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Undergraduate Methods for Hand Dissection in Human Cadavers



JOESEPH D. MANRING

WARNING: THE FOLLOWING MANUSCRIPT CONTAINS GRAPHIC IMAGES AND CONTENT DESIGNED FOR MEDICAL AND ACADEMIC PURPOSES. DO NOT CONTINUE BEYOND THIS POINT IF YOU ARE DISTURBED OR OFFENDED BY THE DISSECTION AND STUDY OF HUMAN CADAVERS.

Foreword

The procedure outlined in this document is intended to serve as a quick reference and dissection guide for an interested student of anatomy. This dissection will go beyond the “bare minimum” and will elucidate structures that typically are only minimally studied during undergraduate coursework. If you are attempting to follow this procedure it is recommended that you prepare to invest a large amount of time outside of your regularly scheduled lab to do so. The goal of this text is to provide a procedure by which an undergraduate student may expand their knowledge of the human hand out of professional or academic interest, rather than necessity.

*****Disclaimer*****

This document is not intended to serve as a replacement for any course material or instruction. It is by no means a complete educational text, and should only be used to supplement or aid in the cadaver dissection learning experience.

About the Author

Joeseph D. Manring is a senior undergraduate student in his last semester at Southern Utah University. This document was created from his notes, records, research, and tireless effort to become a professional in the health sciences. His declared baccalaureate degree plan is a dual major in Biology and Chemistry, with an emphasis in health care.

Introduction

This text will assume that you already have a firm grasp of the anatomy of the forearm and extrinsic hand muscles. If that is not the case, stop now and review before you do any work with the cadaver. It is important not to cut if you don’t know with certainty what you’re looking for, and to never cut what you cannot clearly see. If you work carefully and follow these basic guidelines, your dissections will become a much more fruitful and enjoyable experience.

Removing the Skin

The arm of the cadaver is most easily skinned by using three incisions. The first is a radial incision around the arm at the most proximal end of your dissection. For our purposes this incision could be in the mid-brachial region, but if you're planning on removing the skin from the entire cadaver this doesn't have to be specific. Your second incision will be a single cut that starts from your radial incision, and extends all the way down the anterior face of the arm until it reaches the most proximal portion of the palm. Your final incision is another radial cut around the distal wrist.

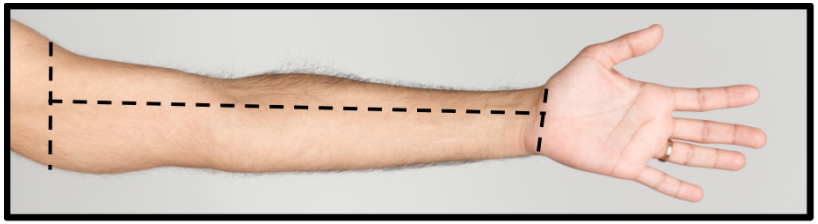
Next, you'll need to carefully remove the skin from the back of the hand and palm. It is very important that you do this as superficially as possible, **or you will damage the underlying structures**. At this point, if you pay close attention to your scalpel you will immediately feel a change if you are cutting something you shouldn't be.

Finally, remove the skin from each finger by starting at the tip and working your way to the proximal attachment. This is a great way to avoid damaging any of the vessels and nerves because there are very few structures in the fingertips. While it is possible to remove the fingernails, it is not necessary. Work around them.

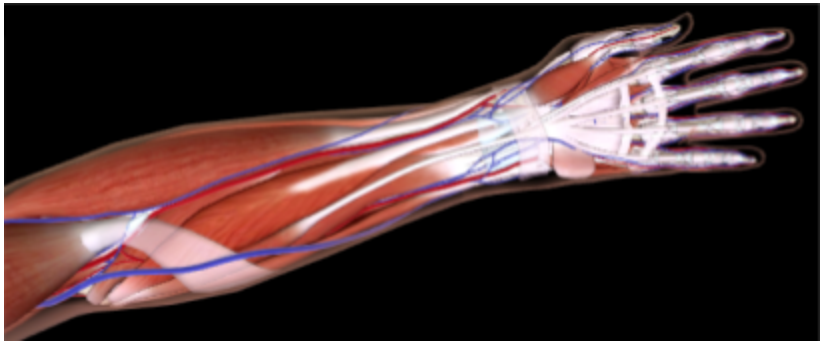
Now that all of the skin is removed, you should be able to clearly see an opaque sheath that covers nearly all of the musculature. This is a part of the **deep fascia**.

Look out!

