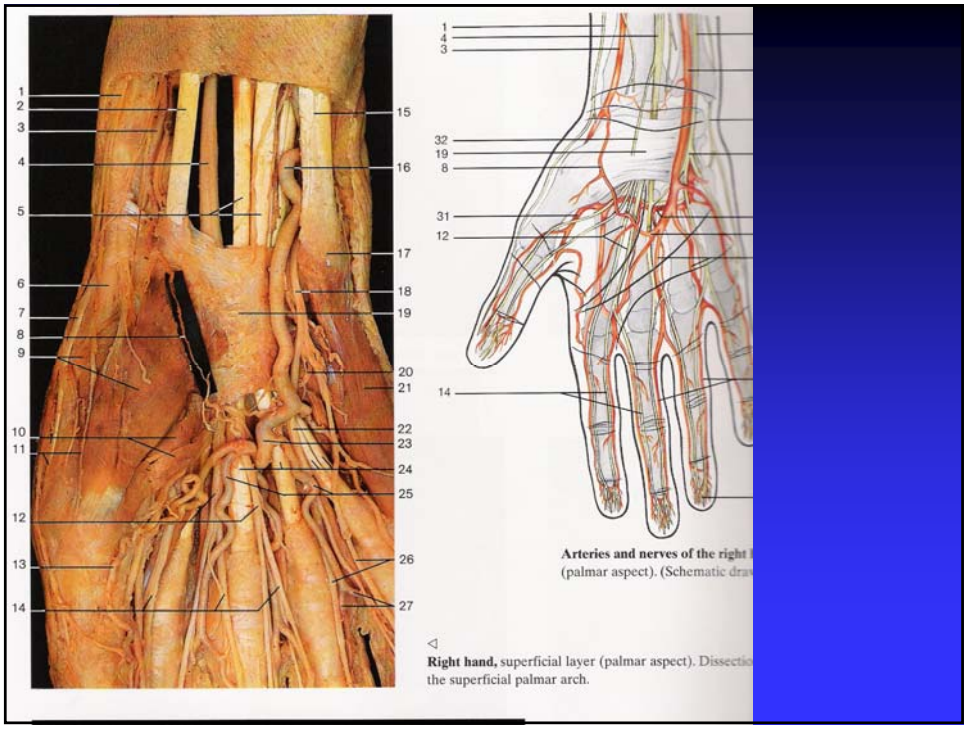
From that origin the muscl
the upper third of the radius, w
into its lateral surface which, in
and front of the bone. The attac
of the radius, as far upwards as
part of the anterior border and
p. 476, and 404, p. 479).

