CARPAL TUNNEL RELEASE
HARTFORD HOSPITAL
HARTFORD, CONNECTICUT
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ANNOUNCER: Over the next hour, live from Hartford Hospital in Hartford, Connecticut, see surgery to correct carpal tunnel syndrome. When the median nerve in the carpal tunnel is compressed, it can cause hand weakness, pain, and potentially permanent numbness. To treat the condition, surgeons cut the carpal tunnel roof to decompress the nerve, allowing for improved nerve function. Orthopedic hand surgeon Dr. Andrew Caputo will perform the surgery. During the procedure, you can e-mail your questions right to the O.R. by clicking the MDirectAccess button at any time. Now let's go live to the operating room.
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KEVIN J. BURTON, MD: Welcome. We're coming to you live from Hartford Hospital in Hartford, Connecticut. Today we'll be performing a carpal tunnel release on a patient with carpal tunnel syndrome. I'm Dr. Kevin Burton, and I'll be joined today by Dr. Andrew Caputo, who will be joined -- who will be doing the surgery today. Before we go to Dr. Caputo, I have a few housekeeping items for you. First, we will be answering questions from the viewing audience later in the webcast. To send us your questions at any time, click the MDirectAccess button on your screen and we'll try to answer those questions as best we can later on in the program. Also, CME credit is available for participating in the webcast. If you are interested in receiving credit, click the "take the CME test" button at the conclusion of the program. Now let me turn things over to Dr. Caputo.
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ANDREW E. CAPUTO, MD: Hello. Welcome. Here today we're doing a carpal tunnel release surgery. Here in the operating room, we have Carl Becker, who's our surgical -- surgical technologist, Dr. James Boyle, orthopedic resident who's the first assistant, Dr. Susan Lowry, who's performing the anesthesia tonight, she's the director of anesthesia here at the ambulatory center at the hospital, and Elaine Guyuski, who's our nurse and circulator. The patient that we're working on tonight is a 70-year-old right-hand dominant female. She's had symptoms associated with carpal tunnel syndrome with constant numbness and tingling over the last six months. She has failed conservative treatment, she has the typical signs and symptoms of carpal tunnel syndrome, specifically difficulty with numbness and tingling causing her functional problems with driving, writing, and reading. We'll go over some of the exam findings relative to her carpal tunnel diagnosis later. Today we're going to be performing an open carpal tunnel release, which is a method to decompress the median nerve. The patient is already under a general anesthetic at this point. Today we're using a general anesthetic for specifical-- specific technical reasons relative to accomplishing this today; most of the time, we do perform this under a local I.V. sedation or it can be done under a light general. The patient has a tourniquet on which we can't see underneath the sterile drape at this point, and we're going to use an S-mark to wrap out the hand. And we've already clarified our patient's name and location and that we're performing a right carpal tunnel release

on her, and this S-mark, we're exsanguinating the blood from the extremity prior to elevating the tourniquet. The tourniquet's on the upper arm. It's elevated to about 250 mm of mercury, and that in essence stops the blood flow to the hand during the procedure. And what we have marked out here are two spots on the incision. Specifically, these denote the distal and proximal aspects of the incision that we're going to make. What we can see is that these are in line with the radial side of the ring finger and also to the owner side of the palmaris longus tendon. The distal aspect of this runs in line with the abducted thumb here, and that's what we call Kaplan's line, which we'll show you in a diagram during the slide portion of the tape. So we'll start here with an incision of the skin. And we use a small retractor called a Heiss retractor, and we're working our way down through the fat tissue, getting down to a tissue called the palmar fascia, and these are these small white fibers that we see below here. We use a blunt spreading technique, trying to protect any small nerve fibers that we see along the process. And we're going to retract this fat tissue proximally up towards the forearm. Down on the distal end of the wound, we're going to localize what's called the ulnar nerve and artery and safely retract them out of the way. Once we localize the distal end of the carpal tunnel ligament which is right here, we have the ulnar nerve vascular bundle protected by this retractor here. I know that's hard to see in this very small incision, but we're going to explain to you why we use such a small incision to make this and also, on an anatomic specimen, we'll show you the full extent of what's actually going on here. So now we're actually releasing the transverse carpal ligament. Okay. Come all the way out. And as we're tracing the nerve proximally up into the forearm... And through this maneuver here, we're releasing the nerve up into the forearm, what's called the flexor retinaculum. Can you reposition now? And as you can see, we're tunneling with the retractor up into the skin beyond the area where the incision is made in the skin to ensure that the nerve is actually released all the way from here in the skin proximally up to the level and then far down to the distal portion here. And if you look in deep, we can actually see the nerve here lying deep in the wound, and then adjacent to that, the flexor tendons and the carpal tunnel. Once we've confirmed that the decompression is complete, we'll then close the skin with nylon. Dr. Burton's going to go over some of the history behind why we've gone to becoming -- using just a small incision here for doing this surgery. In the past, this was a larger incision to accomplish this, but we try to keep the incision as small as possible, trying to minimize pain in their palm during the healing process. We're going to inject her hand with some local anesthetic. This is 0.5% Marcaine plain. And we'll use about 3 cc's to get that done. And then we'll apply a dressing with first some Xeroform, and these are fluffed gauze, and we'll use two of these small ones. Can we have the O.R lights down, please? And that's the procedure there. I like to tuck the dressing in nice down -- We can let the tourniquet down, please. I like to tuck the dressing down deep, past the distal palmar crease here so the patients can open and close their hands fully, and we encourage them to use their hand after the procedure. Okay. Next we're going to have Dr. Burton go over some slides.