It is very easy to sever the cutaneous veins and nerves during the skinning process. It may not be worth the time investment to completely isolate them, but you need to decide what you are interested in visualizing before you begin! Even though veins are incredibly variable between individuals, there are a few common structures that you may want to take note of. Can you identify the **cephalic**, **basilic**, and **median cubital veins**?



Dotted lines represent the three arm incisions. Palmar and digital incisions omitted for clarity, as they are highly subjective and complex.



Graphical representation showing the cephalic, basilic, and median cubital veins in blue.

Deep Fascia

The deep fascia is a very dense layer of connective tissue that is intimately bound to the muscles of the arm. Throughout the body it divides the muscles into neat compartments, but in the limbs it can be quite difficult to remove without tearing the muscles. It is important to understand that you will do minor damage to the musculature, but there are a few strategies that will minimize this. Your ability to isolate and identify structures should therefore be unimpaired. **Take your time**. This part of the dissection can be incredibly time consuming, and your patience will be tested throughout.

Use tweezers or forceps to grab a very small portion of the fascia, and use a scalpel or small probe to make a hole. Insert your probe between the deep fascia and the muscle and gently tease them apart. Once you have made a large enough starting position, you can use your fingers to peel them away from each other. As you do this **blunt dissection**, you will notice that there are “hard-points” where layers of fascia meet. These are places where the nerves and arteries move between compartments. You should cut these minor structures so that you can completely isolate the compartments and slowly remove the majority of the deep fascia. You will not be able to remove all of the deep fascia yet, but when you move on to isolating muscle groups you will be able to clean this part of the dissection up much further.

In the actual hand, the anterior portion of the deep fascia is a lot easier to remove. The palm however, has an added layer of complexity. The deep fascia blends into a triangular structure



Anterior view of the forearm with most of the deep fascia and superficial veins attached.



Anterior view of the forearm with deep fascia and superficial vasculature removed. Note that the palmar aponeurosis has been isolated and is easily identifiable.

called the **palmar aponeurosis**, which is a fibrous segment of connective tissue with fibers that spread distally from the wrist. At this point, you should take note of whether your cadaver has the vestigial **palmaris longus** muscle (~25% of people do not have it). If your cadaver does not have this muscle, you should completely remove the palmar aponeurosis. If your cadaver does have this muscle, the palmaris longus tendon and the palmar aponeurosis are connected and become one common structure. Cut deep to the palmar aponeurosis while taking care not to damage the blood vessels below it, and slowly relieve its connection to the palm. Finally, cut the most distal portion of the aponeurosis away from the hand. It should remain attached to the palmaris longus tendon if your cadaver has one, and they can be reflected together.

There is comparatively small amount of dense connective tissue in the phalanges. As long as care has been taken to preserve their smaller structures, your first goal in the digits will be to identify the **digital arteries** and **digital nerves**. We will continue working on the major finger structures shortly.

Identifying Extrinsic Muscles of the Hand and Wrist

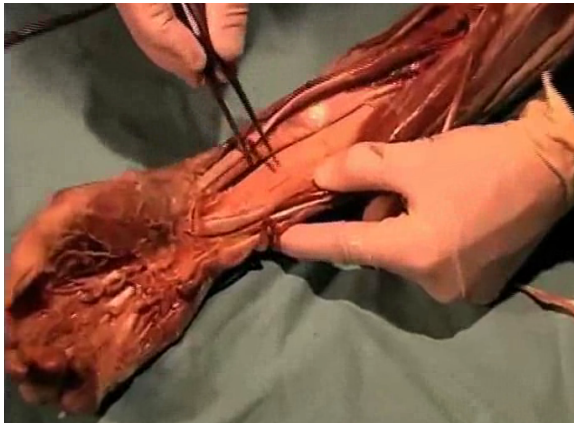
Your next step is to start isolating muscles from one another the deep fascia that you did not initially remove. As you get deeper into each compartment, you will be able to cut away more fascia. There are a lot of muscles that you will be targeting here, and you will notice that the muscle bellies often become difficult to separate as you move more proximally. After you have identified each muscle, separate them as much as possible without causing any excessive damage.

Look out!

