ARTHROSCOPIC ACL REPLACEMENT SURGERY
AKRON CHILDREN'S HOSPITAL
AKRON, OHIO
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ANNOUNCER: Live from Akron Children's Hospital in Akron, Ohio, a surgery to repair a damaged ligament in the knee of a young patient. Though often seen with pro athletes, anterior cruciate ligament damage occurs often in young people and more often in girls than boys. Orthopedic surgeon Kerwyn Jones says athletes aren't the only victims of the knee injury.
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KERWYN JONES, MD: Certainly athletes do usually require ACL, or anterior cruciate ligament, reconstructions, but also anybody that just wants to get back to everyday activities without having the pain, the giving way, the buckling in their knee that they typically experience.
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ANNOUNCER: You can take part in today's procedure by e-mailing questions to the doctors in the O.R. Just click the MDirectAccess. You can also make referrals or make appointments at any time through OR Live. Now to Akron's Children's Hospital and Dr. Mark Adamszyk, the moderator for today's program.
00:01:07
MARK ADAMCZYK, MD: Good morning. Welcome to Akron Children's Hospital. I'm Dr. Mark Adamczyk, and today with Dr. Kerwyn Jones, we're going to be demonstrating an ACL, or anterior cruciate ligament reconstruction for you today in one of our teenage patients. As many of you know already, this injury occurs commonly in the athletic population. However, we've been seeing recently an increase in this injury in some of our much younger patients as well. I just wanted to remind you also that you can participate in today's webcast by e-mailing your questions in by clicking the button on your screen, and we will be happy to answer to questions that you have for us. So let's go inside and see how the surgery's beginning. Hi, Kirwyn.
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KERWYN JONES, MD: Hey, Mark. How's it going?
MARK ADAMCZYK, MD: Good. How are you?
KERWYN JONES, MD: Good.
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MARK ADAMCZYK, MD: How are things coming along?
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KERWYN JONES, MD: So far, so well. We've done a little bit of work ahead of time just so that we can get this all done within the one hour time limit. For the people out there, welcome. This is a left knee here. The girl's lying on her back. So I'm looking at the front of her knee right here. I don't know if you can see this on the camera, but we've made several incisions, or cuts. Most of the work is done through these two small puncture wounds that in the front of the knee right here. There's one there and one right there. There's also a third incision, which is right here, and this incision is used primarily for obtaining the tendons that are going to be used for the

new ACL graft. It would be nice if we could just toe together to old ACL, but that's been shown to not really work well, so we have to borrow tendons from somewhere else on her body. So what we have here is one of the two tendons that'll be harvested. The second tendon has already been harvested – in fact, is on the back table there, and I'll show you that in just a bit, but when I'm going to do now is just pull out the second tendon. We've detached from where it attaches below the knee on the front of the shin. It's a hamstring tendon, so those are in the back of the thigh. They run up like this, and I'll detach it now from the muscle up in the top part of the thigh.
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MARK ADAMCZYK, MD: So – so, Kerwyn, what's that instrument that you're using there?
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KERWYN JONES, MD: This is called a tendon stripper. It is a device that's actually sharp right at the tip as opposed to on the sides, like most knives are sharp on the sides.
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MARK ADAMCZYK, MD: So that – that instrument's used to take the tendon off of where it normally is in the thigh, and then we can use it for the ACL, is that right?
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KERWYN JONES, MD: That's right. It's one of the few things we do blindly in any type of surgery. You can see this device is pretty far up inside the knee right now, and I'm pulling down on the tendon more so than I'm passing this up the back of the thigh. And here it comes; it's about to come out. And you may see a little muscle still attached to it. This is going to be a good one. Holy smokes. This girl's quite the athlete. You can tell by the size, the thickness of that tendon. That's actually larger than most, and yet, she is a very thin, athletic girl. So there we have the tendon. Now I'll sure you the arthroscope, actually, is a device that allows us to do the surgery through small holes. It is a 5-millimeter scope, and basically, the end of the scope is angled at 30 degrees. It's a lot easier to see around corners if you have a scope that's angled. So right now, I can look at my assistant even though the device is pointing ahead. It's sort of like a periscope that you used when you were a little kid that you could use to spy on your brother and sister looking around the corner. To get the device into the knee, we use this little blunt sheath. You can see the sheath has a hole in it, and that's where the arthroscope will go through. I put this little blunt tip through it so I don't do any inadvertent damage to the knee. It slides in pretty easily. We'll take the scope. Now we're going to be looking in through the knee using the arthroscope.
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MARK ADAMCZYK, MD: And the arthroscope is used for other things besides just ACL reconstruction, too. Isn't that right?