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KEVIN J. BURTON, MD: Actually, we're back over here. We've got a few questions from our audience. First off, there is a question: what are the causes of carpal tunnel syndrome? And I'm going to actually defer on that question because there is a slide presentation that's coming up that reviews a little bit more about the history of carpal tunnel syndrome, as well as the causes and other diagnoses, so I'm going to skip over that one for right now. The next question: is physical therapy necessary after this procedure? If so, how extensive? I think every surgeon varies on that question just a little bit differently. Again, we'll review a little bit of the postop rehab after the surgery has been performed, but typically, it entails patients moving their

fingers as much as possible. I think some patients do indeed require therapy because a handful of patients will develop some significant stiffness in their fingers, but that's a relatively small percentage of patients. Some surgeons do choose to send every patient that they perform a carpal tunnel release on over to a physical therapist to ensure that they recover all their motion, so if -- unless Dr. Caputo has any additional comments on that one. And then just one other question: do you have to be under general anesthesia for this operation? And the answer to that is no, there are multiple different anesthetics that can be used. General anesthetic is obviously a relatively short one, as in this particular case. Other anesthetics that can be used are regional anesthetic, where the entire nerve -- I'm sorry, the entire arm is numbed and the patient can be completely awake. Or additionally, there can be local anesthetic with just some intravenous sedation so the patient is relatively comfortable and relaxed in the operating room, and that's actually a relatively common way that the procedure is performed as well. And at this point, I think we're going to switch over now and begin going through some of the slides to address some of these other questions that we're receiving. So if we could have the slides up, please. we're going to backtrack just a little bit. You've already seen the surgery for carpal tunnel release, and now we're going to talk a little bit about what carpal tunnel syndrome is and how we diagnose and subsequently treat. So first off, carpal tunnel syndrome is a compressive neuropathy, which just means that the nerve is being compressed at the level of the wrist. The nerve that's involved is the median nerve, and if you're looking at the slide here, it is the structure that's shown in yellow. That is the nerve that's crossing across the wrist at the level of the wrist, which is also called the carpus. What happens here is there is swelling of the flexor tenosynovium, which is the protective layer around the tendons, and in this diagram, it's the structure that's shown in blue that wraps around the tendons which also pass through that tunnel. This is a confined space, and the transverse carpal ligament, which is -- I'm going to back up one slide -- seen on the left side here is a structure that crosses across the carpal bones and forms a tight, restrictive space. In this particular slide, again on the left, the median nerve is depicted and the other structures around it are the tendons that go to the fingers. If we advance here again, if you look at the tendons, if those become swollen, that will put pressure on that nerve as it's crossing at the level of the wrist and decreases the function of the nerve. Early on in carpal tunnel syndrome, there is increased pressure in the carpal tunnel which causes some decreased blood flow to the nerve. That's typically a transient process where patients will feel intermittent symptoms that resolve relatively quickly. In the immed-- sorry, in the intermediate stages of carpal tunnel syndrome, the nerve starts to develop edema in the epineural tissue, which is the tissue that surrounds the nerve. Later on, there is decreased circulation to the nerve, and that actually will begin to affect the myelin sheath, which is the protective sheath around the nerve. And finally, in the late phases, there is actually fibrosis, which is scar tissue that develops around the nerve and the nerve will undergo permanent changes that cannot be reduced -- sorry, cannot be reversed regardless of what we do. There are multiple medical conditions that can be associated with carpal tunnel syndrome; there's a list of them here: diabetes, rheumatory arthritis, hypothyrism, and gout are certainly common contributors to this. Other factors which we will address: often body-mass index, patients who tend to be more obese can have a higher risk for developing carpal tunnel syndrome. Also carpal tunnel syndrome tends to be more common in women, and additionally, there is also some contribution from the wrist depth-to-height ratio. Again, those are anatomic measurements that can be taken on cross-section and not something that we typically look at when we're simply seeing a patient in the office.
