Acland's DVD Atlas of Human Anatomy

Transcript for Volume 1

PART 1

THE SHOULDER

00.00

The best way for us to learn about the upper extremity is to begin at the very beginning, right up here. We'll start by looking at the bones of the shoulder region: the clavicle, the scapula and the humerus. Then we'll look at the joints that let them move, and the muscles, which make them move. Lastly we'll look at the principal blood vessels and nerves in the region. First, the bones.

00.30

BONES, JOINTS AND LIGAMENTS

The bones that connect the upper extremity to the trunk are the clavicle, or collar bone, and the scapula, or shoulder blade. The parts of them that we can feel beneath beneath the skin can be seen in this dissection: here's the spine of the scapula, here's the clavicle. In the dry skeleton, here's the clavicle, here's the scapula.

01.00

The proximal long bone of the upper extremity, the humerus articulates with the scapula at the shoulder joint. The scapula and clavicle articulate with the bones of the thorax at one point only, here, at the sternoclavicular joint.

01.19

The lateral end of the clavicle articulates with this projection on the scapula, the acromion, forming the acromio-clavicular joint. Apart from this one very movable bony linkage, the scapula is held onto the body entirely by muscles. It's thus capable of a wide range of movement, upward and downward, and also forward and backward around the chest wall.

01.50

Looking at the clavicle from above we can see that it's slightly S-shaped, with a forward curve to its medial half. At its medial end this large joint surface articulates with the sternum. At the lateral end this smaller surface articulates with the scapula. On the underside, massive ligaments are attached, here laterally and here medially.

02.21

The scapula is a much more complicated bone. The flat part, or blade, is roughly triangular with an upper border, a lateral border, and a medial border. The blade isn't really flat, it's a little curved to fit the curve of the chest wall.

2.42

This smooth concave surface is the glenoid fossa. It's the articular surface for the shoulder joint. Above and below the glenoid fossa are the supraglenoid tubercle, and the infraglenoid tubercle, where two tendons are attached as we'll see.

03.02

A prominent bony ridge, the spine of the scapula, arises from the dorsal surface, and divides it into the supraspinous fossa, and the infraspinous fossa. At its lateral end the spine gives rise to this flat, angulated projection, the acromion, which stands completely clear of the bone. The clavicle articulates with the scapula here, at the tip of the acromion. This other projection, looking like a bent finger, is the coracoid process.

03.40

Here's how the clavicle and the scapula look in the living body. Round the edge of the shallow glenoid fossa, a rim of fibrocartiilage, the glenoid labrum, makes the socket of the shoulder joint both wider and deeper. This flat ligament, the coraco-acromial ligament, joins the coracoid process to the acromion. Here's the acromio-

clavicular joint. Two strong ligaments, the trapezoid in front and the conoid behind, fix the underside of the clavicle to the coracoid process. There's very little movement at the acromio-clavicular joint.

04.16

As we've seen, the medial end of the clavicle articulates with the sternum at the sterno-clavicular joint. Strong ligaments between the clavicle and the sternum and between the clavicle and the underlying first rib, keep the two bones together but permit an impresssive range of motion: up and down, and backward and forward.

04.42

Now let's see how the clavicle and the scapula move, relative to the trunk. Upward movement of the scapula is called elevation; downward movement is called depression. Forward movement around the trunk is called protraction; the opposite movement is retraction. This movement is called upward rotation. The opposite movement is downward rotation.—In real life these movements of the scapula are often combined.

05.16

The range of motion of the scapula provides fully one third of the total range of motion of the humerus, relative to the body, sometimes more. Without this movement of the scapula, we'd only be able to abduct our arm to here. That's as far as the shoulder joint goes, before bone hits bone. It's scapular movement that lets us get all the way to here.

05.41

Now let's look at the shoulder joint. To understand the shoulder joint, let's get acquainted with the upper half of the humerus.

This is the head of the humerus. The articular surface is half of a sphere. On the anterior aspect is a well marked groove known as the bicipital groove, because the tendon of the long head of the biceps runs in it. At the proximal end of the groove are the lesser tubercle, and the greater tubercle. Because it's between two tubercles, the bicipital groove is also known as the inter-tubercular groove. Down here on the lateral aspect of the humerus, almost halfway down the bone, is a rough spot, the deltoid tubersosity.

06.21

Here's the shoulder joint, also known as the gleno-humeral joint. This loose sleeve of tissue which encloses the joint is the joint capsule. The capsule doesn't hold the bones together, it's quite a weak structure. What it does is to permit movement. The structures which hold the two bones together are muscles, as we'll see. Here's the tendon of one of those muscles.

06.48

Let's look at the movements that can occur at the shoulder joint. Movement forward and upward is called flexion. Movement downward and backward is called extension. Movement away from the side of the body is ab-duction. The opposite movement is ad-duction. Rotation which moves the front of the arm towards the body, is internal rotation. Rotation the other way is external rotation.

07.23

Now that we've taken a look at the bones, joints and ligaments, let's spend about a minute reviewing what we've seen so far.

07.30

REVIEW

Here's the clavicle, for an easy start. On the scapula here's the blade, the glenoid fossa, the supraglenoid, and infraglenoid tubercles, the spine of the scapula, the supraspinous and infraspinous fossa the acromion, and the coracoid process.

07.57

Here's the proximal humerus, with the head, the greater tubercle and lesser tubercle, the bicipital groove, and the deltoid tuberosity.

08.12

Here's the sterno-clavicular joint, and here's the acromio-clavicular joint, with the conoid ligament and the trapezoid ligament.

08.24

On the scapula, here's the glenoid labrum, and the coraco-acromial ligament. Lastly, here's the capsule of the shoulder joint

08.37

MUSCLES

Now let's move on to look at the muscles. We'll build our understanding pretty much from the inside to the outside. First we'll look at the deepest muscles, the ones that go from the scapula to the humerus. Then we'll look at the ones that go from the trunk to the scapula, and lastly we'll look at the big three muscles on the outside, which cover up almost all the others.

