BRACHIAL PLEXUS – 1. PARAVERTEBRAL AREA

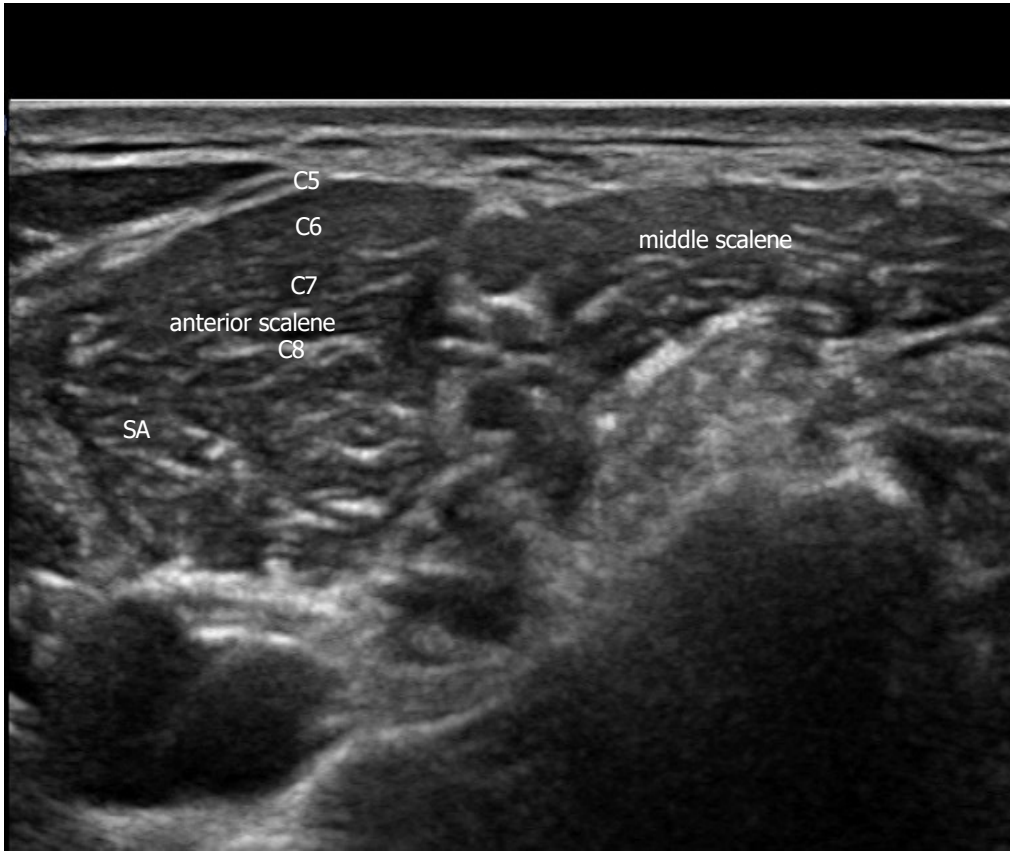
INSTRUCTIONS[1]

MAIN LANDMARKS: C5-T1 vertebrae (targeting transverse process shapes)
SCANNING TECHNIQUE: As the roots exit the neural foramina, they slide between two apophyses of the transverse processes of the cervical vertebrae, the anterior and posterior tubercles. Based on the peculiar appearance of the transverse process of C7, in which the anterior tubercle is absent, US is able to establish the level of nerve roots. The scanning technique must be systematic and should reveal the C7 vertebra as the first landmark. The C7 root is detected on the same plane of the C7 vertebra. Shifting the probe upward, the C6 vertebra is then recognized due to the presence of prominent anterior and posterior tubercles: the C6 root is housed in between them. The transverse process of C5 have the same shape of C6 but with a narrower intertubercular space where the C5 root can be identified. Shifting the probe downward from C7, the lateral aspect of the T1 vertebra is masked by the head of the first rib and appears flat without any tubercle; at this level, the C8 root can be observed exiting the foramen. In the paravertebral area, each root has a homogeneous monofascicular hypoechoic structure.

SUPPLY: complex network of interconnecting nerves formed by the anterior rami of the lower four cervical nerves and first thoracic nerve that supplies the skin and the whole musculature of the upper limb

[1] C. Martinoli et al. Am J Roentgenol (2002). 179(2): 481-484

BRACHIAL PLEXUS
PARAVERTEBRAL AREA



BRACHIAL PLEXUS – 2. INTERSCALENIC and SUPRACLAVICULAR

INSTRUCTIONS[1]

MAIN LANDMARKS: interscalene triangle (anterior and middle scalene muscles), subclavian artery, first rib, costoclavicular space

SCANNING TECHNIQUE: At the interscalene level, the nerve roots appear as monofascicular hypoechoic rounded images aligned from surface to depth between the anterior and middle scalene muscles. In this space, the most superficial fascicles belong to C5 and the deepest to C8. Common anatomical variants include the passage of C5 completely in front of (3%) or piercing (13%) the anterior scalene muscle and the course of the C8 and T1 roots behind the middle scalene muscle rather than passing anterior to it. The ability of ultrasound to recognize the exact level of the roots in the paravertebral area also leads to a confident identification of the trunks by simply following the nerve bundles from where they arise. Within or soon after exiting the interscalenic space, the nerve bundles forming the trunks become multifascicular and continue down in the supraclavicular space interconnecting and forming nerve divisions and the initial part of the cords. They are grouped in a cluster of hypoechoic rounded images, most of which running alongside the posterior aspect of the subclavian artery, just superficial to the first rib or to the bright interface of the areated lung. The transverse cervical artery, a small vessel arising from the subclavian artery, may be seen encroaching the nerve divisions and cords in the supraclavicular region. This vessel may pass posterior to or among the fascicles, in this latter case forming a cleavage plane that often intervene between the middle and the lower plexus components. More distally, the costoclavicular space is blind to US examination owing to the interposition of the clavicle and the lack of an acoustic window.

[1] C. Martinoli et al. Sem Musculoskelet Radiol (2010). 14: 523-546

BRACHIAL PLEXUS – 3. INFRACLAVICULAR, RETROPECT MINOR, AXILLARY

INSTRUCTIONS[1]

MAIN LANDMARKS: axillary artery, pectoralis minor muscle

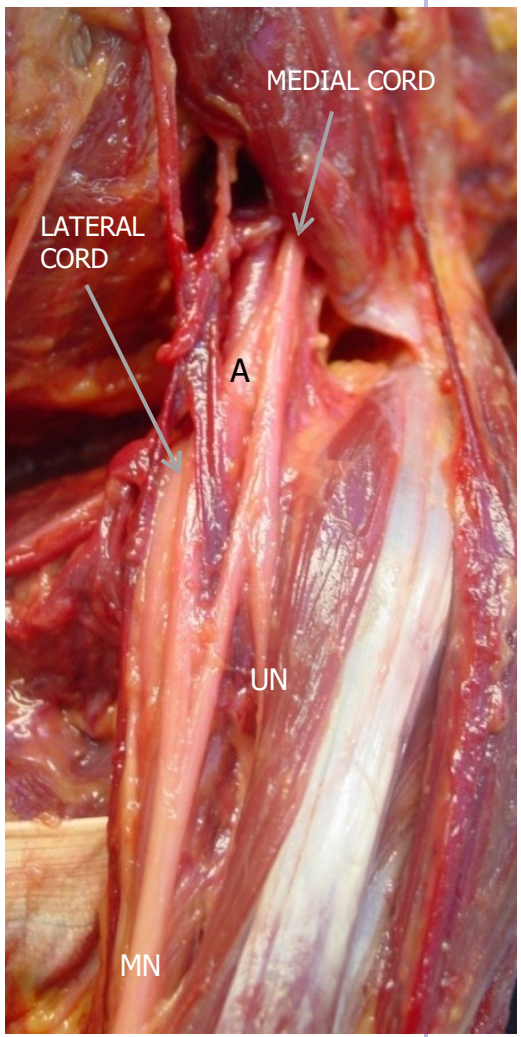
SCANNING TECHNIQUE: Crossing down the clavicle, in the retropectoralis minor space, the nerve cords redistribute around the axillary artery. The fascicles belonging to the posterior cord course behind the artery; the lateral cord runs external and the medial cord internal to it. On short-axis planes, the axillary artery is the main landmark to identify the nerves in this area. This arrangement is maintained across these spaces like a ‘‘three-point’’ star with the artery centered in the middle.
The examination of the most distal part of brachial plexus nerves is completed using an axillary approach as these nerves assume a deeper course distally.

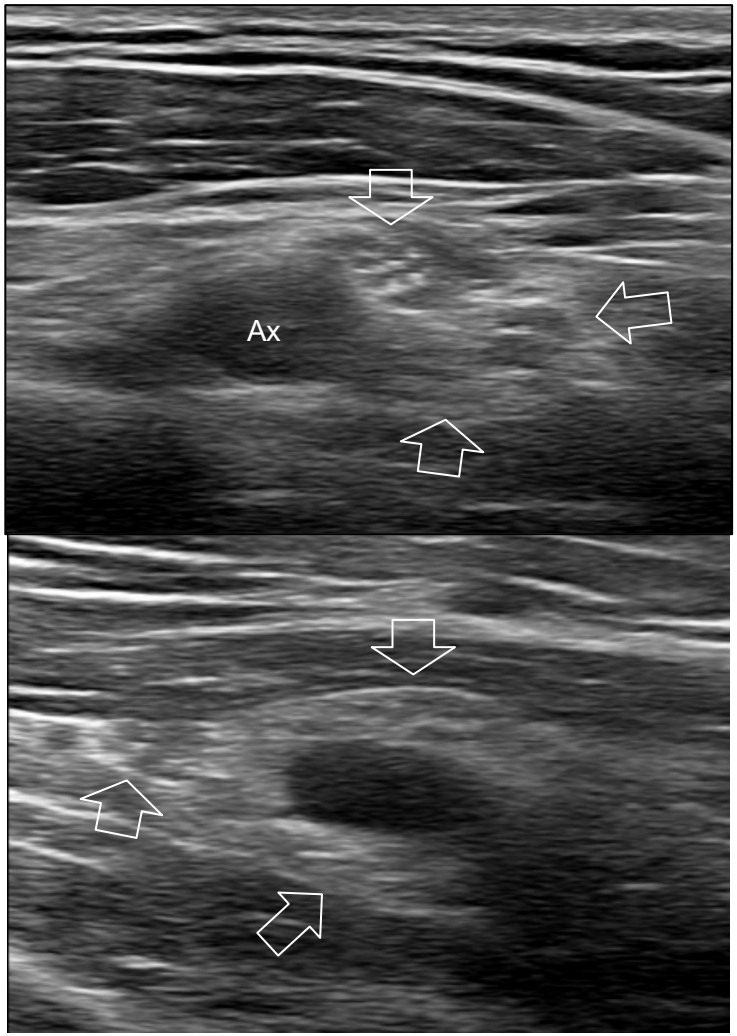
With an axillary approach, nerves are imaged in a more superficial position and can be more accurately evaluated. Ultrasound scanning should first start at the proximal arm to identify the median, the ulnar, and the radial nerves as they surround the brachial artery. Then the probe is swept up along the short axis of the nerves to reach the distal part of the cords.

[1] C. Martinoli et al. Sem Musculoskelet Radiol (2010). 14: 523-546

BRACHIAL PLEXUS

CORD





SUPRASCAPULAR

INSTRUCTIONS[1]

MAIN LANDMARKS: C5 nerve root at the distal interscalene triangle, omohyoid muscle, scapular notch, spinoglenoid notch

SCANNING TECHNIQUE: After identifying the transverse process of the C5 vertebra and the C5 root, follow it down in its short-axis until the root becomes multifascicular. One of those fascicle arising from from the postero-superficial side of C5 is the suprascapular nerve. It then assumes a straight course directed obliquely down and externally to reach the scapular notch on the upper scapula. The suprascapular nerve parallels the omohyoid muscle during its descent across the lateral neck spaces and the supraclavicular region.

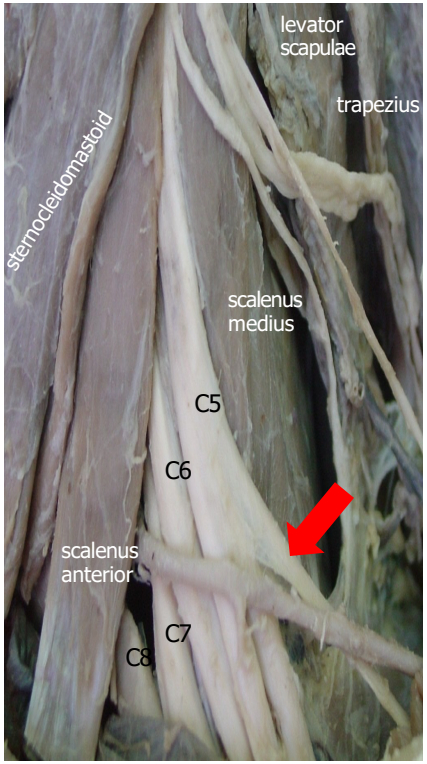
For examining the nerve at the level of the scapula, the probe is oriented in a coronal plane posterior to the AC joint tilting it to make the beam slight oblique toward anterior. The scapular notch appears as a focal bony defect in the upper edge of the scapular body: it houses the suprascapular nerve whereas the suprascapular artery passes outside it.