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It's important to understand that the most common cause of carpal tunnel syndrome is something called idiopathic, which simply means that we don't really know where it's coming from. We do know that there tend to be associated activities, such as repetitive typing or tool use or also repetitive grasping or moving of objects, and here is the infamous keyboard, which is typically associated with carpal tunnel syndrome, but we'd like to point out today that carpal tunnel syndrome certainly pre-dated the keyboard, and so all keyboard users are not somebody who'd develop carpal tunnel syndrome, and just because you've used a keyboard at some point in your life certainly does not mean that you'll develop it. Meatpacking tends to be an occupation, again for unknown reasons, which typically will produce carpal tunnel syndrome, and some others are listed here. Part of the history that patients will present with is typically complaints of numbness and tingling in the fingers, and that typically involves the thumb, index, and middle fingers, and often will radiate proximally, which means up the undersurface of the forearm. Other common complaints are weakness of grip and decreased finger flexion. Additionally, we hear common complaints of nocturnal symptoms; people who wake up at night with pins and needles in their hands and need to shake their hand to -- to reestablish sensation in their -- in their fingers. In the daytime, the symptoms tend to be more with a fixed wrist position such as while driving, writing, or reading, and that keeps the wrist in a fixed position, which also can provoke the symptoms. Part of the exam tests multiple different things; one of these is muscle strength and the muscles which Dr. Caputo's going to run through. Also sensation in the thumb, index, and middle finger, as well as all the other provocative tests, again, which are going to be run through in this video. And so if we can move to that video, please, and Dr. Caputo's going to run through that.

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ANDREW E. CAPUTO, MD: Thank you, Kevin, for that introduction. Here's an examination of the hand for carpal tunnel syndrome. First, just by observation, we're looking at the thumb, specifically the thenar musculature, looking for any atrophy that can be associated with that. The thumb is important for opposition, and specifically that function is placing the thumb away from the hand for grasping objects. Here we're testing that motion specifically against resistance. The muscle that's most specific for that is the abductor pollicis brevis. We're looking at the other intrinsics in the hand, going to the small finger, the abductor digiti minimi, and the first interosseous for the index finger. And we also evaluate for full grip, looking at the extrinsic function of the hand, testing the long extrinsic flexors. As Dr. Burton pointed out, the nerve is also important for sensation. We're checking sensation by light touch, and when it's diminished by light touch, we like to quantify that using a two-point discriminator. And this device quantifies patient sensation based on one or two points. once they get familiar with the exam, we ask them not to see what we're doing and have them guess whether they can feel one or two points when we hold them. Two-point discrimination is recorded as the smallest level that they can obtain with two points. normal discrimination is between five or six millimeters or less. We're going to examine the other digits, too. The index finger, again asking them between one and two points. and here they can do it at four millimeters, which is, again, normal. And they're able to obtain it at four. Sometimes in severe carpal tunnel syndrome, that can be up in the range of 10 to 15 millimeters. Again, we're looking at the thumb for a position relative to the function of opposition. Opposition placing the thumb in a position where it can be opposed to press up against the adjacent fingers. The next portion of the exam are what are called provocative tests, specifically Tinel's, which is tapping along the course of the median nerve, trying to provoke symptoms distally to the fingertips or even proximally towards the forearm. The symptoms would be a paresthesias, or numbness and tingling to the thumb and

index and middle finger. We also try to elicit the same symptoms by pressing on the median nerve, called a median nerve compression test. Again, we're looking for the similar re-creation of symptoms with numbness and tingling radiating to the hand or proximally.