09.05

MUSCLES PASSING FROM SCAPULA TO HUMERUS

Before we look at any shoulder muscles, we need to take note of the tendons of two long elbow muscles, which arise very close to the shoulder joint, and lie deep to everything else.

09.15

They're the tendons of the long head of the biceps, and the long head of the triceps muscles. The long head of triceps arises here, from the infraglenoid tubercle. The long head of biceps arises, surprisingly, here from the supraglenoid tubercle. To get there, it passes inside the joint capsule, and right over the top of the head of the humerus.

09.43

Now let's look at the four short muscles which hold the shoulder joint together. There are three on the back, one on the front. The one on the front is subscapularis. It arises from almost almost all of the anterior, or costal aspect of the scapula. Its tendon inserts here, on the lesser tubercle.

10.05

Subscapularis, acting alone, produces internal rotation of the humerus. Acting with the other three short muscles, it holds the humeral head and the glenoid fossa together, while other, more powerful muscles are at work.

10.20

On the back, there are two muscles below the scapular spine, and one above it. The one above is supraspinatus. It arises from almost all of the supraspinous fossa. It passes under the acromion and inserts here, on the greater tubercle.

10.41

The tendon of supraspinatus runs through a tight spot, between the acromion and the head of the humerus. There's a synovial lined pocket, a bursa, here between it and the acromion. Supraspinatus initiates abduction of the humerus.

11.01

The two muscles below the spine are infraspinatus and teres minor. Between them, they arise from almost all of the infraspinous fossa, infraspinatus here, teres minor here. Infraspinatus inserts here on the back of the greater tubercle, teres minor just below it. Both these muscles produce external rotation of the humerus.

11.28

These four short muscles: subscapularis, supraspinatus, infraspinatus, and teres minor, converge on the humerus to form an almost continuous cuff of flat, supporting tendons, often referred to as the rotator cuff. It's these tendons together with the long head of the triceps down here, which keep the head of the humerus from sliding out of its very shallow socket.

11.58

There are two other muscles to note, that also run from the scapula to the humerus, one on the front, and one on the back. The one on the back is teres major. It arises here, from the lower lateral border of the scapula, and inserts here, on the crest of the lesser tubercle. Teres major is quite a powerful ad-ductor of the humerus.

12.22

On the front here's coraco-brachialis. It arises from the coracoid process. It inserts down here, on the humerus. Coraco-brachialis helps to flex the shoulder joint.

12.40

Altogether there are seven muscles that go from the scapula to the humerus, and so far we've seen six of them. The last one, the deltoid, is so big that it covers up almost everything else, so we'll leave it out of the picture till the very end.

12.54

MUSCLES PASSING FROM TRUNK TO SCAPULA

Now it's time to look at the muscles which hold the scapula in place, and move it in relation to the trunk. There are six of them, four on the back, one in the front, and one underneath.

13.04

The one on the underneath is the large and powerful serratus anterior muscle. This is just part of it. To see it all, we need to move the scapula away from the body. This big expanse of muscle is all serratus anterior. It arises from the side and front of the first eight ribs. In runs back under the scapula, and it's inserted all the way back here, along the medial border of the scapula.

13.36

When the whole serratus anterior muscle contracts, it pulls the scapula forward around the rib cage: that's protrusion. When its upper, or lower fibers contract separately, they help to produce downward, or upward rotation of the scapula.

13.57

Now let's look at those four muscles on the back. One, the trapezius is large and superficial, the other three are small and deep. The three deep ones are levator scapulae, and the two rhomboids, rhomboid minor, and rhomboid major.

14.18

Levator scapulae arises here, on the outermost point of the first three cervical vertebrae. It inserts here, on the upper medial corner of the scapula. Levator scapulae helps to elevate the scapula. The rhomboids arise here, from the fourth cervical to the fifth thoracic vertebrae. They insert here, along the medial border of the scapula.

14.45

The rhomboids elevate and retract the scapula. The large muscle which overlies these three is the trapezius. It's a beautiful but complicated muscle. The trapezius has an upper part, and a lower part, which both converge on the spine of the scapula.

15.09

The upper part of trapezius arises from the occiput, and from the nuchal ligament, and from T1 to T3 in the mid-line. It's inserted along the upper edge of the spine of the scapula, around the acromion, and along the lateral third of the clavicle.

15.28

The lower part of the trapezius muscle is not so massive. It arises from T4 to T12 in the mid-line. It inserts here, on the lower edge of this part of the spine of the scapula. When the whole of trapezius contracts, it powerfully retracts the scapula. When the upper part contracts, it powerully elevates the scapula.

15.58

Last on the list of muscles passing from the trunk to the scapula is the one on the front. It's pectoralis minor. Pectoralis minor arises between the second and the fourth ribs. It's inserted on the coracoid process. Pectoralis minor produces depression of the scapula.

16.21

There are two very small muscles to mention just for completeness. One is subclavius which goes from the first rib to the clavicle. Its function is uncertain. The other is omohyoid, which arises from the hyoid bone way up here, and inserts over here, on the upper edge of the spine of the scapula. Its function is to depress the hyoid bone and the larynx.

16.51

PECTORALIS MAJOR, LATISSIMUS DORSI, DELTOID

Now we'll complete our picture by looking at three big external muscles: pectoralis major, latissimus dorsi, and deltoid.

17.00

Of these, the first two have much in common - pectoralis major on the front, and latissimus dorsi on the back. These two are alike, in that they both pass directly from the trunk to the humerus, bypassing the scapula. Between them they define the posterior and anterior walls of the axilla.

17.27

Pectoralis major arises from the medial third of the clavicle, from the front of the sternum, and from the front of the first six costal cartilages. It's inserted here, on the anterior edge of the bicipital groove.

17.41

Pectoralis major is a powerful adductor of the humerus. When its adducting effect is held in check by other muscles, it also produces internal rotation.

17.53

Latissimus dorsi has a very wide origin. It starts here, under the tail end of trapezius, at T7, and goes all the way down to the sacrum, and out onto the posterior iliac crest. It also has some fibers arising from the lower four ribs, and occasionally from the tip of the scapula.