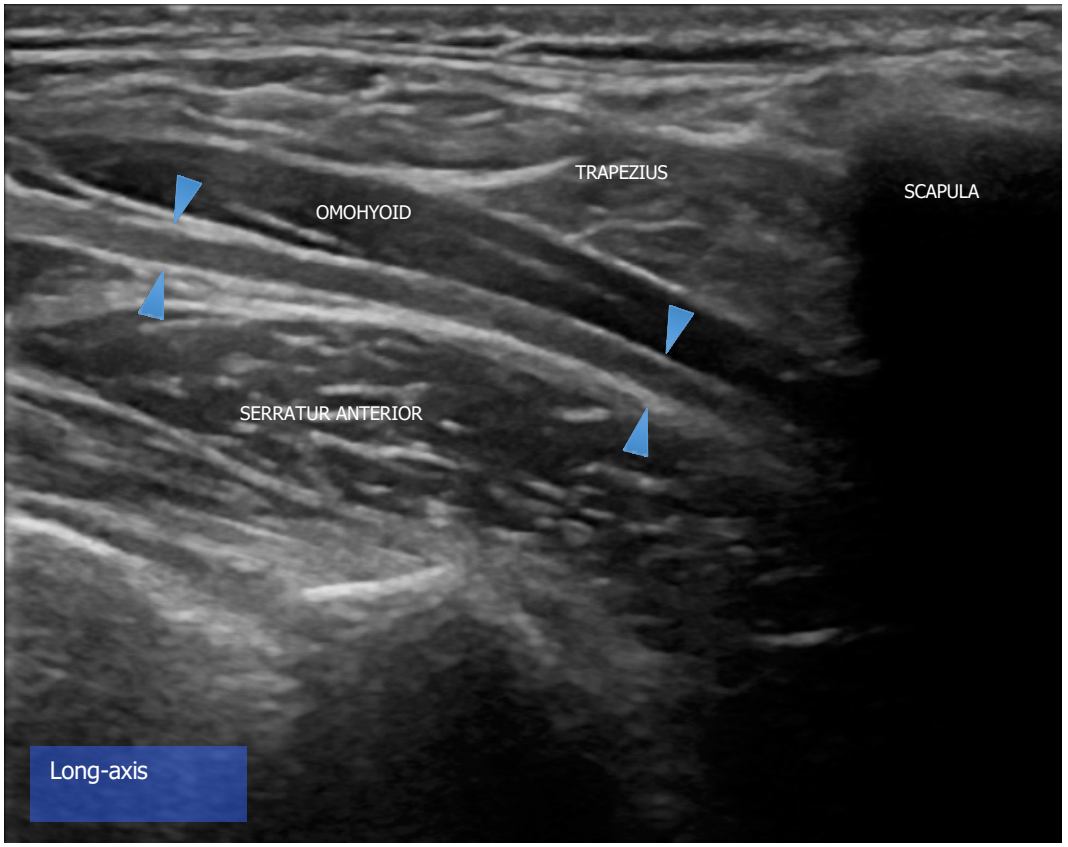
The probe should finally be placed in a transverse plane over the spinoglenoid fossa using a posterior shoulder access. The infraspinatus tendon Scanning should be planned at the level of the infraspinatus tendon and cranial to it.

SUPPLY: motor nerve, supplying the supraspinatus and infraspinatus muscles

[1]F. Bilfeld et al. Diagn Interv Imaging (2017).98(12): 873-879,1:745-749

Suprascapular





LONG THORACIC

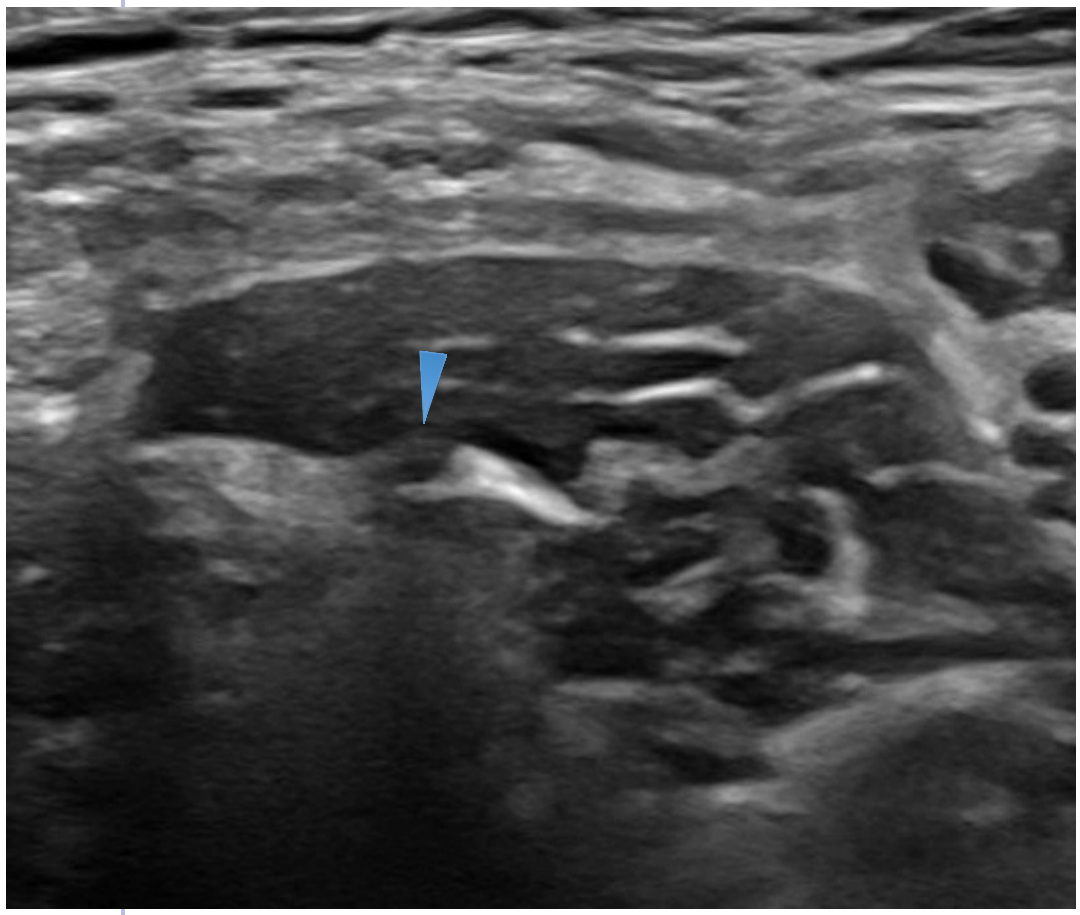
INSTRUCTIONS[1]

MAIN LANDMARKS: middle scalene muscle, serratus anterior muscle
SCANNING TECHNIQUE: Place the probe in the short axis of the C5 and C6 roots, where they emerge from the neural foramina until a small branch can be seen arising from their lateral edge to enter a cleavage plane within the middle scalene. Distally, the nerve is seen exiting the middle scalene to reach the surface of the upper portion of the serratus anterior. The nerve then courses along the lateral chest wall on the mid-axillary line, under the fascia of the serratus anterior muscle. The lateral thoracic artery is a valuable anatomical landmark to pinpoint the nerve along the serratus anterior surface, where the nerve lies lateral to the artery. The dorsal scapular nerve arises from C5 and can easily be confused with the long thoracic nerve due to a similar course in the supraclavicular area.
ADDITIONAL NOTES: The long thoracic nerve has a 1.6-2.2mm caliber. The upper infraclavicular and subcoracoid segments of this nerve are difficult to visualize.

SUPPLY: The long thoracic nerve is the motor nerve to the serratus anterior muscle

[1]. Faruch Bilfeld et al., Diagnostic and Interventional Imaging (2021). 102,4: 241-245

LONG THORACIC



PHRENIC

INSTRUCTIONS[1]

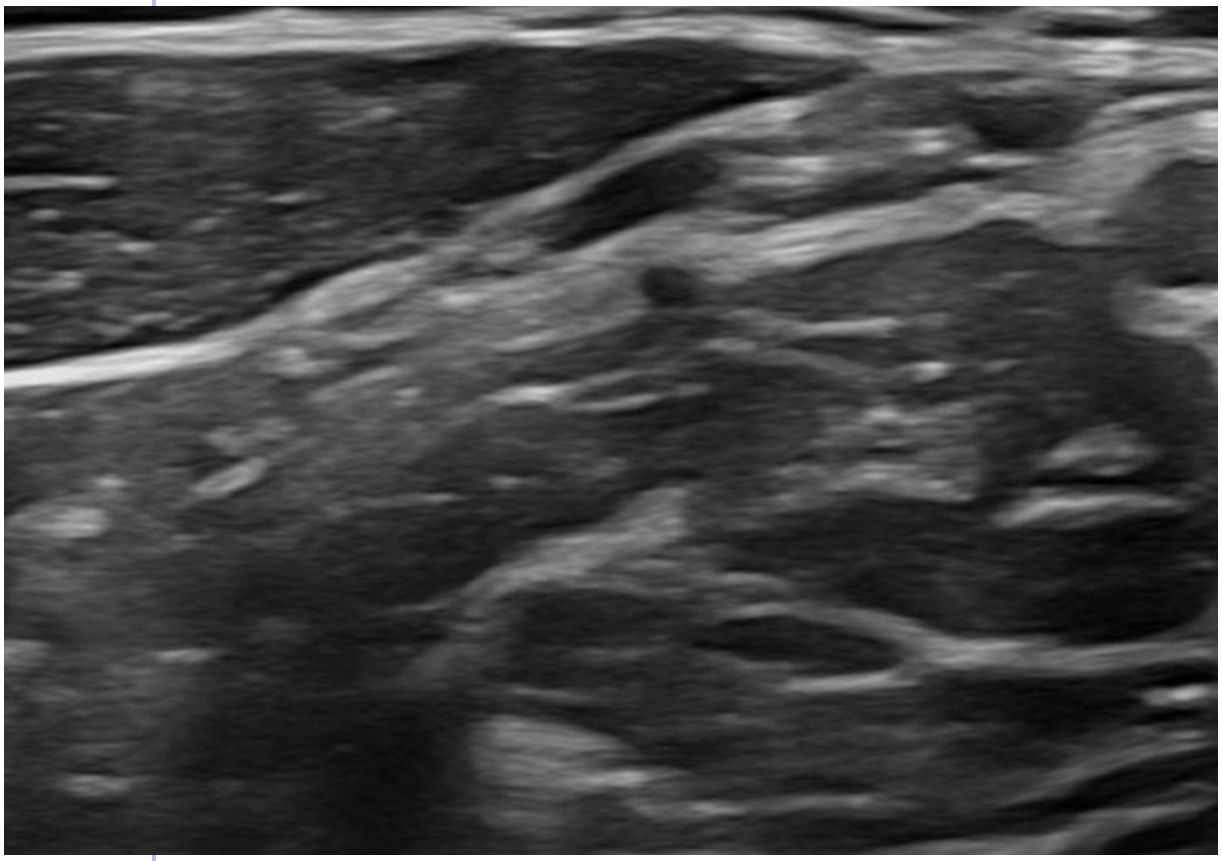
MAIN LANDMARKS: M. sternocleidomastoideus, anterior scalene m.

SCANNING TECHNIQUE: derives from C3-C4-C5; the probe should be placed over the C4 transverse process, on a axial plane. At this level, a nervous branch running obliquely and anteromedially in the interscalene triangle, coursing anterior over the anterior scalene muscle can be recognized; its course lateral and posterior to the internal jugular vein but distally following a more anterior course due to its entrance in the intrathoracic segment. Before entering the intrathoracic segment, the nerve can be seen passing over the subclavian artery and vein.
The phrenic nerve course below the supraclavicular route is not amenable ultrasound.

SUPPLY: diaphragm

1 Piccaso et al, Semin 2020

PHRENIC



Supraclavicular

INSTRUCTIONS[1, 2]

MAIN LANDMARKS:. C4 transverse process, posterior neck triangle, cervical fascia. Three branches: anterior, middle and posterior.

SCANNING TECHNIQUE: Once identified the C4 transverse process, the posterior divisions of the C4 root can be tracked distally, dividing into the three supraclavicular branches in the subcutaneous tissue of the posterior triangle of the neck. A high frequency transducer is mandatory to be able to pick up the tiny superficial branches.

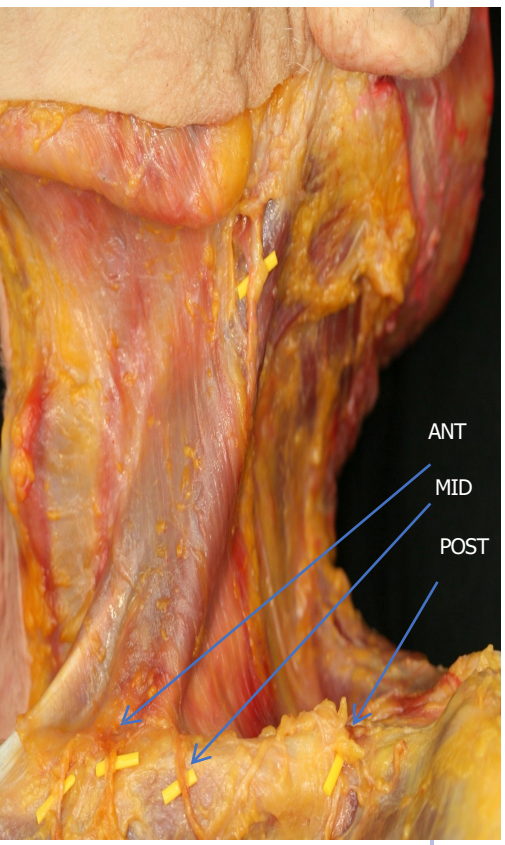
ADDITIONAL NOTE: In clavicular injuries the nerve can be trapped or injured by the impact of trauma.