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KEVIN J. BURTON, MD: Okay, we're back to the exam findings. Dr. Caputo just ran through a few of the physical exam findings. Where we left off, the median nerve compression test, the Phalen's test, and Tinel's test, which are classic tests described for carpal tunnel syndrome. It is important to note not in that slide pres-- or that video presentation was the proximal examination, because it is important to rule out contribution from the cervical spine or the cervical nerve roots as well as in other portions of the upper extremity. As with any nerve, the nerve can actually be compressed at any point where it's leaving the spinal cord all the way down to the fingertips. It just so happens that the carpal tunnel is the most common place where that nerve is compressed. There was actually a question as well, and I'll answer that now, about whether or not C-5 and C-6 problems can imitate or produce symptoms similar to carpal tunnel in a patient who actually e-mailed us in some findings from his nerve conduction test, and it is important to understand, in his nerve conduction test as well there's findings of carpal tunnel syndrome. And that's a common problem that we see, it's called a double crush phenomenon, where the nerve can actually be compressed at the level of the neck as well as at the level of the wrist. So it is possible for that to happen; that's called double crush, and the nerves are actually very sensitive to being compressed at two different points along their course. So I'm going to move along here, and on the diagnosis, the next step in diagnosis, nerve conduction studies, often called the gold standard for diagnosis. And useful with that double crush phenomenon where a patient can have compression at multiple different sites or in unusual sites. We've listed here pronator syndrome, which can happen more up in the middle of the forearm, but again is a relatively rare phenomenon. I think it's important to understand that nerve conduction tests are not always positive. The patients with negative nerve conduction tests can still have carpal tunnel syndrome, and so that does not completely rule out the diagnosis. So back to treatment stages. Early on, the carpal tunnel syndrome is potentially curable with conservative treatment. We'll go through a few of those in a minute. Intermediate carpal tunnel syndrome can be successfully treated with surgical decompression. And later on in the disease, when there is permanent nerve damage, some of that nerve damage cannot be recovered with decompression of the median nerve, but what we can do with decompression is halt any further progression, and oftentimes patients who present with those later findings can have some -- some of the painful numbness and complaints relieved by the decompression even though they will continue to have some persistent numbness in the fingertips. So early on, things that can be done to try to alleviate carpal tunnel syndrome is to limit repetitive activities, especially the ones that tend to provoke symptoms, use of nocturnal splints -- we'll have a picture of those in a minute for you -- oral anti-inflammatory medications, use of Vitamin B6. there are several things like this out there. Other things, including therapy modalities such as ultrasound and iontophoresis have not been clinically proven to be effective, although some patients will note that they feel better with those therapies. Finally, cortical steroid injection or injection of a steroid into the wrist can provide transient relief and can be helpful in diagnosis, also found to be extremely helpful in pregnancy, where carpal tunnel syndrome is very common. But most studies with cortical steroid injections do not show a very long-lasting benefit from those. So here we have a -- the rationale behind use of the nocturnal wrist splint. This is a typical position that most of us assume while we're sleeping, and you can see the flexed position of the wrist. That

decreases the actual volume of the carpal tunnel and puts excess pressure on the nerve while we're sleeping and most likely why people will wake up in the middle of the night with their hand numb. You can see on the right side the patient with the brace on, that wrist position is limited, and so in theory takes away the compression during sleep. Other interventions, such as workplace furnishings and layout, ergonomic tools reducing vibrational pressure, and adjusting job schedule as well as change of keyboards can be helpful, again, if those symptoms are being provoked by work activities. So next we're going to move back to surgical options, and the goal here is to incise the transverse carpal ligament, which in the diagram here on the right, is the ligament that crosses over the top of the median nerve. Again, we'll have a little bit more of that later on in another cadaver video. And so all we're doing here is taking the pressure off of the median nerve. In the traditional open approach, there is excellent visualization of the median nerve, but over the years, people have been concerned about the painful aspect of the surgery, which puts an incision on the heel of the palm and can cause some discomfort. There was a move for endoscopic release, which involves two small portals and use of passage of an endoscope underneath the ligament. This allows for indirect visualization in release but some reports have noted some increased risk of nerve and tendon damage with that technique. So here in this next slide, we have a diagram of the traditional open incision, which is shown in red, and then in blue, there are the two portals for the endoscopic release, so you can see the limitation of the incisions. Some of the studies that have been done on the open versus endoscopic typically show both to be quite effective in relieving pain. Both patients can return to their activities and have long-lasting results, but early on, the endoscopic approach showed a slightly earlier return to work with the tradeoff of increased complications. And you can see listed here partial median nerve lacerations and arterial lacerations, all of which can be considered pretty catastrophic complications. Additionally, open and endoscopic later on have been tested. At this point, you can see the study was performed in 2002, at that point, most people had transitioned to a smaller incision for carpal tunnel release, and so there's really no difference seen between the two surgeries in this particular study. The mini-open carpal tunnel release uses a much smaller incision; that's essentially what you saw Dr. Caputo perform a short while ago. There is a minim-- it's a minimized scar, and therefore reduces the tenderness along the scar, and there's similar return of hand function as in the endoscopic technique. Proponents of this type of approach like the visualization as well as the decreased chance of injury to the nerve as well as the artery at the end of the carpal tunnel. And so back to this diagram here where the traditional is the long red incision and the endoscopic is the blue; the yellow here is the mini-open which you just saw performed live. Some of the landmarks that Dr. Caputo did point out. First off is Kaplan's line along the thumb as well as the radial border of the ring finger. Places the incision along the ulnar side of the tunnel, which decreases risk to the recurrent motor branch of the median nerve. And again, that's going to be shown for you in just a little bit. So the goals of carpal tunnel decompression initially in the superficial dissection is to get through the subcutaneous tissue, which is the fat tissue. A little deeper to that is going to be the fibrous connective tissue, or the palmar fascia. And deeper to that is the transverse carpal ligament, which was shown in cross-section on our diagrams, completely into the forearm flexor retinaculum to allow for a complete decompression of the median nerve. Additionally, occasionally, we will need to perform a flexor tenosynovectomy in a patient who has excessive tenosynovium around the flexor tendons. And typically that is going to be a patient with rheumatoid arthritis. So at this point we're going to transition back to Dr. Caputo and the patient who's working on recovering.
