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

PART 3

THE HAND

00.00

To understand the hand we'll begin by looking at the bones and joints. Then we'll look at some important pulleys, and then we'll see the muscles. After that we'll add the vessels and nerves, and lastly we'll look at the skin.

00.19

The terms that we'll use for orientation are ulnar and radial for the sides of the hand, radial being the side with the thumb, and palmar and dorsal, for the front and the back.

00.34

BONES, JOINTS AND LIGAMENTS

To begin looking at the bones and joints of the hand, lets see what they're called. Here are the eight carpal bones, and here are the five metacarpals. Each finger has a proximal phalanx, a middle phalanx, and a distal phalanx. The thumb just has two phalanges, a proximal phalanx and a distal phalanx.

00.55

The joints of the hand have long names. The joints between the carpus and the metacarpals are the carpometacarpal joints. The joints between the metacarpals and the proximal phalanges are the metacarpo-phalangeal joints.

01.12

The joints between the phalanges are the interphalangeal joints - proximal and distal. We'll often refer to these joints as CMC joints, MP joints, and IP joints, for short.

01.28

To look in some detail at the bones and joints of the hand, we'll look first at the carpus, then at the four fingers with their metacarpals, then at the thumb with its metacarpal.

01.39

We saw he individual names of the carpal bones in theprevious section. Let's look at their overall shape. There are two bony projections on each side. On the ulnar side , the pisiform bone and this part of the hamate called the hook. On the radial side, the tubercle of the scaphoid and the crest of the trapezium. With these projections the bones of the carpus form the base and side walls of a space called the carpal tunnel.

02.07

Here's how the carpus looks in the living body. The radiocarpal, and mid-carpal joints are hidden by their heavy capsular ligaments. Here are those four projections again, the tubercle of the scaphoid, the crest of the trapezium, the pisiform, and the hook of the hamate. And here's the carpal tunnel, still without its roof.

02.34

Now let's move on to look at the metacarpals of the four fingers, and at their CMC joints. Here are the carpometacarpal joints. The bases of the four finger metacarpals, tightly packed together, articulate here, with the distal row of carpal bones. The base of the first metacarpal, the one for the thumb, articulates separately here, with the trapezium.

03.06

These four carpometacarpal joints allow only a small amount of movement. The fifth metacarpal is the most mobile, the fourth is less so, the third hardly moves at

all, and neither does the second. When the CMC joints are flexed, the metacarpal heads lie in a curve.

03.02

This strong ligament is the deep transverse metacarpal ligament. It keeps the metacarpal heads of the four fingers from spreading apart. As it crosses each MP joint,the ligament is continuous with a structure that we'll meet shortly, the palmar plate. Since it doesn't connect to the first metacarpal, the ligament doesn't prevent movement of the thumb away from the hand.

03.57

Next we'll move on to look at the bones and joints of the fingers themselves. The proximal and middle phalanges are flattened on their flexor aspects. The flexor tendons run along here. The sheath that surrounds the flexor tendons is attached to these ridges. The tip of the distal phalanx is flattened. The fibrous pulp of the fingertip is attached here. The bed of the fingernail is attached here.

04.26

Now let's look at the metacarpophalangeal joint, the MP joint. It's the joint at which the finger becomes separate from the hand. We'll take the other fingers away, so that we can see it from all sides.

04.40

The articular surface of the metacarpal head is curved in two planes, from side to side, and from front to back. The base of the proximal phalanx has a concave articular surface that's also curved in two planes.

04.59

The shape of the bones allows a wide range of flexion and extension at the MP joints. It also allows a range of side to side movement that's greater when the joints are extended, less when they're flexed. We'll see why that is in a minute. Let's see how the joint looks in the living body.

05.21

The MP joint has a capsule that's loose on the back to allow the joint to flex. On the front , the capsule thickens remarkably, into a tough piece of fibrocartilage, the palmar plate, also called the palmar ligament. The palmar plate moves along with the proximal phalanx when the joint flexes.

05.43

Here's the palmar plate incised, to show how thick it is. As we'll see, some important structures are attached to the palmar plate, or merge with it. One of them we've seen already, the deep transverse metacarpal ligament. It goes here.

06.01

Here we've removed most of the joint capsule, so that we can see the two massive collateral ligaments which hold the MP joint together. The collateral ligaments run obliquely from the back of the metacarpal head, to the front of the base of the proximal phalanx. The collateral ligaments are loose when the joint is extended, but when it's flexed, they become tight. So when the joint is extended, side to side movement can occur readily, but when the joint is flexed, the tightness of the ligaments prevents side to side movement.