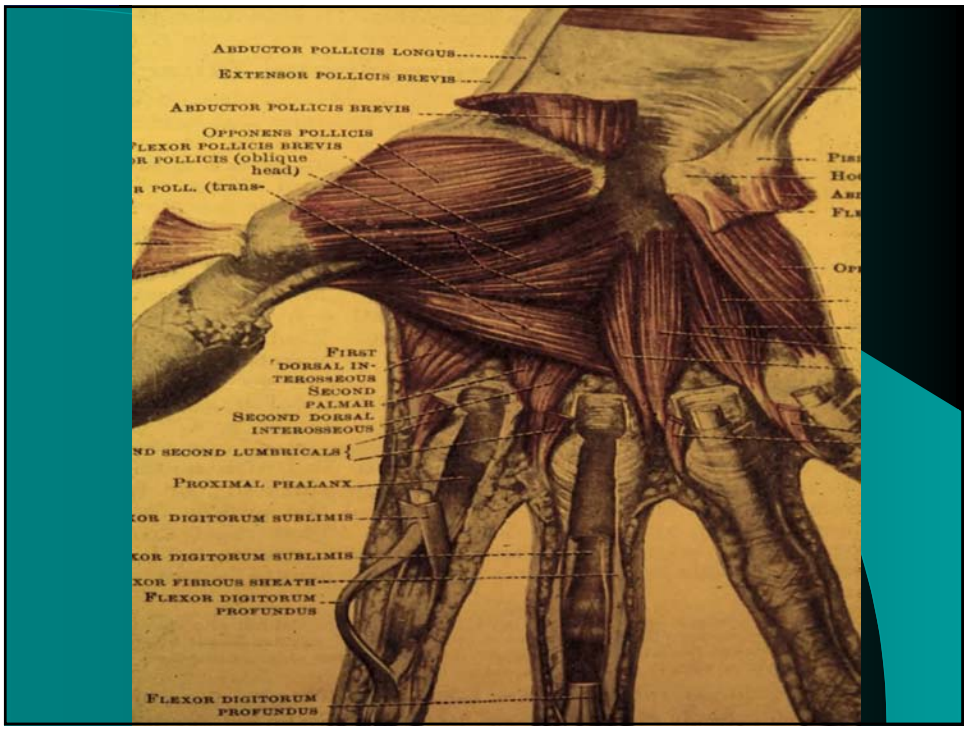


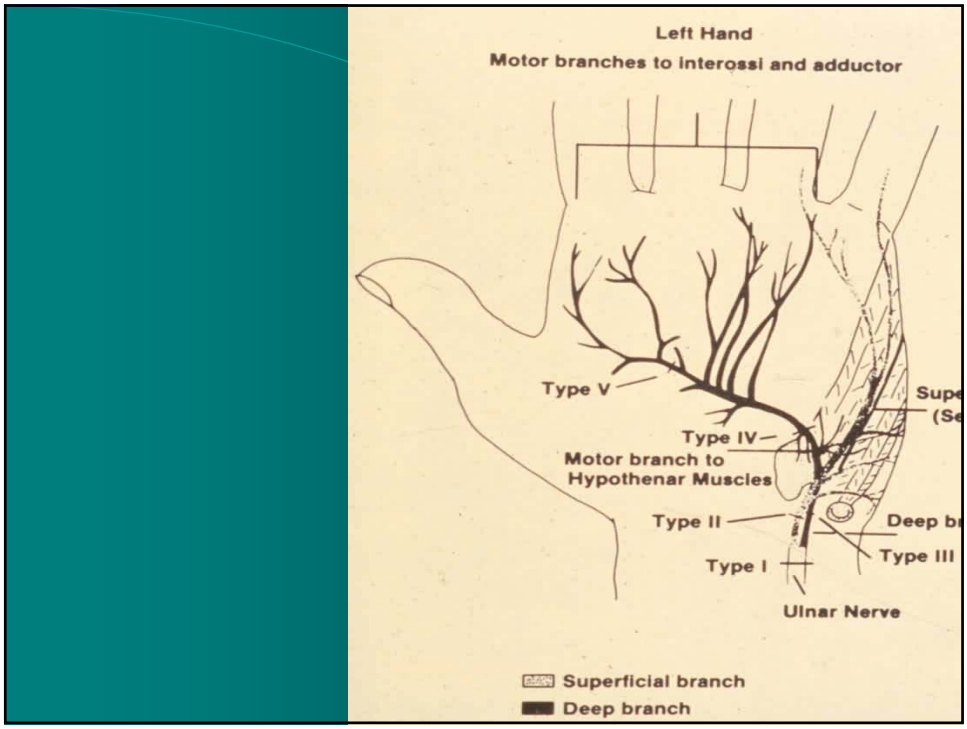



Interactive Hand 2000 © 2001 Primal Pictures Ltd


RADIAL
ULNAR
POSTERIOR BRANCH OF RADIAL
MEDIAN
ANTERIOR BRANCH OF RADIAL
PALMAR CUTANEOUS OF MEDIAN
DEEP BRANCH OF ULNAR
SUPERFICIAL BRANCH OF ULNAR
COMMUNICATING TO MEDIAN
COLLATERALS TO THUMB
MUSCULAR TO ABDUCTOR, OPPONENS, AND FLEXOR BREVIS POLLICIS
NERVE TO FIRST LUMBRICAL
NERVE TO SECOND LUMBRICAL
EXTERNAL COLLATERAL TO INDEX
LIGAMENTUM VAGINALE


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
1
4
3
32
19
8
31
12
14
Arteries and nerves of the right
(palmar aspect). (Schematic dra
Right hand, superficial layer (palmar aspect). Dissecti
the superficial palmar arch.


ABDUCTOR POLLICIS LONGUS
EXTENSOR POLLICIS BREVIS
ABDUCTOR POLLICIS BREVIS
OPPONENS POLLICIS
FLEXOR POLLICIS BREVIS
OR POLLICIS (oblique
head)
R POLL. (trans-
FIRST
DORSAL IN-
TEROSSEOUS
SECOND
PALMAR
SECOND DORSAL
INTEROSSEOUS
ND SECOND LUMBRICALS
PROXIMAL PHALANX
OR DIGITORUM SUBLIMIS
XOR DIGITORUM SUBLIMIS
XOR FIBROUS SHEATH
FLEXOR DIGITORUM
PROFUNDUS
FLEXOR DIGITORUM
PROFUNDUS