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ANDREW E. CAPUTO, MD: Thank you, Dr. Burton. Our patient has recovered from their brief general anesthetic at this point. She's comfortable now and stable, and you can see with the small dressing that she has on, she's able to open and close her hand fully. You make a tight fist for me there? And open up nice and wide. And we don't restrict the hand motion with the small dressing as this. Open and close again, please. Great, thank you very much. And at this point we'd like to roll to the tape relative to our surgical dissection. Considering what we talked about before, making a very small incision to minimize pain in the palm of the hand, what we're trying to do here is do the small incision on a -- for our live patient here, the small incision is to minimize her pain, but the reason why we're doing this on a cadaver is to show you what we're actually accomplishing when we're doing the surgery on the inside. So this is a cadaver arm, a patient that has thankfully donated their body to science so that we can use their anatomy to teach others here. And this is an extended anatomical approach. And we've already done part of the skin incision, obviously, in the proximal part, which is up towards the forearm. What we're showing you here is the flexor retinaculum, and that's what we're coming through there. Deep to there are the flexor tendons and muscles. And then down towards the distal end of the wound, we're going to localize the ulnar neurovascular bundle, which is the ulnar nerve and artery. Overlying that is the palmar fascia, which we've already incised, and we're finishing the distal cuts of that there. The ulnar nerve and artery ride superficial to the transverse carpal ligament and are not compressed underneath the transverse carpal ligament like the median nerve. The ulnar nerve and artery typically supply innervation sensation to the ring and small finger and also motor control to all of the other small muscles in the hands, the intrinsics. The median nerve, as we mentioned previously, innervates the thumb muscles, the abductor pollicis brevis being the most specific one. At the distal end of the wound here, we're incising the palmar fascia and localize the ulnar neurovascular bundle so that we can protect that when we release the transverse carpal ligament. Here the retractor is holding that towards the ulnar side of the hand. Some patients do have specific compression of the ulnar tunnel; that's called ulnar tunnel syndrome, and that's separate and different than what we're talking about here, but the two tunnels are directly adjacent to each other. And we'll release the ulnar tunnel proximally fully into the forearm, and you can see that there's a large amount of fat at that level, which is the cushioning at the heel of the hand which protects those neurovascular structures. And on the right side of the screen there, the more bluish structure, that's the ulnar artery itself. So here we see the full extent of the transverse carpal ligament along with the flexor retinaculum from the distal forearm. Here is the distal end of the transverse carpal ligament, and at the distal end, this should be the area where we can find the end of the flexor tendons on their way towards the fingers. You can see this if we look closer. And there's the flexor tendon to the ring finger. And you can see how close the ulnar nerve and artery are, right there at the edge. During the surgical procedure, we were protecting that nerve and artery to keep it out of the way or we would directly see it. Again, here's placement of that retractor to safely retract the ulnar nerve and artery out of the way before we begin to cut the distal end of the transverse carpal ligament. In this anatomic dissection, we're going to transect the flexor retinaculum in the forearm proximally and carry that incision distally. When we did the surgery, we went from distal to proximal, in other words, from the distal part of the incision towards the fingers towards the forearm. First we'll show you hear the median nerve and deep to the median nerve there is the muscles of the flexor tendons, and that's the full length of the dissection that we're doing in the anatomical dissection, and that's also the same length that is incised surgically that we did here for our patient tonight. All the tissues that are currently being released are the same tissues that were released during the live surgery. And