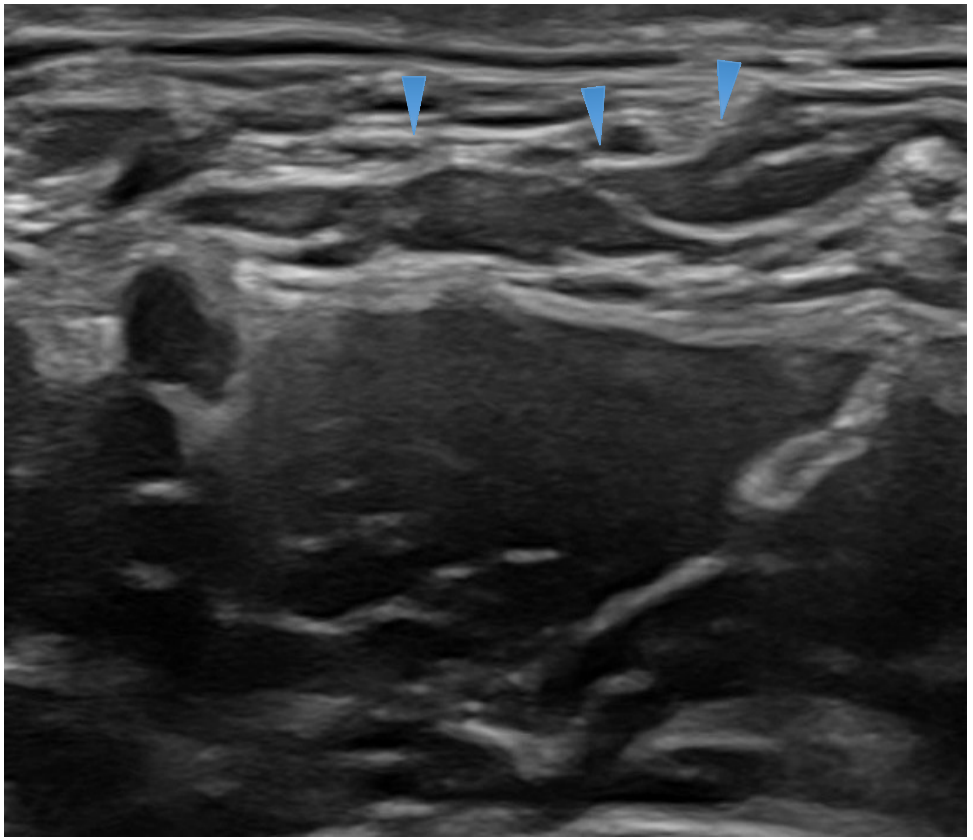
SUPPLY: sensation to skin of mastoid and posterior skull.

1 Piccaso et al, Semin 2020

2 Martinoli et al, 2010

Supraclavicular





Lateral and Medial Pectoral

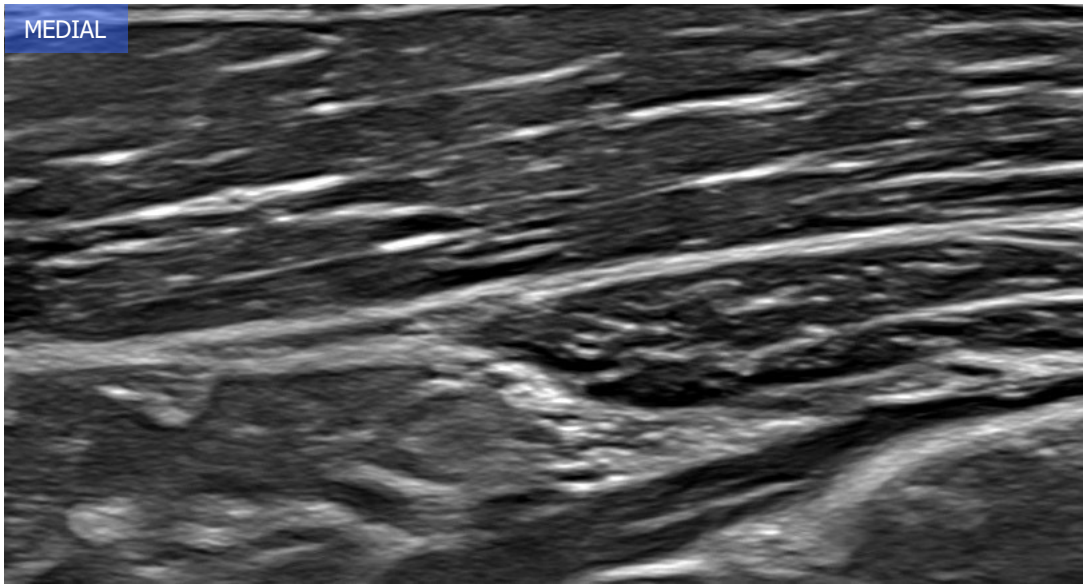
INSTRUCTIONS[1]

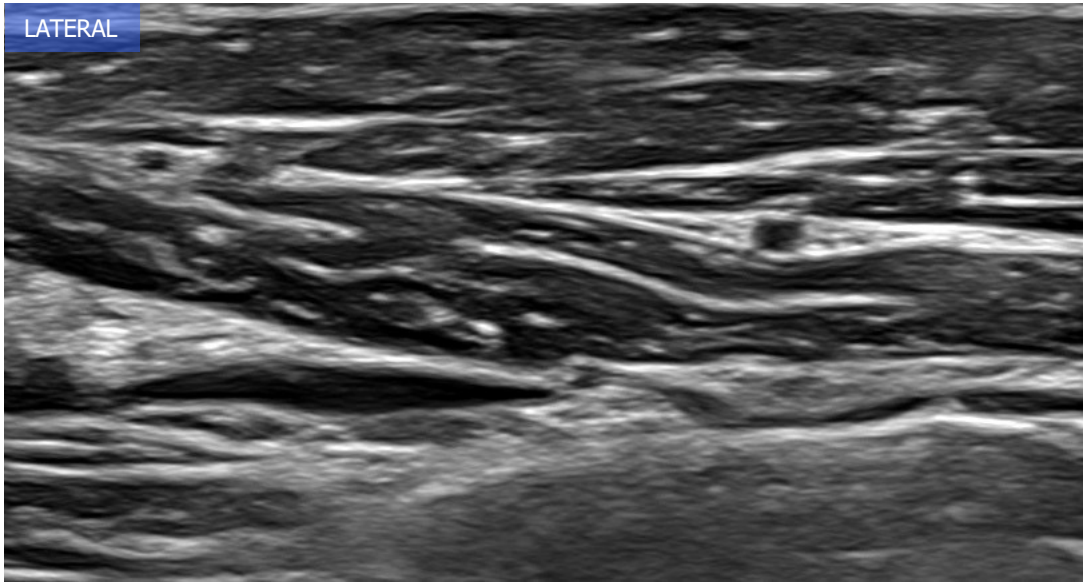
MAIN LANDMARKS: M. pectoralis major & minor, a pectoral branch of the thoracoacromial artery.
SCANNING TECHNIQUE: the probe should be placed just caudal to the coracoid aligned along the axillary artery to identify the nerves. By shifting the probe medially with the same orientation, the small lateral pectoral nerve and the pectoral branches of the thoracoacromial artery can be seen in the plane between M.pectoralis major and minor.
The medial pectoral nerve arises from the medial cord in a more caudal position. It is found by shifting the probe inferiorly, keeping the same orientation as above: the medial pectoral nerve is seen under the pectoralis minor and, more medially, in between this latter and the lower portion of the pectoralis major.

SUPPLY: The lateral pectoral nerve derives from the lateral cord and innervates the upper part of the M. pectoralis major. The medial pectoral nerve comes from the medial cord and innervates the M. pectoralis minor and lower parts of the M. pectoralis major.

Chang, JPR 2017

Lateral and Medial Pectoral





Axillary nerve

INSTRUCTIONS[1]

MAIN LANDMARKS: humeral neck, glenohumeral joint capsule, posterior circumflex (pc) artery, Quadrilateral space.

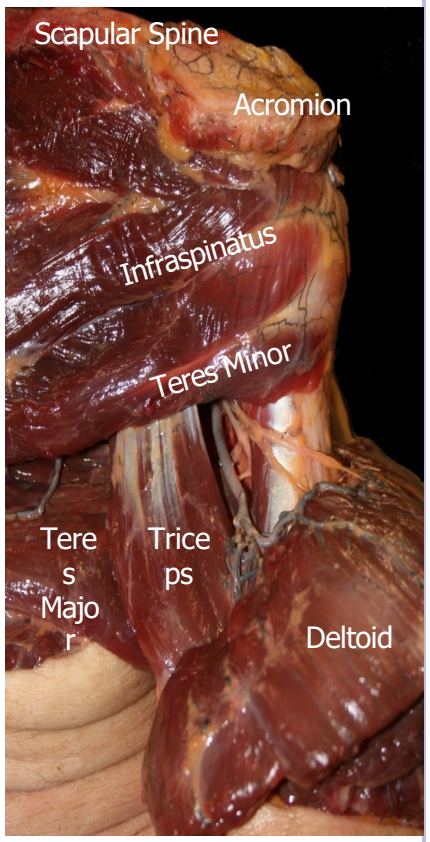
SCANNING TECHNIQUE:

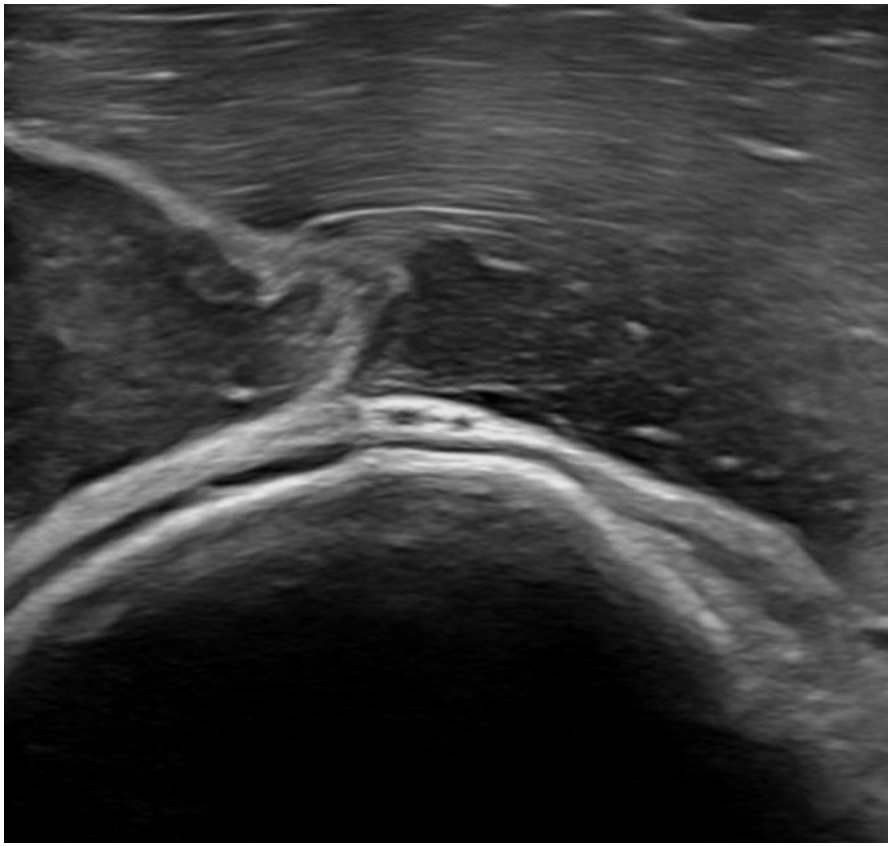
The patient is supine with his arm on his forehead. Place the probe in the armpit in a transverse plane regarding the humeral neck. The pc artery, pc veins, and the axillary nerve run in the fatty plane superficial to the glenohumeral joint capsule. The nerve is lateral to the vessels and consists of multiple branches. The neurovascular structures can be traced medially towards their origin, respectively, from the posterior cord and axillary artery and vein with a gentle medial shift, observing the nerve on the outer fascia of the m. Subscapularis. Moving the probe laterally, the nerve runs underneath the teres major, the triceps' long head, and between the teres minor and posterior deltoid. Alternatively, the nerve can be seen using a posterior approach by placing the probe perpendicular to the humeral diaphysis over the quadrilateral place, a fatty space bordered superiorly by the teres minor, medially by the long head of the triceps, laterally by the humerus and inferiorly by the teres major.

Supply: coming from the posterior cord it divides in the QL space in a posterior division for the posterior part of the m. Deltoideus and the m. teres minor, and an anterior division for the middle and anterior part of the m. deltoideus.