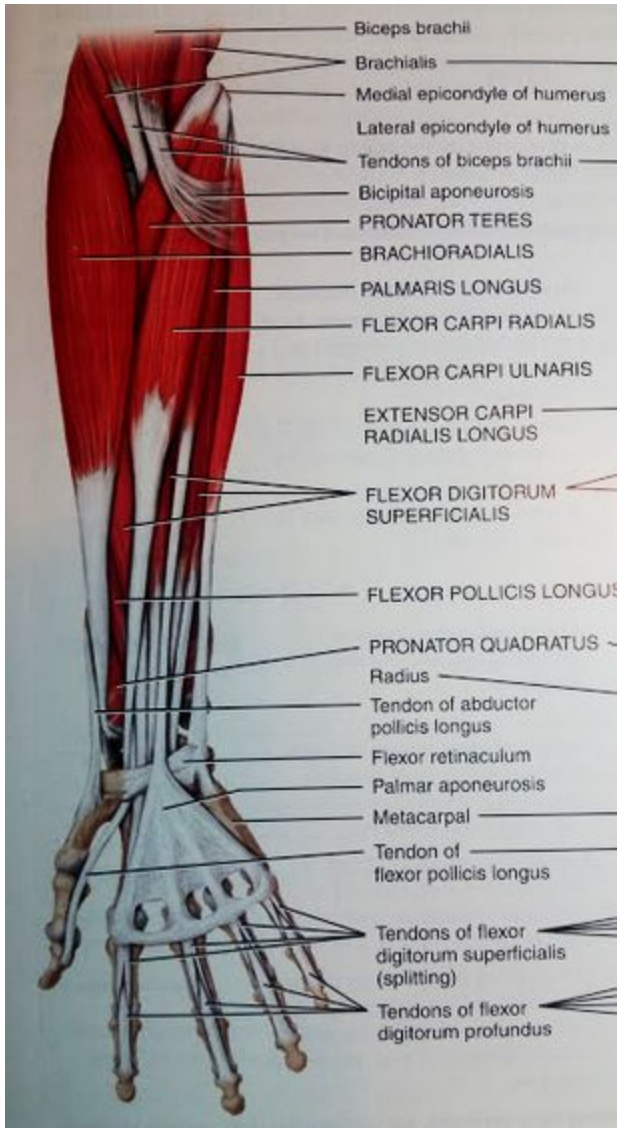
Many of the tendons in the forearm arise from the same muscle belly and shouldn't be separated at all. Even though most of this is done via blunt dissection, our core tenets still apply. It would be very easy to rip apart some of these shared structures so if you don't know precisely what you're working on, STOP UNTIL YOU DO!



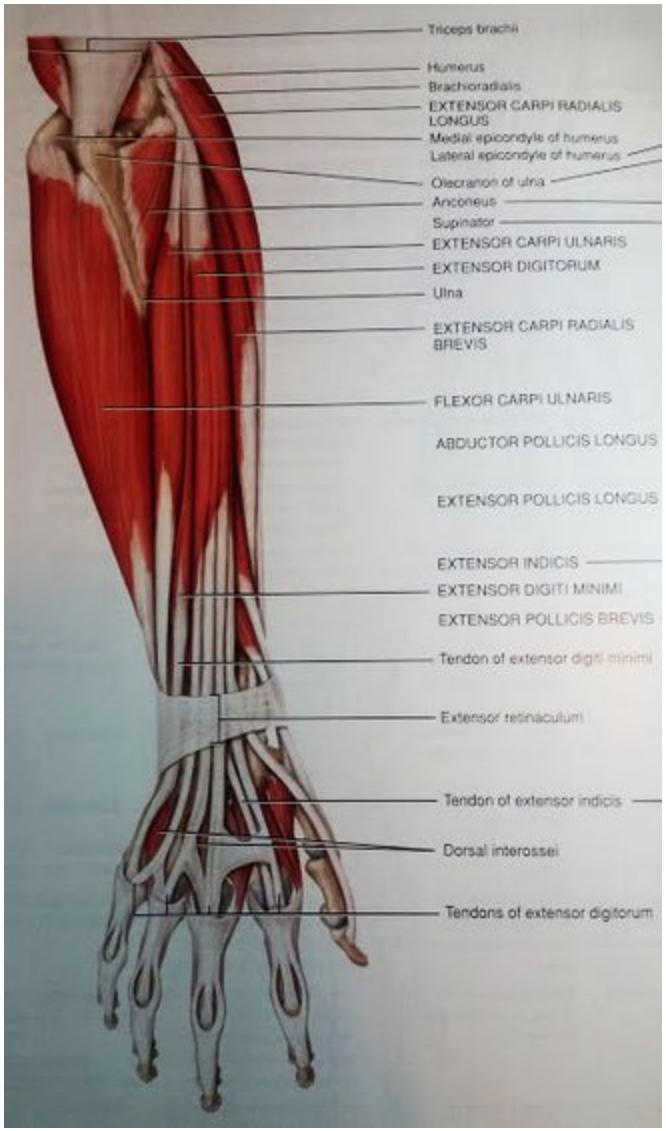
Posterior superficial dissection with extensor indicus clearly exposed. This is the level of isolation your cadavers muscles should have at this point in the dissection.