18.18

It inserts here, on the posterior edge of the bicipital groove. To get to its insertion, the latissimus tendon has to spiral around teres major. Here's teres major. Latissimus spirals from the back, to the front, with the lowest fibers of origin ending up highest.

18.36

Latissimus dorsi, like pectoralis major, is a powerful adductor of the humerus. Acting through the humerus, it's also a powerful depressor of the scapula, powerful enough to overcome the whole weight of the body, as in doing a push-up.

18.52

Last of all, here's the deltoid muscle. It completely surrounds the shoulder joint from the front, to the back. It arises from the spine of the scapula, from the acromion, and from the lateral third of the clavicle. It's inserted here on the deltoid tuberosity of the humerus.

19.16

The deltoid muscle has multiple functions: it's almost like three different muscles. Its anterior part is a powerful flexor, its posterior part is a powerful extensor, and its lateral part is a powerful abductor.

19.36

Now that we've seen all the muscles that act on the scapula, and on the proximal humerus, let's review them. If you want to test yourself, turn off the sound.

19.50

REVIEW OF MUSCLES

Here's subscapularis, supraspinatus, infraspinatus, and teres minor. Here's teres major, and coracobrachialis,

20.14

Now the muscles that arise from the trunk: serratus anterior levator scapulae, the two rhomboids, minor, and major, trapezius, pectoralis minor, subclavius, and omohyoid; and lastly pectoralis major latissimus dorsi, and deltoid.

20.46

We've covered a lot of ground! I suggest you take a break before you watch the rest of the tape. Switch off for a while and start again in a few minutes.

21.05

BLOOD VESSELS

Now let's look at the veins, arteries and nerves of the shoulder region. As you'll see, the main bundle of vessels and nerves lies behind the clavicle, and behind both pectoral muscles, as it passes from the base of the neck to the underside of the upper arm. To understand how things are arranged up here, where the main vessels come up out of the chest, and the main nerves emerge from the vertebral column, there are some key structures that we need to understand: the first ribs, the cervical vertebae, and the scalene muscles. Let's take a look at them.

21.44

Here's the first rib, below and behind the clavicle. This much of it is bone and this much of it is costal cartilage. The two first ribs define the opening at the top of the chest: the superior thoracic aperture. The main artery to the upper extremity, the subclavian artery, crosses the first rib here. The subclavian vein crosses it here, right behind the medial end of the clavicle. Here are the vertebrae: the first thoracic with the first rib; and the seventh, sixth and fifth cervical. Let's take the clavicle away so we can see the vertebrae better.

22.30

The main spinal nerves to the upper extremity emerge here, between the transverse processes. The spinal nerves that we're concerned with are numbered C5, C6, C7, C8, and T1.

22.47

These two landmark muscles, the anterior scalene, and the middle scalene, which are attached to the first rib here, and here, guard the exit of these vital structures. The vein runs in front of the anterior scalene, the artery runs behind it. Between the two scalene muscles, the roots of the brachial plexus also emerge.

23.12

There are two posssibly confusing things that we have to live with. The first is that there's a nerve root named C8, even thought there's no eighth cervical vertebra. The second confusing thing is that the main artery and vein change their names as they go along: here they're called the subclavian vessels, here they're called tha

axillary vessels, and from here on down they're called the brachial vessels. The structures themselves don't change, just the names.

23.40

Let's start by looking at the veins. We can be quite brief about this since the veins parallel the arteries in most important respects. It'll be helpful to start on the outside and progress inward, removing some muscles as we go along.

23.55

Here, in the groove between pectoralis major and deltoid, is the cephalic vein, coming up from the arm. It's a vein that doesn't have an accompanying artery. To see where it's going, we'll remove pectoralis major.

24.13

Here's the cephalic vein. Together with other veins from the shoulder region, it joins the main vein of the upper extremity, the subclavian vein. We'll focus our attention on this important vein. The subclavian vein comes up from the arm and passes beneath pectoralis minor. Emerging from beneath pectoralis minor, it passes over the outer surface of the first rib (here's the first rib) and under the subclavius muscle and the clavicle. To follow the subclavian vein further, we'll remove the clavicle, the subclavius muscle, and this muscle, the sternocleidomastoid.

24.58

Here we are, behind the medial end of the clavicle, which went from here (this is the cut end of the clavicle) to here. This was the sterno-clavicular joint. Here's pectoralis minor. Here's the curve of the first rib, and here's scalenus anterior. These structures, the subclavian artery, and the brachial pleus, we'll be seeing in a minute. Let's follow the vein. Just as the subclavian vein reaches the medial border of the first rib, which is here, it's joined from above by the main vein from the head and neck, the internal jugular vein. Together the subclavian and internal jugular veins form the brachiocephalic vein.

25.46

The brachiocephalic vein passes medial to the first rib, and enters the chest. The dome of the pleura lies immediately behind it: here's the pleura. To follow the brachiocephalic vein into the chest, we'll remove these muscles, and we'll also remove this part of the anterior chest wall. We'll also remove the other clavicle.

26.16

Now we're looking inside the chest. Here are the divided ends of the two first ribs; and here's the divided end of the sternum. Here are the two brachiocephalic veins, the right, and the left. A little to the right of the midline they jon together, to form the superior vena cava.

26.39

Apart from what we've just seen, the veins of the region correspond so closely to the arteries that we don't need to consider them separately.
We'll move on now, to look at the arteries. In the dissections that follow, all the accompanying veins have been removed, to simplify the picture.

27.00

To get a good look at the artery as it runs from here, to here, we need to remove pectoralis major. Now only three structures stand between us and it. Here's the artery, passing behind the anterior scalene muscle, behind the clavicle, and behind pectoralis minor. Three names for one artery: subclavian, axillary, brachial. Let's see where it begins.

27.31

Here's a deeper dissection with the chest wall removed. Here are the divided ends of the clavicle, the first rib, the anterior scalene muscle, and the second rib. In the middle we're looking at the trachea, and the common carotid arteries, the right, and the left. On the right side, the subclavan artery arises, along with the common carotid, from the brachiocephalic trunk, which in turn arises from the arch of the

aorta. On the left side, the subclavian artery arises directly from the arch of the aorta.

