

NERVES AND BONDAGE



FULL CIRCLE

KINK

IMPORTANT DISCLAIMER

Bondage can cause serious injury or death. This class provides information about some but not all of the injuries that can occur during bondage, but it does not teach you how to perform bondage.

We have made every effort to ensure that this material is accurate, but there are many places where definitive information simply doesn't exist. Furthermore, it is entirely possible that this material contains mistakes or omissions.

By taking this class you assume all liability for any injuries or deaths that occur when you engage in these activities.

KEY POINTS

If you remember nothing else from today's class, remember these four points:

1. Nerve damage is a time-sensitive emergency

In most cases, nerve damage gets worse over time: the longer the problem persists, the worse the injury will be and the worse the final prognosis. Quickly detecting and correcting an emerging problem can make the difference between a minor nuisance and a serious injury.

2. TK-related nerve damage is the biggest threat

The most common serious bondage injury involves damage to the radial nerve from suspension in a TK (takate kote). You can't eliminate that risk if you choose to suspend with TKs, but there is a lot you can do to manage it.

3. Take circulation loss seriously

Circulation loss itself is probably not a significant cause of bondage injuries. It is still a serious problem because it makes nerves more vulnerable to damage and can mask nerve injury when it occurs.

4. Nerve damage is cumulative

Even minor nerve injuries may cause permanent asymptomatic damage. The accumulation of too much damage can cause significant problems: be thoughtful about the long-term consequences of your choices.

We'd love to chat

Whether you have questions, want to give us feedback on today's class, or have interesting information or experiences you'd like to share, we'd love to hear from you.

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CHAPTER 1

ANATOMY

p. 5 Sensory Nerves

Sensory nerves transmit sensation from the body to the brain.

p. 6 Motor Nerves

Motor nerves carry instructions from the brain to the muscles.

p. 7 Important Vulnerable Areas

Although it's possible to suffer a nerve injury anywhere, a few vulnerable areas account for most of the injuries we see in bondage.

p. 8 Innervation of the Hand

Sensation in the hand is controlled by the radial, ulnar, and median nerves.

p. 9 The Radial Nerve

The radial nerve is the most important nerve in the arm and accounts for more serious bondage injuries than any other nerve.

p. 10 The Ulnar Nerve

The ulnar nerve is also frequently injured in bondage.

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The median nerve is important but is rarely injured during bondage.

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The femoral cutaneous nerve is often injured by hip harnesses and futomomos, although these injuries are usually not very severe.

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Damage to the common peroneal nerve is less common but can cause serious problems with walking.

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The thoracic outlet isn't a nerve, but it often causes nerve-related issues in the upper arm.

p. 15 The Brachial Plexus

Located above and behind the collarbone, the brachial plexus involves the radial, median, and ulnar nerves.

SENSORY NERVES

Key Points

For our purposes, the nervous system consists of two networks of nerves that branch out from the brain:

- **Sensory nerves** transmit sensation from the body to the brain.
- **Motor nerves** transmit orders from the brain to the muscles.

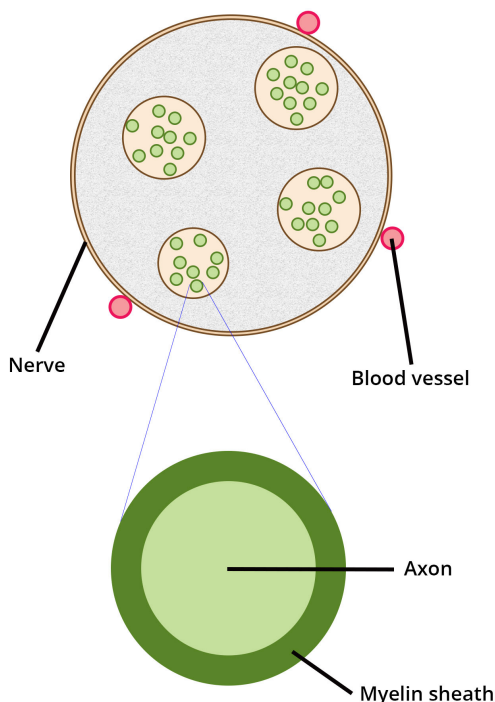
Nerve problems always manifest downstream (distal) from the point of injury.

When we talk about nerves like the radial nerve, we are referring to bundles of thousands of individual axons that run from a given body part all the way to the spinal cord.

Each axon is surrounded by a myelin sheath that is similar to the insulation on an electrical wire. Damage to the myelin sheath can impair nerve function.

Details

Internal structure of a nerve



Vocabulary

Proximal means closer to the center of the body.

Distal means further away from the center of the body.

It's all about the axons

Remember how your high school biology teacher told you that nerves take in information through the dendrites and emit information through the axon? It is our sad duty to inform you that things are more complicated than that. The cell bodies of sensory neurons live in the dorsal root ganglia next to the spine. Their axons split in two: one part transmits information to the spine, and the other runs through the body to connect to the sensory dendrites in the skin (for example). All long-distance transmission involves axons.

MOTOR NERVES

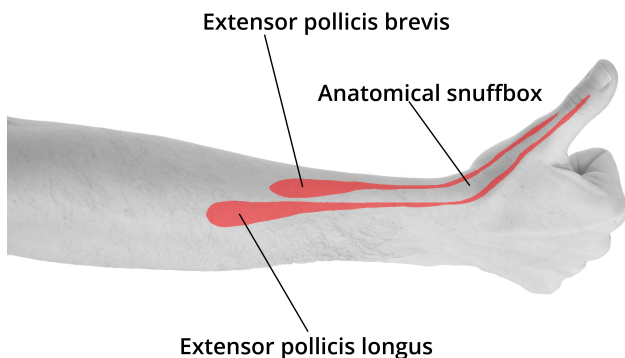
Key Points

Muscles are controlled by motor nerves.

Most body parts are moved by muscles that are proximal to them. Therefore, the motor nerves controlling a body part usually terminate some distance proximal to it.

Axons are either on or off. When you use a muscle at partial strength, some axons (and their associated muscle fibers) are working at 100% while the others are completely idle.

Details



Good to know

The divot in between the two tendons is called the anatomical snuffbox for two reasons:

- you can snort snuff from it
- doctors have trouble letting go of ancient history

Thumb extension

The thumb is raised (extended) by the extensor pollicis longus and extensor pollicis brevis muscles. You can see their tendons protruding from the back of your thumb when you raise your thumb, and you can feel the muscle bodies moving by palpating your forearm.