Anterior intermediate dissection with flexor digitorum superficialis reflected to clearly expose flexor digitorum profundus below.



Anterior superficial diagram of the extrinsic muscles of the hand and wrist. Extensor carpi radialis longus is immediately deep to brachioradialis, but is not visible in the image.



Posterior superficial diagram of the extrinsic muscles of the hand and wrist.The tendons of abductor pollicis longus, extensor pollicis longus, and extensor pollicis brevis are clearly visible on the right.

You will quickly realize that identifying every muscle is much harder to do in the cadaver than it is in any diagram or model, but this experience provides one of the most significant benefits of a thorough dissection. One way to improve at this is to use the tendons of each muscle, and their insertions, to guide you while you practice. You should also pull at the tendons to observe their actions in order to help you understand the function and logical name of each muscle.

Many of the previous structures should look familiar to you from your anatomy courses but as we continue distally through (and beyond) the **carpal tunnel**, we will be able to observe increasingly foreign landmarks.

Creating a Window into the Carpal Tunnel

At this point you should have a fairly clean dissection of the arm and hand, but you may have noticed that it is still very difficult to see the internal structures of the hand. In addition, your ability to further isolate the structures that cross the carpal tunnel may be limited. To solve this, you are going to create a **window** through the carpal tunnel.

Before you make any additional cuts, ensure that you have removed the vast majority of the connective tissue around the wrist, and that the **flexor retinaculum** is clearly isolated. You should be able to see slightly inside the carpal tunnel at this point.

When you are certain that this is has been sufficiently done, gently insert a probe into the proximal side of the carpal

Quick Reference: List of Extrinsic Target Muscles

- **Flexor carpi radialis**
- **Palmaris longus**
- **Flexor carpi ulnaris**
- **Flexor digitorum superficialis**
- **Flexor pollicis longus**
- **Flexor digitorum profundus**
- **Extensor carpi radialis longus**
- **Extensor carpi radialis brevis**
- **Extensor digitorum**
- **Extensor digiti minimi**
- **Extensor carpi ulnaris**
- **Abductor pollicis longus**
- **Abductor pollicis brevis**
- **Extensor pollicis longus**
- **Extensor indicus**



Transverse section of the wrist with the carpal tunnel clearly visible in a cadaver.

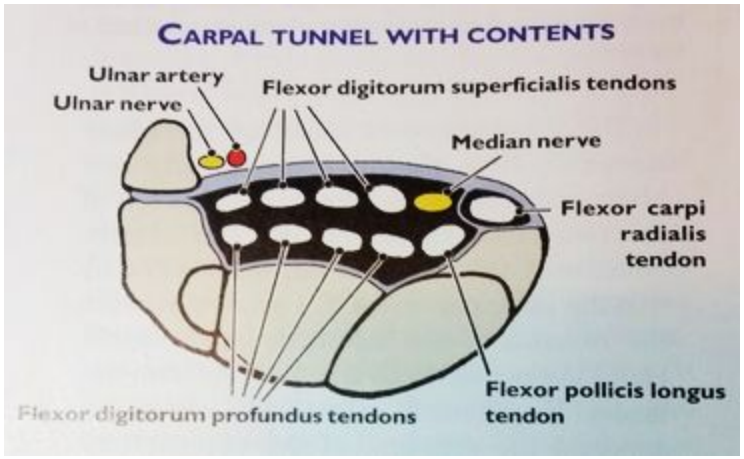
tunnel until it passes through and is visible in the hand. It is very important that the probe is as superficial as possible, and that there are no structures between it and the flexor retinaculum. Using the probe to regulate your scalpel depth and to guide you, you should make your first incision across the flexor retinaculum. Using forceps and a pair of scissors, you can now easily trim away any excess tissue so that the window is at its maximum width.