Sunderland's dissection

LUMBAR PARASPINALS

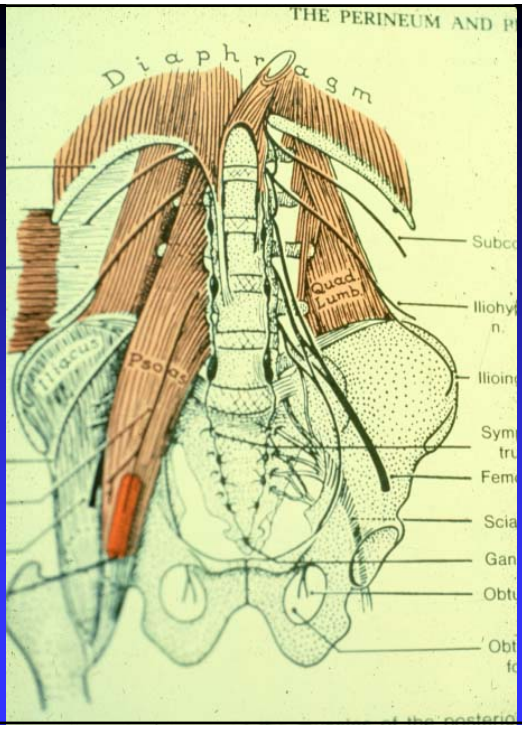
Brim of pelvis – L-4

Next lumbar spinous process – L-5

Lowest muscle bulk – S-1

Iliacus and psoas