there's the thickened portion of the transverse carpal ligament. We carry that all the way to the distal end. We want to safely protect the ulnar nerve and artery, and there's the last portion there. And that effectively decompresses the median nerve at the wrist. The tissues surrounding the flexor tendons is the flexor tenosynovium, which is the tissue that surrounds the tendons and lubricates them to allow independent finger motion and allows the tendons to glide smoothly. That's the same tissue that can be very swollen, especially in situations of, like, rheumatoid arthritis. And in diseases as rheumatoid arthritis, we may do what's called a flexor tenosynovectomy, which is to remove that tenosynovium from around the tendons. Here's the median nerve with tenosynovium surrounding it, and as Dr. Burton had pointed out, we keep the incision of the transverse carpal ligament on the most ulnar portion to protect the recurrent motor branch of the median nerve, and that's what we're going to find now. Typically, this does come off on the radial portion of the nerve, but there are nerve anomalies when a nerve branch is not in a position that we typically would expect it, but if we keep our incision on the ulnar side of the carpal tunnel, then we minimize any injuries to the nerve regardless of whether it's an aberrant or abnormal one. Now if we look on the underside of the transverse carpal ligament, there's a small portion of the flexor tenosynovium there attached to the nerve. That's not the motor branch. And on the -- here the most radial and volar portion of that median nerve is the motor branch, and that's the one that innervates the muscle, the abductor pollicis brevis and the other thenar muscles that are important for opposing the thumb. As you can see, the median nerve lies on the more radial or the thumb side of the carpal tunnel, and the incision we made was on the ulnar side towards the small finger, again, to protect any aberrant motor branches. Here we're showing the structure together. And then after decompression. Again, that's the median nerve. In rheumatoid arthritis, as we mentioned before, sometimes we do a flexor tenosynovectomy, and that's where we remove this tenosynovium because it's quite inflamed and also limits digital motion. And that gives us a good visualization of these flexor tendons. These tendons go from this point in our wrist all the way up to the fingertips and facilitate full digital flexion normally, and that's flexor tenosynovium there. As you can see, when we pull on the tendon here, specifically the one for the ring finger, this is called the flexor digitorum superficialis to the ring finger, flexing through the PIP joint, and adjacent to that, we find the one for the middle finger.

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KEVIN J. BURTON, MD: Okay, we're back here and just going to remind everybody that that was indeed a cadaver specimen that was prerecorded earlier, and dissection was obviously much more extensive for the purposes of viewing. That was the same procedure that Dr. Caputo essentially performed through a much smaller incision. We're going to go back and show you the last slide here on postoperative rehabilitation before we jump to a couple of questions. You can see in the slide here, the dressing is essentially exactly as is the one that Dr. Caputo has placed on the patient already. The important things to note about this is it's a relatively low-profile dressing. It encourages the use of finger motion, and we certainly encourage all the patients to move their fingers as much as possible and keep the postoperative swelling down. This can be changed within the first few days into a smaller dressing. It is important to keep the wound clean and dry after the surgery has been performed to minimize any risk for infection, and sutures can be removed at 10-14 days. After that, patients can proceed with activities as tolerated. And that concludes our PowerPoint presentation. We do have a few questions. I'm going to bounce back and forth to Dr. Caputo as well to help address some of these questions. The first one, and Andy, I'm going to bounce this to you: how long after symptoms appear is surgery recommended?

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ANDREW E. CAPUTO, MD: That can be variable for different people. The most important things when considering treatment for carpal tunnel syndrome is importantly to avoid any long-term damage. In situations where it's quite severe, when their symptoms are very severe, especially after trauma, sometimes it's done immediately within the same day as say, an injury like a wrist fracture, in the most common situation where we see it, after idiopathic treatment or idiopathic carpal tunnel syndrome, is some patients can go along years with only mild amounts of compression but still be able to maintain their nerve function. As long as they can maintain nerve function, then it's not necessary that we immediately treat that, so the important clarification there is it truly depends upon the severity of their compression. On most -- on the average patient, if they've already had symptoms for one or two years sometimes, they may have had conservative treatment for two to three months, if they have no relief, then at that point we would consider operative treatment.