06.40

We need to understand the names that are given to those side to side movementsat the MP joints. Spreading all the fingers apart is called abduction. Bringing them all together is adduction. Those are useful terms for describing those collective movements of the fingers, but when we're speaking of an individual finger, it's often simpler to speak instead of ulnar deviation and radial deviation.

07.06

Now let's move on to the interphlangeal joints. The proximal and distal IP joints are very much alike. They're different from the MP joints in that they only allow flexion, and extension

07.21

The head of the phalanx is curved mainly from front to back, with a slight depression in the middle. The base of the adjoining phalanx has a corresponding curve to it.

07.35

The capsule of an IP joint is much like that of an MP joint, but the collateral ligaments are different, in that they're equally tight in flexion and in extension.

07.53

Now let's move on from the fingers, to look at the bones and joints of the thumb The first carpo-metacarpal joint is the joint which gives the thumb its special position, and a great deal of its special mobility.

08.08

Let's take off the metacarpal heads, to see the joint surfaces. Here's the first CMC joint. It sits in front of the other CMC joints, and at an angle to them. Because of this, the thumb and its metacarpal lie in front of the fingers and their metacarpals. Because of the angle of the carpometacarpal joint, the thumb faces not forward, as the fingers do, but sideways, across the hand.

08.40

The articular surface on the trapezium is curved in two planes, from side to side, and from back to front. The base of the first metacarpal is curved in the same way. The shape of the joint surfaces enables the first metacarpal to move in this plane, and in this plane. We'll name those movements in a minute, but first let's look briefly at the other two joints of the thumb.

09.09

The MP joint of the thumb is unlike the finger MP joints. It's much more like an interphalangeal joint. It permits only flexion and extension. On its flexor aspect there are two tiny sesamoid bones, which are embedded in the joint capsule. The one interphalangeal joint of the thumb is just like the IP joints of the fingers.

09.32

Now let's go back to the CMC joint, and see how the first metacarpal moves, and what the movements are called. Movement away from the second metacarpal is called abduction. Movement toward it is adduction. Movements at right angles to this axis are called flexion and extension.

09.56

These two sets of movements often happen in combination. As it makes these movements, the first metacarpal also rotates around its own long axis, as the pen is doing. When it's abducted and flexed, it rotates medially. When it's adducted and extended it rotates laterally.

10.16

This rotation can't happen in isolation, but only as part of those other movements. It happens because of the curious and complex shape of the CMC joint surfaces. This important and complex movement of the thumb is called opposition. It's a combination of abduction, flexion, and medial rotation, all occurring here at the CMC joint. Because of the rotation that occurs, the tip of the thumb ends up pointing toward the fingers. Once the thumb is in opposition, flexion at the MP and IP joints brings the tip of the thumb into contact with the fingers

10.58

PULLEYS AND SLIDING STRUCTURES AND FASCIA

We've looked at the bones and joints of the hand, and at the movements they're capable of. Before we move on to look at the muscles which move the fingers and thumb, and the tendons by which they act, there are a number of important pulleys and sliding strutures that we need to understand. These structures guide the

direction of pull of the tendons as they cross the wrist joint, and pass along the fingers.

11.23

We'll look first at the two big pulleys at the wrist, the flexor retinaculum, and the extensor retinaculum.

11.30

Here's the flexor retinaculum. It's a tough , unyielding strap of fibrous tissue. The flexor retinaculum is the structure that forms the roof of the carpal tunnel. It's attached on the radial side to the scaphoid and the trapezium, and on the ulnar side to the pisiform bone, and the hook of the hamate. As we'll see, the median nerve , and all the flexor tendons to the fingers and thumb go through the carpal tunnel.

11.59

The flexor retinaculum branches off in two places, here and here, to enclose two small, separate tunnels. This one, on the radial side, encloses the tendon of flexor carpi radialis. This one, superficial and on the ulnar side, encloses the ulnar artery and nerve.

12.23

We'll be returning to the flexor retinaculum later, to look at some important structures that arise from it: the palmar aponeurosis, and some of the thenar and hypothenar muscles.

12.35

Let's go round now to the dorsal aspect of the wrist, to see the other big pulley, the extensor retinaculum. It runs obliquely, from this ridge on the radius, to the ulnar styloid, the triquetrum, and the hamate.

12.52

The extensor retinaculum has a number of deep extensions which are attached to the underlying radius. These divide the space under the retinaculum into several small, separate tunnels. All three wrist extensors, and all the extensor tendons to the fingers and thumb, pass under the extensor retinaculum.

13.17

Now let's look at the structures in the fingers, and in the thumb, which hold the flexor and extensor tendons in place, allow them to move, and guide their direction of pull.