Wrist extension

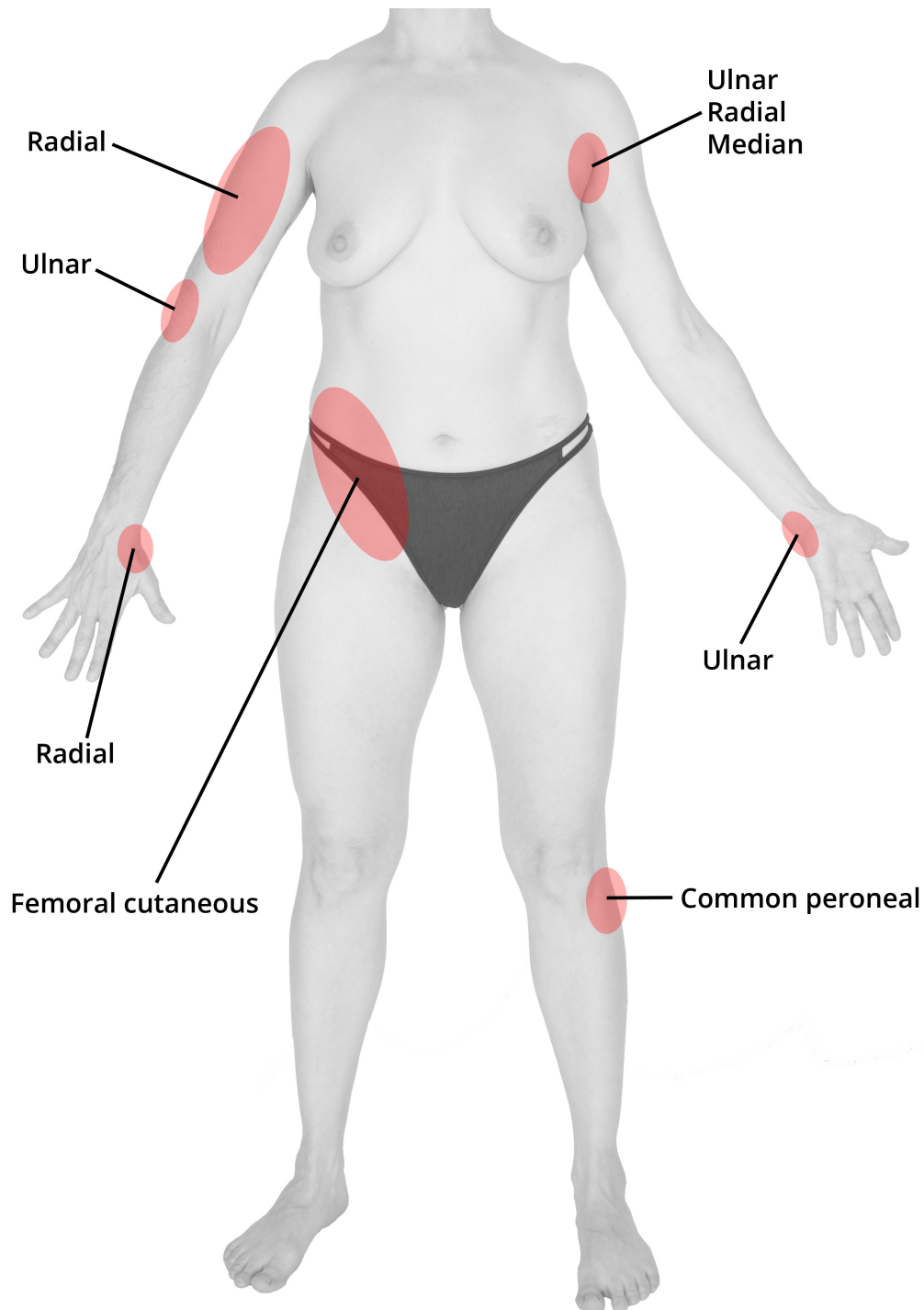
The hand is raised (extended) in the same way. The radial nerve innervates the extensor carpi radialis longus and extensor carpi radialis brevis muscles in the forearm, which pull the hand up into position. You can see their tendons attaching to the index and middle fingers when you raise your hand.

Progressive recruitment

The process by which more neurons are activated to increase muscular force is called progressive recruitment. This is a complicated process which initially activates slow twitch muscle fibers and later activates fast twitch fibers as needed.

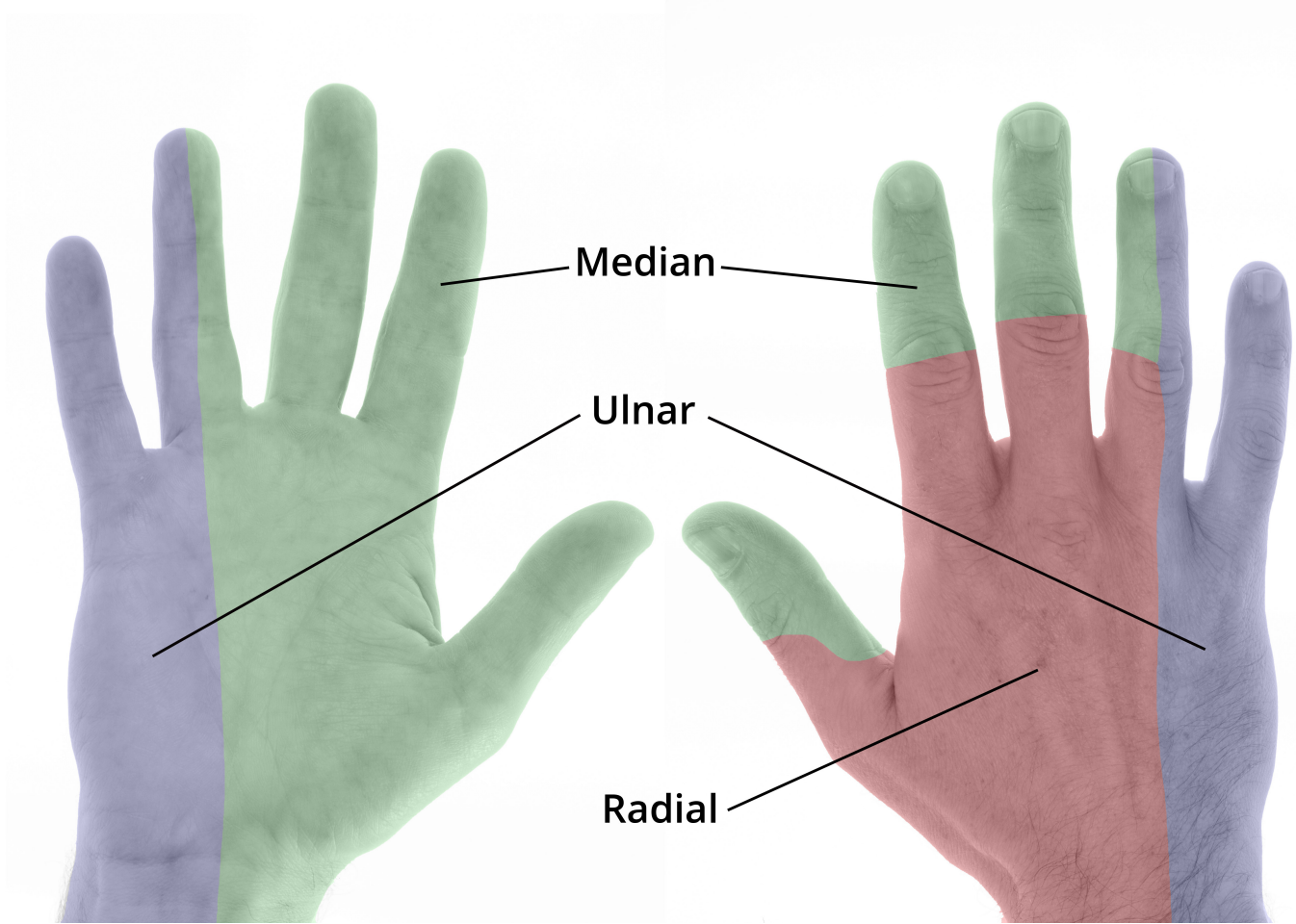
You will not be surprised to hear that the implications for weight training are rather more complicated than we've suggested in class.

IMPORTANT VULNERABLE AREAS



Nerves are most vulnerable to injury where they pass over bone close to the skin. This diagram shows the approximate locations of the most common bondage nerve injuries, but the only way to know for sure where a nerve is vulnerable is to palpate it.

INNERVATION OF THE HAND



Vocabulary

The area of the body connected to a particular nerve is **innervated** by that nerve.

This diagram shows typical innervation of the hand. Very broadly speaking, the radial nerve serves the thumb side, the median nerve serves the middle, and the ulnar nerve serves the pinky side.

One way to troubleshoot nerve problems is by knowing what areas and muscles are innervated by a particular nerve. These are the areas that will suffer a loss of function if that nerve is damaged.

A caveat

Things are much more complicated than this diagram suggests. There is significant individual variation and we haven't even touched on the dermatome map, which is a completely different mapping of the nerves of the hand.

THE RADIAL NERVE

Radial nerve injuries are the most common severe injuries associated with bondage.

The only way to know the exact location of a nerve in a specific pose is to palpate it in that pose. See [Nerve Palpation](#) (p. 27)

Vulnerable areas

1. Of greatest concern to us is the upper arm, where the nerve spirals around the outside of the arm. Damage to this part of the nerve is frequently the result of suspension in a TK.
2. At the wrist, where the superficial branch of the radial nerve crosses on the back of the hand near the base of the thumb.
3. Underneath the armpit, especially if there's a large mass of rope high in the armpit.