- Outer 1/3 of inguinal ligament
- Femoral nerve is lateral to femoral artery



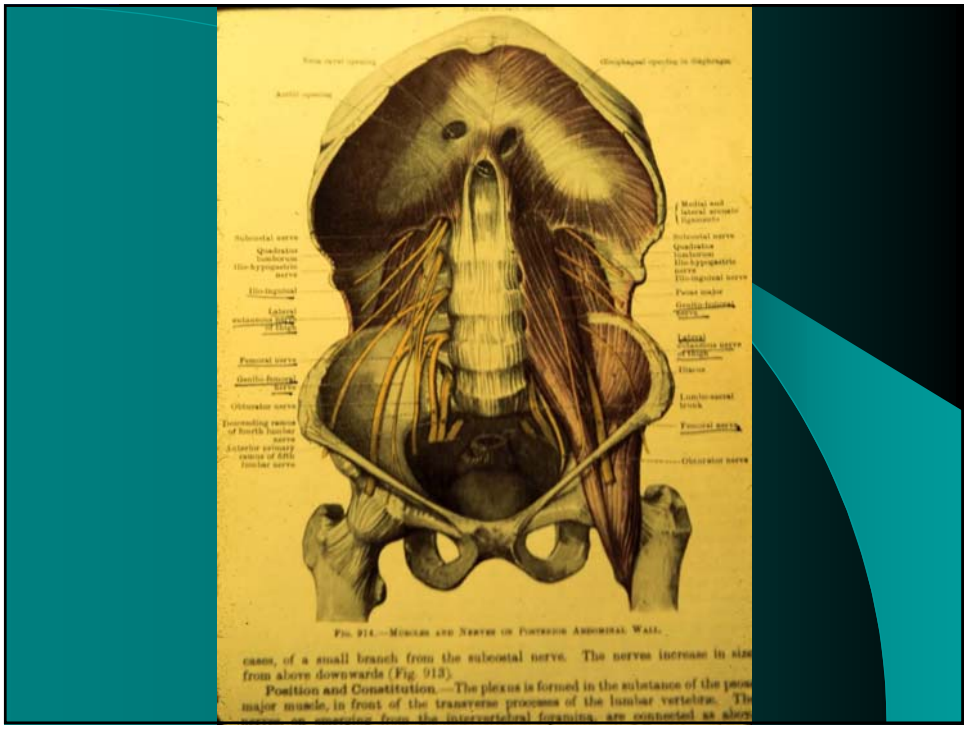
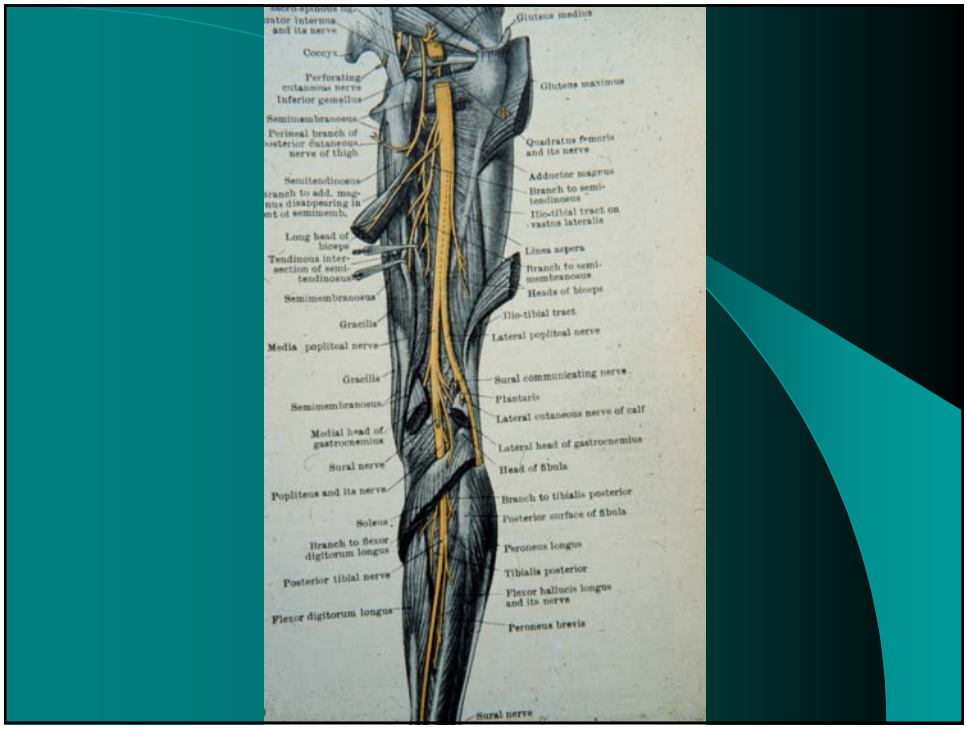
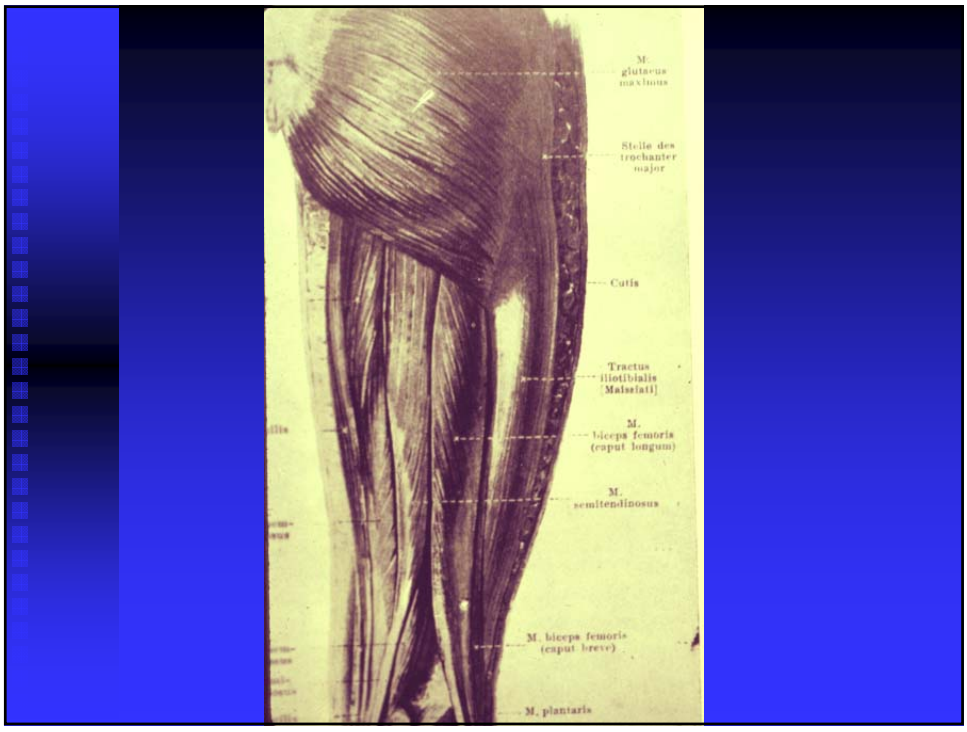