28.13

In the early part of its course, as it passes over the dome of the pleura, the subclavian artery gives off some major branches, which we'll see in other parts of the Atlas. These are the internal thoracic, the thyrocervical trunk, and the vertebral. In addition, the subclavian gives off two branches to the back and shoulder region: these are the transverse cervical and the suprascapular arteries. These two are variable, sometimes they arise here, sometimes here.

28.44

The main artery, now called the axillary, next gives off two branches behind pectoralis minor. They're the thoraco-acromial, and the lateral thoracic arteries. In the axilla, three more branches arise, often close together: the subscapular, and the two circumflex humeral arteries, the anterior and the posterior. The posterior circumflex humeral winds round behind the neck of the humerus. Finally the artery, now known as the brachial artery, passes on down the upper arm.

29.23

NERVES

Now let's look at the nerves. Between about here and here, the five spinal nerves unite, and divide, unite again, and divide again. The tangle which this produces is called the brachial plexus. It's not really too formidable. At the end of the brachial plexus the four main nerves of the arm emerge: the musculo-cutaneous, the median, the ulnar, and the radial. In the course of the brachial plexus, the nerves that supply the shoulder region are given off. We'll look at the main components of the brachial plexus first, then at the local branches.

30.05

Here's the brachial plexus, with several of its small branches removed so we can see the big picture. We'll also remove pectoralis minor. Here are the five roots of the brachial plexus: they are in fact the ventral rami of their respective spinal nerves. They emerge, as we've seen, from between the anterior scalene and middle scalene muscles.

30.31

The top two roots join, and the bottom two join, and the middle one, C7, stays alone. These three big units are called the three trunks: upper, middle and lower. Each trunk divides (here's one of them dividing) into an anterior and a posterior division.

30.52

Of the three anterior divisions, the upper two unite, and the lower one stays alone. The three posterior divisions all unite, as we'll see in a minute.
Once that's all happened, there are again three big units, now called cords: lateral, medial and posterior. They surround the axillary artery.

31.19

The lateral cord divides, to become the musculocutaneous nerve, and one half of the median nerve. The medial cord divides, to become the ulnar nerve, and the other half of the median nerve. This arrangement produces an M-shaped pattern of nerves, musculocutaneous, median, and ulnar.

31.46

Now let's see the posterior cord. We need to remove the medial cord, the lateral cord, and the artery, to get a good look at it. Here's the posterior cord all by itself. Sometimes it starts dividing before all three of the posterior nerves have united. Its principal branches are the axillary nerve, which we'll see again, and the radial nerve.

32.12

Now that we've looked at the main components of the brachial plexus, let's look at the nerves which supply the muscles of the shoulder region. Some of these arise from the cords of the brachial plexus. Some arise in other ways. Let's look at the ones that arise from the cords first. We were looking at a simplified dissection before. Now we'll see the details.

32.33

The medial cord gives rise to one local nerve, the lateral cord to two. The one from the medial cord is the medial pectoral nerve. It's one of a pair. Here's its partner, the lateral pectoral nerve, which arises from the lateral cord. The pectoral nerves supply pectoralis major, and pectoralis minor.

33.00

Also arising from the lateral cord is the musculocutaneous nerve. It supplies three upper arm muscles, one of which we've seen: coracobrachialis. The other two we'll see in the next section.

33.14

The posterior cord (here it is again with all its branches intact) has four branches. The axillary nerve runs round the neck of the humerus, along with the posterior circumflex humeral artery, to supply the deltoid muscle, and also teres minor.

33.35

The subscapular nerves, an upper and a lower, supply subscapularis, and teres major. The thoracodorsal nerve supplies latissimus dorsi.

33.50

Now let's see the shoulder muscle nerves which don't arise from the cords of the brachial plexus. Of these, one is the branch of a trunk, two arise from the roots of the brachial plexus, and two aren't part of the plexus at all.

34.06

Arising from the upper trunk is the suprascapular nerve, which supplies supraspinatus, and infraspinatus. Arising from the C5 root and passing through the middle scalene muscle is the dorsal scapular nerve. It supplies the rhomboid muscles.

34.26

Arising from the C5, 6 and 7 roots, the long thoracic nerve emerges through the medial scalene muscle, runs deep to all three trunks of the brachial plexus, and supplies serratus anterior.

34.41

Trapezius gets its nerve supply from the spinal accessory nerve. Lastly levator scapulae gets a private nerve supply from the nearby roots of C3, 4 and 5.

34.55

We've looked at some prettycomplex and detailed anatomy in the last few minutes. Let's review what we've seen of the veins, arteries and nerves of the shoulder region.

35.06

REVIEW OF VESSELS AND NERVES

First, the few veins that we saw, the cephalic, subclavian, and brachiocephalic veins.

35.16

Next the arteries: the brachiocephalic trunk, the subclavian artery, the axillary, and the brachial artery; the transverse cervical, and suprascapular arteries. The thoracoacromial, lateral thoracic, subscapular, and anterior, and posterior circumflex humeral arteries.

35.52

Lastly nerves, starting with the main components of the brachial plexus. The roots of the brachial plexus, C5, C6, C7, C8 and T1. The three trunks, upper, middle and

lower. Each trunk splitting into divisions, anterior, and a posterior. From the divisions, three cords arising, the lateral and medial from the anterior divisions, and the posterior from the posterior divisions.

36.36

Arising from the lateral, and medial cords, the musculocutaneous, medial and ulnar nerves, and the pectoral nerves, medial, and lateral.

36.52

Arising from the posterior cord, the axillary and radial nerves, also the subscapular nerves, and the thoracodorsal nerve. Arising higher up, the suprascapular nerve, the long thoracic nerve, and the spinal accessory nerve.

37.15

Understanding the shoulder region gives us a good foundation for understanding the upper extremity. In part 2 of the upper extremity we'll take a long trip, from here to here, and in part 3 we'll look at the hand.

37.37

END OF PART 1

PART 2

THE ARM AND FOREARM

00.00

In this section we'll go from the shoulder to the wrist. We'll look at the bones, joints and muscles that are involved in three different functions: elbow movement, forearm rotation, and wrist movement. We'll also look at the vessels and nerves, from the shoulder to just below the elbow.