11.28

In each finger this structure, the flexor tendon sheath, provides the two flexor tendons with a smoothly lined, tightly enclosing tunnel to run in. The sheath starts just proximal to the MP joint, and extends all the way to the distal phalanx. To see the sheath better, we'll divide it.

13.52

Parts of the sheath are thick and fibrous, and parts of it are thin and collapsible. On this finger we'll remove the thin parts of the sheath and just leave the thick parts. These act as pulleys for the flexor tendons, as we'll see. At each joint the sheath is attached to the edge of the palmar plate. Between the joints the sheath is attached along each phalanx.

14.20

The floor of the tunnel for the flexor tendons is formed by the palmar plates, and by the smooth flattened surfaces of the phalanges. The thumb has a similar flexor tendon sheath for its one long flexor tendon.

14.37

The arrangement for the extensor tendon is entirely different, and quite complex. On each finger the extensor tendon, and the tendons of three intrinsic muscles, come together to form a structure called the extensor mechanism. Let's take a look at it. We'll look at the muscles themselves a little later. So that we can see the extensor mechanism from all sides, well look at one finger in isolation.

15.08

Here's the extensor tendon, approaching the back of the MP joint. Here, both on the radial side, and on the ulnar side, is the tendon of one of the interosseous muscles. In addition here, on the radial side only, is the tendon of a lumbrical muscle. On each side a triangular sheet of tendinous tissue fans out, and connects the extensor tendon to the interosseous tendon. This triangular sheet is called the extensor hood.

15.41

The extensor tendon divides into three slips over the proximal phalanx. The central slip crosses the proximal IP joint and inserts here, on the base of the middle phalanx.

15.54

The slips on each side fuse with the interosseous tendon to form the two lateral bands. The lateral bands join together over the middle phalanx and insert here, on the base of the distal phalanx.

16.09

The thumb doesn't have such a complex extensor mechanism. The insertion of its two extensor tendons is relatively simple, as we'll see.

16.20

One last structure to look at before we move on to muscles is the palmar fascia, or palmar aponeurosis.

16.28

It's a dense triangular sheet of fibrous tissue which covers the middle part of the palm of the hand. Proximally it's continuous with the flexor retinaculum and with the tendon of palmaris longus. Distally it separates into slips, which insert into the edges of the palmar plates of the MP joints. The palmar fascia protects the underlying nerves, tendons and vessels from harm. The skin of the palm of the hand is firmly attached to it.

16.58

Now that we've looked at the bones, joints and pulleys of the hand, we're about ready to see the muscles. Before we do that, lets review what we've seen so far.

17.11

REVIEW OF BONES, LIGAMENTS, JOINTS, PULLEYS

Here are the carpal bones, the metacarpals, the proximal phalanges, middle phalanges, and distal phalanges; the carpometacarpal joints, the MP joints of the fingers, added words the proximal IP joints, the distal IP joints. On the thumb, the MP joint, and the IP joint.

17.48

The flexor retinaculum, and the side tunnel for the ulnar nerve, the extensor retinaculum, the flexor tendon sheath, the palmar plate, the collateral ligaments of the MP joint, the extensor mechanism, and the palmar aponeurosis.

18.17

End of time sequence

MUSCLES

Start of new time sequence

00.00

Now we'll move on to look at the muscles of the hand. We'll begin by looking at the extrinsic muscles, the long muscles of the hand which lie in the forearm. Then we'll move on to look at the intrinsic muscles, the short muscles that lie in the hand. Starting with the extrinsic muscles, then, we'll look first at the flexors of the

fingers, then at the extensors of the fingers, and lastly we'll look at the four long muscles of the thumb.

00.28

EXTRINSIC MUSCLES - FLEXORS OF THE FINGERS

Flexion of the fingers is produced by two long muscles, flexor digitorum profundus, and flexor digitorum superficialis

00.36

Here's the deep finger flexor, flexor digitorum profundus. It arises from the anterior and medial surface of the ulna, and from the interosseous membrane. Here are its four tendons, entering the carpal tunnel. We'll follow them in a minute. This adjoining muscle we'll see later on. It's flexor pollicis longus, the long thumb flexor.

01.10

Now let's add the superficial finger flexor, flexor digitorum superficialis to the picture. Here it is. It lies right on top of the profundus. It has two heads of origin, a radial head and a humero-ulnar head. The humero-ulnar head arises, as part of the common flexor tendon, from the medial epicondyle of the humerus, and also from the adjoining ulna. Its radial head arises from this long oblique line on the radius. Between the two heads there's a gap, which the median nerve and the ulnar artery both pass through.