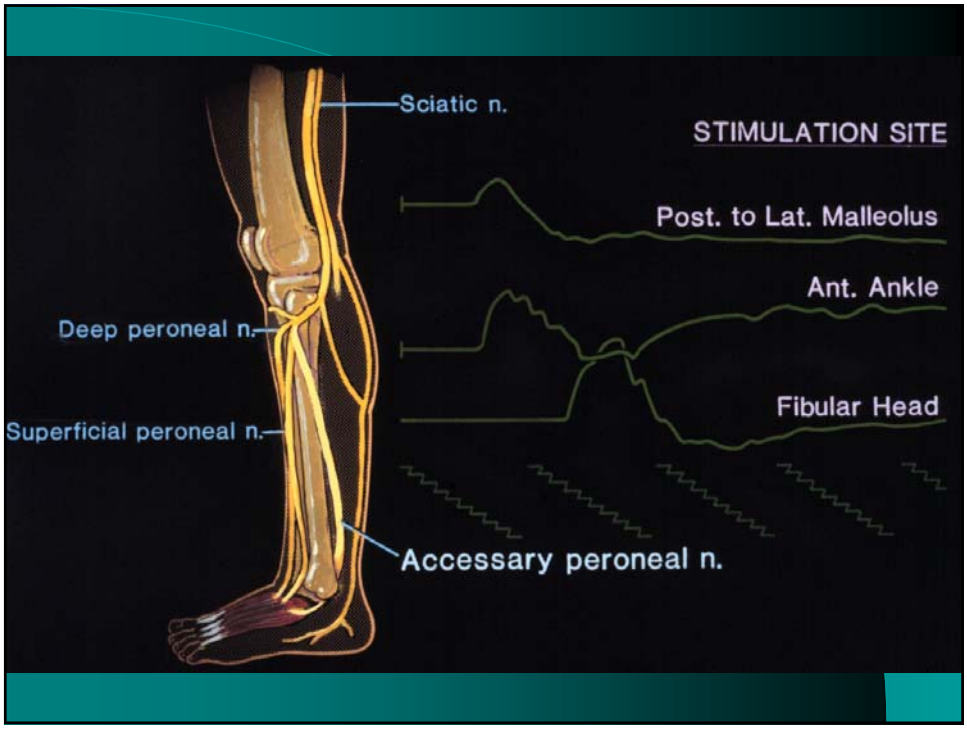
Fig. 914.—Muscles and Nerves of Posterior Abdominal Wall.

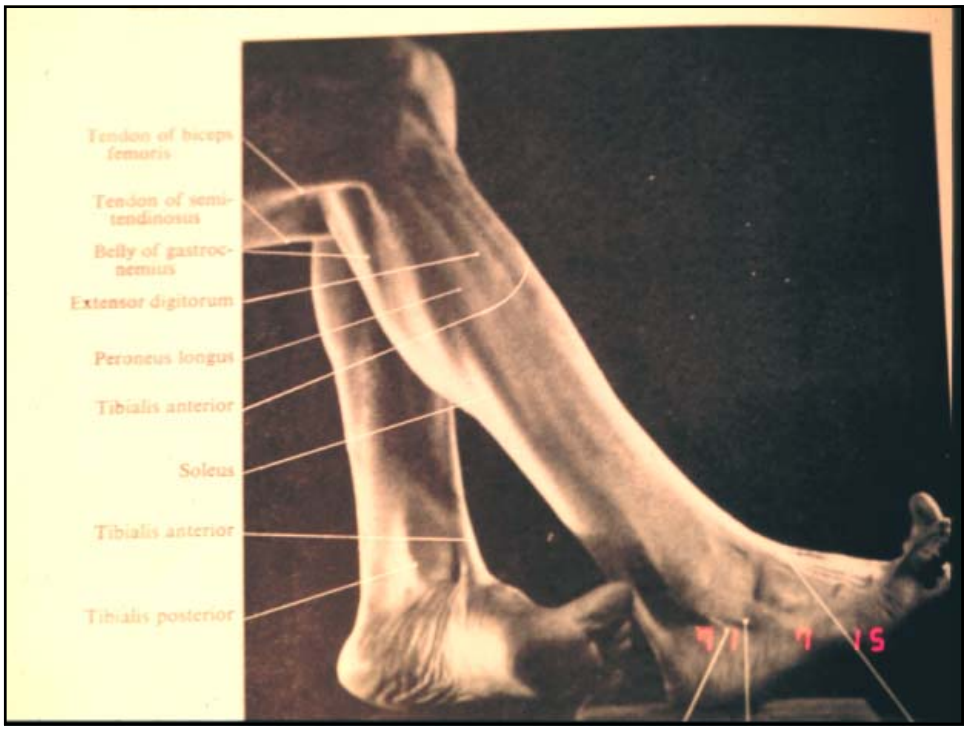
cases, of a small branch from the subcostal nerve. The nerves increase in size from above downwards (Fig. 913).