Motor function

Damage to the radial nerve in the upper arm can cause significant motor impairment:

- Inability to make a thumbs up gesture ("*thumb drop*").
- Inability to raise the hand as though making a stop gesture ("*wrist drop*").

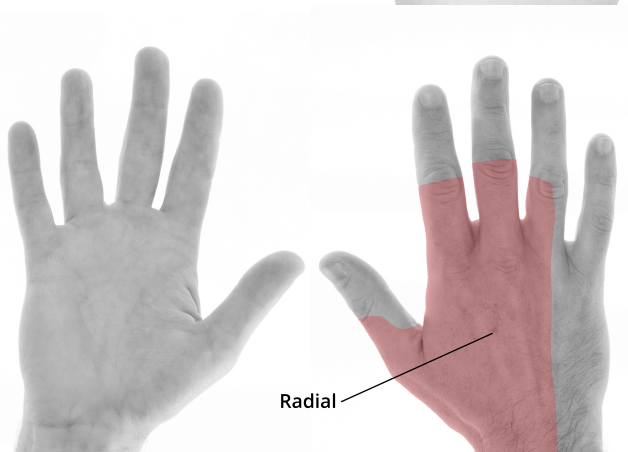
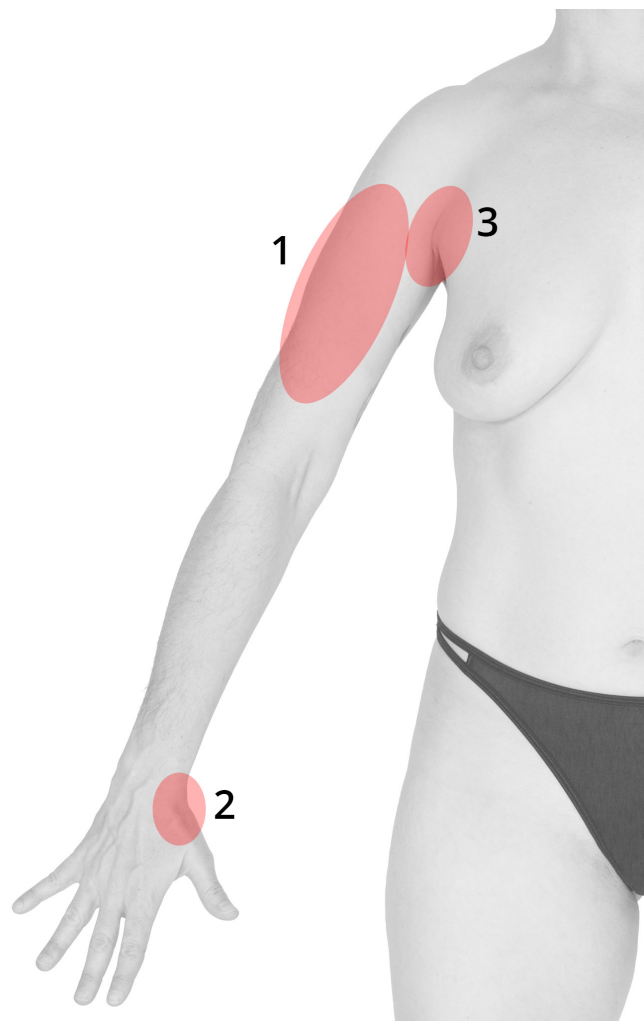
Sensory function

The radial nerve innervates much of the back of the hand, including the first segment of the thumb.

Dangerous ties

Be particularly careful with the following ties:

- The TK, especially when suspended.
- Heavily loaded wrist ties.
- Any harness that puts a lot of rope high in the armpit.



THE ULNAR NERVE

The ulnar nerve is the second-most important nerve in the arm for our purposes.

Vulnerable areas

The ulnar nerve has three vulnerable areas:

1. The “funny bone” is on the inside back of the arm right above the elbow.
2. At the outside of the wrist on the palm side.
3. Underneath the armpit, especially if there’s a large mass of rope high in the armpit. There is some evidence that the ulnar nerve is the most vulnerable of the nerves that pass near the armpit.

Motor function

The ulnar nerve controls wrist flexion (the motion of knocking on a door) as well as some finger motions.

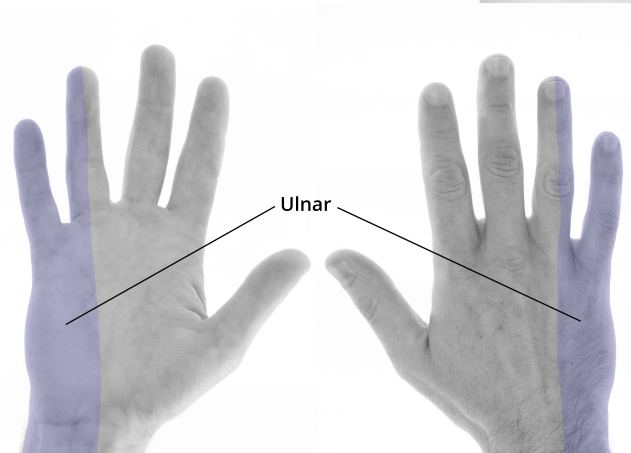
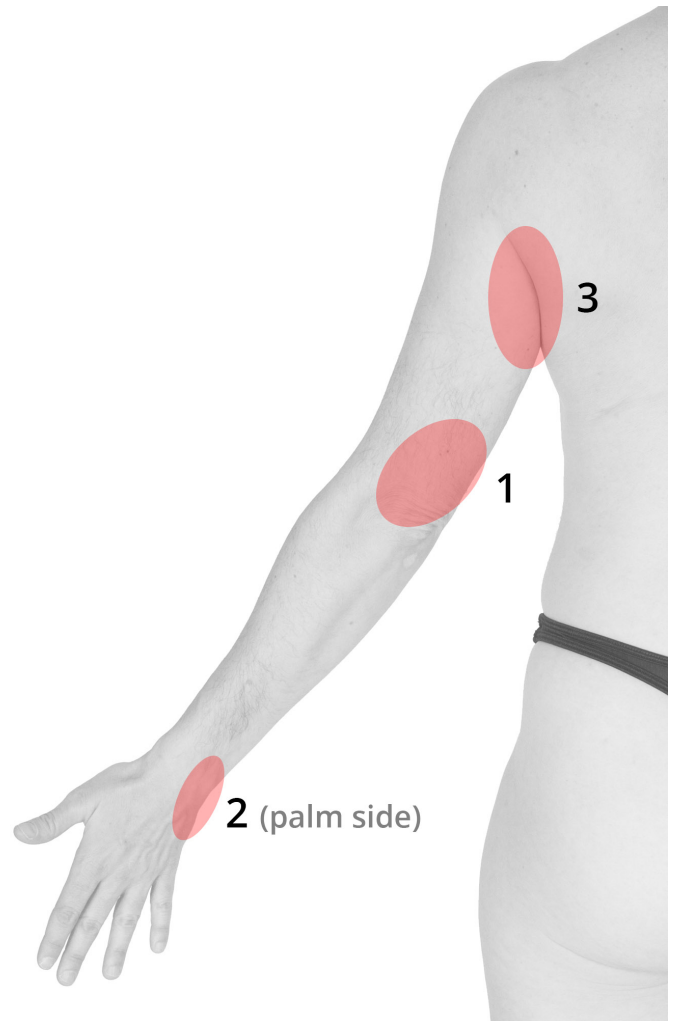
Sensory function

The ulnar nerve innervates the pinky and half of the ring finger, as well as some of the hand on the pinky side.

Dangerous ties

Be particularly careful with the following ties:

- Any wrist tie, especially when heavily loaded.
- Any rope over the upper arm right above the elbow (be careful with the lower wraps of your TK).
- Any TK or chest harness that puts a lot of rope high in the armpit, especially if the rope is pulled upward or the arm is tightly compressed against the chest.



THE MEDIAN NERVE

The median nerve is rarely injured in bondage.

Vulnerable areas

The median nerve is well protected for most of its journey through the arm.

1. Like the other nerves of the arm, it is vulnerable to pressure from bulky rope in the armpit.

Motor function

The median nerve controls a number of hand and wrist motions.