00.26

A good many of the muscles that are in the forearm are finger and thumb muscles. We'll leave those muscles out of the picture in this section, and see them when we do the hand.

00.36

ANATOMICAL TERMS DEFINED

We need to give a clear meaning to our usual anatomic terms, medial and lateral, anterior and posterior. When we use those terms in the upper extremity, we imagine the extremity to be fixed in this so-called anatomic position. That's useful, but calling something medial or lateral can become pretty confusing below the elbow, because everything can rotate so much.

01.01

To get our bearings in the forearm and hand we often use the more convenient terms that are derived from the two functions, flexion and extension, and from the two bones of the forearm, the ulna and the radius. This is the flexor aspect of the forearm, and this is the extensor aspect. This is the ulnar side, and this side, with the thumb on it, is the radial side.

01.31

Let's also understand the terms we use for movements. At the elbow, bending is flexion, straightening is extension. Rotation of the forearm is referred to as pronation and supination. Pronation puts the palm of the hand down, and supination brings it up. To remember which is which, remember supination has "up" in it.

1.58

At the wrist, this is flexion, this is extension. The two sideways movements of the wrist are ulnar abduction, and radial abduction. There's one last term to define - the arm. In everyday conversation this whole thing is the arm, but in anatomy this is the arm, just this bit here, and this is the forearm.

02.27

BONES, JOINTS AND LIGAMENTS

HUMERUS AND PROXIMAL FOREARM

Now lets look at the bones, starting with the humerus. We've looked at its proximal end already, now lets see the distal end.

02.37

It's flattened from front to back, with a complicated articular surface, and two prominent lumps, the medial epicondyle and the lateral epicondyle.
These are major muscle origins, as we'll see. Above each epicondyle is a ridge, the epicondylar ridge. Here's the lateral one. The articular surface is in two parts. The pulley-like trochlea articulates with the ulna. The rounded capitulum articulates with the radius.

03.10

Now we'll add the radius and the ulna to the picture. The big hollow on the back of the humerus, the olecranon fossa, accommodates the end of the ulna, the olecranon, in full extension.

03.26

Now let's look at the two forearm bones, the radius and the ulna. They're different, in that the ulna is bigger proximally, the radius is bigger distally. They're also different in that the radius rotates, the ulna doesn't. The two bones are held togeher by two radio-ulnar joints, the proximal and the distal. Forearm rotation happens simultaneously at both these joints.

04.01

The two bones are also held together along most of their length by the strong but flexible interosseous membrane, which prevents the two bones moving lengthwise relative to each other. Let's look at the proximal ends of the redius and thee ulna.

04.18

We'll look at the ulna first. The main feature of the proximal end of the ulna is this large curved articular surface. The curve that it forms is called the trochlear notch. It articulates with the trochlea of the humerus.

04.37

The very proximal end of the ulna is the olecranon. The triceps tendon is attached to it. This projection is the coronoid process. Distal to it this rough area, the ulnar tuberosity, marks the insertion of the brachialis tendon. This small curved surface, the radial notch, is where the head of the radius articulates.

05.03

This is the head of the radius, This is the neck. The end of the head articulates with the capitulum of the humerus. Its curved side aticulates partly with the radial notch of the ulna, and partly with the ligament that surrounds it, as we'll see. Just radial to the neck is the radial tuberosity, which is the insertion for the biceps tendon.

05.28

Now let's look at this unique joint, where two quite different things happen. The humerus articulates with the forearm bones to form the elbow joint, and the forearm bones articulate with each other to form the proximal radio-ulnar joint.

05.45

Here's the joint with its loose capsule removed and its ligaments intact. Here's the front of the joint in extension, and here's the back of the joint in flexion.

06.00

The key structure to understand is this remarkable ligament, which not only holds the radial side of the elbow together, but also holds the rotating head of the radius in place against the ulna. It has two parts. This part is the radial collateral ligament, this part is the annular ligament. We'll take the humerus out of the picture for a minute, to get a look at the proximal radio-ulnar joint.

06.27

Here's the trochlear notch of the ulna, here's the head of the radius seen end on. The annular ligament, together with the radial notch of the ulna, provides a perfectly fitting socket for the head of the radius to rotate in.

06.45

Here's the anular ligament with the radial head removed. It's attached to the edges of the radial notch of the ulna. It's shaped like a shallow cup, wider here than here, to fit the radial head not just round here, but also under here. So the radial head, while it's free to rotate, is otherwise totally trapped.

07.12

Now let's go back to the intact elbow joint, and see how it's held together by its two collateral ligaments. The radial one arises from the lateral epicondyle. It fans out, and becomes continuous with the anular ligament.

07.27

The two parts of this complex ligament hold the humerus and the radial head securely together. What we see here isn't the edge of the ligament, it's the cut edge of the tendon of origin of a muscle, the supinator, which arises from the ligament. We'll see this shortly.

07.45

Here's the ulnar collateral ligament. It arises from the medial epicondyle, and fans out in a triangle. It's attached to the ulna all along the medial side of the trochlear notch.

07.59

To complete our picture of the elbow joint, here it is with its its capsule intact. It's thin and baggy in front, and also behind, to allow a full range of movement. There's also a very flexible sleeve of joint capsule here, between the anular ligament and the neck of the radius.

08.21

The elbow joint is stable, that means it stays together, for two reasons - partly because of the strength of the ligaments, which we've seen, and partly because of the shape of the bones. The humerus and the ulna interlock closely and deeply. Their surfaces are curved in two planes, from front to back, and from side to side.

08.46

The elbow and the proximal radio-ulnar joint are considered to be all one joint, because they're enclosed in one continuous space. By contrast, the two joints that we'll look at next, the distal radio-ulnar joint and the wrist joint are physically separate, even though they're close together, so we'll look at them separately.

09.07

DISTAL FOREARM AND WRIST

To understand the distal radio-ulnar joint, let's look at the distal ends of the radius and ulna. The head of the ulna has a rounded articular surface. This part articulates with the radius, this part articulates with a key structure that we'll see shortly, the triangular fibrocartilage. The pointed tip of the ulna is called the ulnar styloid.