A good opportunity has now presented itself to you, such that you may easily complete your isolations of flexor digitorum superficialis and flexor digitorum profundus at any time. You may now cut the **fibrous digital sheaths** on each digit, finalizing your finger dissection and liberating the tendons all the way to their distal insertions. This can be done with a single lateral incision on the anterior surface of each phalanx if you avoid the digital arteries. **The tendons within the synovial sheaths are under a great deal of pressure and as such, they will "pop" out of the connective tissue when you make your incision. Be prepared for this to occur!**

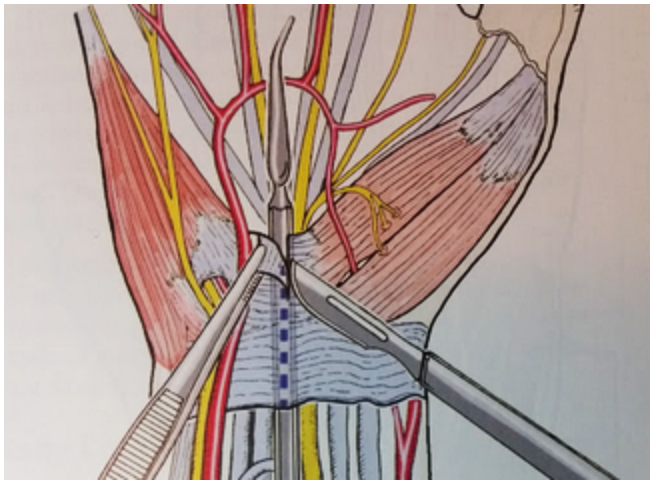
Arterial Vasculature of the Hand and Forearm

Most major arteries have a venous counterpart, but they are often more variable in their pathways. Here, we will explore the major arterial vasculature of the hands and forearm but in the interests of time and simplification, I leave the exploration of the veins to your discretion.

Complete isolation of the arteries can be a difficult and time consuming task. Our goal is to understand the major routes



Carpal tunnel diagram. Note the similarities and differences when compared to the cadaver transverse section, but understand that there can also be differences between individuals. Can you recognize all of the structures that pass through the carpal tunnel in the cadaver image? What about in your cadaver?



Correct probe placement and incision method for the first cut of the carpal tunnel window.

that blood travels in the hand, and to be able to see which muscles are supplied by the larger vessels. With this in mind, you do not want to unnecessarily cut the arteries away from the musculature, even though your instinct tells you to isolate them completely. In the arm, your dissection of the muscles should already be complete enough to allow you to easily trace the arteries with very little connective tissue removal.

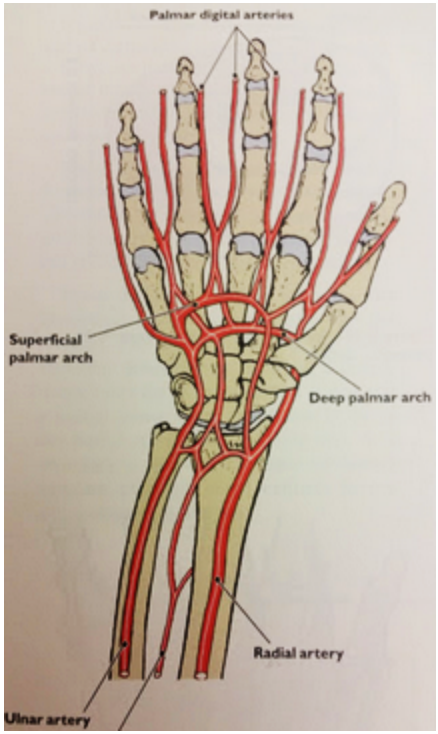
In the arm, it is important in this dissection to identify the **radial artery** and the **ulnar artery**. As you follow the ulnar artery into the hand, it forms a branched structure called the **superficial palmar arch**. Each branch of the superficial palmar arch that extends toward the phalanges is called a **common digital artery**, and each common digital artery splits into two **proper digital arteries**. As you trace the ulnar artery into the hand, you may be surprised to find that it dives deep to the thumb and then laterally crosses the palm as the **deep palmar arch**. You may or may not not be able to see this structure by pushing the more superficial structures aside, but in the last stages of the dissection it will become clearly visible.

We are making a conscious choice to stop our blood vessel identification at this level, but you should appreciate that the blood vessels will progressively get smaller and more complex as they divide and reach their target structures as capillaries.

While the physical locations and pathways of the hand nerves are very similar to that of the arteries, there are important differences and between the two. Your next task is to sufficiently isolate the major nerves of the hand so that they are easily traced and identified.



Dissection of the ulnar artery, superficial palmar arch, and the digital arteries. The ulnar, median, common digital, and proper digital nerves are also visible in similar anatomical positions.