01.50

The four separate tendons of flexor digitorum superficialis are bundled together as they enter the carpal tunnel. Before we follow the superficialis and profundus tendons into the hand, we'll bring the forearm to the upright position.

02.05

As the flexor tendons pass through the carpal tunnel, they're all enfolded within this common synovial sheath which extends into the palm of the hand. Just as the flexor tendons emerge from the carpal tunnel, the four profundus tendons give rise to these four intrinsic muscles, the lumbricals. We'll be looking at these later. For now we'll remove them to simplify the picture.

02.31

Just before reaching the MP joint, the superficialis and profundus tendons of each finger enter the flexor tendon sheath together. To follow them we'll remove the sheath. Over the proximal phalanx, the superficialis tendon splits into two halves, which pass around the profundus tendon. We'll remove. the profundus tendon for a moment. The two halves of the superficialis tendon re-unite, and as they do so they insert here, on the middle phalanx.

03.05

The profundus tendon (here it is back in place) emerges between the two halves of superficialisand continues distally to insert here, on the base of the distal phalanx.

03.20

The action of flexor digitorum superficialis is to flex the proximal IP joint, and the MP joint. The action of flexor digitorum profundus is to flex both the IP joints, and the MP joint.

03.41

EXTRINSIC MUSCLES - FLEXORS OF THE FINGERS

Now let's look at the muscles that extend the fingers. There are three, a large one, that extends all four fingers, and two small ones, for the index and little fingers.

03.51

The large one is extensor digitorum, sometimes called extensor digitorum communis. It arises from the common extensor tendon, and thereby from the lateral epicondyle. As it passes distally it divides into four slips, which pass together under the extensor retinaculum. We'll follow them beyond there in a minute.

04.13

The extensor muscle to the little finger, extensor digiti minimi, arises from the ulnar side of extensor digitorum, and passes under the retinaculum by itself. The extensor muscle to the index finger, extensor indicis, lies deep to extensor digitorum. It arises from the ulna and the interosseous membrane. Its tendon passes under the retinaculum along with extensor digitorum.

04.44

Emerging from beneath the extensor retinaculum, the extensor tendons fan out. As they approach the MP joints they branch and rejoin in an irregular fashion. Extensor indicis and extensor digiti minimi join the respective extensor digtorum tendons as they reach the MP joint. Here at the MP joint each extensor tendon gives rise to the extensor hood, then divides into three parts, as we saw when we looked at the extensor mechanism a little while back. The extensor muscles produce extension at all three joints of the finger. Their main effect is at the MP joint.

05.25

As we'll see later, the interosseous muscles and the lumbricals also have major roles in extending the interphalangeal joints.

05.33

EXTRINSIC MUSCLES - LONG MUSCLES OF THE THUMB

Now let's move on, to look at the long muscles of the thumb. The thumb has a long flexor, a long abductor, and two extensors, a long one and a short one.

05.43

The long flexor, flexor pollicis longus, lies deep in the forearm. We'll remove flexor digitorum superficialis to see it. Here's flexor pollicis longus, lying alongside flexor digitorum profundus. It arises from the anterior surface of the radius, and from the interosseous membrane.

06.08

Its tendon passes through the carpal tunnel with the finger flexors. Here's the tendon of flexor pollicis longus emerging. It enters the fibrous flexor sheath of the thumb, and inserts on the base of the distal phalanx. Flexor pollicis longus flexes both the MP joints and the IP joints of the thumb.

06.32

The other three long thumb muscles lie on the extensor aspect of the forearm. They lie deep to extensor digitorum, which we'll remove.

06.44

This is the long abductor, abductor pollicis longus, and these are the extensors, extensor pollicis brevis, and longus. The abductor arises from the radius here, and also from the interosseous membrane. The two extensors arise a little more distally, the short one here, the long one here.

07.09

Here's extensor digitorum back in the picture. The three thumb muscles emerge obliquely from beneath the extensor digitorum. Their tendons pass beneath the extensor retinaculum, extensor longus by itself, the other two together.

07.28

The tendon of abductor pollicis longus inserts round here, on the base of the first metacarpal. Extensor pollicis brevis inserts on the base of the proximal phalanx, and extensor pollicis longus inserts on the base of the distal phalanx.

07.46

The movement produced by abductor pollicis longus is a combined abduction and extension occurring at the CMC joint. It's the reverse of opposition.

07.59

Extensor pollicis longus extends the IP joint and the MP joint of the thumb. Extensor pollicis brevis extends only the MP joint.