Sensory function

The median nerve supplies sensation to the palm of the hand as well as most of the fingertips.

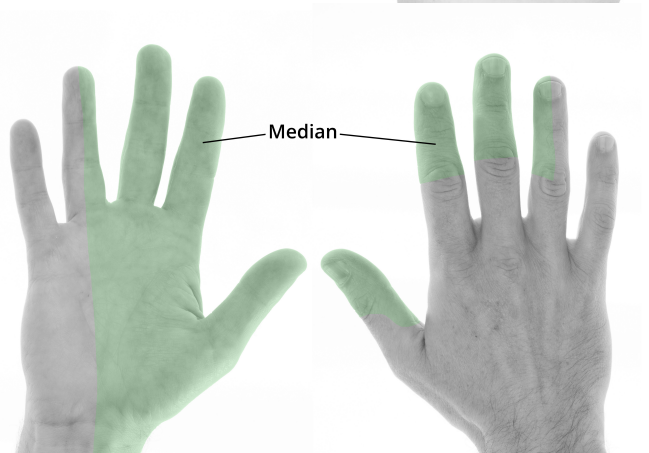
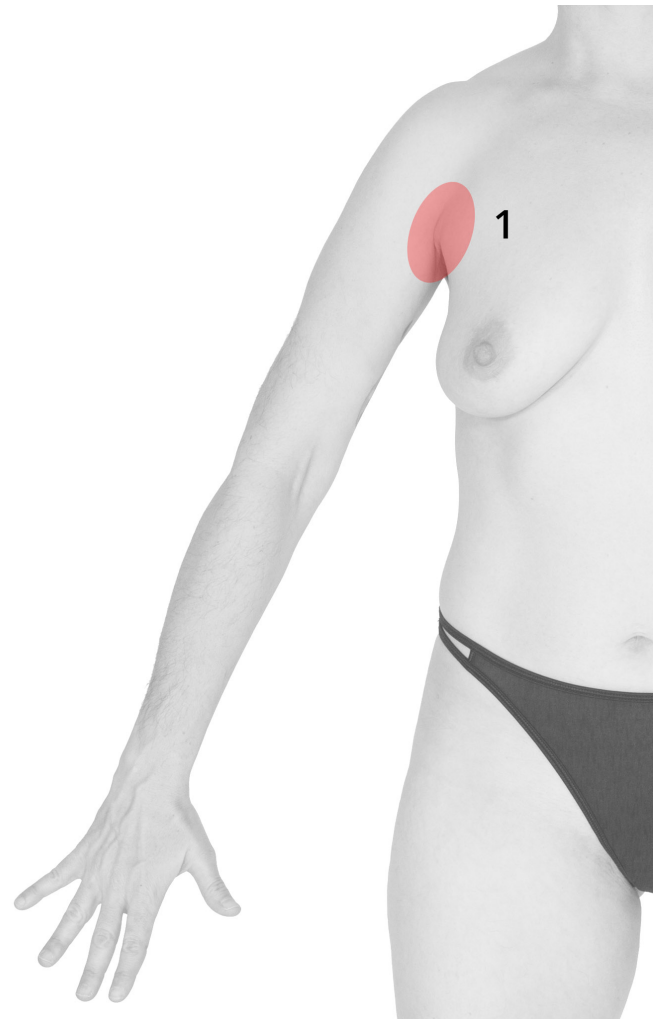
Dangerous ties

Be particularly careful with the following ties:

- Any TK or chest harness that puts a lot of rope high in the armpit, especially if the rope is pulled upward or the arm is tightly compressed against the chest.

Trivia

Carpal tunnel syndrome is caused by compression of the median nerve in the wrist.



FEMORAL CUTANEOUS NERVE

Numerous nerves pass through the hip and are vulnerable near the iliac crest and in the groin. Based on the available evidence, we believe the main culprit in bondage injuries is the Femoral Nerve (FN), especially the Anterior Femoral Cutaneous Nerve (AFCN) and the Lateral Femoral Cutaneous Nerve (LFCN).

Vulnerable areas

1. The FCN is most vulnerable where it crosses over the Iliac Crest (aka Anterior Superior Iliac Spine / ASIS, or “pointy part of the hip bone”). The exact path of the FCN is highly variable from person to person.
2. Secondly, portions of the FCN are susceptible to damage from very tight rope almost anywhere on the thigh.

Motor function

Although the Femoral Nerve innervates some muscles below the knee, most bondage-related FN injuries seem to be purely sensory.



Sensory function

The AFCN innervates the front of the thigh and the LFCN innervates the outside of the thigh.

Dangerous ties

Be particularly careful with the following ties:

- Hip harnesses that cross over the iliac crest, especially when heavily loaded as in an inversion.
- Heavily loaded futomomos, especially when used for single leg inversion.

COMMON PERONEAL NERVE

The Common Peroneal Nerve (CPN, aka Common Fibular Nerve) is probably the most vulnerable of the nerves in the lower leg and the most problematic when damaged.

Vulnerable areas

1. The CPN is vulnerable on the outside of the lower leg, just below the knee.

Motor function

The CPN innervates the muscles that raise the foot. Damage to the CPN can cause foot drop, which significantly interferes with walking.

Sensory function

The CPN innervates much of the calf.

Dangerous ties

Be particularly careful with the following ties:

- Any rope near the top of the calf. We like to keep leg ties at least 2 inches below the bony knob at the top of the shin bone.
- Tight futomomos.

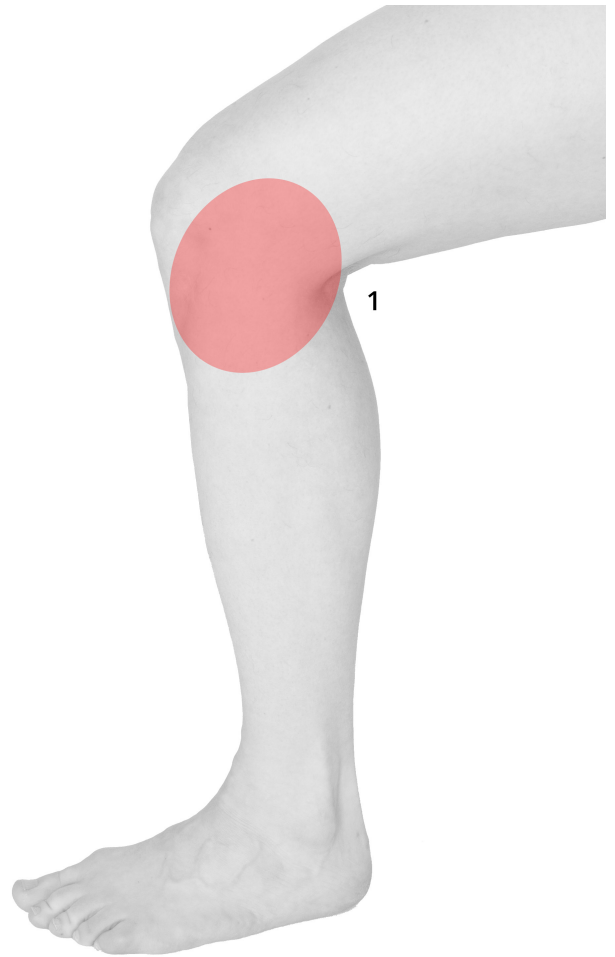
Bonus: some whining by Tornus

Let's take a moment to complain about anatomists and their two related word problems:

They have too many words, so they use multiple words for the same thing. The common peroneal nerve is also called the common fibular nerve.

They don't have enough words, so they use the same word to mean completely different things. For example, the word nucleus refers to a) the DNA-containing structure at the center of a cell and b) a cluster of neurons.

Oh, by the way: we're talking about the peroneal nerve, which is unrelated to the perineal nerve.