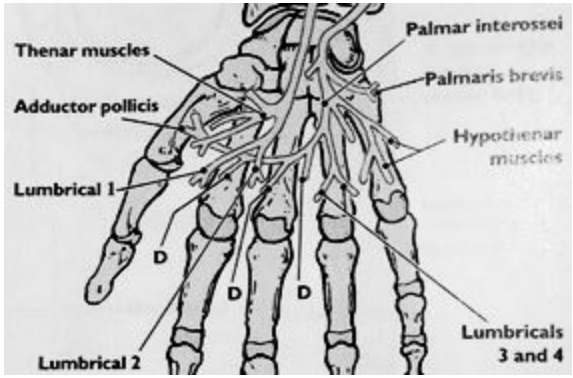
Anterior diagram of the arterial pathways of the hand with most structures removed. Can you identify each of these blood vessels in your cadaver? Recognize that the particular structures we have identified here should be very similar in location to what you will see in vivo, despite any slight variations.

Innervations of the Hand and Forearm

The nerves of the hand can be incredibly difficult to isolate, recognize, and memorize. This is especially true without having good knowledge of the intrinsic muscles of the hand. With that being said, it may behoove you to use this section of the procedure in conjunction with the **Identifying Intrinsic Muscles of the Hand** segment. The nerves must be dissected and cleaned prior to the intrinsic muscles of the hand due to their primarily superficial positions, and because we will be removing them (thereby destroying their relative anatomic locations) prior to studying the intrinsic hand muscles.

The **ulnar nerve** passes superficially with respect to the carpal tunnel, in close association with the ulnar artery. You should isolate the ulnar nerve such that its branches become apparent. Similar to the ulnar artery, the ulnar nerve splits into **common digital nerves**, followed by **proper digital nerves** as it moves into the 5th digit and lateral aspect of the 4th. Do your best to identify and trace the deep branches of the ulnar nerve, but appreciate that these structures are small and difficult to isolate. You should be able to see the nerve enter the **hypothenar muscles**, **interosseous muscles**, **lumbrical 3**, **lumbrical 4**, **adductor pollicis**, and **flexor pollicis brevis**.

The median nerve passes through the carpal tunnel. It has branches that become the common and proper digital nerves for digits 1-3, as well as the medial aspect of digit 4. The deep branches of this nerve should be traced into the **thenar muscles**, **lumbrical 1**, and **lumbrical 2**. **Cutaneous innervation of the hand is not covered in this manual**.



Deep branches of the radial and ulnar nerves. "D" represents the dorsal interosseous muscles.

Quick Reference: List of Target Vasculature

- **Ulnar artery**
- **Radial Artery**
- **Superficial palmar arch**
- **Deep palmar arch**
- **Common digital arteries**
- **Proper digital arteries**

Quick Reference: List of Target Nerves

- **Ulnar nerve**
- **Median nerve**
- **Lumbrical nerves (both origins)**
- **Hypothenar nerves**
- **Interosseous nerves**
- **Thenar nerves (both origins)**
- **Common digital nerves (both origins)**
- **Proper digital nerves (both origins)**

Identifying Intrinsic Muscles of the Hand

In this final segment of the dissection, you will be focused exclusively on the intrinsic muscles of the hand. Many of the structures that you isolated prior to this point will be cut, reflected, or removed during this process. You should ensure that you have satisfactorily accomplished your goals for all of the previous sections before you continue.

You will begin this portion of your dissection by removing the nerves and superficial vasculature from the hand. This is most easily done by cutting the distal portion of each branch away from its respective point of attachment and reflecting it from the target structure. Once you have done this, you can isolate the **four lumbrical muscles**, which originate on the flexor digitorum superficialis and profundus tendons, and insert on digits 2-5.

In order to more easily access the deep muscles of the hand, we will be reflecting flexor digitorum superficialis and profundus. To do this, you will need to cut the tendons or muscle bellies of these muscles in a location more proximal than the wrist, and reflect them distally off of the palm.

At the most lateral position you will find the **thenar muscle group**. It is made up of **abductor pollicis brevis**, **opponens pollicis**, **flexor pollicis brevis**, and **adductor pollicis**. Note that abductor pollicis brevis is the most superficial muscle in the group, and that you may need to cut and reflect it in order to properly see abductor pollicis brevis and flexor pollicis brevis. Make sure you can identify opponens pollicis.

Look out!