08.10

We've now seen all the extrinsic muscles of the hand. Before we move on to look at the intrinsics, let's back up, and see how the extrinsics fit in with the elbow muscles, the rotator muscles, and the wrist muscles that we saw in the last section. If you'd like to use this next overview as a review section, turn off the sound.

08.32

REVIEW OF ALL FOREARM MUSCLES

Here are all the muscles intact. Here's biceps, brachialis, and brachioradialis. We'll remove brachioradialis. Here, arising from the medial epicondyle and sharing the common extensor tendon, are pronator teres, partly hidden, and the three wrist flexors, flexor carpi radialis, palmaris longus, and flexor carpi ulnaris.

09.07

We'll remove the wrist flexors, but leave pronator teres still in place. Here's flexor digitorum superficialis. Its long oblique origin runs right next to pronator teres.

09.23

We'll remove pronator teres, and flexor digitorum superficialis. Here are the three deepest muscles, flexor digitorum profundus, flexor pollicis longus, and beneath them all, pronator quadratus.

09.42

Now let's look at all the muscles on the extensor aspect of the forearm. We've already removed brachioradialis, it went from here to here. Here are extensor carpi radialis longus, and brevis, and extensor carpi ulnaris. Here between the wrist extensors, sharing the common extensor tendon, is extensor digitorum.

10.09

We'll remove the wrist extensors to see extensor digitorum by itself. Here's extensor digitorum. Supinator lies deep to it here, and distally the three long thumb muscles emerge from beneath it.

10.28

Removing extensor digitorum, we see supinator, abductor pollicis longus, extensor pollicis brevis and longus, and extensor indicis.

10.46

INTRINSIC MUSCLES - INTEROSSEI AND LUMBRICALS

Now we'll move on to look at the intrinsic muscles of the hand. They're in four groups: the interosseous muscles, the lumbricals, the short muscles of the thumb, and the short muscles of the little finger.

11.05

There are seven interosseous muscles, or interossei. Here they all are together. There's one for each side of the index, middle, and ring fingers, and one for the radial side of the little finger. By tradition they're divided into these four dorsal

interossei, and these three palmar ones, but to understand what they do, it's simpler to consider them in twos, like this.

11.34

The two interossei for the middle finger are a typical pair. They arise from the shaft of their own metacarpal, and from its neighbors. They pass behind the deep transverse metacarpal ligament. We'll remove the ligament, and we'll also remove the other fingers and metacarpals to simplify the picture. On each side of the MP joint, the interosseous muscle narrows down to a double tendon, which has a long part, and a short part.

12.03

The short part inserts here on the base of the proximal phalanx. The long part of the interosseous tendon joins the extensor mechanism to become its most outlying part. Merging with the lateral slip of the extensor tendon, it forms the collateral band of the extensor mechanism. The two collateral bands come together distally, as we've seen, to insert here on the distal phalanx.

12.30

The line of action of the interosseous tendon passes in front of the axis of rotation of the MP joint, marked by this pin, and behind the axes of the two IP joints. When the two interosseous muscles of a finger contract together, their action is to flex the MP joint, and extend both the IP joints. When one of the interossei contracts separately, it produces either ulnar deviation, or radial deviation at the MP joint.

13.06

The many fine gradations of finger movement are produced by complex interactions between the interossei, the lumbricals, and the long flexors and extensors.

13.18

The interosseous muscle on the radial side of the index finger is unusually large. It's the first dorsal interosseous muscle. It has two heads, which arise from the first, and from the second metacarpals. The radial artery, coming round the side of the carpus, passes between its 2 heads, as we'll see.

13.43

The first dorsal interosseous produces powerful radial deviation of the index finger. It's one of a pair of intrinsic muscles that are strongly involved in this action, called key pinch, as in holding a key.

13.58

We'll see the other one of the pair, adductor pollicis, when we look at the thumb muscles. Let's move on now to look at the four lumbrical muscles.

14.08

Here are the lumbricals, one for each finger. Each lumbrical muscle arises from the side of one or both of the adjoining flexor digitorum profundus tendons. The lumbricals pass in front of the deep transverse metacarpal ligament. Each lumbrical inserts on the radial side of the extensor mechanism, just distal to the long part of the interosseous tendon. The action of the lumbricals reinforces the action of the interossei in extending the IP joints. They also assist in radial deviation of the MP joint.

14.46

INTRINSIC MUSCLES - SHORT MUSCLES OF THE THUMB AND LITTLE FINGER

Now we'll move on to look at the four short muscles of the thumb. One of them lies by itself, and three lie close together. The one that's by itself is adductor pollicis, the other key pinch muscle.