Brachial plexus and nerves around the shoulder, Martinoli etc al. 2010

Axillary nerve





MUSCULOCUTANEOUS

INSTRUCTIONS[1]

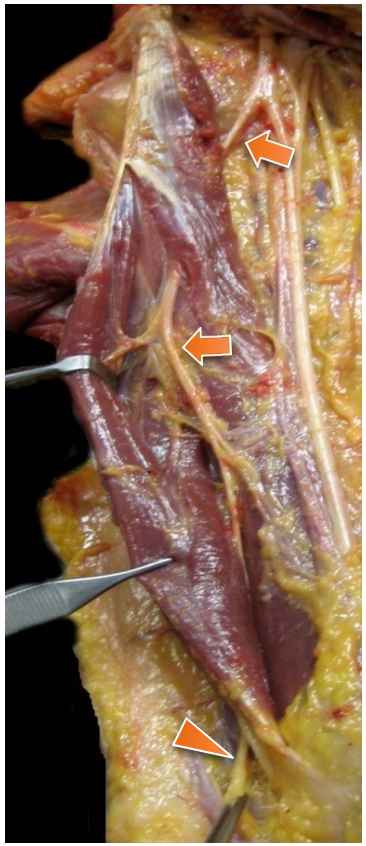
MAIN LANDMARKS: lateral cord of the brachial plexus, coracobrachialis muscle

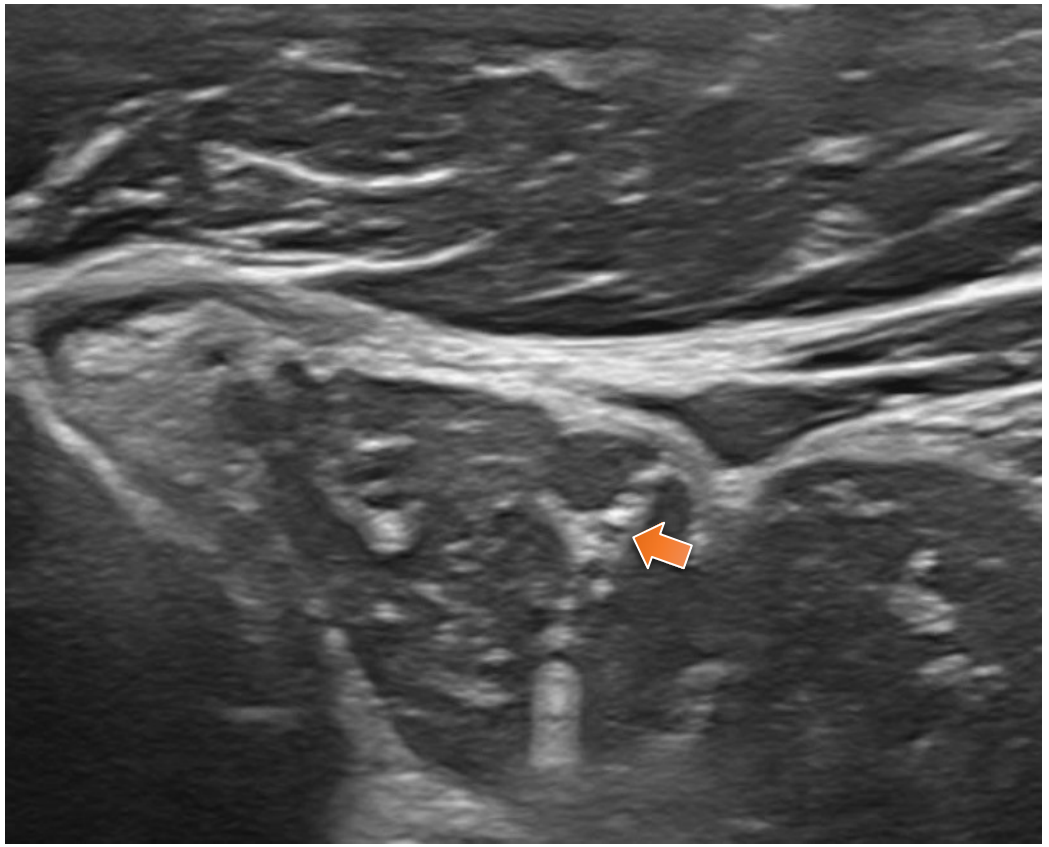
SCANNING TECHNIQUE: The patient should be positioned with the arm in abduction and the hand on the forehead**.** Placing the probe in a short axis over the coracoid, the conjoined tendon (coracobrachialis and short head of the biceps) can be seen with the bulky muscular component of the coracobrachialis lying posterior. The musculocutaneous nerve can be identified as piercing the coracobrachialis from the deep to the superficial. Following the nerve distally, it can be seen running in between the two coracobrachialis heads, between the biceps and coracobrachialis, and, at the distal third of the arm, between the biceps and brachialis. In the last part of its course, the nerve runs from the medial to the lateral and gives origin to the terminal branch, the lateral cutaneous nerve of the forearm. The lateral cutaneous branch of the forearm is seen to pierce the deep fascia in between the distal biceps tendon and the cephalic vein.

Supply: comes from lateral cord of the brachial plexus, innervating M. biceps, M. coracobrachialis and M. brachialis. Variant course wth musculocutaneous nerve running alongside the the median nerve without piercing the coracobrachialis.

[1] C. Martinoli et al. Am J Roentgenol (2002). 179(2): 481-484

MUSCULOCUTANEOUS





SPINAL ACCESSORY (CN XI)

INSTRUCTIONS[1]

MAIN LANDMARKS: intramuscular cleavage plane within the upper sternocleidomastoid muscle; anterolateral border of the trapezius muscle in the lower neck.

SCANNING TECHNIQUE: Place the probe in a transverse plane over the upper sternocleidomastoid. After piercing this muscle, the nerve can be seen travelling under the fascia in a superficial position from anterior to posterior to descend the posterior triangle of the neck with an oblique course. Distally, the nerve continues its course down between the anterior border of the trapezius and the levator scapulae. Considering the trapezius as the initial landmark, sweep the probe up in the short axis of the nerve from distal to proximal until it is seen piercing the upper sternocleidomastoid.

Short-axis imaging of the spinal accessory nerve with transverse oblique scans may provide screening of the nerve status along its neck course.

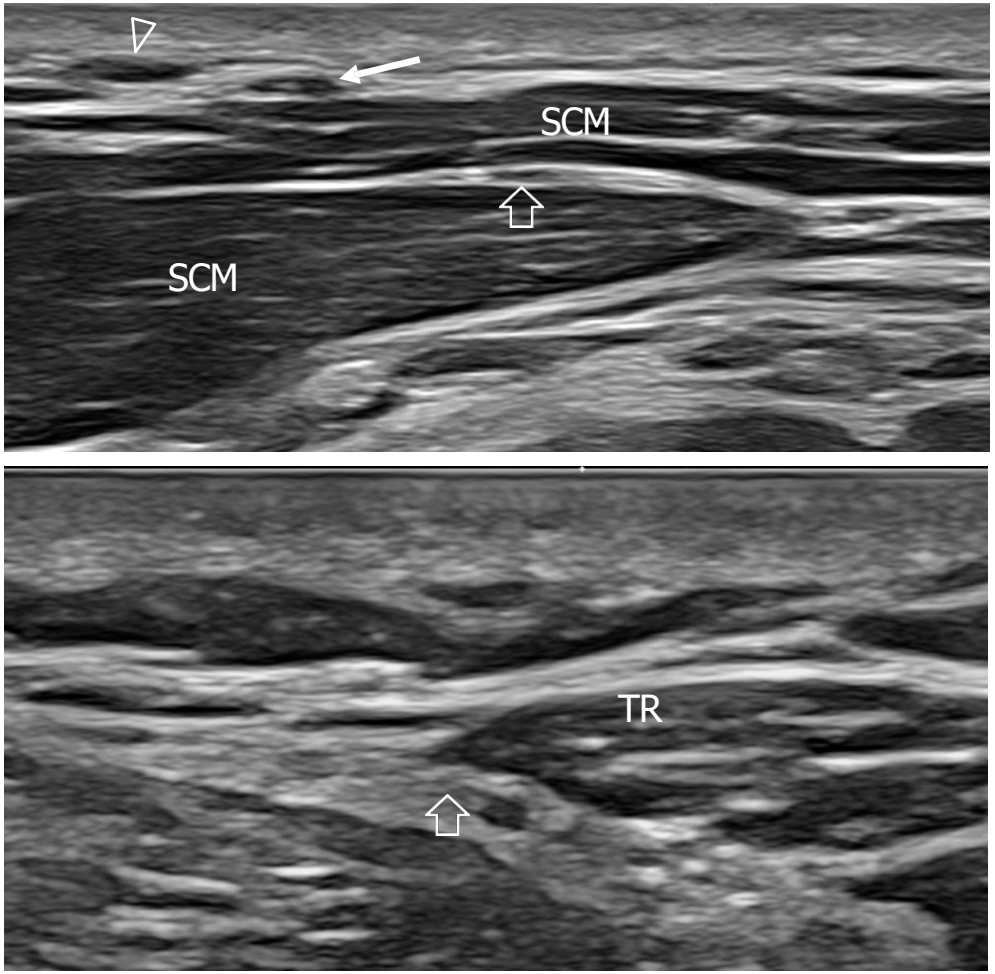
ADDITIONAL NOTES: The nerve looks monofascicular and has a caliber of 0.3-0.4mm. Its most cranial segment combines with the vagus nerve and is not accessible to the ultrasound beam.

SUPPLY : motor nerve, supplying the sternocleidomastoid and the trapezius muscles

[1]C. Canella et al., Eur J Radiology (2013). 82,1:56-61

Brachial plexus and nerves around the shoulder, Martinoli etc al. 2010

SPINAL ACCESSORY



GREATER AURICULAR

INSTRUCTIONS[1]

MAIN LANDMARKS: M. sternocleidomastoideus (SCM), Erb's point. GAN is the largest branch of the four sensory nerves of the cervical plexus. It has an anterior and posterior branch. The nerve pierces the deep fascia to ascend at the posterior border and superficial of the SCM.

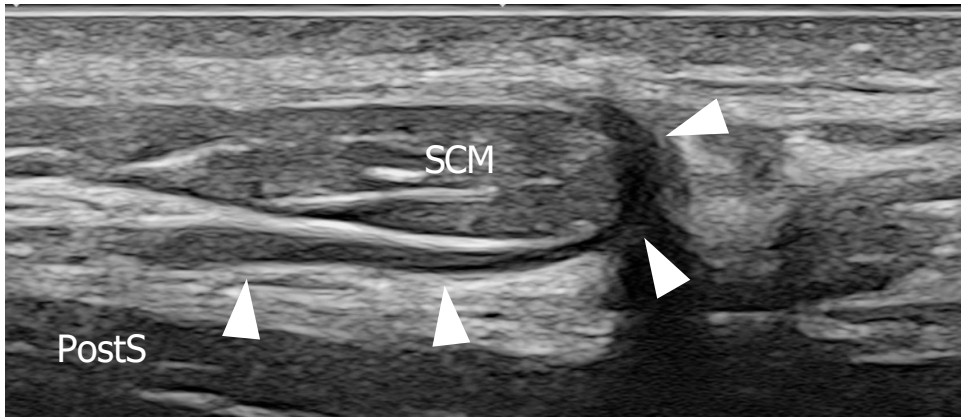
SCANNING TECHNIQUE: C2-C3: The transducer is placed at the posterior border of the SCM at the midlevel of the muscle. The ascending nerve travels superficially and winds around the border of the SCM in the anterior direction underneath the investing layer of the deep cervical fascia.

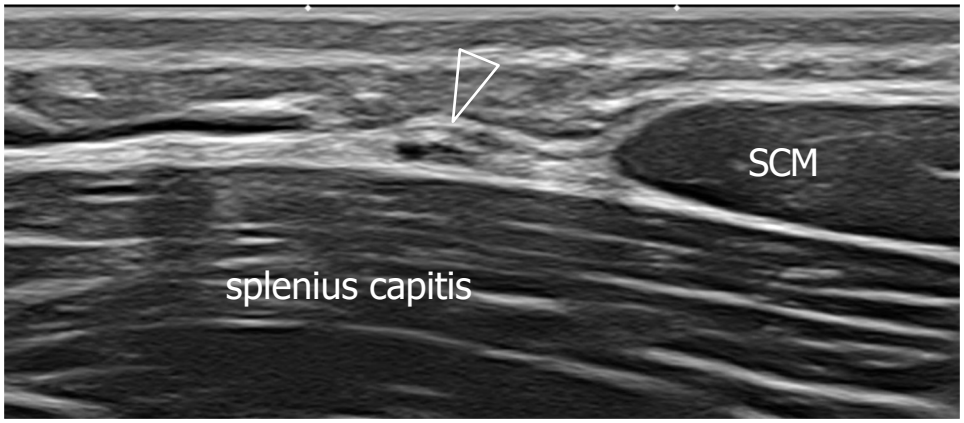
ADDITIONAL NOTE: GAN and LON are implicated in the pathogenesis of occipital neuralgia, cervicogenic headaches, and migraine headaches. Arising interest has been shown in the past years in the field of anesthesiology for ultrasound-guided blockage of the nerves due to its relation to occipital headaches.

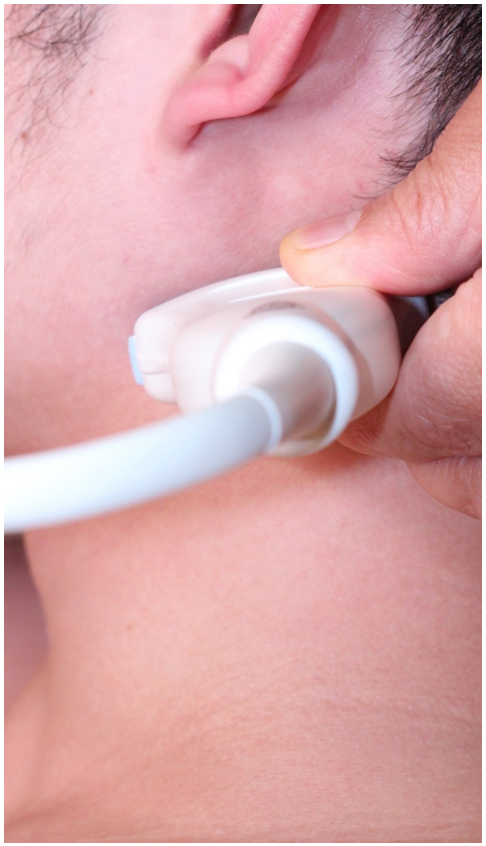
SUPPLY: external ear, skin of the parotid gland, side of the neck behind the ear.

