Objectives

- Describe the embryology of the upper limbs, primarily focusing on limb bud formation, differentiation and growth; Describe the primary malformations associated with limbs.
- Describe the dermatomal patterns of the upper limb and how they formed.
- Describe the major anatomical landmarks of the arm, including bones and anatomical spaces.
- Locate and describe the proximal and distal attachments of individual muscles; Identify and compare the functions of the muscles in each of the compartments.
- Describe the vascular patterns and major arteries (subclavian & axillary) and their primary branches; describe the anastomoses around the shoulder.
- Describe the relationship of the nerves in the arm to other local structures.
- Define the boundaries and describe the components of the axilla.
- Describe the gross anatomical structure(s) and function of the breast; Define the lymphatic drainage of the breast and its importance in cancer.

Limb Development

- Four limb buds develop from the ventrolateral body wall (A & G; lateral plate mesoderm)
- Circular groove appears separating hand plate from upper limb (B)
- Foot plate from lower limb (H)
- Digital rays (C, I) → Notches (D, J) → webbed digits (E, K) → digits (F, L)
Arm Bud
Leg Bud
Limb Rotation
Upper limb (rotates 90° laterally)
- Flexors (anterior); extensors (posterior);
- Radius (lateral); Ulna (medial);
- Thumb (lateral); elbow points backward.
Lower limb (rotates 90° medially)
- Flexors (posterior); extensors (anterior);
- Fibula (lateral); Tibia (medial);
- Big toe (medial); kneecap points forward.

Limb Anomalies
- Amelia ➔ absence of an entire limb.
- Meromelia ➔ absence of part of a limb.
- Polydactyly ➔ extra digit.
- Syndactyly ➔ fusion of digits.

Thalidomide is absolutely contraindicated in women of child-bearing age.
Pectoral Fascia - covers pectoralis major m.

Axillary fascia - continuation of pectoral fascia laterally

Clavipectoral Fascia - deep to pectoralis major; encloses subclavius m. and pectoralis minor m. (fatty)

Fascial Compartments of the Shoulder/Pectoral Region

Clavipectoral fascia

Fascia investing subclavious m.

Costocoracoid membrane

Fascia investing pectoralis minor m.

Pectoralis major m. and pectoral fascia

Axillary fascia (anterior part)

Dermatomes

C5: Clavicles; Anterolateral arm & forearm
C6: Lateral arm & forearm; Thumb
C7: Back of arm & forearm; digits 2 & 3
C8: Medial arm & forearm; digits 4 & 5
T1: Anteromedial arm & forearm

Bones and Spaces of the Upper Extremity

ARM (Brachium)
FOREARM (Antebrachium)
HAND

C5
C6
C7
C8
T1
Bones of the Shoulder and Arm

Anterior

Right Clavicle

Scapula

Humerus

Posterior

Clavicle

Acromion

Spine

Coracoid process

Anatomical neck

Greater tubercle

Lesser tubercle

Surgical neck

Intertubercular sulcus

Head

Glenoid process

Coronoid fossa

Lateral epicondyle

Capitulum

Trochlea

Medial epicondyle

Radial groove

Suprascapular notch

Go to LUMEN LEARN 'EM Bone Box

Muscles of the Anterior Shoulder

Pectoralis major – large, fan-shaped muscle covering most of anterior thoracic wall.
Pectoralis minor is useful as a landmark for axillary structures (Axillary a.).
Muscles of the Anterior Shoulder

Serratus anterior – sawtoothed muscle helps stabilize scapula (boxer’s muscle).

Muscle attaches to MEDIAL border of scapula on the anterior surface, and keeps the scapula from “floating off” of the ribcage. Protracts (pulls forward) and rotates scapula.

Long thoracic nerve

Deltoid – abducts humerus to 90° (supraspinatus initiates first 10-15°; trapezius completes to 180°)

Rotator Cuff Muscles

Supraspinatus, infraspinatus, teres minor, and Subscapularis (S i t S).
- Supraspinatus does not rotate the humerus; instead, it initiates abduction of the arm (first 15°), which is completed by the deltoid; most frequently torn in rotator cuff injuries.
- Rotator cuff muscles fix the head of the humerus in the glenoid cavity during abduction and flexion of the arm.
Rotator Cuff Muscles

- Subscapularis muscle (upper & lower subscapular n.)
- Supraspinatus muscle (suprascapular n.)
- Infraspinatus muscle (suprascapular n.)
- Subscapularis tendon
- Supraspinatus tendon
- Infraspinatus tendon
- Teres minor muscle (axillary n.)

Like a Hand on a Baseball

- Subscapularis
- Supraspinatus
- Infraspinatus
- Teres minor

Muscles of the Posterior Shoulder

- **Teres Major**: adducts & medially rotates arm
- **Latissimus dorsi**: extends, adducts, and medially rotates humerus at shoulder (*Lady between 2 Majors; Teres & Pectoralis onto humerus*)
- **Levator scapulae**: elevates scapula medially, inferiorly rotates glenoid cavity
- **Rhomboids**: fix scapula to thoracic wall; retract and rotate scapula to depress glenoid cavity (drop shoulder)
Go to complete upper extremity muscle table
Go to Master Muscle List

**Subclavian Artery Branches**

To remember the branches, simply think of:

V I T amin C and sometimes D

1st 2nd 3rd

**Axillary Artery Branches**

Branches of the Axillary a. are related to the Pectoralis minor m.:
1st Part (1): Superior thoracic artery
2nd Part (2): Thoracoacromial trunk (Acromial, Clavicular, Deltoid & Pectoral) & Lateral thoracic arteries.
3rd Part (3): Subscapular (Circumflex scapular & Thoracodorsal), Anterior & Posterior circumflex humeral arteries.