15.01

Adductor pollicis has two heads, a transverse head and an oblique head. The transverse head arises from the third metacarpal. The oblique head arises from the ligaments in the base of the carpal tunnel. Adductor pollicis inserts on the ulnar sesamoid bone, and on the base of the proximal phalanx of the thumb. Adductor pollicis produces adduction at the carpometacarpal joint.

15.30

The other three thumb muscles make up this bulge, that's called the thenar eminence. Collectively these three are called the thenar muscles. On the outside are flexor pollicis brevis, and abductor pollicis brevis. Deep to them both is opponens pollicis.

15.53

Abductor brevis arises from the trapezium, and from the flexor retinaculum. Flexor brevis arises from the flexor retinaculum and from the trapezoid. These two muscles insert here, on the base of the proximal phalanx of the thumb, on the radial side.

16.11

Opponens pollicis, here it is by itself, arises from the trapezium, and from the flexor retinaculum, and inserts along the radial side of the first metacarpal.

16.23

The three thenar muscles overlap, and their actions overlap too. Between them they produce abduction and flexion at the carpometacarpal joint, bringing the thumb away from the second metacarpal and across the palm, and thereby also rotating it medially. As we've seen, these movements add up to opposition of the thumb.

16.50

Lastly, let's look at the three short muscles of the little finger. They make up this smaller bulge, the hypothenar eminence, and collectively they're called the hypothenar muscles.

17.03

They're arranged in much the same way as the thenar muscles, and their names are similar. On the outside are abductor digiti minimi, and flexor digiti minimi. Deep to them lies opponens digiti minimi

17.19

The abductor arises from the pisiform bone, and inserts just like an interosseous muscle, partly into the base of the proximal phalanx, and partly into the extensor mechanism.

17.33

The flexor arises from the hamate bone, and the flexor retinaculum, and inserts near the abductor on the proximal phalanx. The opponens arises from the hook of the hamate, and inserts along the ulnar side of the fifth metacarpal. The ulnar nerve and artery pass underneath the flexor and opponens as they enter the hand.

17.56

The abductor has the same actions as an interosseous muscle. The flexor helps to flex the MP joint, and the opponens produces flexion of the fifth metacarpal at the carpometacarpal joint. These three muscles help to make the little finger specially mobile.

18.18

Now that we've looked at the extrinsic muscles and the intrinsic muscles of the hand, let's see how they all fit together. This can be a review session, if you'd like to turn off the sound.

18.30

REVIEW OF ALL HAND MUSCLES

Here's the hand with all the muscles and long tendons present. On the back, here are the tendons of extensor digitorum, extensor indicis, and extensor digiti minimi.

18.47

Deep to the extensor tendons are the interossei. Here's the tendon of extensor pollicis longus, and brevis, and abductor pollicis longus.

18.59

On the front, here's the palmar aponeurosis, which we'll remove. Here are the tendons of flexor digitorum superficialis, and profundus, and here's one of the lumbrical muscles.

19.17

Here's flexor pollicis longus, surrounded by flexor pollicis brevis. Here are abductor pollicis brevis, and deep to it, opponens pollicis. Here are abductor digiti minimi, together with flexor digiti minimi, and deep to them opponens digiti minimi.

19.38

We'll remove the flexor tendons, to see adductor pollicis, and the interossei. The three most radial interossei lie here, behind adductor pollicis.

19.51

BLOOD VESSELS

Now we'll move on to look at the principal veins, arteries and nerves of the hand. First, the veins.

20.06

We've filled the veins by injecting blood here. That's why the veins of this finger stand out so much more clearly. The small veins of the thumb, fingers and hand pass mainly to the the dorsal aspect of the hand, to join these large superficial dorsal veins. Crossing the wrist, these are joined by the superficial veins draining the dorsal aspect of the forearm. These unite to form the cephalic vein, seen here at the elbow.

20.36

The veins draining the flexor aspect of the forearm unite to form the basilic vein. The antecubital vein passes from the cephalic to the basilic just below the elbow.

20.50

We'll remove the superficial veins, and the superficial fascia, to see some of the deep veins of the forearm. These run alongside the arteries. Here are the accompanying, or concommitant veins of the radial artery, coming together with those of the ulnar artery, just below the elbow.

21.09

Next, let's look at the two main arteries of the hand, the radial, and the ulnar. In the dissection we'll see, the arteries have been injected with red latex to make them more visible.

21.20

The radial artery runs down the forearm deep to brachioradialis. It lies on pronator teres, flexor digitorum superficialis, and flexor pollicis longus. In the distal foream the radial artery emerges from beneath brachioradialis, and lies superficially, between the border of the radius, which is here, and the tendon of flexor carpi radialis.