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KERWYN JONES, MD: That's right. We can use it for fixing cartilage tears. We can use it for – in some cases, for fixing fractures or broken bones that extend into the knee. We can use it when the cartilage on the surface of the bones is damaged to smooth that out. Now, what we're looking at here is I'll go right up into the front of the knee. We're underneath the kneecap here. And if I look up, we might get a glimpse of the kneecap. That's the kneecap right there, and the kneecap glides on the thighbone, which is right here. So now we're running down the front of the thighbone into what's called the notch. I'm bending the knee, and you see what's called the notch. And this is where the ACL ligament normally resides. Can I have a probe? So what we're looking at here, this is the thighbone here, the femur, and it has a normal sort of arch formation to it. Between this arm lives two major ligaments

of the knee. One of them is the PCL, the posterior cruciate ligament, and you can see that here. The PCL has two major strands. There's one strand there. It's nice and shiny. And the second strand is running more up and down right there. You can see it behind this little bit of fat that she has there. The ACL is missing. Normally, the ACL would have been attaching right here and runs all the way up into the back of the notch, and it attaches way back in there in the very back side of the thighbone, or the femur. And you can see it's missing. We've also already taken the – the advantage that we've cleaned off some of the remaining scar tissue from the ACL that was in this area right here just so that the surgery will be a little bit more obvious for you at home. And it will also save some of the time and the less exciting part of the procedure. So what I'm going to do now is I'm going to go to the back table and go ahead and prepare that graft for you.
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MARK ADAMCZYK, MD: I've got the – I've got a model here, too, we can look at while Dr. Jones is moving to the back table there. This is basically a knee straight out from the front. This would be a right knee of a patient with the fibula bone on the lateral side of the knee, or the outside part of the knee. This is kneecap up front and the quadriceps tendon with the kneecap right in it. If we flip that off to the side and open up the knee joint, inside you can see similar view to what Dr. Jones was just looking at arthroscope there. What's different about this particular knee is it does have an ACL still in it. So this is what you would be seeing if the patient's ACL was intact and not torn. This here in the front is the ACL, which is what's missing in this case. So the view that Dr. Jones was able to show was something more similar to this, with the ACL gone, this being the PCL here. These are the menisci, the lateral meniscus and the medial meniscus here and then the collateral ligaments on the side, the lateral collateral ligament and the medial collateral ligament, and any of these structures can be damaged or injured during a sports-type injury or a motor-vehicle accident or something like that, obviously the more common being an athletic type injury. But this is just a model that we use in the office, for example, to explain how these things occur and how they look. So that's just a representation more of what Dr. Jones was showing on the arthroscope. How are things going over there, Kirwyn?
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KERWYN JONES, MD: Good. This is the second tendon that we've harvested. This is the one that you saw coming out of the knee, one of the two hamstring tendons. Could you show then the other tendon that we've already harvested and prepared? What we're trying to do is get a stitch in each end of each tendon. So there's the one that's already been prepared, and you can see that that tendon is smaller in diameter or width than this one, and that's not unusual. This tendon here is usually the bigger of the two. What we'll do is use both these tendons as her new ACL, and you'll see the way we do that is by taking these two tendons, folding them over so that we end up with four strands of tendon that will be inside the knee used as the new ACL. So we actually have four strands that are made from two tendons, if that makes sense. So I'm going to keep preparing this here. This is just called a whip stitch. It's just something to hold onto the tendon with.
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MARK ADAMCZYK, MD: So while – while Dr. Jones is working back there on the tendon, one of our senior residents, Dr. Benyon, is working on the knee here. He is performing what's called a notchplasty, or a slight widening of the area where the ACL and the PCL live. Again, now, to refer to our – our knee model, it's the area right in the middle of the knee that we refer to as the notch. So the area right in between these two things, we think, in especially some of our female athletes, that this may be a little bit too narrow and may predispose them to some ACL-type injuries. So

that's what Dr. Benyon is working on there. We do have a questions from one of our viewers in Alliance. They wanted to know, "What are the symptoms of an ACL injury, and how is it – how is it diagnosed?" Typically, what will happen is the child or the athlete, if they're a little older and not a child, they'll be participating in a sport or, like I mentioned before, may have an injury from a motor-vehicle accident, something like that. Typically, it's more of a hyperextension and, we think, a little bit of valgus. What that means is the knee is directed – the shinbone is moved away from the center of the body towards the side, and the knee moves towards the middle. So that hyperextension and vlagus-type injury causes the notches, as we saw in the model and the surgery, to impinge on the CL and actually tear it. Typically, what they then feel will be a sense of a popping sensation, and immediately, they will develop a large swelling inside the knee that is what we refer to an effusion. Now, they can develop other types of injuries at the same time, such as meniscal tears, things like that, and our patient today – I don't know if Dr. Jones is going to demonstrate this again for us with her – with the arthroscope, but earlier in the – in the case, we're – we're looking at her knee and discovered that she has a tear of her lateral meniscus. So this was trimmed by Dr. Jones back to a stable area where the – we don't think the tear will be causing any more symptoms for her, and it will not re-tear any further as long as knee is stabilized.