THE THORACIC OUTLET

The thoracic outlet is a small opening that all the nerves and blood vessels serving the arm pass through. When things go well, it's more or less big enough for them all. If there's scarring, inflammation, or too much compression, it may not be big enough. The resulting condition is called thoracic outlet syndrome and involves compression of some or all of the blood vessels and nerves serving the arm. Typically, it involves two factors:

1. The arm is rotated at an extreme angle (for example, in a strappado).
2. There is some pre-existing condition that narrows the thoracic outlet. Common conditions include injury, scarring, muscle bulk, fat tissue, or just unlucky genetics.

Thoracic outlet problems often manifest as tingling, numbness, or weakness in large areas of the arm. It's the first thing we think of when we see nerve problems in the arm that don't seem to be caused by compression of a single nerve.

Wright's Hyperabduction Test

Wright's test is a simple test that will give you a sense for whether you might be prone to having thoracic outlet problems. For diagnosing a medical problem, it should obviously be performed by a trained professional. We think, though, that it's appropriate for use by civilians who just want to get a general sense of the condition of their thoracic outlet.

Yet another rant about terminology

There are two openings in the rib cage:

The **inferior thoracic outlet** is the big opening at the bottom of the rib cage, and is also called the **thoracic outlet**.

The **superior thoracic outlet** is the little opening at the top of the rib cage where thoracic outlet syndrome happens. It's also called the **thoracic inlet**.

So this section ought to be called "The Thoracic Inlet", except that in clinical usage the thoracic inlet is called the thoracic outlet.

We trust that clears everything up for you.

THE BRACHIAL PLEXUS

The brachial plexus is a network of nerves in the upper shoulder, above and behind the collarbone. It's a giant interchange that connects a set of major nerves from the spine (C5 - C8 and T1) to a set of nerves in the arms (including the radial, ulnar, and median nerves).

Direct damage to the brachial plexus occurs but is relatively uncommon.

Some of the nerves coming out of the brachial plexus pass fairly close to the inner surface of the armpit and the inside of the arm adjacent to the armpit. In theory, any of the nerves of the arm could be damaged by bulky rope in that location. Anatomical theory and anecdotal evidence suggest that the ulnar nerve is the most vulnerable nerve in the armpit.

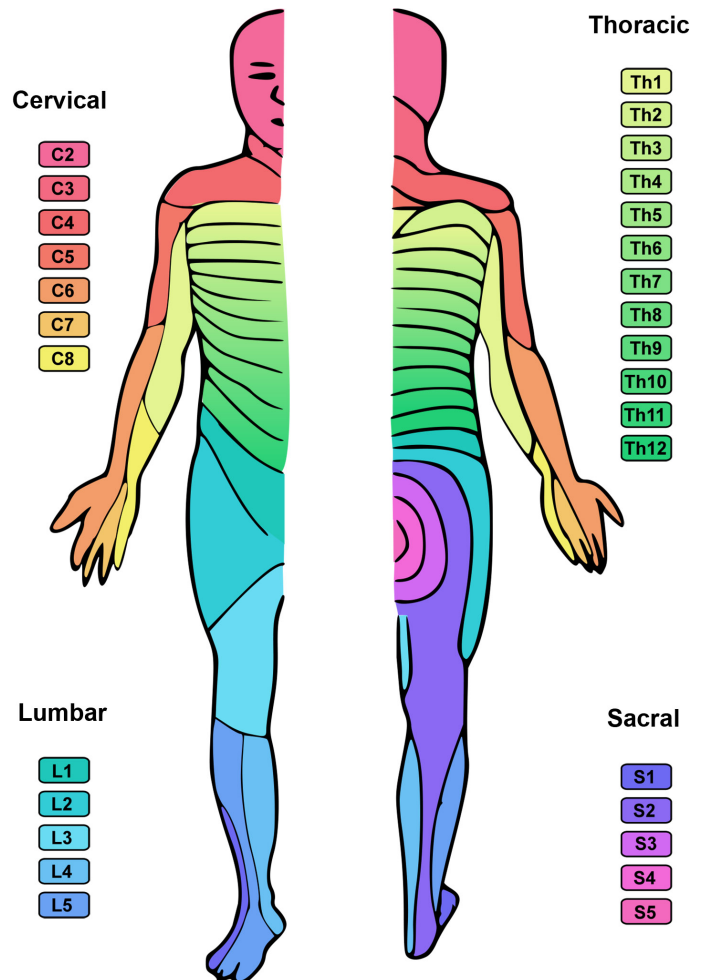
Why does the brachial plexus even exist?

The nerves in the peripheral nervous system connect to the spine between the vertebra. Those connections are named after the vertebra, so C1 - C8 connect to the cervical spine, T1 - T12 connect to the thoracic spine, and so on.

Those spinal connections map to the body in a very sensible way, shown by the dermatome on the right. C6 connects to the thumb part of the hand, C7 connects to the middle of the hand, and so on.

Unfortunately, all the arm nerves contain elements of a number of different spinal nerves. The radial nerve, for example, contains elements of C5-C8 and T1. The brachial plexus is like a giant switchboard: C5-C8 and T1 go in and the arm nerves come out.

Why do you care? Because a problem distal to the brachial plexus will cause symptoms in the area affected by a specific arm nerve. But a problem proximal to the brachial plexus will cause symptoms in the area affected by a specific spinal nerve.



CHAPTER 2

NERVE INJURY

p. 17 Nerve Injury

Most nerve injuries are caused by physical force against a vulnerable nerve. Let's take a look at what actually happens when a nerve is injured.

p. 18 Risk Factors

Certain risk factors greatly increase the chance that a given tie will cause injury.

p. 19 Individual Risk Factors

Some people are at greater risk of nerve injury than others.

p. 20 Circulation Loss

Circulation loss produces symptoms similar to nerve damage and increases your risk of nerve damage.

p. 22 Fainting

Fainting is surprisingly common during suspension bondage. It isn't dangerous on its own, although it can cause dangerous falls.

p. 24 Sciatica

Typically caused by heaving lifting with poor form, sciatica can happen to riggers as well as bottoms.

p. 25 Harness Hang Syndrome

There are a lot of mistaken beliefs about harness hang syndrome. Here are the facts.

NERVE INJURY

Key Points

Nerve injuries get worse over time: detecting and fixing problems quickly is critical.

In bondage, most nerve injuries are caused by physical force on the nerves.

Contrary to popular opinion, loss of circulation is probably not a primary cause of nerve injury in bondage. It does, however, make nerves more vulnerable to physical injury.

Details

How does physical damage occur?

Most bondage-related nerve injuries are caused by physical force on a nerve. We worry about four kinds of forces:

- **Crush forces** are the simplest: if there's too much weight on a TK in the wrong place, it crushes the radial nerve against the bone.
- **Grinding forces** occur when crush forces move: if the TK shifts slightly, it will grind the nerve into the bone.
- **Shearing forces** occur when two surfaces slide against each other.
- **Stretching forces** occur when a nerve is stretched too far. Nerves can stretch a little bit but take damage when stretched too far.

Think of these as four ways that physical damage can occur, rather than four distinct types of injury.

Sensory nerves go first

For reasons that are not well understood, sensory nerves seem to be more vulnerable to permanent injury as well as temporary shut down from blood loss.

Loss of sensation may be an early warning sign of impending motor nerve damage, although motor nerve damage can occur without loss of sensation.

We don't have all the answers

Be aware that our sources disagree about some of these topics, and most of the available data are only partly relevant to the injuries we see in bondage.

Are stretch injuries common in bondage?

It's definitely the case that nerves can be injured by stretching, and that those injuries are theoretically possible during bondage. Stretch injuries can either be sudden (common in sports injuries) or slow (common in injuries during long surgeries). There's broad agreement that nerves that are near their stretch limit are especially vulnerable to other injuries, but our sources disagree about the likelihood of stretch injuries as a primary factor during bondage.

RISK FACTORS

Multiple factors determine whether a given tie will cause nerve injury. Starting with the most important:

Location

Rope over a vulnerable part of a nerve is far more likely to cause injury. Nerves are generally most vulnerable where they pass over bone close to the skin.

Amount of force

Stronger forces do more damage, which is one reason most serious nerve injuries are suspension-related.

Duration of force

This is critically important and frequently misunderstood. Nerve injuries get worse over time, so a tie that might cause mild tingling after 5 minutes could cause a debilitating injury if left in place for 20 minutes. Detecting and fixing nerve problems quickly is essential.