21.46

At the wrist, the radial artery gives off this superficial branch, then spirals around the lateral aspect of the wrist, running beneath the tendons of abductor pollicis longus, extensor pollicis brevis, and extensor pollicis longus. It passes between the two heads of the first dorsal interosseous muscle, one of which we'll remove,

and gives off branches to the thumb and sometimes the index. Finally it passes between the two heads of adductor pollicis, to enter the palm. We'll see where the radial artery goes in a minute.

22.26

Now, let's go back up to the elbow, and look at the ulnar artery. It has a much deeper course. The ulnar artery passes beneath pronator teres. To see where it goes, we'll remove pronator teres, and flexor carpi radialis.

22.45

After passing beneath pronator teres, the ulnar artery gives off the common interosseous artery. It then passes between the two heads of flexor digitorum superficialis. To follow it we'll go round to the ulnar side of flexor digitorum superficialis and raise it up. Here's the ulnar artery. It runs down the forearm between flexor digitorum superficialis, and profundus.

23.16

In the distal forearm it emerges, along with the ulnar nerve, between flexor digitorum superficialis and flexor carpi ulnaris. At the wrist it passes through the tunnel in the side of the flexor retinaculum, to reach the hand.

23.35

Let's get re-oriented. Here's the radial artery, with its superficial branch; here's the ulnar artery. Emerging from its fibrous tunnel, the ulnar artery divides, into a large superficial branch, and a smaller deep branch. The deep branch dives between the hypothenar muscles.

24.00

The superficial branch runs behind the palmar aponeurosis, which we'll remove, and runs across the palm in front of the flexor tendons. It usually ends by anastomosing with the superficial branch of the radial artery, forming a loop called the superficial palmar arch. The superficial palmar arch gives off these common digital arteries.

24.25

Each common digital artery divides into two digital arteries. Each digital artery runs along one side of the finger, beside the flexor sheath, in company with the digital nerve. At the tip of the finger the two digital arteries re-join, to form this terminal anastomosis.

24.46

Now let's see what happens to the radial artery in the hand. We last saw the radial artery running around the wrist, and disappearing here between the heads of adductor pollicis. To see where it comes out, we'll go round to the front of the hand and remove the superficial palmar arch, and the flexor tendons.

25.05

Here's the radial artery emerging. It crosses in front of the interossei, usually anastomosing with branches of the ulnar artery to form the deep palmar arch.

25.18

NERVES

Now we'll look at the three main nerves of the forearm and hand, the radial, the median and the ulnar. We'll go back to where we last saw the radial nerve.

25.30

Here we are at the elbow, with braschioradialis retracted. Here's the radial nerve. It diivides, as we saw, into a superficial and a deep branch. The superficial branch runs down the forearm deep to brachioradialis. In the distal forearm it passes backwards and emerges from beneath the brachioradialis tendon Approaching the wrist it crosses over extensor pollicis brevis, and longus, to reach the back of the hand.

26.03

The superficial branch of the radial is entirely a sensory nerve. It supplies, usually, the radial half of the back of the hand, the back of the thumb, and part of the back of the index.

26.17

The deep branch of the radial nerve, also known as the posterior interosseous nerve, is a motor nerve. As we saw in the last section, it passes through the supinator , and emerges here, deep to extensor digitorum. It breaks up into several branches. Between them these supply extensor carpi ulnaris, extensor digitorum and the other two finger extensors, and these three long thumb muscles, abductor pollicis longus, and extensor pollicis brevis, and longus.

26.54

Now let's look at the median nerve. Let's go back to the elbow, where we saw it in the last section.

27.02

Here's the median nerve, next to the brachial artery. To see where it's going we'll retract flexor carpi radialis. The median nerve first dives between the two heads of pronator teres. It then immediately passes between the two heads of flexor digitorum superficialis.

27.24

The median nerve passes down the forearm between flexor digitorum superficialis and profundus. It emerges at the wrist to the radial side of the superficialis tendons. It's crossed by the tendons of palmaris longus and flexor carpi radialis.

27.43

The median nerve passes through the carpal tunnel to reach the hand. It lies just beneath the palmar aponeurosis, which has been removed here. The median nerve gives off this small motor branch to the thenar muscles, and then gives off these three common digital nerves. The common digital nerves break up into palmar digital nerves, two each for the thumb. index, and middle fingers, and usually one for the radial side of the ring finger.

28.15

The median nerve typically provides sensation to the medial half of the palm, the flexor aspect of the thumb, the index and middle fingers, and the radial side of the ring finger.