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KERWYN JONES, MD: Mark, I'm going to interrupt if you don't mind. I just want to show something here. We've now got – basically, we have the two tendons here that are looped over each other. So you can see there's four strands of tendons now, and we measure them through this device right here that has varying, different diameters. We can find out how thick her four tendon – her two tendons are when we put them all together. And hers happens to be 9 millimeters wide which is, as I said, pretty good size for a young, petite girl like this. So she's going to have a real nice, thick graft in there. Nine millimeters is a good diameter. And I'm glad you reminded me; I do what to show them that abnormality in the meniscus.
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MARK ADAMCZYK, MD: When we get a chance, I think it would be – they'd like to see that, too. As I mentioned before, it's one of the things that does occur with an ACL injury, and we do see it fairly commonly. So –
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KERWYN JONES, MD: You know, the other thing I'm doing over here – it's important to try and stretch the tendons out a little bit before you put them in the knee, because the last thing I want to do is put them in the knee nice and tight like that, and then over time, we know that the tendons have this phenomenon called creep where the tendon actually will lengthen a little bit. And so we actually put them under some tension until we're ready to use them in the legs. I'm going to put them under tension with this device right here. We should measure – put our blue line on that, too. And that'll pull it out to length so it doesn't loosen up inside the knee. And then we'll keep it under a sterile gauze bandage throughout the rest of the case to avoid any type of bacteria getting on there, although, obviously this is all done in a sterile operating room, but as you know, nothing's perfect. We want to take al the precautions that we can. I think my tail is caught inside that chair there. There you go. Thanks. All right, so, Mark, I'm going to take this opportunity to show what's been done so far. You remember the PCL, which is that shiny thing right here. Here is the notch. You can see he's now contoured it to a nice oval or round shape instead of the sharp, pointy "A" shape that is had before, and I can measure this, too. You got the pituitary? So I'll measure this and see if it is indeed within the right width right now. That looks real good, Phil. He's got a nice, smooth contour all the way up. And then in a minute, I'll show you that meniscus problem that she had. You know,

the MRI's a very helpful tool. It can tell us what's wrong ahead of time. It sometimes is wrong. It will oftentimes over-read things or read things that aren't there, and sometimes it'll under-read things and miss, in fact, an injury that actually is there. So although it's very helpful, it's not perfect. In this case, it was helpful because it did tell us she may have an abnormally shaped cartilage inside of her knee, and in fact, she did have an abnormally shaped cartilage. And I'm going to show you the remains of that on this side of the knee if I can get in there. Here's one of the two meniscuses. Those are the things that get torn – a little hard to get in there. Probe, please? That's good, thanks. So I'm going to point at the meniscus now. You can see right back there, there's a little, thin rim, almost what looks like an oyster inside of a shell. Everything relates back to food here, and that actually is the meniscus on the inside. That's a normal-looking meniscus. Perfect, just what you want to see. Then we go to the other side of the knee. Come on over here, Phil. I'll have you flex that up. And we've already done some work on this, but she had a very unusual thing. She had an extremely large meniscus on this side of the knee. It's a congenital thing. It's something she was probably born with, in other words. It was much larger. Instead of being C-shaped, it was sort of O-shaped, or discoid-shaped, almost like a discus that you throw in track and field. And not only was it larger and thicker, but it also had a tear right out near the rim, right out here, and we just contoured that back to a smoother edge so that that no longer will catch inside of her knee. And you can see it certainly doesn't have that nice taper that the other side has. It's impossible to get it down to the nice taper. It's still a little bit thicker, but certainly, this will do the trick in trying to prevent her from having problems with more cartilage tears inside the knee. And back there – you can see that little white, shiny thing back there that I'm hooking now, that's actually a tendon, one of the smaller tendons in the back of your leg. You can see that from inside the arthroscope.
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MARK ADAMCZYK, MD: Hey, Kerwyn, you mentioned retearing of the meniscus there. How important is it to reconstruct this ACL to prevent that?