1 Piccaso et al, Semin 2020

Greater Auricular







LESSER OCCIPITAL

INSTRUCTIONS[1]

MAIN LANDMARKS: M. sternocleidomastoideus (SCM), Erb's point. LON is a branch of the four sensory nerves of the superficial cervical plexus. It travels cranially at the posterior border of the SCM. Unlike the GAN, the LON stays posterior until it finally runs superficial to the M. splenius capitis and there it reaches the occipital region

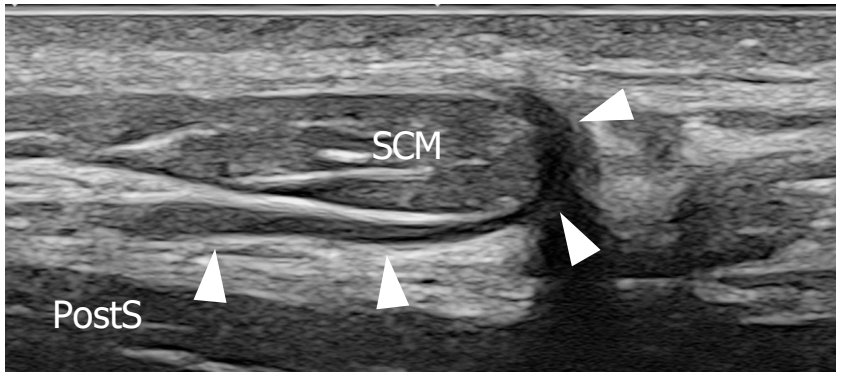
SCANNING TECHNIQUE: C2; The transducer is placed at the posterior border of the SCM at the midlevel of the muscle. The ascending nerve travels at the posterior border of the SCM and once the larger GAN is detected, one should follow the SCM to reach the splenius capitis. In this posterior line of the SCM one finds the lesser occipital.

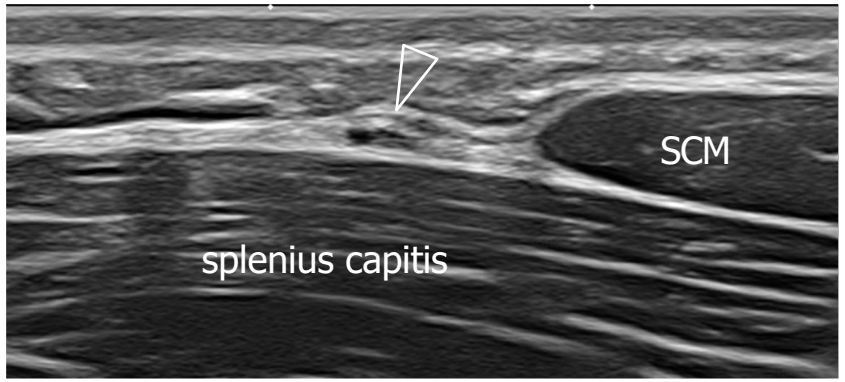
ADDITIONAL NOTE: Both GAN and LON are both implicated in the pathogenesis of occipital neuralgia, cervicogenic headaches and migraine headaches. Arising interest has been shown the past years in the field of anesthesiology for ultrasound guided blockage of the nerves, due to it's relation to occipital headache.

SUPPLY: sensation to skin of mastoid and posterior skull.

1 Piccaso et al, Semin 2020

Lesser Occipital





MEDIAL BRACHIAL CUTANEOUS (MBCN)

INSTRUCTIONS

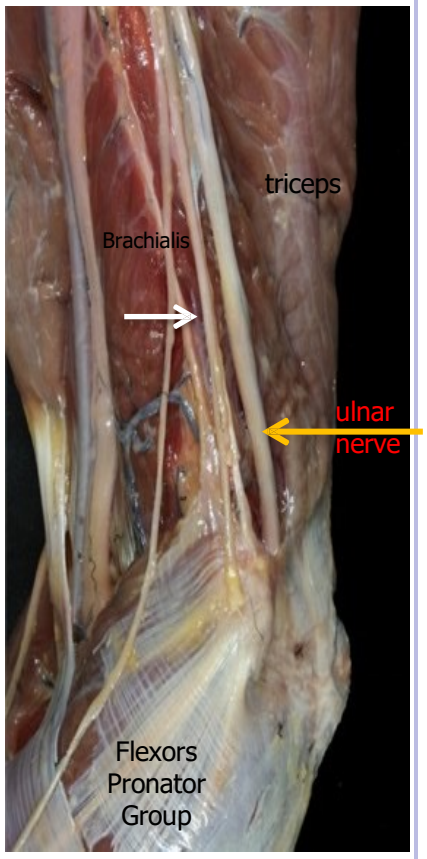
MAIN LANDMARKS: origin medial from the cord Brachial plexus, originating nerve roots C8 and T1. The nerve runs closer to the ulnar nerve and medial to the Brachial artery.

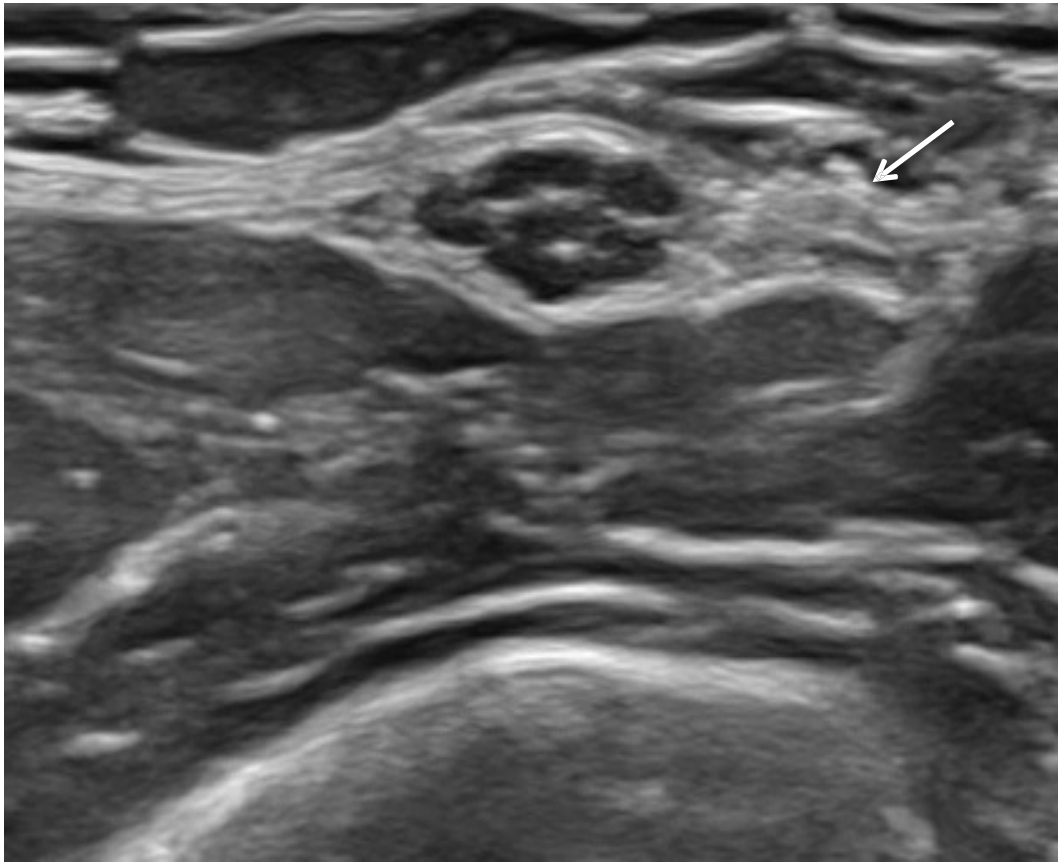
SCANNING TECHNIQUE: Place the probe in a transverse plane over the axilla to identify the Brachial artery and sweep the probe distally. The MBCN nerve can be identified as running close to the ulnar nerve and posterior to the Brachial artery before piercing deep brachial fascia in the middle of the arm. Then, it runs in the subcutaneous tissue medial and posterior to the ulna nerve—variable terminal branching around the epitrochlear and distal forearm.

ADDITIONAL NOTES: Anastomoses with the intercostobrachial nerve in the axilla. Multiple anatomic variations in the course of the nerve and may have 2-4 branches just proximal to the elbow.
The MBCN may become involved with entrapment post-breast augmentation or Lymph node resection.

Supply: Sensory supply to medial upper arm along with the intercostobrachial nerve which also innervates portions of the axilla, tail of the breast and lateral chest wall.

MEDIAL BRACHIAL CUTANEOUS (MBCN)





MEDIAL ANTEBRACHIAL CUTANEOUS NERVE (MABCN)

INSTRUCTIONS[1]

MAIN LANDMARKS: Axillary artery and basilic vein

SCANNING TECHNIQUE: Place the probe in a transverse plane in the armpit over the Axillary artery. At this level, the nerve is superficial to the axillary artery and vein, close to the median nerve and ulnar nerve. Distally, the nerve becomes a satellite of the basilic vein, and at around 10 cm cranial to the medial epicondyle it pierces the deep fascia to become subcutaneous. The nerve may divide into anterior and posterior branches deep into the fascia or in the subcutaneous tissue. Even the distal MABCN branches in the forearm follow the divisions of the basilic vein.

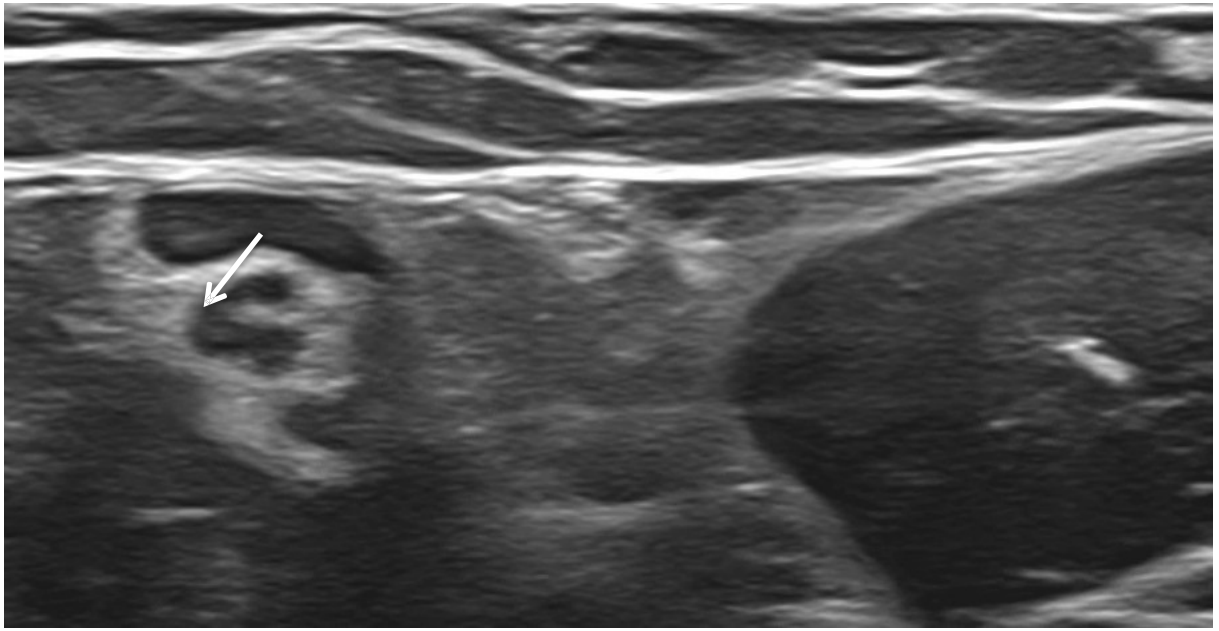
ADDITIONAL NOTES: Variations of anatomy and its branching pattern.

The nerve may be damaged during elbow arthroscopy, fracture fixation, and therapeutic injections of the elbow.

Supply: medial antebrachial cutaneous nerve provides sensory innervation of the medial forearm as well as the skin overlying the olecranon.

Chang, Özçakar, Martinoli 2018

MEDIAL ANTEBRACHIAL CUTANEOUS NERVE (MABCN)



RADIAL NERVE (COMMON)

INSTRUCTIONS[1]

MAIN LANDMARKS: triangular interval, lateral intermuscular septum, the brachialis and brachioradialis muscles.

SCANNING TECHNIQUE: The radial nerve is a large nerve, easily identified by placing the probe in the short axis of the distal arm, where the nerve is located in between the brachialis and brachioradialis muscles. From that point, it can be traced proximally, where it pierces the lateral intermuscular septum, engages the spiral groove around the postero-lateral aspect of the humerus, enters the triangular interval in between the long and lateral head of the triceps, and finally joins the posterior cord in the axilla. Distally, the nerve divides into the superficial radial nerve and posterior interosseous nerve at the level of elbow joints.

ADDITIONAL NOTES: The normal radial nerve is triangular-shaped, multifascicular at the elbow, and round and monofascicular at the radial groove. Doppler can be used to identify the radial artery and veins that travel with the nerve at the radial groove level.

Motor: m. triceps brachii, m Anconeus and all extensor muscles (PIN).