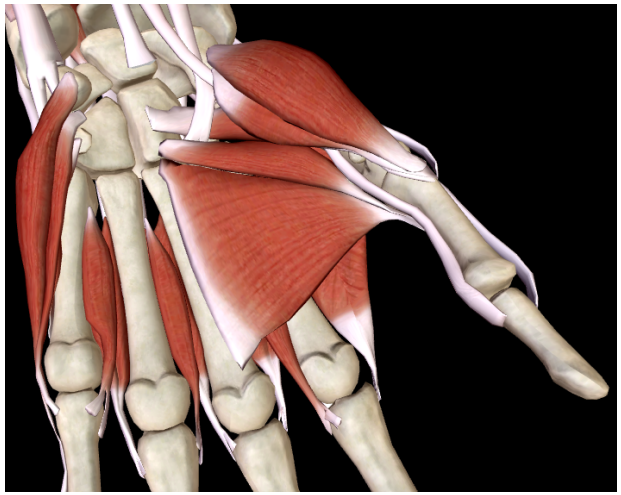
This is your last chance to go back and review the vascular and nervous segments of your dissection! In addition, you will be damaging some of the extrinsic muscles you isolated earlier. ONCE YOU CUT THESE STRUCTURES, THERE IS NO GOING BACK! Do not continue the dissection until you are comfortable with this fact.



Identifying the lumbrical muscles. Lumbrical 2 is being elevated by the forceps, while lumbricals 3 and 4 are not visible. A probe has been inserted beneath the flexor digitorum profundus tendons to make them clearly visible.

Deep to the lumbrical muscles, there are seven **interosseous muscles** that are divided into two groups based on their action. The four **dorsal interosseous muscles** abduct the digits away from an imaginary axial line in the center of the 3rd digit. The three **palmar interosseous muscles** adduct the digits toward the same axial line. As usual, these are numbered from the most lateral to the most medial, in numerical order. In order to better visualize the actions of these muscles, you should cut the **interosseous ligaments** between each finger that normally prevent excessive digital abduction.

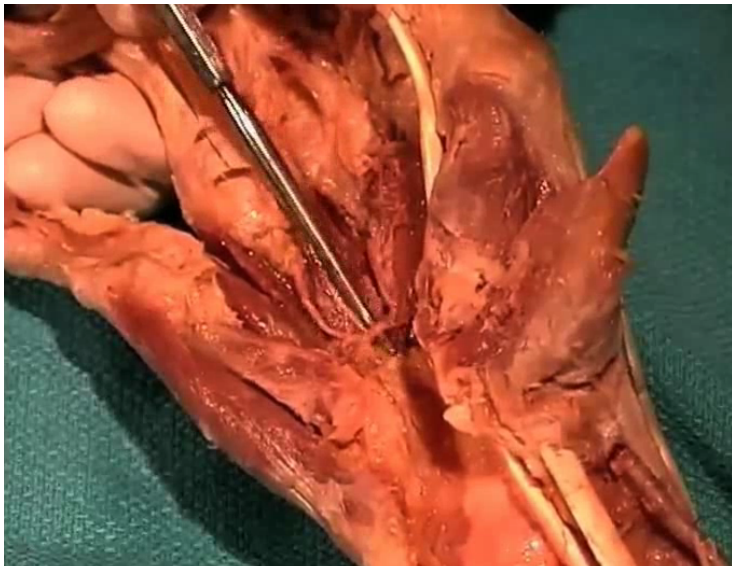
In the most medial position there is a final group that you should identify called the **hypothenar muscles**. This group consists of **abductor digiti minimi**, **flexor digiti minimi brevis**, and **opponens digiti minimi**. You should immediately recognize the actions of these muscles, as they follow the same naming conventions as the thenar muscles.



Anterior view of the palm with lumbricals and superficial structures removed.

Quick Reference: List of Intrinsic Target Muscles

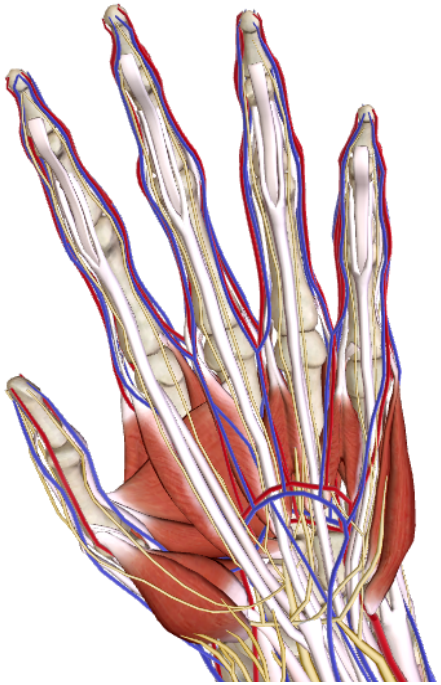
- **Abductor pollicis brevis**
- **Opponens pollicis**
- **Flexor pollicis brevis**
- **Adductor pollicis**
- **Abductor digiti minimi**
- **Flexor digiti minimi brevis**
- **Opponens digiti minimi**
- **Lumbricals 1-4**
- **Palmar interossei 1-3**
- **Dorsal interossei 1-4**



The deep palmar arch is clearly visible at this depth. The interosseous muscles are also shown. Take note of the proper reflection method for abductor pollicis brevis.