Position and Constitution.—The plexus is formed in the substance of the psoas major muscle, in front of the transverse processes of the lumbar vertebræ. The


Gluteus medius
Coccyx
Perforating cutaneous nerve
Inferior gemellus
Gluteus maximus
Semimembranosus
Perineal branch of posterior cutaneous nerve of thigh
Quadratus femoris and its nerve
Adductor magnus
Branch to semitendinosus
Iliotibial tract on vastus lateralis
Long head of biceps
Tendinous intersection of semitendinosus
Linea aspera
Branch to semimembranosus
Heads of biceps
Semimembranosus
Iliotibial tract
Gracilis
Lateral popliteal nerve
Media popliteal nerve
Gracilis
Sural communicating nerve
Plantaris
Semimembranosus
Lateral cutaneous nerve of calf
Medial head of gastrocnemius
Lateral head of gastrocnemius
Sural nerve
Head of fibula
Popliteus and its nerve
Branch to tibialis posterior
Posterior surface of fibula
Soleus
Branch to flexor digitorum longus
Peroneus longus
Tibialis posterior
Posterior tibial nerve
Flexor hallucis longus and its nerve
Flexor digitorum longus
Peroneus brevis
Sural nerve


M. glutaeus maximus
Stelle des trochanter major
Cutis
Tractus iliotibialis [Maissiati]
M. biceps femoris (caput longum)
M. semitendinosus
M. biceps femoris (caput breve)
M. plantaris


Sciatic n.
STIMULATION SITE
Post. to Lat. Malleolus
Ant. Ankle
Deep peroneal n.
Fibular Head
Superficial peroneal n.
Accessary peroneal n.

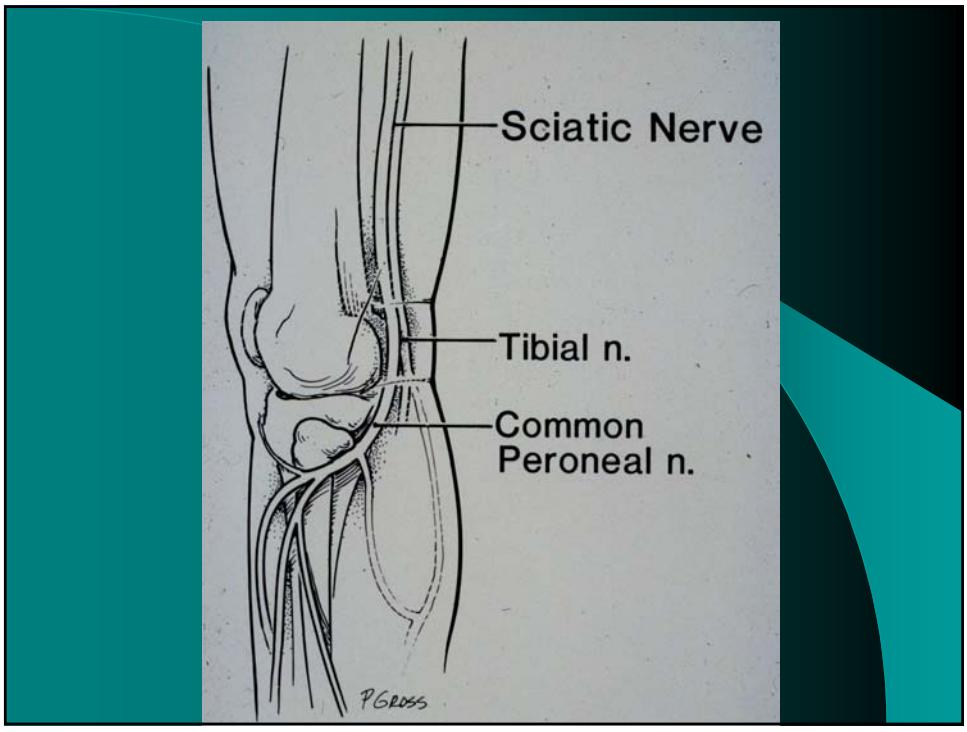

Tendon of biceps femoris
Tendon of semi-tendinosus
Belly of gastroc-nemius
Extensor digitorum
Peroneus longus
Tibialis anterior
Soleus
Tibialis anterior
Tibialis posterior