09.33

The broad distal end of the radius has two articular surfaces. This large one articulates with the proximal row of carpal bones, to form the wrist joint. This small surface articulates with the ulna. This point is the radial styloid. Here's the distal radio-ulnar joint with its capsule intact, and with the capsule removed.

10.05

Here's the structure that holds it together, the triangular fibrocartilage. It's also known as the articular disk. It's attached to the radius here, and to the ulnar styloid here. As the distal end of the radius rides around the head of the ulna, the ulnar styloid provides the pivot point.

10.26

Now let's look at the wrist joint. Though we often speak of it as one joint, there are really two joints here, very close together. They're called the radiocarpal joint, and the mid-carpal joint. To understand them let's look at the bones. We'll look at them this way up.

10.44

Eight small carpal bones form the carpus. Distal to the carpus are the metacarpals, numbered one, two, three, four and five.

11.00

The carpal bones are in two rows, a proximal and a distal. The bones in each row are attached closely to one another. The four bones of the proximal row are the scaphoid, the lunate, the triquetral, and the pisiform, which sits by itself on the

triquetral. The scaphoid, the lunate and part of the triquetral articulate with the distal end of the radius, to form the radio-carpal joint.

11.32

The distal surface of the proximal row forms a deeply concave notch, which the bones of the distal row fit into. The bones of the distal row are the trapezium, the trapezoid, the capitate, and the hamate. The capitate and part of the hamate project proximally.

11.50

The basesof the five metacarpals articulate with the distal row of carpal bones. The first one, for the thumb, articulates by itself with the trapezium. The other four articulate in a row, here. The distal row of carpal bones articulates with the proximal row here, to form the midcarpal joint. The projecting capitate and hamate fit into the notch in the proximal row.

12.17

When flexion and extension occur at the wrist, the movement happens partly at the radiocarpal joint ,and partly at the midcarpal joint. When radial deviation and ulnar deviation occur, the action happens mainly at the radio-carpal joint.

12.37

Here's the wrist joint, or rather joints, with much of the capsule removed, and the two collateral ligaments, here, and here, intact. Here's the radiocarpal joint, here's the midcarpal joint.

12.55

The radial collateral ligament goes from thje radial styloid to the scaphoid and its neighbor, the trapezium. The ulnar collateral ligament goes from the ulnar styloid, to the triquetral and pisiform bones.

13.15

14Here's the wrist joint with the joint capsule intact. The joint capsule is thick and strong all the way round the joint. On the extensor aspect, the capsule forms the broad dorsal radiocarpal ligament. On the flexor aspect it forms the palmar radiocarpal ligament.

13.35

Unlike the elbow, which is held together partly by the interlocking shape of the bones, the wrist is held together entirely by the strength of its ligaments. The two collateral ligaments hold the bones together in radial abduction and ulnar abduction, and the radio-carpal ligaments hold them together in flexion and extension. The strength of the radio-carpal ligaments also ensures that, when the radius rotates, the hand goes with it.

14.04

Before we move on to look at the muscles, let's review what we've seen of the bones and joints.

14.10

REVIEW OF BONES, JOINTS AND LIGAMENTS

On the humerus, here's the medial epicondyle, and epicondylar ridge, and the lateral epicondyle, and epicondylar ridge. Here's the capitulum, and the trochlea.

14.29

On the proximal ulna, here's the trochlear notch, th olecranon, the coronoid process, the ulnar tuberosity, and the radial notch. On the proximal radius, here's the head, the neck, and the radial tuberosity.

14.51

Here's the radial collateral ligament, the anular ligament, the ulnar collateral ligament, and the joint capsule. On the distal ulna here's the head, and the ulnar styloid.

15.12

On the distal radius, here's the surface for the ulna, the surface for the wrist joint, and the radial styloid. Here's the scaphoid, the lunate, the triquetral and pisiform, the trapezium, the trapezoid, the capitate and the hamate; and here are the metacarpals.

15.38

At the wrist,here's the triangular fibrocartilage, the radial collateral ligament, the ulnar collateral ligament, the palmar radiocarpal, and dorsal radiocarpal ligaments

15.56

End of time sequence

MUSCLES

Start of new time sequence

00.00

Now let's look at the muscles. There are three sets of muscles to look at: the ones that flex and extend the elbow, the ones that pronate and supinate the forearm, and the ones that flex and extend the wrist. We'll look at each set of muscles separately. Later on in this section we'll see them all together.

00.24

ELBOW FLEXORS AND EXTENSORS

First the muscles that flex and extend the elbow. There are three flexors, and one extensor. The three flexors are brachialis, biceps, and brachioradialis.

00.35

Here's the brachialis muscle. It arises from this broad area on the anterior humerus. It's inserted here, on the ulnar tuberosity. The action of brachialis is to flex the elbow, which it does equally well whether the forearm is pronated or supinated.

00.56

The biceps muscle, its full name is biceps brachii, lies in front of the brachialis. It's a more complicated muscle. For a start, it has two heads a long and a short. To get a good look at them, let's take away the anterior half of the deltoid muscle, and also pectoralis major

01.20

Here's the long head of biceps, here's the short head. The tendon of origin of the short head merges with that of another muscle, coracobrachialis. Their common tendon of origin arises from the coracoid process.

01.38

The tendon of the long head makes a strange journey. It runs up the bicipital groove, and passes inside the shoulder joint, to reach its origin from the supraglenoid tubercle of the scapula.

01.52

The two heads unite to form a single belly, which narrows to form this unusual tendon. The main part dives down between he radius and the ulna, and inserts on the radial tuberosity. On its lateral edge the tendon fans out, here it is in the intact forearm, into a thin sheet of fascia, the bicipital aponeurosis, which becomes continuous with the deep fascia surrounding the forearm. The aponeurosis gives the biceps an indirect attachment to the ulna.

02.26

The biceps flexes the elbow. It does this more efficiently when the forearm is pronated , because then it's fully stretched when it starts its action. The biceps can also be a powerful supinator of the forearm, as we'll see later.