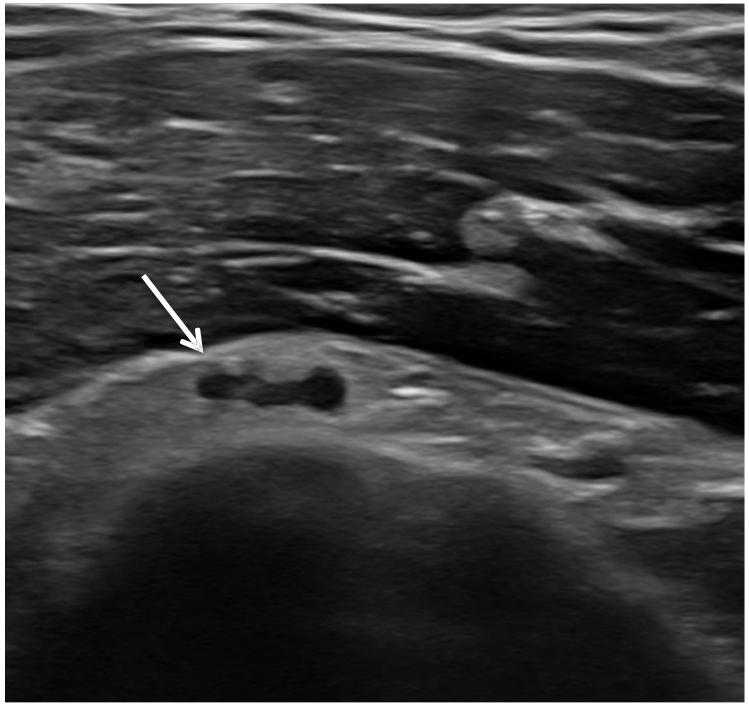
Sensory: Anterior aspect:

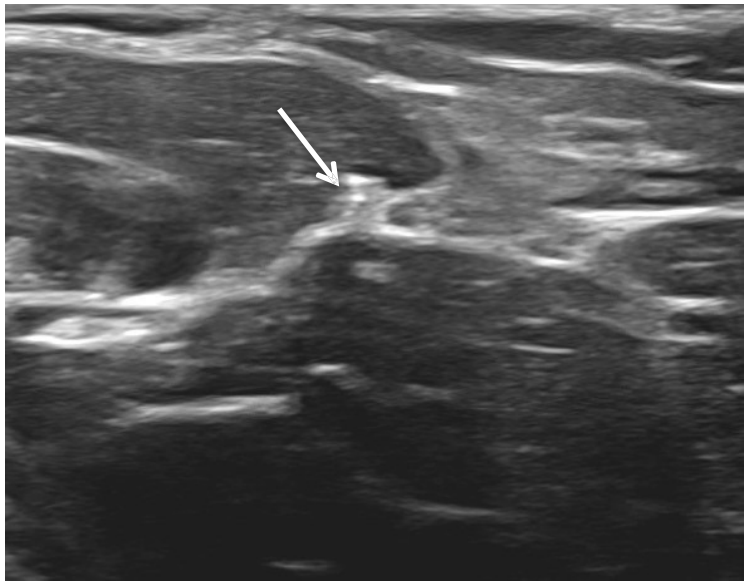
- The inferior lateral cutaneous nerve of the arm - provides sensation to the anterior lateral aspect of the mid-arm.

Posterior aspect:

- The posterior cutaneous nerve of the arm - sensation to the posterior distal arm.
- The posterior cutaneous nerve of the forearm - sensation to a strip posterior aspect of the forearm
- Superficial branch - sensation to the posterior aspect of the thumb, index, middle, and lateral half of the ring fingers, as well as the associated dorsal hand area.

RADIAL NERVE (COMMON)





SUPERFICIAL RADIAL NERVE

INSTRUCTIONS[1]

MAIN LANDMARKS: Anterior elbow above the humeral capitellum (common Radial nerve)

SCANNING TECHNIQUE: Place the probe in the short axis of the elbow, over radial capitellum, the sensory branch sits deep to the plane between the brachioradialis and brachialis muscle . The superficial radial nerve can be visualised all the way through the forearm together with the radial artery underneath the brachioradialis muscle. It then courses dorsally over the distal radius (anatomical snuff box) before dividing into small digital branches in the metacarpal area: the radial dorsal digital nerve of the thumb and the common dorsal collateral nerve of the first and second interosseus space. Either of its main end branches is easily picked up at the wrist, lying on the extensor retinaculum over the thumb extensor tendons.

ADDITIONAL NOTES: The superficial radial nerve is most commonly affected by compression trauma distal to its perforation through the fascia, resulting in Wartenberg syndrome. US can show focal CSA enlargement in this condition.

Additional possible compression sites are more proximally in the region where the nerve transits the forearm fascia and higher up between the tendons of the brachioradialis and extensor carpi radialis muscle. If you are struggling to identify the nerve try picking it up medial to the radius on the ventral side halfway up the forearm- it is located deep to brachioradialis and lateral to radial artery.

SUPPLY: Medial branch ulnar half of the dorsal thumb, dorsal index, long and radial half of the ring finger
Lateral branch: sensory function to dorsal radial thumb.

Causeret et al, 2018

POSTERIOR INTEROSSEOUS NERVE

INSTRUCTIONS[1]

MAIN LANDMARKS: Transverse at anterior elbow joint

SCANNING TECHNIQUE:The deep radial nerve is easiest found at its origin (Posterior branch of division of the radial nerve) with an antero-lateral transversal scan, proximal to the elbow joint line, between the humeral capitellum (posterior), the brachioradialis muscle (lateral) and the brachial muscle (medial). It can be followed distally, into the tunnel between the superficial and deep heads of the supinator muscle. Pronation of the forearm at this point will allow the nerve to be followed distally.
Within the supinator muscle the may divide into smaller branches.

ADDITIONAL NOTES:The most frequent compression point is under the arcade of Frohse (upper edge of the superficial head of the supinator muscle). The nerve can also be viewed in a longitudinal plane with dynamic pronation of the arm.
Compression may sometimes occur more distally in the supinator tunnel.

SUPPLY: Motor : Common extensors: Extensor carpi radialis brevis (ECRB), Extensor digitorum communis (EDC), Extensor digitorum minimi (EDM) Extensor carpi ulnaris (ECU)
Deep extensors: Supinator, Abductor pollicis longus (APL), Extensor pollicis brevis (EPB),Extensor pollicis longus (EPL), Extensor indicis proprius (EIP)
Sensory: Sensory fibres to dorsal wrist capsule

ULNAR NERVE

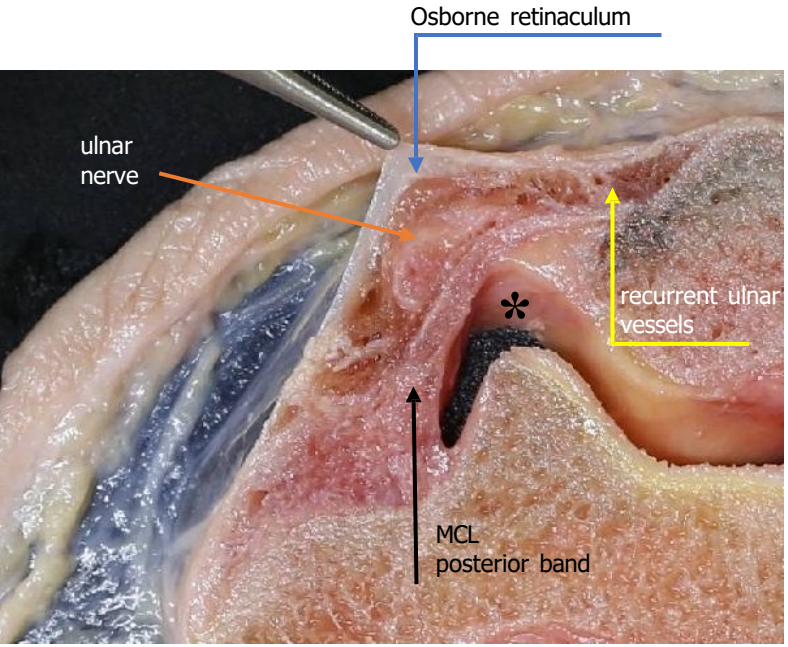
INSTRUCTIONS[1]

MAIN LANDMARKS: Upper arm- medial head to the triceps
Forearm the nerve sits on the ulnar side of the ulnar artery in the mid and distal forearm, underneath the flexor carpi ulnaris.
Wrist: Sits adjacent to the ulna artery in Guyon's canal (pisiform bone).
SCANNING TECHNIQUE: The patient should be asked to place the upper limb straight on the bench, with the forearm pronated and internally rotated. The nerve can most easily be found by placing the probe 3.5 cm below the elbow, and after detection of the honeycomb structure of the ulnar nerve, the nerve can be followed more proximally into the cubital tunnel. From the cubital tunnel, the ulnar nerve can be followed distally to Guyon's canal and proximally to the axilla. In the case of ulnar neuropathy at the elbow, we usually measure the height (in longitudinal view) and cross-sectional area at the level of the medial epicondyle and 2 to 3 cm proximal to and 2 to 3 cm distal to this level.
ADDITIONAL NOTES: Ulna nerve enlargement may be seen just above the sulcus.
Compression at Guyon's canal is less common but can occur due to anomalous muscle, ganglion cyst or thrombosed ulna artery.
Patient positioning: Selected to allow easy nerve tracking but also dynamic assessment in the ulna groove and may include sitting or supine with the elbow flexed and forearm above the head.

SUPPLY: Motor: Flexor carpi ulnaris and medial half of flexor digitorum profundus
Intrinsic hand muscles (excluding Thenar muscles and 2 lateral lumbricals)
Sensory: Cutaneous innervation to medial forearm, medial wrist and medial one and a half digits

1 Depukat 2014

ULNAR NERVE


Osborne retinaculum
ulnar nerve
recurrent ulnar vessels
MCL posterior band

MEDIAN NERVE
INSTRUCTIONS[1]

MAIN LANDMARKS: Arises medial and lateral cords of Brachial plexus (roots C6-T1)
Upper arm: Initially located lateral to artery and then moves medially to it in the upper arm
Forearm: nerve runs between flexor digitorum superficialis and profundus muscles.
Wrist: the nerve run in the carpal tunnel

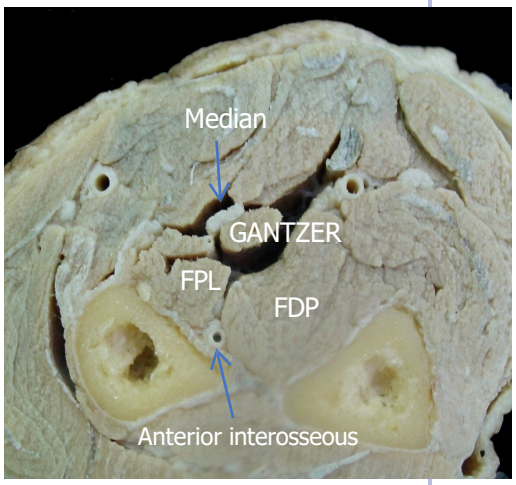
SCANNING TECHNIQUE: the arm can be easily identified in short-axis scanning at the proximal third of the arm, close to the brachial artery. It can be followed distally until the carpal tunnel. The proximal limit of the carpal tunnel can be identified by looking for the trapezium tubercle and the pisiform Transverse tracking of the nerve from the Carpal tunnel to the axilla.

ADDITIONAL NOTES: while scanning the median nerve at the level of the wrist, the patient should be asked to move their fingers to verify the normal gliding of the nerve with respect to the surrounding structure. The gliding is limited in case of post-surgical perineural fibrosis.

SUPPLY: Motor: Innervates flexor and pronator muscles (exception: m. flexor carpi ulnaris and part of m. flexor digitorum profundus). Branches to thenar muscles and lateral two lumbricals
Sensory: Palmar cutaneous branch (lateral aspect palm) digital cutaneous lateral 3 and half fingers on the palmar surface of hand.

Löpponen, proximal median nerve compression, J. Clin. Med 2022

MEDIAN NERVE



ANTERIOR INTEROSSEOUS NERVE (AIN)

INSTRUCTIONS[1]

MAIN LANDMARKS: Median nerve at the level of fibrous arcade of the flexor digitorum superficialis- flexor pollicis longus.

SCANNING TECHNIQUE: In the proximal forearm it may be found between flexor pollicis longus and flexor digitorum profundus muscles. Asking the patient to flex and extend the thumb during scanning help to indentify the cleveage plane in between the flexor pollicis longus and flexor digitorum profundus
Distally courses close to interosseous membrane and pronator Qaudratus muscle.

ADDITIONAL NOTES: Compression of AIN> Kiloh Nevin Syndrome (rare< 1% of median nerve neuropathies)- forearm compressive neuropathy giving motor deficit (Pt cannot make the OK sign with finger and thumb)
Nerve may entrap between:

- Tendinous edge pronator teres
- Fibrous arch of flexor digitorum superficialis.
- Accessory head Flexor Pollicis longus (Gantzer muscle)
- Aberrant and accessor muscles.

SUPPLY: Motor: deep forearm muscles, Flexor digitorum profundus, flexor pollicis longus, pronator quadratus.
Sensory fibres to volar wrist joint capsule. No cutaneous innervation

Yang, springer 2016

LATERAL ANTEBRACHIAL CUTANEOUS NERVE (LABCN)

INSTRUCTIONS[1]

MAIN LANDMARKS: Terminal sensory branch of the musculocutaneous nerve.
Biceps and brachialis. Adjacent to cephalic vein in distal forearm.