Distribution of force

The same amount of force spread over a wider area will be less damaging. In some cases, adding more wraps can spread the load over a wider area.

Moving forces

Moving forces can cause shearing or grinding. A TK that shifts is more dangerous than one that stays put.

Loss of circulation

Nerves are more vulnerable to physical injury when their blood supply has been disrupted.

Stretching

Stretched nerves are more vulnerable to physical injuries. You should assume that the arms are especially vulnerable to nerve damage whenever they're held in an extreme position.

Double crush

If a nerve is crushed in two places (not necessarily at the same time), each location is more vulnerable than it would otherwise be.

INDIVIDUAL RISK FACTORS

Some people are simply more susceptible to nerve damage than others. We don't entirely understand why, but we do know some of the important risk factors:

Individual variation

People are different, and some people are simply more susceptible to nerve damage. It's entirely possible for a given person to have some especially vulnerable nerves and some especially robust ones.

How do you know if you're particularly susceptible? You find out the hard way.

Pre-existing injury

If you injure a nerve, it will be more susceptible to damage in future. It's most vulnerable immediately after injury, but it will remain somewhat vulnerable for the rest of your life. Surprisingly, a damaged nerve is more vulnerable to future injury at any location, not just at the location where the original injury occurred.

Nerve injuries can be sub-clinical, without any obvious symptoms. If you do a lot of hard TK suspensions, you may be accumulating damage that makes each subsequent suspension a tiny bit more risky.

Systemic health conditions

Various systemic conditions can damage your nerves and make them more vulnerable to injury. Among them: diabetes, alcoholism, poor circulation, peripheral neuropathy, and thyroid disease.

Age

Aging damages your nervous system, so older people are more likely to suffer nerve damage in suspension. This goes both ways: if you suffer a lot of nerve damage in your youth, you will be more susceptible to the damage that aging will do to you later in life.

Being thin

Fat and to some extent muscle provide protective padding to nerves. Our best guess is that in balance, thin bottoms are at greater risk of nerve injury and very thin bottoms are at substantially increased risk.

Irritation, inflammation, or muscle tension

This can be due to heavy workouts, injuries, or other causes.

CIRCULATION LOSS

Key Points

Circulation loss and direct pressure on the nerves often go hand in hand, in part because blood vessels and nerves generally travel through the body together.

Circulation loss isn't a primary cause of nerve injury in bondage. It is important, however, because it makes nerves more vulnerable to physical injury and because it can mask the symptoms of physical injury.

There are two types of circulation loss:

- **Venous blockage** means that blood is still entering the limb, but is trapped there. The limb will typically be red or purple, swollen, and warm to the touch. In a healthy person, it's probably fairly safe to leave a limb like this for 20 minutes.
- **Arterial blockage** means that fresh blood can't enter the limb, which will likely be blue or white and cold to the touch. You should fix this immediately.

Details

How long can you safely restrict circulation?

Much of our data comes from studies of tourniquet use during surgery and in combat. The consensus among these studies seems to be that in healthy individuals, complete arterial blockage for less than 90 minutes is unlikely to cause permanent nerve damage.

What does that mean for us? On the one hand, the results from the literature are likely to be conservative because they involve complete arterial occlusion, which should never occur in a bondage context.

On the other hand, these studies are looking at damage from a single incident of **ischemia** (inadequate blood supply) and don't address the possibility of cumulative ischemic damage, such as a bottom might experience if they get tied regularly. In addition, the studies are only looking for permanent damage that is significant in the context of some who is in surgery or has undergone serious trauma. They are likely missing injuries that we would consider to be significant.

Given all that, we are inclined to agree with the common rule of thumb that in a healthy individual, 20 minutes of impaired venous return is probably a reasonable limit. And we agree with Shay that impaired arterial flow should be fixed promptly.

What are the exceptions?

All of this applies to "healthy" individuals. You should consult with your doctor if you have any kind of systemic health condition including diabetes, peripheral neuropathy, or poor circulation. Many of these conditions can significantly reduce your body's ability to tolerate loss of circulation.

What about blood clots?

Blood clots are potentially life-threatening. Deep Vein Thrombosis (DVT) is a kind of clot that frequently occurs in the deep veins of the leg. Two out of three factors (Virchow's triad) are typically required for a DVT to form:

- Blood flow is restricted or stopped.
- Blood is flowing past an uneven surface, such as a plaque or partial blockage.
- A medical condition that increases clotting.

We aren't aware of any bondage-related DVT incidents, but bondage that severely restricts venous return from the legs theoretically creates two of those three factors. If you know you are susceptible to clotting problems, you should talk to your doctor about whether bondage might increase your risk.

Why is venous blockage more common?

Pressure on a limb will almost always occlude the veins before the arteries for three reasons: veins typically lie closer to the surface of the body, they're less stiff than arteries, and venous blood pressure is lower than arterial blood pressure.

Capillary refill test

You can get a sense of whether circulation to the hands is restricted by squeezing a fingernail and seeing how quickly the pink color returns. Make sure to test this before you start bondage, so you know what's normal for you.

A note about terms

We've used the terms "arterial blockage" and "venous blockage" because they're easy to understand. Better terms would be "arterial occlusion" and "venous occlusion" or "impaired arterial flow" and "impaired venous return".

FAINTING

Key Points

Standing still for too long can cause fainting due to a vasovagal reaction.

Fainting is not intrinsically dangerous but can lead to injury from a fall.

The vasovagal reaction can also be triggered by stress, fear, pain, the sight of blood, or pressure on the neck.

Symptoms of a vasovagal reaction include nausea, tunnel vision, light-headedness, and fainting.

You can reduce the likelihood of fainting by:

- Making small leg motions while standing still (especially raising your heels up off the ground a few inches)
- Being adequately hydrated and fed
- Managing your blood sugar if you are diabetic
- Speculatively, controlled slow breathing (1 breath every 5 seconds) might help

Details

What's so hard about standing up?

When you stand up, a significant amount of blood (about 500 mL) pools in your legs and abdomen. This results in a drop in blood pressure which can be severe enough to cause presyncope or syncope.

In a healthy person, the body quickly responds by constricting blood vessels and increasing your heart rate, so that your blood pressure remains approximately constant. If you've ever felt lightheaded after standing up, you experienced a failure of this compensatory system. In healthy people, that can be the result of dehydration (which reduces blood pressure) or being hot (which causes your blood vessels to dilate).

Terminology

Syncope means fainting.

Presyncope is a state of lightheadedness and weakness which may or may not progress to syncope.

Orthostatic Hypotension

Some people are prone to a condition called **orthostatic hypotension** in which the compensatory systems don't work properly. This is most common in people over 50 and manifests within 3 minutes of standing up.

A vasovagal reaction to standing up, on the other hand, is characterized by correct stabilization of blood pressure for an extended period of time, followed by an abrupt decompensation. The mechanisms for this aren't entirely clear, although it is possible that the Bezold-Jarisch reflex is involved.

Is it a seizure?

Especially if held in an upright position, someone who has fainted may experience minor tremors that look a bit like a seizure. So long as they resolve promptly, there is no cause for alarm.

Nerd note: vasovagal reflex

Don't confuse vasovagal syncope or a vasovagal reaction with vasovagal reflex, which is a contraction of your gut when you eat.

Every gray hair has a silver lining

Strong vasovagal reactions are most common in young adults. So if you're prone to having strong vasovagal reactions, the problem may resolve as you get older.

Oops!

In the past, we have mistakenly conflated orthostatic hypotension and a vasovagal reaction caused by prolonged standing. The two have similar causes and symptoms, but are distinct phenomena.

SCIATICA

Key Points

The term sciatica often gets used somewhat loosely. Generally, speaking, sciatica is:

- caused by irritation or pressure on the sciatic nerve,
- causes pain that shoots below the knee,
- usually in just one leg.

Sciatica is typically brought on by exertion, especially heavy lifting with poor body mechanics. It's different from the other kinds of nerve injury we've discussed, but it's useful to know about it and be able to distinguish it from other types of injury.