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KERWYN JONES, MD: Yeah, in my opinion, I think it's very important, especially in the population that we're seeing. We see kids mostly in the early teens, 14-, 15-, 16-year-old age group, but we're also seeing now is some 9- and 10-year-olds. And what we know from pervious studies are that if the kid doesn't have it repaired, the chances of he or she being able to go back to sports a the same level are very dismal. It's somewhere around 15% depending on what study you read. If they *do* have it repaired, those numbers are completely reversed. In fact, about 85%, maybe 90% will be able to get back to their sports at the same level. And I think what you're asking is, "Can they do more damage, too?" And there's some pretty clear evidence that if they don't have it repaired, they can also have further meniscal tears, cartilage damage, other ligament tears, and kids will be kids. So even if we try to keep them out of sports and keep them at a low activity level, they'll get out and do things when we turn our heads. So we generally recommend fixing them. All right, I'm going to take the chair now., I think we're ready to drill our tunnels.
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MARK ADAMCZYK, MD: And that's -- that's a really good point. You know, sometimes – we talked about younger kids having ACL injuries, and one of the issues there is, you know, they have growth plates under their thighbone and the upper end of their shinbone, and obviously, any injury around that area can predispose them to a growth injury. I'm going to highlight something from the Powerpoint presentation here. If you look at this slide, this is an example of a child who's had an ACL reconstruction in the past and has developed a growth injury from that. So as Dr. Jones mentioned, you know, kids will be kids, and they'll kind of do their thing. One

of the treatment recommendations that has been put forward in a child that still has open growth plates is to just put them in a brace and limit their activities, but as any parent out there who's watching today knows, there's absolutely no good way to keep a kid down. So they'll – they'll reinjure themselves in the backyard playing with other friends, just pickup games, that sort of thing. So it's real problem, and there have been some techniques developed. We'll get to those in a minute. Do you have the next move here?
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KERWYN JONES, MD: Yeah, I want to show you something here. Now, to get the new tendons, which is going to be the graft into the knees, we have to drill what we call tunnels, which are essentially holes in the knee. One of the tunnels is drilled in the shinbone, and one of the tunnels is drilled up there, in the thighbone, or the femur. So this device right here – I don't know if you can see it from outside the knee – goes in through one of these two small holes that we made, and we put her in a certain position -- which is, perhaps, part of the most important part of the whole procedure is positioning this properly. And then my assistants here is going to use this device to drill what`s called a guide pin up into the leg. So you it going from inside the leg up into the knee, and it should come out pretty close to that little black line there. So this device is just used to make sure that everything's put into proper position. And the nice thing is if we didn't like where that was, we could just change it because that drill that you're seeing going in there is not the final hole. This is just a guide pin, and we're going to use that to actually drill over top of in just a second. So if I was unhappy with that, I'd take it out, and we'd replace it. But actually, I think it looks quite good. What do you think, Mark?
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MARK ADAMCZYK, MD: I love it.
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KERWYN JONES, MD: All right. We'll take it, then.
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MARK ADAMCZYK, MD: And you can see one of the places that Dr. Jones is aiming for on the – on the guide-pin placement is right where the old ACL used to be. You can see some of the fibers below where they debraded that, and he's going to put the new ACL reconstructed in as close to the same position as we can get it so that the knee will function normally. So…
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KERWYN JONES, MD: And here we go. We're going to drill now, or ream, over top of that guide pin that was put in there. So there's the drill going in from the outside, and then he's the guide pin. And in about 30 seconds or less, you'll see the drill coming into the knee. I'm just protecting the PCL, which is the other ligament, from the drill. And then you come back out. That's actually good and smooth. That's good. There you go. And then I'll take a rasp to sort of smooth that out a little bit. Yep, right up through the bottom. I'll just rasp that. Now you see the rasp. And then we'll take a plug for a minute so we can get resituated, reoriented. Yeah, we're going to have to do that. Now, this is a step that I do that not everybody does. Some people believe in it, some people don't. This little device looks like a bullet with four fins on it, and those four fins will just place little notches inside of the tunnel that we just drilled in the shinbone, and those four notches are used for seating of the new ACL graft. So Dr. Benyon's going to tap that up into the tibial tunnel, the tunnel that's inside the tibia bone. You won't see it coming out.
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MARK ADAMCZYK, MD: Some of tat – some of that fluid that you could see coming out of the knee is – is a – a saline solution that we run through the knee during the surgery which helps to allow us to see what's going on inside the knee. It expands

the knee joint, so to speak, so that you can have more room to work, and it also allows us to see what's going on as we're doing the surgery. So that's what the fluid that you see coming out of the – of the tibial tunnel that Dr. Jones just made is.