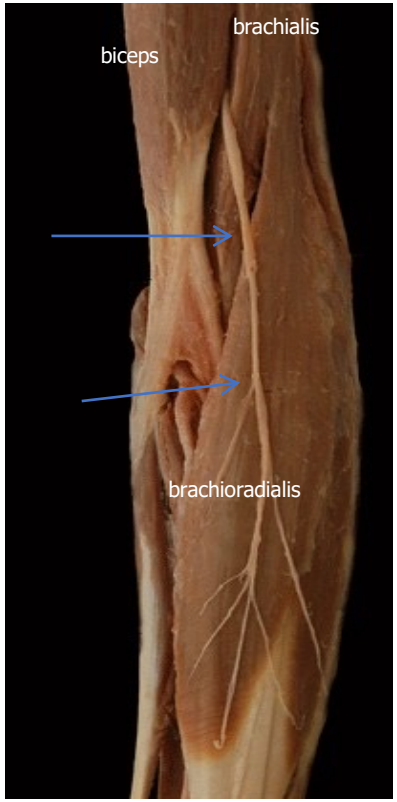
SCANNING TECHNIQUE: Transverse over the distal Biceps brachi muscle, sweep the transducer slowly towards the elbow until you come into the tendinous component of the biceps brachi. The nerve should sit lateral to the biceps tendon and located on the posterior side of the cephalic vein in most cases and piercing the deep fascia.

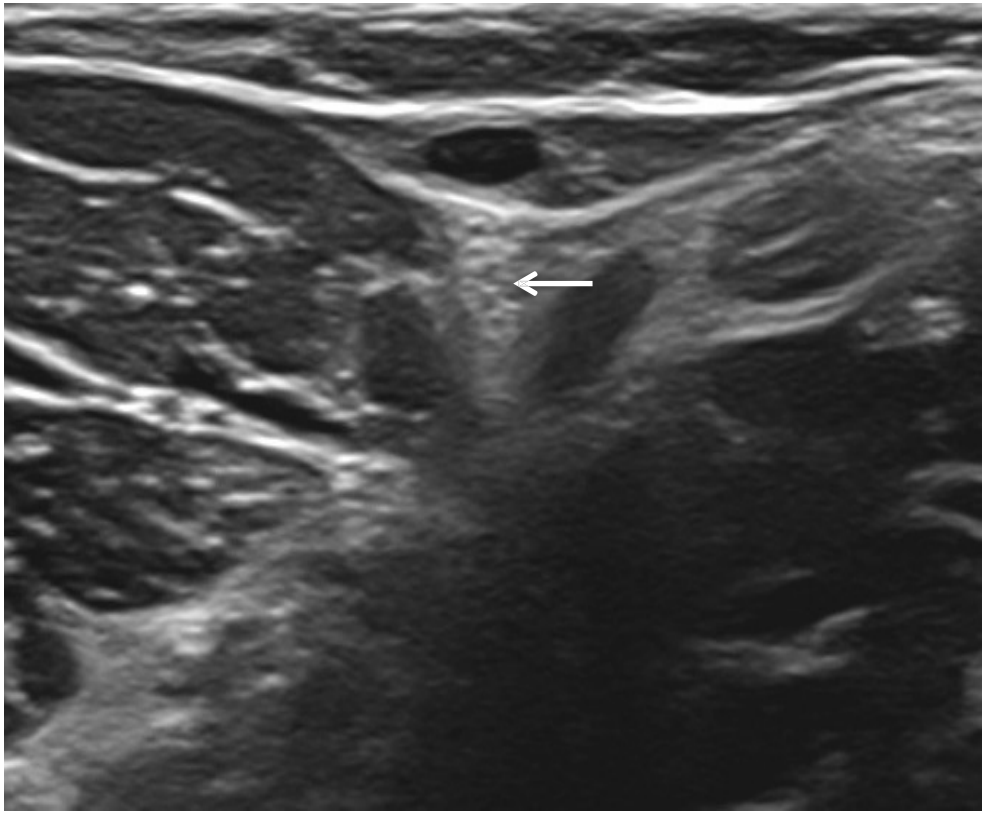
ADDITIONAL NOTES: The nerve may be damaged during canulation or involved with Biceps tendon rupture .
Terminal branches:
- Volar: Runs along radial border of the forearm supplying the lateral skin sensation
- Dorsal: Runs along dorsal radial forearm supplying dorso- lateral cutaneous innervation.

SUPPLY: Sensory radial side of the forearm

1 Chiavaras 2014

LATERAL ANTEBRACHIAL CUTANEOUS NERVE (LABCN)





POSTERIOR ANTEBRACHIAL CUTANEOUS (PABC)
INSTRUCTIONS[1]

MAIN LANDMARKS: Radial nerve

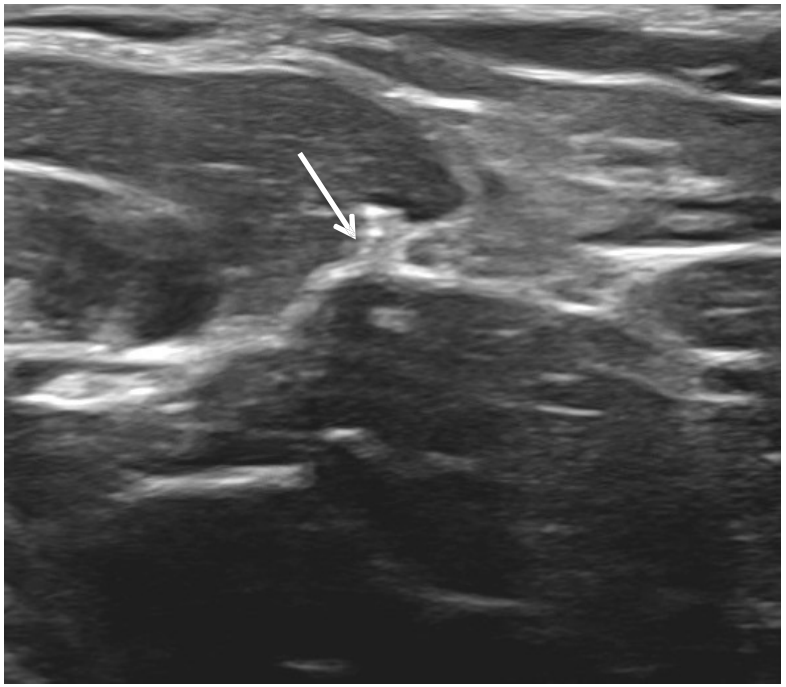
SCANNING TECHNIQUE: Look for the PABC posteriorly to the lateral antebrachial septum, in proximity to the point where the radial nerve pierces the septum. At that level, the nerve should be seen to pierce the deep fascia and divide in anterior and posterior branches.

ADDITIONAL NOTES: PABC may be injured with humeral shaft fracture, and orthopedic hardware may cause nerve impingement in this area due to direct trauma or post-injury compromise. The point of visualization can be the lateral epicondyle

SUPPLY: Sensory supply to the skin of the lateral epicondyle and the posterior forearm.

1 Garcia Martinez/Miquel Perez 2021

POSTERIOR ANTEBRACHIAL CUTANEOUS (PABC)



MEDIAN NERVE – CARPAL TUNNEL

INSTRUCTIONS

MAIN LANDMARKS: Radius, ulna, Flexors to fingers and pronator quadratus

SCANNING TECHNIQUE: Transverse probe position approximately 3- 4 cm above wrist crease. Slide toward the fingers identifying flexor tendons to the fingers and then Pronator quadratus.

Carpal tunnel is defined by

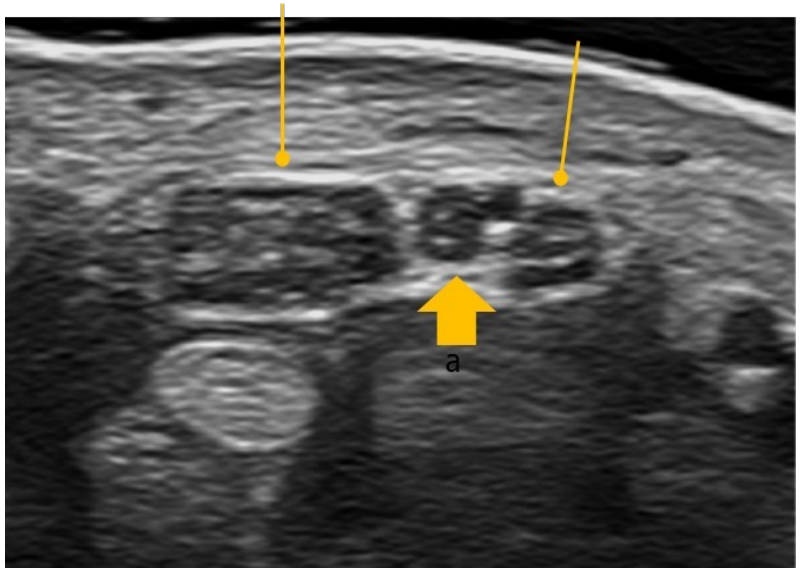
- Prox- Scaphoid tubercle -Pisiform
- Distal Tubercle of trapezium- hamate hook
- Roof Transverse carpal ligament
- Nerve can be scanned in transverse to do cross sectional ratios and long to assess for flattening and proximal entrapment swelling. Once placed there one can ask the patient to twinkle the fingers to asses the dynamic mobility and sliding of the nerve between the flexor tendons.

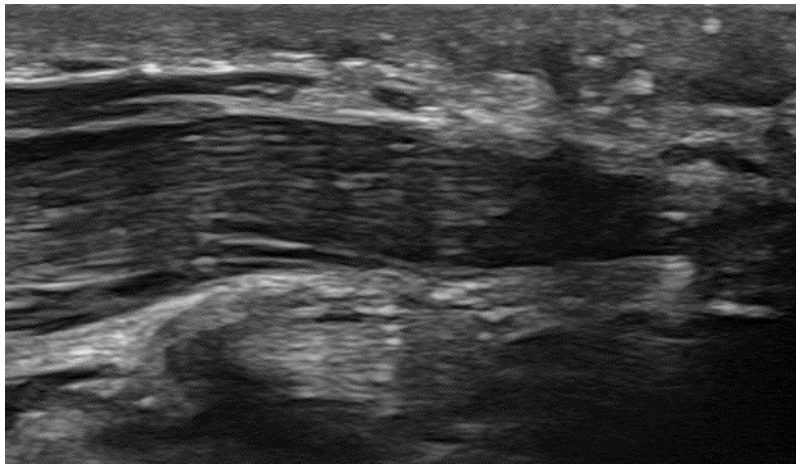
SUPPLY: Motor: Flexors to forearm (excluding FCU and ulna head FDP. Muscles of thenar eminence (recurrent motor branch) Radial 2 lumbricals

Sensory: Skin – Palmar and distal dorsal aspect lateral three and half digits & adj palm. Palmar & distal dorsal thumb radial half 2nd finger.

Klauser et al 2008

MEDIAN NERVE – CARPAL TUNNEL





PALMAR CUTANEOUS & RECURRENT MOTOR BRANCH
INSTRUCTIONS

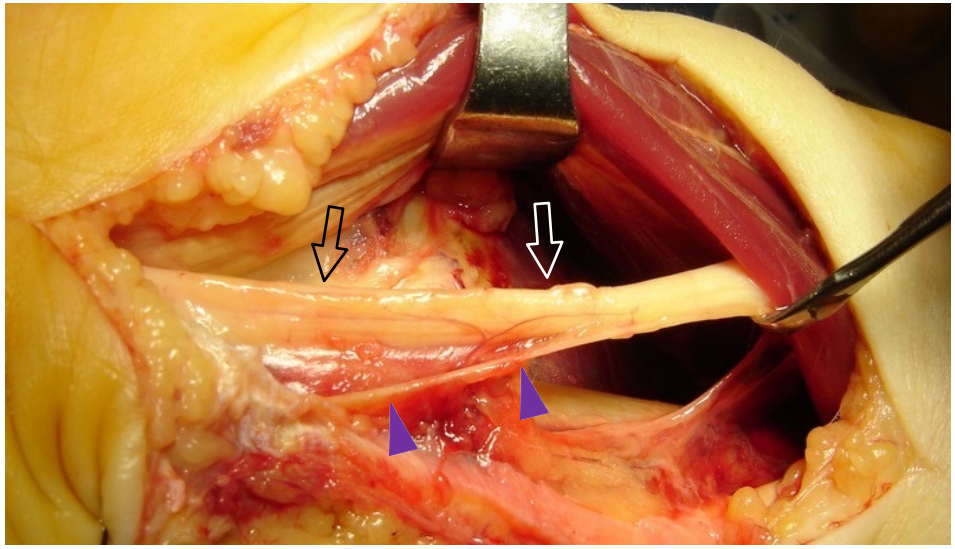
MAIN LANDMARKS: Median nerve, flexor carpi radialis (FCR) and Palmaris longus
SCANNING TECHNIQUE: **Palmar Cutaneous nerve of the median nerve (PCBMN)**
Transverse probe position approximately 3- 4 cm above wrist crease the nerve lies beneath the brachial fascia. PCBMN should arise proximal to the carpal tunnel towards the radial side of the nerve.
Perforates the antebrachial fascia at a variable distance to the wrist crease to sit between FCR and m. palmaris longus and divides into two or three terminal branches.
Recurrent motor nerve (Million dollar nerve)- Ts median nerve. The branch arises distal to the retinaculum (92%) but can be interligamentous as well (8%).
Winds around the retinaculum to end in the thenar muscles, anatomical variance present. To identify the branch it is sufficient to check the surface of the flexor pollicis brevis muscle, where the nerve lies in most of cases before digging into the opponens pollicis.