02.42

The last of the three elbow flexors is brachioradialis. It arises halfway up the humerus, just below the radial tuberosity. It's inserted all the way down here, on the distal radius. Brachioradialis is an efficient flexor of the elbow, whether the forearm is pronated or supinated.

03.05

The action of the flexors is opposed by just one extensor muscle, the triceps. The triceps muscle has three heads, a long head, a lateral head, and a medial, or deep head.

03.24

The long head arises, as we saw in the last section, from the infraglenoid tubercle of the scapula. The lateral head arises high up on the lateral side of the posterior humerus. The medial head arises from a broad area lower down and more medially. As we'll see, the radial nerve runs next to the bone, between the lateral and medial heads

03.46

The three heads of triceps converge, to form this massive tendon, which inserts here, on the olecranon. Contraction of the triceps extends the elbow.

04.00

Just for completeness, we need to mention this tiny muscle, the anconeus. It runs from the lateral epicondyle to the lateral aspect of the proximal ulna. Anconeus is a very minor elbow extensor.

04.16

WRIST FLEXORS AND EXTENSORS

Now let's look at the muscles that produce pronation and supination. There are two of each.

04.22

Of the two pronator muscles, the larger and more proximal one is pronator teres. Along with several other muscles, it arises from the medial epicondyle. In addition it has a small deep head of origin which arises from this part of the ulna.

04.39

Here's the deep head of pronator teres. The median nerve passes between the two heads of pronator teres as it enters the forearm. Pronator teres inserts here, halfway down the lateral surface of the radius. Here's its action: pronation.

05.00

The second pronator muscle is pronator quadratus, which arises from the anteromedial aspect of the ulna, and inserts here, on the anterior surface of the radius. Here's the action of pronator quadratus.

05.16

Now let's look at the two muscles which produce supination. The one that we haven't seen yet is simply called supinator. Here it is. It arises from the lateral epicondyle, from the anular ligament, and from this ridge on the ulna, the supinator crest. It's inserted on the radius, along a line ending just above the insertion of pronator teres. The deep branch of the radial nerve runs through the supinator. It enters here, and emerges under here. Here's the action of supinator it's a nice match for pronator teres.

06.11

The other supinator muscle we know about already. It's the biceps. The insertion of the biceps on the radial tuberosity gives it plenty of power to rotate the radius,

especially when the elbow is flexed. When the biceps is working as a supinator, its flexing action is held in check by the simultaneous action of the triceps.

06.38

Because of the great strength which biceps contributes, supination is a more powerful action than pronation. Now let's look at the muscles which produce wrist movement. There are three flexors and three extensors.

06.54

We'll look at the flexors first. The two important ones are flexor carpi radialis, and flexor carpi ulnaris. They both arise from the medial epicondyle, where they share a massive tendon of origin, the common flexor tendon, with two other flexor muscles. In addition, flexor carpi ulnaris has an extensive ulnar head, which arises from this border of the ulna

07.26

The ulnar nerve, as we'll see, passes between the two heads of flexor carpi ulnaris as it enters the forearm. The two wrist flexors diverge, to arrive at the radial and ulnar sides of the wrist. Flexor carpi radialis passes through a deep ligamentous tunnel, and ends up inserting on the base of the second metacarpal.

07.53

Flexor carpi ulnaris inserts on the pisiform bone. From the pisiform, the pull of flexor carpi ulnaris is transmitted to the hamate bone, and to the base of the fifth metacarpal, by these strong ligaments, the piso-hamate and piso-metacarpal ligaments.

08.11

The two wrist flexors, acting together, produce flexion of the wrist. Acting separately, the ulnar and radial flexors contribute to ulnar abduction, and radial abduction respectively.

08.27

Lying between these two main wrist flexors is a third small one, palmaris longus. It arises from the medial epicondyle, like the other two. Its tendon, seen here in the intact forearm, lies superficial to all its neighbors, and inserts not into bone, but into this dense layer of fascia, the palmar aponeurosis, which covers the palm of the hand. Through this soft tissue insertion, palmaris longus helps to flex the wrist. It's frequently absent.

09.00

Now let's go round to the other side of the forearm and see the wrist extensors. Here they are: extensor carpi radialis longus, and brevis, and extensor carpi ulnaris. Brachioradialis, which you'll remember goes from here to here, has been removed in this dissection.

09.23

Extensor carpi radialis longus arises from the lateral epicondylar ridge, just below brachioradialis. Extensor radialis brevis arises from the lateral epicondyle, an origin which it shares with several other extensor muscles. They all arise together from the epicondyle and from this common extensor tendon.

09.43

Extensor carpi ulnaris arises from the lateral epicondyle, and it also has an ulnar head, just like flexor carpi ulnaris, which arises from this border of the ulna.

09.53

As the extensor tendons cross the back of the wrist they pass under this structure, the extensor retinaculum, which acts as a pulley. Extensor radialis longus and brevis are inserted on the bases of the second and third metacarpals, extensor ulnaris on the base of the fifth metacarpal.

10.14

When the wrist extensors act together, they extend the wrist. That's an important part of the action we make when we go to grip something. The powerful gripping

muscles, whose tendons run over the front of the wrist, are slack and feeble when the wrist is flexed, but become tight and powerful when it's extended.

1034

When the radial extensors, or the ulnar extensor contract separately, they help to produce radial or ulnar abduction of the wrist. They do this in conjunction with the corresponding wrist flexor muscle, either radial or ulnar.

10.50

It's good to study muscles function by function, as we've done so far in this section, but it's also important to see how they all overlap and fit together. If you'd like to use this next overview as a review section, turn off the sound.

11.16

REVIEW OF MUSCLES

Let's look at a dissection that includes all the muscles that we've looked at so far, in the arm and forearm, and in the adjoining shoulder region.

11.30

Here's the biceps, with its two heads hidden both by the deltoid, and by pectoralis minor. Here's the short head of biceps, running close to coracobrachialis.

11.45

Running up behind biceps and coracobrachialis is latissimus dorsi. Here's brachialis, going to its insertion on the ulna, and here's biceps, on its way to the radius. Here's pronator teres, crossing over from the medial epicondyle to the radius.