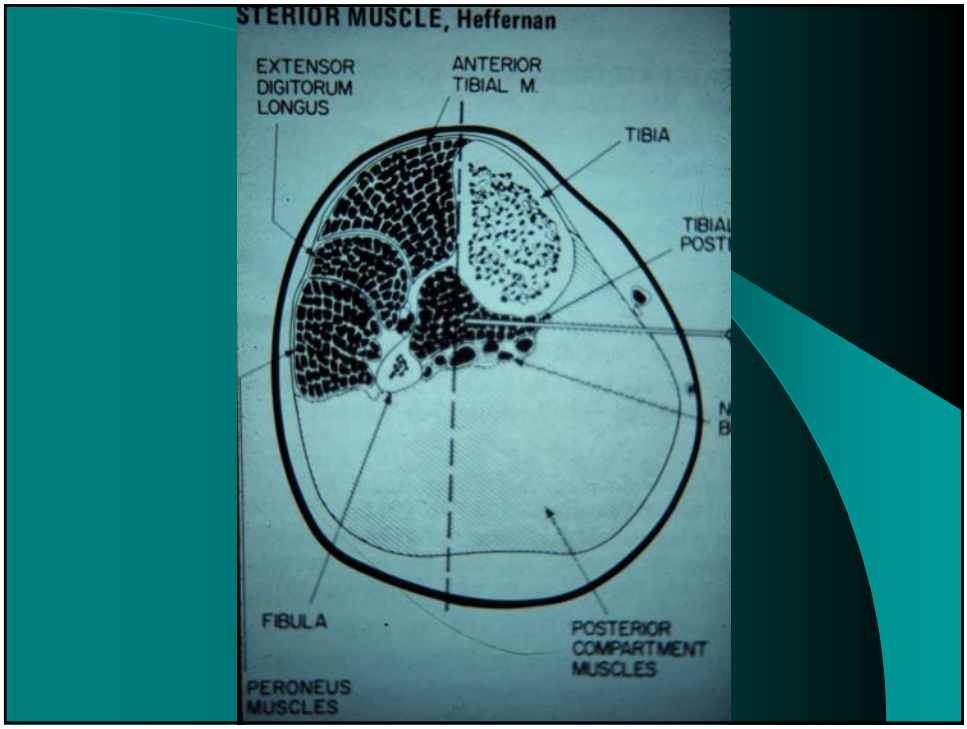

514 MYOLOGY

fleshy fibres, from the lateral side of the lateral condyle of the tibia, from the upper two-thirds or more of the anterior surface of the shaft of the fibula, from the deep fascia and intermuscular septa and from the upper part of the interosseous membrane.

It gives rise to a tendon which passes deep to the superior extensor retinaculum, and divides into four tendons on the front of the ankle,

under cover of the inferior extensor retinaculum; these tendons, together with the tendon of the peroneus tertius, are enclosed in a single synovial sheath as they lie in the most lateral compartment of this retinaculum. They are inserted into the