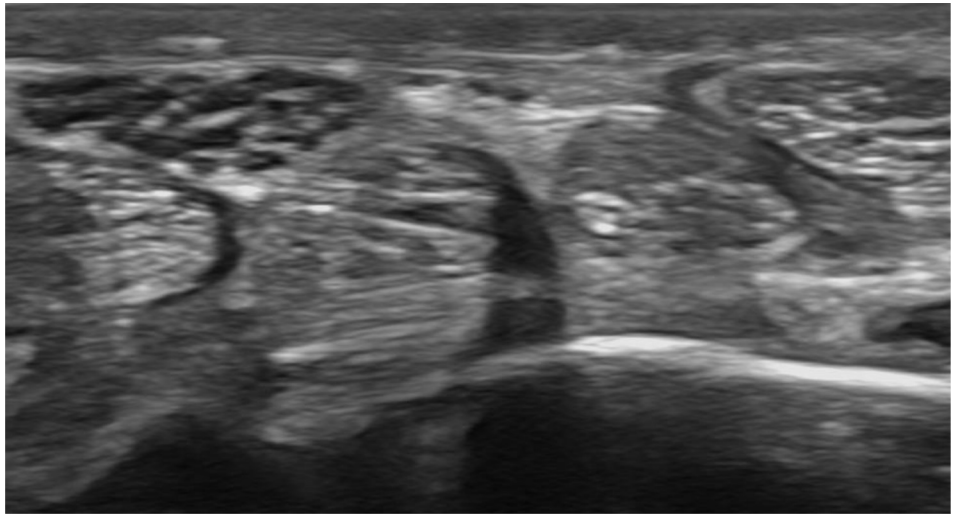
ADDITIONAL NOTES: Both these branches are vulnerable to surgical procedure around the Carpal tunnel. Damage to the palmar cutaneous nerve can lead to wrist pain. Damage to the recurrent motor branch can lead to functional motor loss to the thumb.

SUPPLY: Palmar cutaneous nerve- Sensory: cutaneous innervation to thenar eminence and palmar skin
Recurrent Motor branch:
→Motor: Abductor pollicis brevis , Opponens, superficial head flexor pollicis brevis muscle

Tagliafico et al. 2008, Schmidt, thieme 2004

PALMAR CUTANEOUS & RECURRENT MOTOR BRANCH





DISTAL COMMON AND PALMAR DIGITAL BRANCHES

INSTRUCTIONS

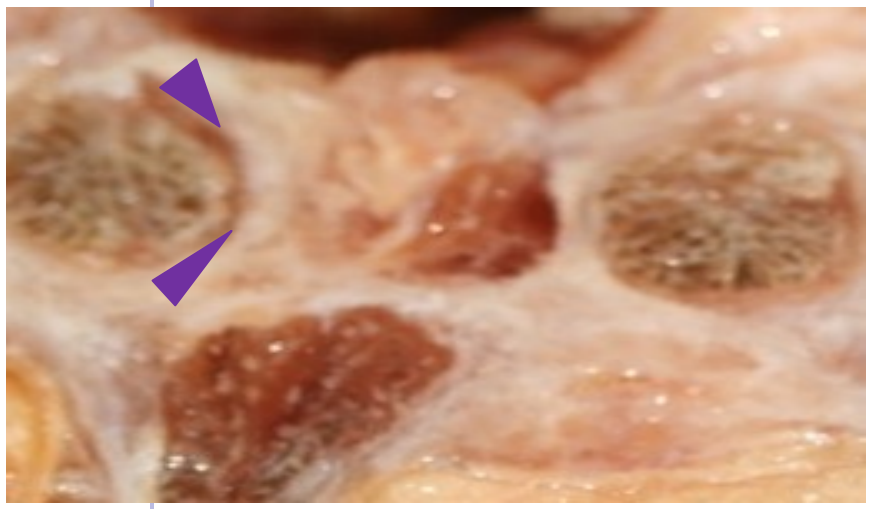
MAIN LANDMARKS: Deep to the superficial palmar arch, Flexor tendons to the finger under examination.
Palmar digital nerves
Median nerve origin- supplies palmar aspect 1,2,3 radial aspect 4th.
Ulnar nerve superficial branch supplies remainder.
Common digital nerves give rise to proper digital nerves that course along the palmar side of each digit superficial to the artery

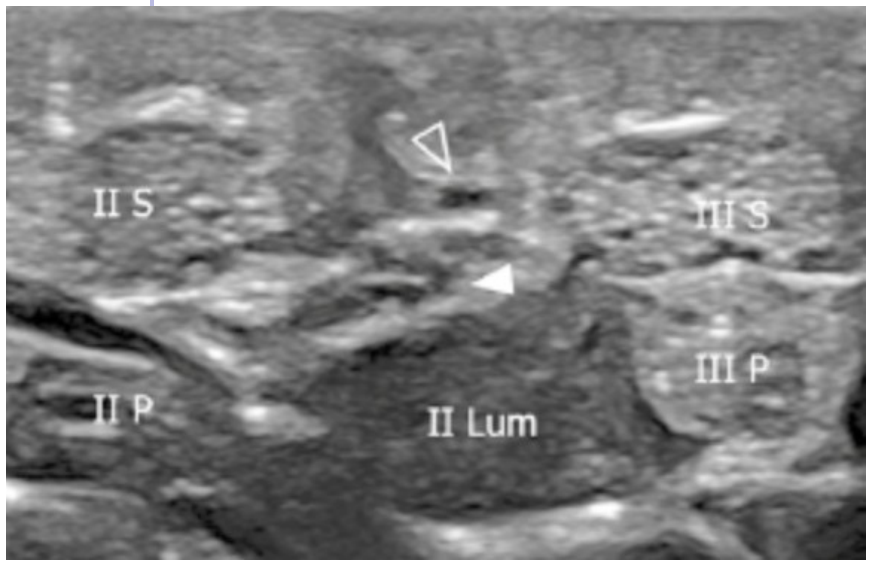
SCANNING TECHNIQUE:
Transducer transverse mid palm.
Palmar common nerves sit beside Flexor digitorum -superficialis/ profundus with common digital artery.
Superficial in location to palmar interosseous muscles.
Scan towards the fingers and proper palmar digital nerves can be seen alongside the phalanges.

ADDITIONAL NOTES: Most peripheral nerve injury to the hand is due to laceration with most involving the proper digital nerves.
Nerve entrapment can occur due to ganglia, tenosynovitis, fibroma etc.

SUPPLY: Sensory supply to palm and fingers

DISTAL COMMON AND PALMAR DIGITAL BRANCHES





ULNAR NERVE GUYONS CANAL

INSTRUCTIONS

MAIN LANDMARKS: Ulnar artery, ulnar nerve, Pisiform proximal Guyon's canal, fibrous arcade of the hypothenar muscles, Hook of Hamate distal Guyon's canal.

SCANNING TECHNIQUE: Transverse just proximal to Guyon's canal. Identify the ulnar artery and ulna nerve scan and scan distally over the Pisiform bone. The nerve has a:

Superficial branch: Lies directly over the hook of hamate under the m. palmaris brevis splits into two branches and travels straight with the ulnar artery in the subcutaneous palm lying radial to the nerve. These branches give rise to the fifth finger's proper digital nerve and the fourth webspace's common digital nerve.

Deep branch: Dives around the ulnar slope of the hook of the hamate (ulnar to the two superficial branches) traveling over the pisohamate ligament under the hypothenar muscles through the pisohamate hiatus with the deep branch of the ulnar artery now ulnar to the nerve. The nerve gives off branches to the hypothenar musculature and winds around the hook of the hamate to travel its course to the thenar muscles. (add poll & fpb).

ADDITIONAL NOTES: 3 levels of nerve compression

Zone 1. Proximal to or in Guyon's canal prior to superficial/ deep branch division- deficits in ALL muscles and sensory innervation provided by ulna nerve

Zone 2. Distal to zone 1 and contains only deep branch> deficit in ALL innervated muscles of the hand from ulna nerve.

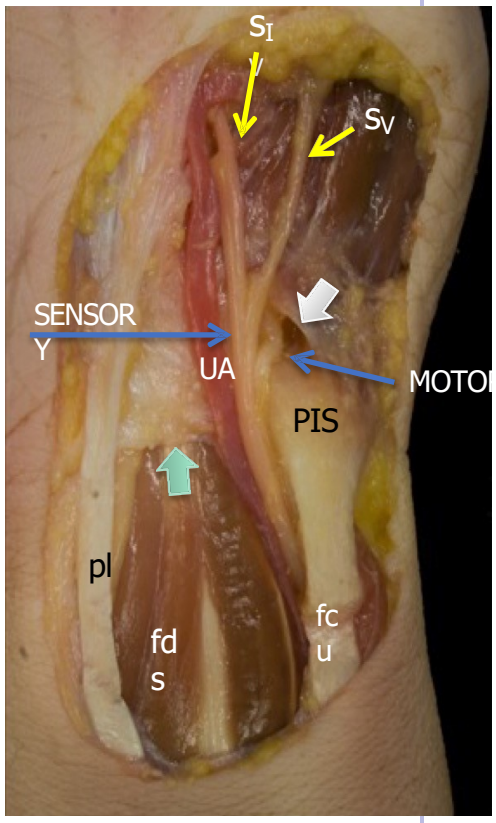
Zone 3. Distal to zone 1. and radial to zone 2 > only superficial branch affected and sensory changes to the little finger and ulna side of the ring finger. Palmaris brevis deficit.

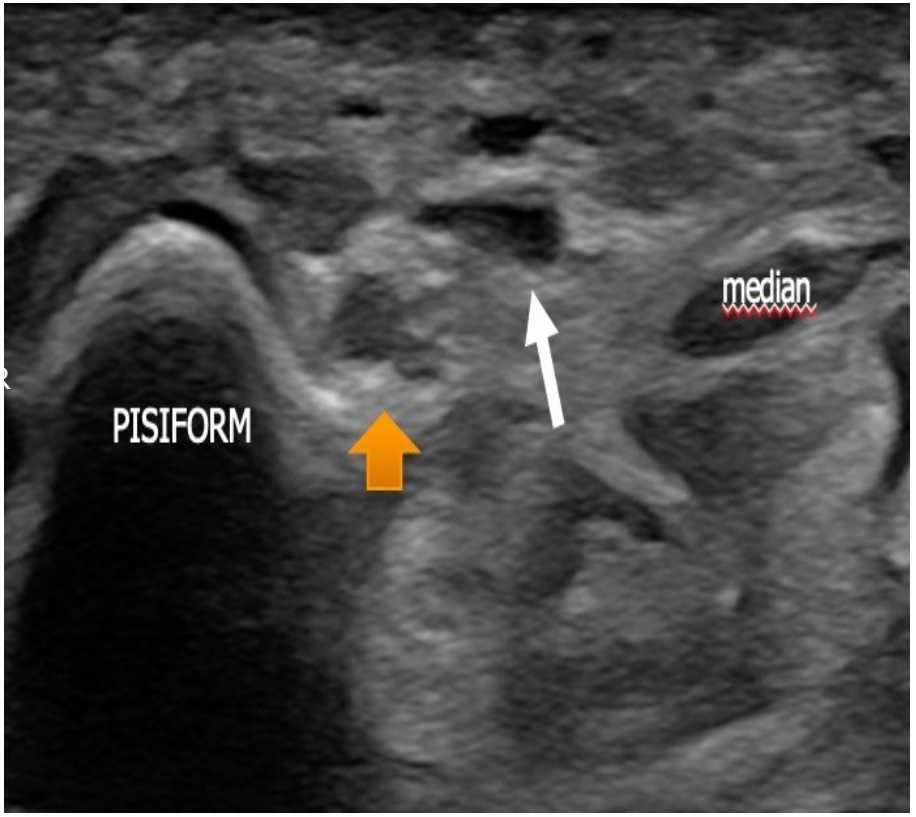
SUPPLYMotor: Flexor carpi ulnaris and medial half of flexor digitorum profundus. Adductor pollicis and deep head of the flexor digitorum brevisMost of the intrinsic hand muscles

Sensory: Anterior aspect of the little finger and half of the ring finger and medial palmar skin

- Dorsal aspect of the ulnar 1½ fingers and medial aspect of dorsum of hand

ULNAR NERVE GUYONS CANAL





DORSAL CUTANEOUS BRANCH OF THE ULNAR NERVE (DCBUN)

INSTRUCTIONS

MAIN LANDMARKS: Ulna artery, ulna nerve , flexor carpi ulnaris(FCU)

SCANNING TECHNIQUE:

Dorsal cutaneous branch - Transverse scan plane proximal forearm, identify ulnar artery and ulna nerve sitting to the ulnar side of artery.

Scan distally, occasional a single fascicle may be seen off the radial side of the nerve and this is the palmar ulnar cutaneous nerve.

Keep moving towards the wrist the Dorsal cutaneous branch of the ulnar nerve should arise from the ulnar aspect of the ulnar nerve and courses deep to the FCU.

It then pierces the antebrachial fascia on the dorsal side of the wrist before dividing into common digital branches > little finger and ulnar side of the ring finger

ADDITIONAL NOTES: This nerve can be compressed by bracelets, tenosynovitis of ext. carpi ulnaris or orthopaedic hardware post surgery.

SUPPLY: Sensory supply little finger and ulnar side ring finger.

Chang, Özçakar, Martinoli 2018