Sciatica may need medical attention depending on severity and duration.

This is the one nerve injury that is probably more likely to happen to riggers than to bottoms.

HARNESSE HANG SYNDROME

Key Points

Don't worry about Harness Hang Syndrome and don't do anything differently because of it.

"No change should be made to the standard United Kingdom (UK) first aid guidance for the post rescue recovery of a semi-conscious or unconscious person in a horizontal position, even if the subject of prior harness suspension."

UK Health and Safety Laboratory

Details

What is harness hang syndrome?

Harness hang syndrome (aka **suspension trauma** or **HHS**), which might or might not actually exist, is a speculative condition that might affect climbers and industrial workers who have been rescued after an extended period of hanging unconscious in a climbing harness.

A few decades ago, medical professionals involved with recreational climbing and high angle rescue began to notice a pattern of abrupt death in people who had been rescued after an extended period of hanging unconscious in a climbing harness. There was a great deal of speculation about what was going on, and what possible steps might be appropriate when rescuing people in that situation. Many myths and theories from that period are still in circulation in the rope community.

Our conclusion

The literature on this topic is confusing and somewhat contradictory, but we feel comfortable asserting that:

1. Harness Hang Syndrome is completely different from vasovagal syncope (p. 22).
2. There is no credible evidence that HHS occurs quickly: it might be relevant to protracted high angle rescue scenarios, but not to scenarios where an unconscious bottom is promptly lowered to the ground.
3. There is no credible evidence that someone who has been rescued from suspension should be placed in a seated position rather than the standard prone recovery position.

CHAPTER 3

PRACTICAL STRATEGIES

p. 27 Nerve Palpation

You can't avoid the vulnerable areas if you don't know where they are. Palpation is how you find out.

p. 28 Testing Nerve Function

The sooner you notice a nerve problem, the sooner you can fix it.

p. 29 When Problems Arise

What should you do if you experience nerve problems during bondage?

p. 30 First Aid

What can you do to reduce the damage? What shouldn't you do?

p. 32 Prognosis and Recovery

So you've taken a nerve hit. What happens next?

p. 34 Strategies for Bottoms

Skilled bottoms can do a great deal to manage and reduce their risk of suffering a bad injury.

p. 36 Strategies for Riggers

As a rigger, how can you minimize the chance that you'll harm your partner?

NERVE PALPATION

Nerve palpation is the process of probing with your fingers to find exactly where a nerve lies. It's most useful with the radial nerve.

Nerve positions vary from person to person, from side to side, from position to position, and from day to day. If you want to know where your left radial nerve is when you're in a TK, you have to palpate your left radial nerve when you're in a TK position.

Process

Palpation is simple in theory: just poke around until you find the nerve. In practice, it's harder than it looks.

Use the pads of your fingers, not the fingertips. Work slowly and systematically, being careful not to press so hard that you cause a nerve injury.

If you're doing the palpating, you should be able to feel a thin, cable-like structure close to the bone. It should feel similar to 3mm hemp.

If you're being palpated, you will likely feel a strange, sharp pain—people often describe it as electrical or zinging. If your radial nerve is palpated, you may feel pain down your arm or on the back of your thumb and hand.

It can be helpful to mark each place you find the nerve with a marker. When you're done, you will have a series of marks showing where you found the nerve and where it seemed most vulnerable.



Palpation is hard

Medical students spend many months working on their palpation skills. Plan on putting in significant practice time before you can reliably palpate the radial nerve. Practicing on yourself is especially helpful.

TESTING NERVE FUNCTION

Self Test

You can perform this test on yourself while you're in rope. Test yourself before you get tied so you have a baseline for comparison.

1. Stroke the tip of the thumb with your index finger and make sure you can feel it.
2. Stroke the back of the first segment of the thumb with your index finger and make sure you can feel it.
3. Bend the thumb down with your index and middle fingers. Push against them with your thumb, as though trying to make a thumbs up gesture.



Partner Test

We learned this test from Topologist. It tests many (but not nearly all) finger motions. Make sure to get a baseline before tying.

1. Have your partner squeeze your finger with all their fingers.
2. Wrap your hand around your partner's closed hand and have them straighten their fingers and thumb against resistance.

Pro tip: doctors use the index finger and middle fingers wound around each other for this test. That provides protection against people who think it's amusing to squeeze your finger too hard.



WHEN PROBLEMS ARISE

Key Points

The most important thing to learn from this class is that nerve injuries get worse over time, so detecting and fixing them quickly is critical.

If possible, fix the problem in the air by dressing rope, changing positions, or shifting weight.

If you can't quickly fix the problem in the air, descend and untie as quickly as possible. If appropriate, don't hesitate to cut rope.

Continuing a scene despite loss of sensation due to circulation loss is a high risk choice.

FIRST AID

An ounce of prevention is worth a pound of cure: the most important thing is to quickly detect and fix any emerging problems. If you do find yourself with a nerve injury, we recommend that you follow Shay's advice:

DO

Protect the area from future injury without completely immobilizing it.

Let it heal completely before putting rope on it again.

Consider taking anti-inflammatory drugs like ibuprofen or naproxen.

Consider taking vitamin B12 supplements.

DON'T

Don't massage, rub, compress, or stretch the area.

Don't apply tight bandages or wraps.

Should you use ice?

Probably not. If you must, use it sparingly.

SHOULD YOU SEEK MEDICAL ATTENTION?

Minor injuries probably don't need urgent medical help. The more serious an injury is and the more slowly it seems to be recovering, the more likely it is that you need professional help.

Always seek care if:

- The injury gets worse after you remove rope.
- The injury is severe.
- You believe there may be a **hematoma** (essentially a severe bruise) putting pressure on the injury. This rare condition is likely to get worse over time, so seek urgent treatment for it.
- Trust your gut. If you think you need to see a doctor, go see a doctor.

Shay is the authority on this

Shay is an ER nurse, rigger, and bottom who has done extensive research on treating nerve injuries. We recommend that you check out her site [Remedial Ropes](#) for an in-depth discussion of this and many other topics.

Over 50? Consider taking B12

Because your ability to absorb B12 diminishes with age, anyone over the age of 50 should consider taking B12 supplements.

PROGNOSIS AND RECOVERY

Key Points

Prognosis for a nerve injury is variable and hard to predict if you aren't a professional. Recovery may take anywhere from minutes to many months, and may or may not be complete. Many nerve injuries heal within two weeks and most heal within two months.

Shay reports anecdotal evidence that if a nerve injury shows significant improvement within hours, it will likely recover within a few days or a week. If you don't see improvement for several days, recovery will likely take weeks or longer.

Details

In all but the best case, recovery will be imperfect. This is a major reason why nerve damage is cumulative: each injury (even injuries without noticeable symptoms) will cause additional damage in the nerve.

Figuring out exactly what is going on with a given injury is a job for professionals. If you're curious about what might be going on, here are four typical mechanisms that may be at work:

Nerves shut down because of ischemia

The best case is that a nerve has shut down because of lack of blood. Once circulation is restored, it will typically recover quickly, perhaps with brief tingling or weakness.

The myelin sheath is damaged

When an axon's myelin sheath is damaged, it continues to work at greatly reduced capacity. Recovery will typically take days to weeks and will be good but not perfect. In many cases the myelin sheath will regrow thinner or with more gaps than the original had.

Some of the axons are damaged.

In this case, the distal parts of the damaged axons will die and the remaining axons will grow new branches to take over the jobs of the dead axons. Recovery may take 3 - 6 months and will likely be incomplete as the new branches won't fully cover all the targets of the dead axons.

Most of the axons are damaged.

The distal parts of the damaged axons will die and the stumps will regrow from the point of injury. This is a slow process (1 - 3 mm / day) and usually imperfect: some axons won't regrow, and others will regrow improperly. Recovery will probably be slow and partial.

Formal classification of nerve injuries

There are two commonly used classification schemes: Seddon's and Sunderland's. Neither of those, unfortunately, is well suited to describing compression injuries. Most bondage injuries are probably best classified as **Neurapraxia** or **Axonotmesis**.