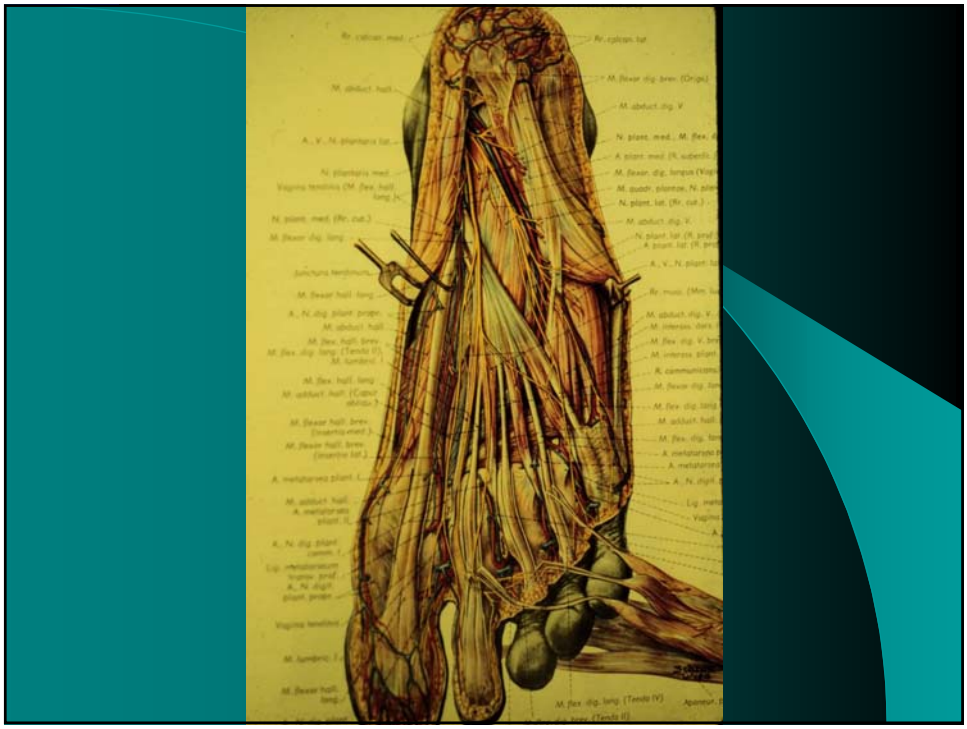


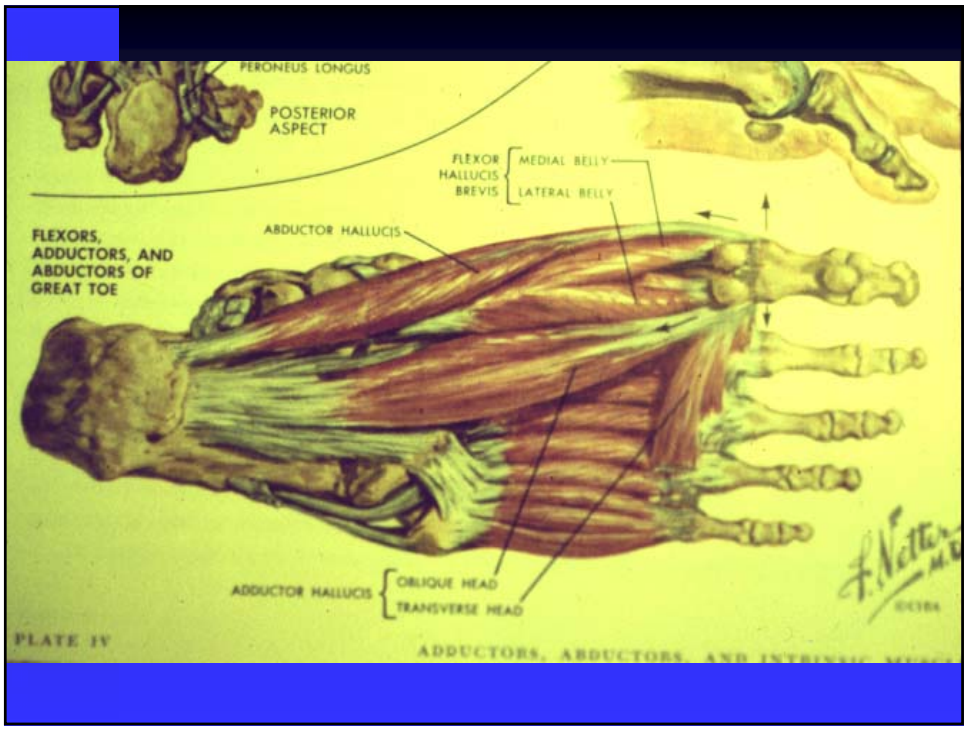
Where ? – needle in posterior tibial muscle

- Middle 1/3 of leg
- Insert needle through anterior tibial muscle
- Just deep to ant tib electrical activity – post tibial muscle

Foot – locate intrinsic muscles

- Abductor hallicus – 1 cm below navicular tubercle
- Abductor dig V pedis – below the lateral malleolus at junction of normal and sole skin




PERONEUS LONGUS
POSTERIOR ASPECT
FLEXOR HALLUCIS BREVIS
MEDIAL BELLY
LATERAL BELLY
ABDUCTOR HALLUCIS
FLEXORS, ADDUCTORS, AND ABDUCTORS OF GREAT TOE
ABDUCTOR HALLUCIS
OBLIQUE HEAD
TRANSVERSE HEAD
PLATE 349
ADDUCTORS, ABDUCTORS, AND INTRINSIC

Physiologic misnomers

- 'Deep tendon' reflexes – no such thing! Correctly called ***muscle stretch reflexes!***
- ***'Evoked response' –*** this is a tautology (I learned this from Dr Kimura !!)
- 'Denervation potential' – BAD TERM – positive waves and fibrillation potentials are seen in many conditions besides 'dead axons'

More terminology

- Radiation of pain is a ***misnomer***
  - ***Radiating*** means a continuous line from a point source
  - Better – referral to a distant site eg. Buttock. Thigh, shin, heel

PROUNCIATION

- Physiatrist – physi – a' –trist (NB. 'iatry' is from Greek – ***medical care*** how do you say "physiology"???
- Cerebral – cer'-e-bral
- Vertebral – ver' – te – bral
- Data – day-ta is preferred! Not dah-ta.
- Facet – fac'- et in English (in French fa – cette')

Anatomic misnomers

- Extremity – this is the end of an elongated structure. Misused for ***LIMB***
  - ***Upper limb –*** comprises arm (shoulder to elbow); forearm (elbow to wrist) and hand
  - ***Lower limb –*** comprises thigh (hip to knee); leg (knee to ankle) and foot
  - NB. Upper extremity is ***HAND***; lower extremity is ***FOOT***

Summary – *anatomy & words*

- Have a chart or anatomy book nearby
- Verify your recollection
- Never assume you are correct !
- ***Review. Review. Review. Surface anatomy***
- *Frequent error is 'exploring opponens when it is most likely - abd poll brevis*
- Have a medical dictionary nearby, also

THANK YOU!

Email -
ernest.johnson@osumc.edu