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KEVIN J. BURTON, MD: Great. We're going to go to the next question: once this procedure is done, can you be sure the problem won't happen again? So that's going to address recurrence rates. Published recurrence rates vary from a little over 1% to on the order of 3%, depending on which study you read. And so this carpal tunnel syndrome certainly can recur. In terms of recurrence, if the recurrence is very early on, obviously the consideration needs to be whether the carpal tunnel was completely released or if the symptoms are simply a matter of persisting compression on -- I'm sorry, residual defect of the median nerve, which may or may not recover. Later on, certainly several years down the road, patients can re-present with carpal tunnel syndrome as the ligament which has been cut actually tends to reform, reform some fibrous bands over the nerve itself, and can begin to exert some compression again later in life. But again, those numbers are relatively small. Andy, I'm going to bounce this one back to you: are there any differences in the procedure for children with carpal tunnel and any suggestions for making parents aware that this condition does affect children?
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ANDREW E. CAPUTO, MD: The only patients that I've seen specifically children, and I say that as being skeletally immature patients that have this, often may have some either anatomic issue going on that's causing trouble or some possible syndrome. It doesn't mean that if they had the diagnosis themselves that they have an undiagnosed syndrome, but it's most commonly that we see it grouped together such as what certain types of diseases called Morquio's syndrome or mucopolysaccharidosis, which are storage disorders. The other situation that I've seen and is in the literature also is where specific muscles in the hand called the lumbricals are unusually large and proximally oriented. The surgery itself for either patients with a storage disorder or with anatomic variants as a child, if they need surgery, because of the -- the benefits of doing the open procedure, that would be my recommended procedure for them without significant change from what we've done here tonight. However, it's pretty rare to see them in kids.
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KEVIN J. BURTON, MD: Okay, we're going to go to the next question: can the ulnar nerve mimic carpal tunnel syndrome? And I think the answer to that is they certainly can present with similar symptoms such as numbness and tingling, and that's the symptoms of nerve compression. Typically, the ulnar nerve involves the small finger and portions of the ring finger and so the distribution in most patients is going to be different. The ulnar nerve is typically compressed at the level of the elbow. You'll note as you're following along with the cadaveric dissection, Dr. Caputo pointed out

the ulnar nerve throughout the fat on the portion of the hand closest to the small finger, and that actually travels through a different tunnel, so the ulnar nerve could potentially be compressed at the level of the wrist, but it is typically compressed at the elbow. Dr. Caputo, going to bounce this one back to you: how long does the recovery process take?
00:49:53
ANDREW E. CAPUTO, MD: We leave the sutures in for about two weeks, and that's mainly the timeframe where we have patients have restrictions, and the restrictions being that they want to try to avoid direct compression of the wound and keep their wound clean and dry. I encourage patients to use their hands actively right away after surgery, but it does cause pain when you use your hand such as leaning, putting weight on your hand, weight-bearing on it, or twisting open large jars. An important thing to realize, though, is that while patients do have pain when doing those maneuvers, it's not going to damage anything that we've done surgically here to decompress the nerve. When patients feel that they have adequate control of their hand and can use it without significant pain, I have no specific restrictions for them at all after they finish with their sutures out at two weeks. Having said that, an important thing to realize though is that the pain in the hand sometimes restricts your ability to use your hand, and certain tasks such as heavy lifting, grasping, weight-bearing may be uncomfortable even one, two, or three months after the procedure, but gradually diminish into a normal function.
00:51:01
KEVIN J. BURTON, MD: I'm going to go back to another question. I think this one may have been sent in by one of the hand surgeons following along: why are you still doing the open approach? The endoscopic technique is faster, the recovery is quicker, and the risk and results are the same. So I'm going to bounce to you in a second, Andy. I think from the standpoint of my training, my approach is exactly the way Dr. Caputo's approach, which is essentially the mini-open approach. That tends to give excellent visualization and reduce risk. Throughout my training, the -- we certainly saw several patients who had had complications from the endoscopic technique, and so there probably is a bit of a curve in terms of patients who have had experience. I know there are several surgeons around, and certainly some here, who perform thousands of endoscopic carpal tunnel releases and do them quite well. For me, that is, I've never been anxious to pursue that learning curve because all it takes is one patient to have a devastating complication, and that's pretty much all you need. So I'm going to bounce that one back to you, Andy, if you have any other comments about endoscopic versus open.
00:52:08
ANDREW E. CAPUTO, MD: I think what we've learned from the endoscopic technique and the evolution is that if we minimize the amount of surgical dissection and minimize the amount of scarring on the palm, then we can obtain the similar or same outcome. It varies for different surgeons, obviously, which technique that they can do specifically faster, but I think importantly though, the literature does stand and reinforce the fact that there are, even in good hands, the potential of higher risk of nerve injuries -- tendons, arteries, or nerve -- with the endoscopic technique. At the last American Society for Surgery of the Hand meeting, one of the original proponents of doing the endoscopic technique actually retracted his recommendation for doing that, which he made approximately 10 years prior. So even the pioneers in the field of doing that have stated that they have gone back to doing it open technique.