Neurapraxia (Seddon) / Type 1 (Sunderland)

Damage to the myelin sheath

Axonotmesis (Seddon) / Type 2 (Sunderland)

Damage to the axon, but outer structure remains intact

Neurotmesis (Seddon) / Type 3, 4, or 5 (Sunderland)

Severe damage, up to and including a completely severed nerve

STRATEGIES FOR BOTTOMS

Key Points

Get to know your body. Learn what placements and tensions work for you. Learn what you're good at and what you need to avoid.

Learn how to move in rope. Skilled bottoms can do a great deal to shift weight to places that are safer and more comfortable. Consider doing appropriate strength and flexibility training.

If you suspend in TKs, learn to perform appropriate hand tests.

Learn what ties work best for your body.

Details

Know your body

What does circulation loss feel like for you?
Muscle fatigue?

Pay attention to your range of motion—in what positions do your joints feel under stress?

Can you engage muscles at the limit of your range of motion? Are there muscles that aren't strong in those positions?

What direction do your hips and shoulders like to move? Internal rotation? External rotation? Which feels more muscularly supported to you?

Learn the warning signs that a particular body part is close to timing out.

Learn what symptoms you can safely work through, and what symptoms indicate danger.

Understand what factors limit your body awareness—do you begin to panic under chest compression? Is circulation masking other symptoms for you?

Don't rig at an advanced level with anyone who doesn't also put the time in to learn your body and preferences. A rigger who ties every bottom the same way is clearly unqualified to perform advanced suspension.

Map out exactly where your radial and ulnar nerves run on the arm.

Test your thoracic outlet using Wright's Hyperabduction test.

Set a baseline for all of your handchecks by evaluating what your usual grip strength is.

Determine what shoulder position is most "neutral" and locked against the body, if you're trying to bottom for TKs. Work with your rigger to determine if you prefer locked or unlocked shoulders.

Learn how to move in rope

Learn how to make microadjustments to protect yourself while in rope.

- Flexibility and strength work are super useful for every aspect of bottoming, including injury prevention.
- If you have specific injuries or issues that affect flexibility (and especially shoulder flexibility), consider seeing a physical therapist for help mitigating them or learning how to take care of them. You will get better care if you're able to be honest with your therapist about doing bondage.
- If you have hyperflexible shoulders, learn how to protect them.

Learn to self test

If you get suspended in TKs, you should become familiar with an appropriate set of hand tests.

If you use the TK

There are many different styles of TK. Which one you use should depend on what's best for your body, not what's trendy this week.

If you don't have hyperflexible shoulders, consider:

- Placing your own hands
- Avoid rotating into extreme or unsupported positions
- Using a TK with a stem from the Akechi Denki lineage (Kanna / Kinoko / Kazami / OS 2/3)

If you have hyperflexible shoulders and can come into a very high hands TK, consider:

- Having your rigger place your arms locked against your body
- Using a TK from the Nureki lineage (Naka / Gorgone / WykdDave)

Be careful about nerve flossing

Based on professional advice, we recommend that you not self-prescribe nerve flossing or neural glides. If you think that might be helpful for you, consult with a qualified physical therapist. Doing this incorrectly or in the wrong circumstances could cause long-term damage.

STRATEGIES FOR RIGGERS

Key Points

Listen to your partner!

Learn the anatomy. Know which nerves might be vulnerable to the ties you're using and how damage to those nerves is likely to manifest.

Learn your ties. Instead of memorizing patterns, understand what each tie is appropriate (and not appropriate) for.

Work on your technique, especially your tension and placement. Be thoughtful about the tradeoff between tension and keeping rope from moving.

Be mindful of time. The riskier a position, the less time you should spend in it. Master the art of making a fast, safe emergency descent without help.

Know your risk factors and remember that risk factors compound each other.

Details

Distributed load

Because a distributed load tends to be less damaging, common advice is to use thicker rope and more wraps. That's good advice to a point, but it doesn't always work. For example, no matter how wide your wrist cuff is, it's likely that only one or two wraps will be loaded when someone pulls on it.

In almost all cases, however, it's important to dress your rope so that all the wraps lay flat and have even tension. If one band is tighter than the rest, it'll take all the load no matter how many other bands there are.

Understand your ties

Don't just memorize patterns: understand what problem each harness is trying to solve and what situations and body types it is appropriate or inappropriate for. For example:

- Some hip harnesses are not designed for loading from the back and are dangerous when used in that way.
- Stemless TKs solve a different problem and are appropriate for different situations than TKs with stems.
- A Mount Fuji 3rd rope is appropriate for a different chest type than a Naka-style 3rd rope.

CHAPTER 4

REFERENCE

p. 39 References

Want to dig deeper into the underlying science? We have so many references to get you started.

p. 43 Further Reading

A few of our favorite books and websites for learning more.

p. 44 Glossary

What do all those fancy words mean?

p. 47 Follow Along

If you're following along during class, here's what we'll cover in each section.

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Shay is by far our favorite resource for everything at the intersection of kink and medicine (and many other things, actually).

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GLOSSARY

ASIS Anterior Superior Iliac Spine, aka Iliac Crest or “pointy part of the hip bone”.

Axon The part of a peripheral nerve cell that travels long distances through the body.

Axonotmesis An intermediate nerve injury in the Seddon classification: the axon is damaged but the framework of the nerve is intact. Comparable to a Type 2 injury in the Sunderland classification.

Brachial Plexus A structure in the shoulder where the arm nerves combine and reassemble. Located above and behind the collarbone.

C1 - C8 The eight vertebral nerves associated with the cervical spine. The arms are primarily innervated by C6 - C8, with some involvement by C5 and T1 (the first nerve from the thoracic spine).

Distal Anatomical term meaning “further away from the center of the body”.

Ennervate To weaken. Sounds like innervate, means something completely different.

Ganglion Peripheral nerves run from the body to dorsal root ganglia next to the spine, where they interface with neurons that run up the spine to the brain.

Hematoma Essentially a bad bruise, a hematoma occurs when blood pools outside a blood vessel.

Humerus The bone of the upper arm.

Iliac crest Anterior Superior Iliac Spine (ASIS), or “pointy part of the hip bone”.

Innervated Specifies which nerve connects to a body part. “The back of the thumb is innervated by the radial nerve”.

Ischemia A body part is ischemic when it is receiving an inadequate blood supply.

Motor nerves transmit orders from the brain to the muscles.

Myelin sheath A fatty layer that surrounds some nerve axons. It is important for proper functioning and is easily damaged.

Nerve A nerve is a bundle of nerve axons that run through the body.

Nerve flossing or **neural glides**. Specialized physical therapy techniques.

Neurapraxia The mildest type of nerve injury in Seddon’s classification: the myelin sheath is damaged but the axon is intact. Equivalent to a Type 1 injury in the Sunderland classification.

Neurotmesis The most serious type of nerve injury in Seddon’s classification: severe damage up to and including a completely severed nerve. Comparable to Types 3, 4, and 5 in the Sunderland classification.

Occluded An occluded blood vessel is blocked and has limited (or no) blood flow.

Orthostatic hypotension Low blood pressure caused by standing up too fast.

Palpation Exploring an anatomical structure by touch.

Paresthesia Abnormal sensation like tingling or numbness. For example, pins and needles.

Peripheral nervous system All the nerves other than the brain and spine.

Progressive recruitment The process by which increasing numbers of muscle fibers are activated to increase the force of a muscle contraction.

Proximal Anatomical term meaning “closer to the center of the body”.

Radius One of two bones in the forearm, the radius is on the thumb side.

Sciatica Nerve pain in a leg caused by compression of the sciatic nerve, often in the lower back or butt.

Sensory nerves transmit information from the body to the brain.

Syncope Syncope is a fancy word for “fainting”.

Thoracic outlet A small passage in the shoulder through which all the blood vessels and nerves of the arm have to pass.

Tibia The shin bone.

Ulna One of two bones in the forearm, the ulna is on the pinky finger side.

Vasogagal syncope Fainting caused by the vagus nerve.

FOLLOW ALONG

Module 1: Basic Anatomy

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Alex Hits Their Funny Bone

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