12.07

Also arising from the medial epicondyle here's flexor carpi radialis, palmaris longus, and flexor carpi ulnaris. Here's pronator quadratus, deep to everything. Let's go round to the other side. Here's the triceps, with its long head going up beneath the deltoid.

12.33

Here's teres major, and here's latissimus dorsi again, both lying in front of the triceps. Here's triceps going to its insertion on the olecranon. Here's brachioradialis, going to the radius here.

12.55

Here's extensor carpi radialis longus, and brevis, and extensor carpi ulnaris. Lying deep to all the muscles which share the common extensor tendon is supinator, all on its own.

13.08

BLOOD VESSELS

At this point our picture of the forearm is complete as to some functions, incomplete as to others. That's the way we're going to leave it for now. We'll be returning to the forearm in the next section to look at the important muscles there that we've not seen yet: the long muscles of the fingers, and of the thumb.

13.34

Now let's move on to look at the vessels and nerves of the region. We'll go from the shoulder to just below the elbow. First we'll look at the veins.

13.46

Many superficial veins from the forearm converge just below tghe elbow to form two large veins - the basilic and the cephalic. The cephalic vein stays at a superficial

level as it runs up the arm over the biceps. At the top of the arm it lies between deltoid and pectoralis major.

14.09

The large vein crossing the front of the elbow is the antecubital vein. It crosses from the cephalic, to the basilic vein. The basilic vein then runs up the medial aspect of the arm to join this brachial vein, which is one of a pair.

12.25

The two brachial veins join together as they pass up the arm, here they are joining, to become one brachial vein, The name of this vein then changes: up here it becomes the axillary vein.

14.40

To get a good look at it proximally we'll remove pectoralis major. Here's the axillary vein, running alongside the median nerve and the axillary artery, and disappearing with them behind pectoralis minor.

14.56

Now lets look at the artery, and the principal nerves of the arm. From here on the veins, which run parallel to the arteries, have been removed to simplify the picture.

15.07

Here's the main artery, the axillary artery. It emerges from beneath pectoralis minor surrounded by major nerves. As it passes into the arm its name changes. From here on down, its the brachial artery. Here , right next to the latissimus tendon, it gives off a large branch,the deep brachial, or profunda brachii , which passes backwards deep to the triceps. Along with it goes the radial nerve, which we'll see in a minute.

15.37

The brachial artery runs down the medial side of the arm, alongside the brachialis muscle. The median nerve crosses over the artery. The brachial artery passes beneath the bicipital aponeurosis, which we'll remove.

15.56

Alongside the biceps tendon it divides into the two major arteries of the forearm, the radial, and the ulnar. The radial artery stays quite superficial. It runs down the forearm between pronator teres and brachioradialis. The ulnar artery has a much deeper course. It dives down alongside the brachialis tendon, and passes deep to pronator teres.

16.23

We'll leave the arteries there. We"ll see their further course in the next section.

16.31

NERVES

Now we'll go back up to the top, and look at the nerves. Four nerves surround the axillary artery as it emerges from beneath pectoralis minor. They're the musculocutaneous, the median, the ulnar, and the radial. We'll look at them in that order.

16.51

The musculocutaneous nerve supplies three flexor muscles in the arm. The first of these is a flexor of the shoulder, coracobrachialis. The musculocutaneous nerve runs right through coracobrachialis, and emerges here, deep to the biceps. It runs down the arm between biceps and brachialis, supplying both muscles. It emerges here, to become the lateral cutaneous nerve of the forearm.

17.19

The median nerve and the ulnar both run all the way down to the elbow without supplying anything.

17.28

They start out close together. Halfway down the arm they diverge. The median nerve stays close to the brachial artery, crossing in front of it . At the elbow it lies medial to the artery. It dives down between the brachialis tendon and pronator teres, and passes between the two heads of pronator teres to enter the forearm.

17.50

The ulnar nerve slants backwards. It runs down just medial to the triceps tendon, and behind the medial epicondyle. It turns a sharp corner round the underside of the medial epicondyle, where there's a fibrous tunnel for it. It passes between the two heads of flexor carpi ulnaris to enter the forearm.

18.14

Once they get below the elbow, the median and ulnar nerves get busy. Between them they supply all the flexor and pronator muscles of the forearm. Of the muscles that we've seen already, the median nerve supplies four, pronator teres, flexor carpi radialis, palmaris longus, and pronator quadratus. The ulnar nerve supplies one muscle that we've seen so far, flexor carpi ulnaris.

18.45

Lastly, let's look at the radial nerve. It has a long spiral course, from here, round to here. Up here, the radial nerve lies behind all the other nerves and vessels. Just below the latissimus tendon it runs back between the long head and the medial head of triceps.

19.10

To follow its course, we need to go right round to the back, and find the same spot again from behind. Here's the long head of triceps, here's the medial head, and here's the radial nerve. To see where it goes, we'll remove the long head of triceps.

19.30

As the radial nerve passes round the humerus, it lies right on the bone. It runs between the medial and lateral heads of triceps, then runs beneath the lateral head, to emerge here, still right on the bone, just above brachioradialis.

19.51

Under cover of brachioradialis it reaches the ateral epicondyle, where it divides into a deep, or motor branch and a superficial, or sensory branch. That's as far as we'll follow the radial nerve for now. Of the muscles that we've seen, the radial nerve supplies the triceps, anconeus, brachioradialis, all three wrist extensors and supinator.

20.233

To end this section, let's briefly review first the vessels and then the nerves, from the shoulder to the elbow.

20.42

REVIEW OF BLOOD VESSELS AND NERVES

Here's the cephalic vein, and the basilic vein, the antecubital vein, the brachial vein, and the axillary vein. Here's the axillary artery the brachial artery the profunda brachii artery. At the elbow, the radial artery and the ulnar artery.

21.22

Now the nerves: here's the musculocutaneous nerve, the median nerve, the ulnar nerve, and the radial nerve, with its superficial branch and its deep branch.

21.47

That brings us to the end of this section. In the next section, we'll move on, to look at what the upper extremity is all about: the hand.

22.00

END OF PART 2