00:53:04

KEVIN J. BURTON, MD: All right, very good. We're going to bounce back and just take a look at the patient real quick with you, Dr. Caputo, and see how she is doing over there.
00:53:14
ANDREW E. CAPUTO, MD: I think she's doing wonderful here. Again, she's thankfully agreed to be with us, and she's actually basically fully recovered by this point after the procedure, and I think ready to go home shortly.
00:53:26
NURSE: Put your thumb up.
00:53:32
ANDREW E. CAPUTO, MD: We do have a -- another tape which we may roll in just to reinforce some of the surgical points. prior to that, we're going to take a question if we have another one, Dr. Burton.
00:53:52
KEVIN J. BURTON, MD: We have several here, actually. Would you use similar techniques for tarsal tunnel syndrome? Well, tarsal tunnel syndrome is actually a complet-- a different nerve that's compressed in the ankle, so we're going to defer a little bit on that one today because it's a little outside the realm, but again, any nerve can be compressed at any point in the body, and so nerve decompression is important in other parts of the body as well, but tarsal tunnel occurs at the ankle, so we're going to stay outside of that realm today. Are we ready on that tape yet?
00:54:30
ANDREW E. CAPUTO, MD: In this tape here, we're doing another clinical example of doing a carpal tunnel release. So again, we're trying to emphasize keeping a small incision, using gentle surgical technique to initially cut and then bluntly dissect the tissues. You have the Heiss retractor. Here's the palmar fascia that we're incising. And below there, the transverse fibers, the ones running left to right basically, are the transverse carpal ligament. We're going to retract the fat in the proximal portion of the wound so we can see up toward the flexor retinaculum in the distal forearm. And distally, we're localizing the ulnar neurovascular bundle and we're retracting that, again, to safely protect that before we transect the transverse carpal ligament. And there's the ligament below. And there's the transverse carpal ligament. Again, in the clinical setting, different than we did in the anatomical dissection, we're going to incise this ligament from distal to proximal after we've safely retracted the ulnar nerve and artery. And there's the neurovascular bundle retracted. And that's the distal end of the transverse carpal ligament. There's a variety of ways of cutting through the ligament. Different techniques include using a small knife blade or here we use a special type of scissors with a very blunt and rounded end so that when we place them underneath the ligament itself, that it doesn't catch the nerve. Again, there's a variety of different techniques to use to cut that transverse carpal ligament, but the important goal to accomplish here is incising the transverse carpal ligament. And also with the longer scissors here, we carry that into the distal forearm, and you can see proximally up to the level where that goes beyond an inch proximal into the forearm where we do that dissection. Again, the highlights of doing the small incision such as this, trying to keep the scarring on itself as small as possible, maximizing their hand function early. As we were talking about with the endoscopic technique, it is different technique. There's no doubt a number of successful outcomes related to that, and it's a commonly done technique also. Again, the value here is being able to directly observe this, directly visualize the nerve and potential nerve anomalies and safely retract other structures out of the way.
00:58:50
KEVIN J. BURTON, MD: Okay, we're just about out of time here. I'm going to send this back over to Dr. Caputo for any closing comments about the patient that

volunteered for us this evening, and if he has any other questions for us before we close. Dr. Caputo?
00:59:06
ANDREW E. CAPUTO, MD: Thank you, Dr. Burton. I'd like to thank everybody in the room, all our staff and technicians, too. This has been a good production. I think everything went well, and most importantly, I'd like to thank our patient for working with us tonight on this late Monday.
00:59:22
KEVIN J. BURTON, MD: All right, thanks, everybody. Thanks for joining us. And just a reminder, if you are watching this for CME credit, please don't forget to hit the CME button on the screen. An archive of this program will be posted later in the evening. And this has been a demonstration of a live carpal tunnel release performed here at Hartford Hospital in Hartford, Connecticut. I'm Dr. Burton, and for Dr. Caputo and the rest of the team here at Hartford Hospital, good night.
00:59:47
ANNOUNCER: This has been a carpal tunnel release performed from Hartford Hospital in Hartford, Connecticut. To obtain more information, to make an appointment, or make a referral, please click the appropriate buttons on your screen.
01:00:09
[end of program]