28.27

Of the extrinsic hand muscles, the median nerve supplies flexor digitorum superficialis, flexor pollicis longus, and the radial half of flexor digitorum profundus. Of the intrinsic hand muscles, it supplies only the three thenar muscles, and the radial two lumbricals.

28.50

Lastly, let's look at the ulnar nerve. As you'll recall from the last section, the ulnar nerve enters the forearm by passing round the medial epicondyle, and between the two heads of flexor carpi ulnaris.

29.04

Here's the ulnar nerve. It runs down the forearm between flexor carpi ulnaris, and flexor digitorum superficialis, with profundus deep to it. Here, it gives off a dorsal sensory branch, which goes to the back of the hand. At the wrist, it runs along the radial side of flexor carpi ulnaris. Along with the ulnar artery it passes through the side tunnel in the edge of the flexor retinaculum.

29.33

Here it is emerging from the tunnel. Again the palmar aponeurosis has been removed. The ulnar nerve divides into a superficial branch and a deep branch. The superficial branch divides into palmar digital nerves for the little finger, and typically the ulnar side of the ring finger. The deep branch passes between the hypothenar muscles. To follow it we'll remove the flexor tendons. The deep

branch of the ulnar nerve runs across the palm in front of the interossei. It passes in between the two heads of adductor pollicis, we'll remove the transverse head, to reach the most radial of the interossei.

30.19

The ulnar nerve typically provides sensation to the ulnar half of the back and the front of the hand, and to the little finger and the ulnar half of the ring finger.

30.34

Of the extrinsic hand muscles, the ulnar nerve supplies only the ulnar half of flexor digitorum profundus. Of the intrinsic hand muscles it supplies the hypopthenar muscles, all the interossei, adductor pollicis and the ulnar two lumbricals.

30.59

Before we move on to look at the skin of the hand, let's briefly review what we've seen of the vessels and nerves.

31.09

REVIEW OF VESSELS AND NERVES

Here's the cephalic vein, the basilic vein, and the antecubital vein. Here's the radial artery, in the forearm, and at the wrist; the ulnar artery in the forearm, and at the wris; the superficial palmar arch, common digital arteries, and digital arteries, and the deep palmar arch.

32.05

Here's the radial nerve, with its deep branch, and its superficial branch. Here's the median nerve in the forearm, and at the wrist, with its motor branch, the common digital nerves, and digital nerves.

32.38

Here's the ulnar nerve in the forearm, here's its dorsal sensory branch. Here's the ulnar nerve at the wrist, with its superficial branch, and its deep branch. Here's the distribution of the radial nerve, the median nerve, and the ulnar nerve.

33.14

SKIN, FINGERNAILS

Last of all, we'll take a look at the skin of the hand, and at the fingernails. On the back of the hand the skin is thin, and freely movable. This underlying layer of loose areolar tissue enables the skin to move. When the wrist and the MP joints are extended, the skin is loose and redundant. When they're flexed, it becomes tight.

33.52

By contrast, the skin on the front of the hand is quite thick, and much less movable. It's fixed to the underlying palmar aponeurosis by many strands of tough fibrous tissue. The creases on the palmar skin are lines along which the skin is thinner. The creases act as joints in the skin when the MP joints flex.

34.20

It's easy to see where the MP joints are when we look at the back of the hand. But because of the way the skin slopes forward in between the bases of the fingers, the position of the MP joints can be a surprise, when we're looking from the front of the hand. The MP joints aren't here, they're right back here, in line with the distal palmar skin crease.

34.46

So fully half the length of the proximal phalanx of each finger lies beneath the skin of the palm. On the fingers, as in the hand, the skin is thin and extensible

on the back, thick and deeply creased on the front. Let's take a close look at the specialized skin of the fingertip.

35.07

The skin of the fingertip contains huge numbers of sensory nerve endings. The pulp of the fingertip is composed of fat, interlaced with many fibrous strands which anchor the skin to the distal phalanx.

35.24

The fingernail is a hard plate of keratin that's produced by the specialized epithelial cells which lie beneath its base, here. A fold of skin overlaps the edge of the nail, and adheres to it closely. We'll remove the skin on one side, to see the full extent of the nail, here's its edge; and we'll take away one half of the nail, to see the underlying nailbed, or nail matrix.

35.56

Finally we'll remove part of the nailbed, here's the cut edge of the nailbed. It's closely adherent to the underlying distal phalanx. The actual nail forming tissue is just here. It's the nail forming tissue that produces this pale area, the lunula, at the base of many peoples' nails.

36.19

That brings us to the end of this tape on the upper extremity. The remaining tapes of the Video Atlas will be the lower extremity, the trunk, the organs of the thorax and abdomen, and the head and neck.

36.33

END OF VOLUME 1