REMEMBER THIS: Screw The Lawyer, Save A Patient

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7/29/2019
Anastomotic branches around shoulder:
Subclavian branches: Thyrocervical trunk (transverse cervical, suprascapular); Dorsal scapular (?) Axillary branches: Thoracoacromial trunk (acromial); Subscapular (circumflex scapular); Humeral circumflex aa.
Unique Spaces in the Posterior Shoulder Region

Suprascapular Notch: Suprascapular a. & n.; Army over, Navy under (ligament)

Quadrangular Space: teres minor (S), teres major (I), long head of triceps (M) & humerus (L); Axillary n. & Posterior circumflex humeral a. (Question All Patients)

Triangular Space: teres minor (S), teres major (I) & long head of triceps (L);

Circumflex scapular a.

Triangular Interval:
teres major (S), long head of triceps (M) & lateral head of triceps (L); Profunda brachii a. & Radial n.

Arteries of the Posterior Shoulder

Nerves of the Posterior Shoulder
**Nerves of the Shoulder**

Axillary

<table>
<thead>
<tr>
<th>Boundaries:</th>
<th>Apex: 1st rib, clavicle, and superior edge of the scapula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base:</td>
<td>Axillary fascia (arm pit)</td>
</tr>
<tr>
<td>Anterior Wall:</td>
<td>Pectoralis major and minor mm.</td>
</tr>
<tr>
<td>Posterior Wall:</td>
<td>scapula &amp; subscapularis mm.</td>
</tr>
<tr>
<td>Medial Wall:</td>
<td>Serratus anterior over 1st five ribs</td>
</tr>
<tr>
<td>Lateral Wall:</td>
<td>Humerus &amp; coracoid process</td>
</tr>
</tbody>
</table>

Serves as a protected passageway for the neurovascular structures (Axillary a., Brachial plexus, Axillary v.) from the neck to the upper limb.
Axillary Artery
Branches of the Axillary a., related to the Pectoralis minor m.

2nd Part (2): Thoracoacromial trunk (Acromial, Clavicular, Deltoid & Pectoral) & Lateral thoracic arteries.
3rd Part (3): Subscapular (Circumflex scapular & Thoracodorsal), Anterior & Posterior circumflex humeral arteries.

REMEMBER THIS:
Screw The Lawyer, Save A Patient

Anterior view

Brachial Plexus
The brachial plexus will be covered in detail by Dr. Dauzvardis next Tuesday. You will be required to know this in your sleep, so don’t miss those lectures!
Mammary glands are a modified and specialized type of sweat gland.

- Extends transversely from the lateral border of the sternum to the midaxillary line.
- Extends vertically from the 2nd to the 6th rib. A small part may extend toward the axilla - axillary tail (tail of Spence).
- 2/3 rests on deep pectoral fascia; 1/3 on fascia covering the serratus anterior.

**Functional Breast Anatomy**

1. Tubuloalveolar glands + fat = bulk of the breast.
2. 15-20 glands with each forming a lobe: 1 lactiferous duct per lobe (80% of tumors originate in the ducts).
3. Suspensory ligaments (of Cooper) attach lobes to skin & divide glandular tissue into lobes.

**Structural changes in the ductal system and alveoli associated with pregnancy & lactation.**

- Ducts (non pregnant)
- Alveoli (early pregnancy)
- Enlarged Alveoli (mid pregnancy)
- Nipple
- Dilated Alveoli (lactation)
- Regression (after weaning)
Arteries and Veins of the Breast

Thoracoacromial (Pectoral)
Internal Thoracic
Lateral Thoracic
Lateral Thoracic
Thoracoacromial (Pectoral)
Subclavian
Axillary
Internal Thoracic

Lymphatics of the Breast

Central nodes
Humeral (Lateral) nodes
Subscapular (posterior) nodes
Pectoral (anterior) nodes

CLASP:
C = Central;
L = Lateral;
A = Apical;
S = Subscapular;
P = Pectoral

% indicate frequency of breast cancer

Final Thoughts
Obligatory Puppy Pics – Action Photos!

Click on the muscle to see its name.

- Deltoid
- Latissimus dorsi
- Trapezius
- Pectoralis major
- Supraspinatus
- Infraspinatus
- Teres minor
- Subscapularis
Click on the muscle to see its name.

- Levator scapulae
- Rhomboid major
- Rhomboid minor
- Latissimus dorsi
- Teres major
- Supraspinatus
- Infraspinatus
- Teres minor

Click on the artery to see its name.

- Superior thoracic a.
- Thoraco-acromial a.
- Subclavian artery
- Suprascapular artery
- Anterior circumflex humeral a.
- Posterior circumflex humeral a.
- Subscapular a.
- Circumflex scapular a.
- Bccclial a.
- Lateral thoracic a.

Mnemonic: Screw The Lawyer Save A Patient