Ultrasound

## Edited Video Transcript

### Treatment Ultrasound Changes Physiology

Okay, so ultrasound. Now we're going to be using properties of sound to manipulate the body. Today, we're going to be doing treatment ultrasound. This is different than a diagnostic ultrasound. Diagnostic ultrasound is what they do when testing for the sex of your baby, all right. They're going to send sound in. That's going to bounce off that soft tissue and come back, and they read it. It's effectively sonar—same thing that submarines do, but in this case, we're [doing] treatment ultrasound. This sound is more intense, where we're going to send sound in to be absorbed into that tissue, and that's going to change our physiology. Think about standing next to a speaker at a concert, right, and you feel that if you were to touch the side of the speaker cabinet, it actually feels hot. It's the same thing—the sound waves coming out of that speaker change your body; they change the speaker cabinet. So with that, you can do numerous [treatments]. It's most effective with high collagen-content tissues.

### Thermal Ultrasound and Non-Thermal Ultrasound

We've talked about collagen and ligaments, tendons, joint capsule, scar tissue. Those are hard to heal because they're relatively avascular—there's not a lot of blood flow, so this is where it's most effective. And within ultrasound, there's two things we can do. We can do thermal ultrasound or non-thermal ultrasound.

**Thermal Ultrasound** With thermal ultrasound, you're going to send that heat in to heat up the tissue. That's going to do all the effects we talked about with heat, but it's a heat effect from the inside out. So you can think about increasing inflammation and blood flow, increasing metabolism, altering nerve-conduction pain.

 **Non-Thermal Ultrasound** With non-thermal ultrasound, we're going to send that sound in but in a way that doesn't increase the heat, so that's going to increase metabolism, increase immune activity without increasing inflammation. This, in theory, helps to regenerate tissues and heal wounds, okay.

Ultrasound Precautions and Contraindications

In terms of our precautions and contraindications, be really cautious on healing sites—new fractures, new tendon repair, right. [Ultrasound] will change our metabolism, and we can't be guaranteed changing it in a good way.

**Contraindications** With our contraindications—DO NOT [use] over plastic or metal implants. That plastic or metal implant will heat up faster than their body tissue. You'll heat up hotter than their body tissue—that may cause a burn from the inside out. [DO NOT] do it over a suspected DVT—a deep vein thrombosis—because that sound wave might cause that [blood clot] to dislodge and that could cause a stroke or heart attack. We want to be really careful over areas with acute bleeding or edema. Bless you! Because again, if we cause more inflammation, more blood flow to that area increases metabolism to that area. We may be making that problem worse. We DO NOT do this for people with reduced sensation in that area as well. With ultrasound, you actually can't feel it working, so if somebody is feeling something, it's wrong, right, and we are at strong risk of hurting them. So if somebody has reduced sensation, they're [not] going to be able to tell us if it's wrong. We want to avoid doing this on the very young, very old—children and older adults, because their physiology works differently. They have different amounts of of soft tissue, hard tissue, collagen, growing collagen—it's in general not indicated. Never [use ultrasound] over a cardiac pacemaker because this can disrupt the pacemaker. Pregnancy is listed as a contraindication, over a site of infection, over cancers. And we don't want to cause more metabolism, more blood flow over the growth plates of growing bones. This can actually damage the growth plates over nerve bundles. [Nor over] the cervical ganglion carotid sinus—the spinal cord, because this will alter nerve function. And then finally my favorite—the exact quote—over the heart, eyes, or testes. Why? Because yeah, no reason to, all right?

Always Follow Your Ultrasound Protocol

So ultrasound, the reason we do this in small groups is [because] ultrasound is a lot more complex. As you're doing it, this is a 100 percent, 1) established service-based competency before you do it, right. 2) I always recommend having a protocol and following a protocol because there's a lot of decisions that we have to make in here to think about. This… is one protocol you've got in your handout. It's on Canvas. I keep this with my ultrasound machine. This leads you through how to make your decisions.

**Example Protocol** First, you're going to ask yourself what's the depth of the lesion to be treated. Let's say just for convenience, deep vein thrombosis (DVT) veins—that inflammation in your first dorsal compartment holding your abductor pollicis longus—your extensor pollicis brevis—mother's thumb, texter's thumb, right? So that's pretty superficial. We can come here… We know we're going to use three megahertz because that's targeted to be within two centimeters of the skin, whereas one megahertz—it's a broader wave—is targeted to reach deeper into the skin. From there, we ask ourselves the pulse ratio and intensity: is it acute, subacute, or chronic? Acute, we're talking weeks to those first few months; chronic when somebody's been dealing with it six months to years; sub-acute, kind of in the middle ground. So, if this is an acute injury, we're going to come here to the acute line, and this is going to tell us our pulse ratio—that's the amount of time the signal is on—the amount of the time the signal is off. This is saying a 1 to 4 or 1 to 3, right. So, 1 to 4 [would] be 25 percent of the time the signal is on. That's in contrast to chronic, which is a one-to-one, or continuous. But a one-to-one, half the time—the signal is on half the time. The signal is off with acute. We're doing non-thermal ultrasound because we don't want to increase the inflammation.

She's got more than enough there with chronic. Her body has said, “Well, I’ve tried healing this for three years. I’ve had no luck, so I’m not worrying about it anymore; deal with it.” She needs more inflammation, so we're going to be doing a thermal ultrasound to actually heat that tissue up and bring more blood flow to the area, right? So, we decided acute.

Then, we're going to come down here… for intensity. With acute, I’m going to do about 0.1 to 0.3 watts per centimeter squared. So just a little amount of energy, whereas with chronic, it's 0.3 to 1, so more energy. Again, [note] the difference between that non-thermal versus thermal effect. These decisions make sense?

Alright then, what you have to do—if I could see a thumb—you have to select the right head for the machine. We have all these different heads. You want to pick something that's about the size of your area that you're going to treat. This… is about right. The other end is too darn big, right? Then you ask yourself, how many times, how much area, compared to that treatment head? So that's about one to about two heads. We know that information.

Figure Out Your Treatment Goal-Time

We know our power. We know our pulse ratio. We know our intensity. We know our kind of treatment [and] head size to the treatment-area size. We use that to figure out how long our goal is to deliver one minute for each area of the tissue. So there's a couple things here—one minute for each area. I already said that I’m going to need to have twice the area of the head, so that one minute becomes two minutes. I also said that the sound is on only 25 percent of the time, so I need to multiply those two minutes by four. So that two minutes—it's eight minutes that I’m going to need to run this for. The handout kind of walks you through how to do that with an example, all right? Now, with this… first thing I’m going to do, I’ve got my treatment head put on. I click ultrasound. I edit my parameters. I’m going to set my duty cycle. Actually, this one's got 20, so it's actually times. I turn that up to where I’m going to want it to be, apply my conductive gel, and then I hit start. So one thing with ultrasound, you're always moving, moving. If you have to stop for 10 seconds to apply more gel, hit pause on the machine, come back to it. But you're moving this entire time. If you leave it in one spot, all that sound could be concentrated at the head of a pin that can lead to a deep burn that is actually two centimeters under the skin. In this case, that's not good about ultrasound.

What do you do about ultrasound burns? Uh, that is up, no that's up to like the burn profession, the burn doctors—that is a go to the ER. Other questions? Why? Why do you do this [ultrasound]? The theories behind ultrasound is [that] it improves healing. You could do it over a scar to help that scar remodeling. We talked about this case where those tendons [are inflamed], will do that to help those tendons repair and become stronger, yes. So, if there's a lot of edema in that, this is going to be a contraindication, all right? I’m just going to stop, okay?