Conclusion

While this dissection is complete, the learning process never is. Our intent here was to gain a practical and working knowledge of the hand. The menial memorization is something you should address and maintain outside of your dissection. This is especially true for any structures that you may have damaged or incompletely isolated during your work here. The innervations, origins, and insertions of each of these muscles should be committed to memory and understood in their anatomical context. As you move forward, continued study is of paramount importance to improvement and expansion of the comprehension you have already developed.



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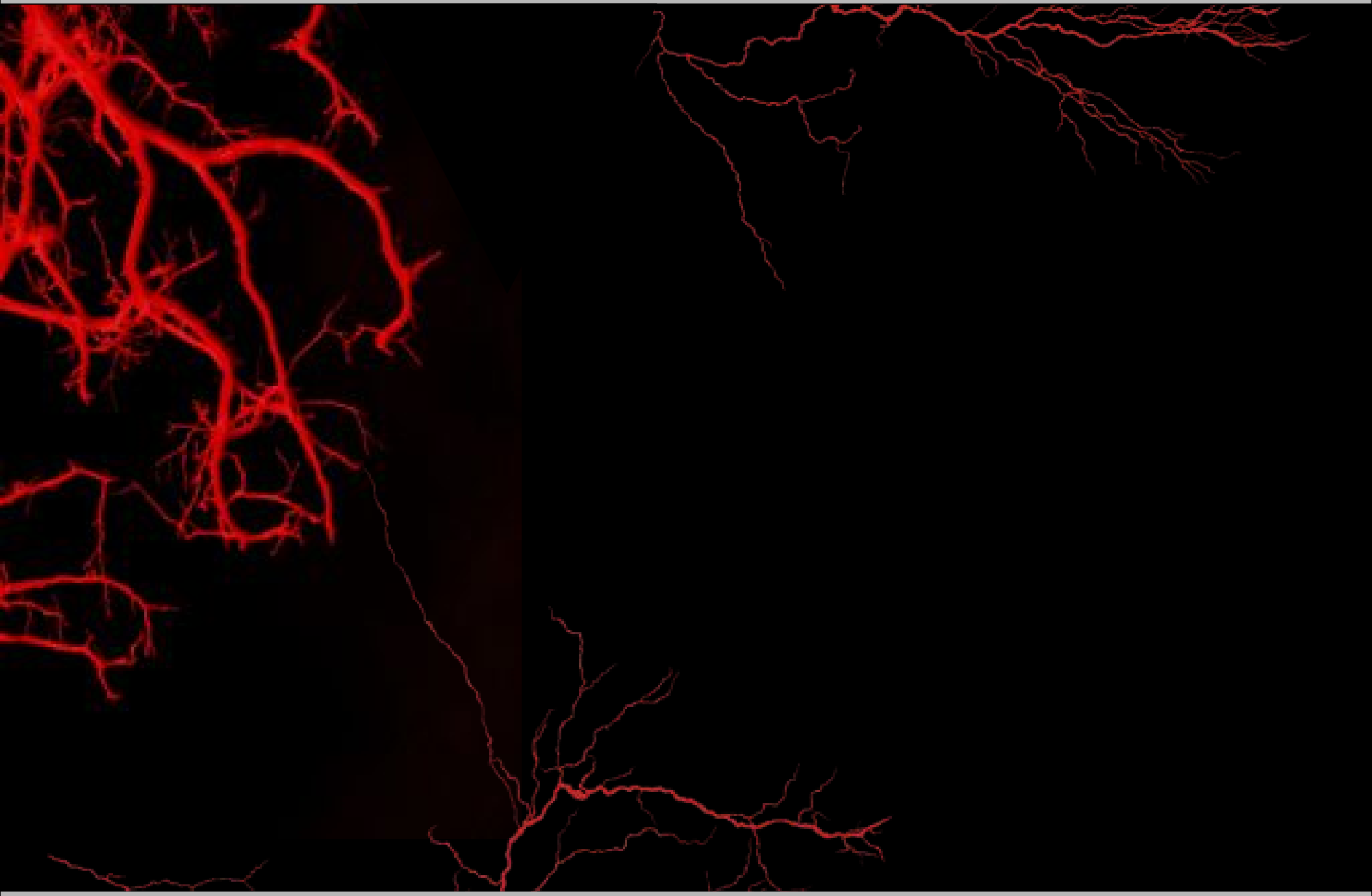
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