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KERWYN JONES, MD: That's a good point, Mark, because the next thing we're going to do is try to drill our femoral tunnel. So first, I'm going to stop the water from coming out here by putting a little white plug in that hole instead of my finger. I feel like the boy who plugged up the dyke there. So there's a little white plug holding the water in. Now, you can come down here. You can kind of see where that tunnel's been drilled, right there. In fact, there's still a little material in there. I need to get that out. SO how about handing me the shaver?
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MARK ADAMCZYK, MD: And why is it important to get that material out of there, Dr. Jones?
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KERWYN JONES, MD: Well, for one thing, it might impede with the healing, because we want the bone to heal right to the tendon. And secondly is that it can get pushed out into the knee and sort of get stuck in front of the ACL and cause scar tissue there that might impede her – or keep her from being able to straighten her knee. So here comes the shaver from the hole we made in the tibia.
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MARK ADAMCZYK, MD: And this shaver that he's using here is the same – it's the same tool that we use to remove a damaged ACL. It's what we use to help trim a meniscus when that's been injured. It's a very versatile tool used in a lot of different surgeries, not only knee surgery but shoulder surgery. We use it in ankle scopes, all types of – all types of different – all types of different arthroscopic surgeries. We do have a question from one of our viewers. The question is: "Is there any advantage to using the hamstring over the patellar tendon?" That a great question. Obviously today, we're using hamstring graft, and that's a very good graft to use. It's the one I particularly choose to use most often as well. Do you have any particular thoughts on that, Dr. Jones?
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KERWYN JONES, MD: Well, for one thing, if you have a kid who still has open growth plates, which we do pretty frequently, you have to use the hamstrings because if you the bone – petallar tendon bone, which is what she's alluding to – that's the kneecap tendon – then the bone that you're using will stop the growth plates from growing because it's going to go across the growth plates and stop them from growing. So you have to use hamstrings in those kids. Otherwise, I'd say it's pretty evenly divided as to which is better. The one thing I do know is if you had a kid who's a sprinter, we'll sometimes use the kneecap tendon. It's because there is just a very small amount of loss in strength in the hamstring tendons using this technique. On average, it's 1 or 2%, maybe as high as 4 or 5% in the unusual cases. But in fact, most of the kids form what's called a pseudotendon or a new tendon that will function as the old hamstring. So just in the sprinters, I'll sometimes use the kneecap tendon, but I don't think one's more advantageous, in general, than the other one.
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MARK ADAMCZYK, MD: I'd agree with that also. I think you're – it's kind of, in a way, dealer's choice as to which graft you use. Probably historically, the most common graft was a bone – patellar tendon bone using that patellar tendon, but certainly, more recent studies and more recent techniques show equal results for hamstrings versus patellar tendons so I think it's whichever graft you feel comfortable and

whichever one, in the discussion with the family, that they feel that they'd like to have also. So…What are you doing there, Dr. Jones?
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KERWYN JONES, MD: All right, so we showed you – we drilled the tibial tunnel, which is the tunnel in the shinbone down here. Now, through that same tunnel, we passed another guide wire up into the knee, and it's going into the thighbone here. And so now I'm happy where that's placed right now. So now he's going to ream over top of that guide pin. You can se the reamer coming into the knee. He passes it past the PCL, which is that other ligament. We'll try to keep the water on here if we can. Sometimes it's difficult. Now he's reaming to hole in the thighbone there. You can see there's measurements on this because we know just how far to drill this, or ream it. A little bit further. There we go. Yeah, okay. Now, that guide pin will probably, in fact, come out. That's okay if it does. That's fine, too. And then I'll pull out. So I'm taking the guide pin out of the knee. And – so if you look here at that hole, I like the position of it. There's a little bit of bone chips floating around in here. We'll try to get those out. But what you have to worry about is the new ACL will be draped over the front of it. It's sharp there. See how it's a little bit of sharp edge? So we're going to smooth that out with this rasp. It's almost like a file you'd use for woodworking. I'll smooth that out a little bit there. And there you can see it smoothed it out just a little bit just to take that sharp edge off there. We can see way up into that tunnel. Now, we mentioned before the growth plates, and this is the concern with the littler kids. If this kid was still – if this girl was still growing and we drilled a hole up here, we'd be drilling right through what's called the growth plate. You'd be able to see a little what band there. I think I tried to show that in one of the Powerpoint slides. You don't want to do that if you can help it because if you drill a hole through the growth plate, there's a chance it could stop it from growing, and that would cause to that knee. So in the younger kids, we use a different technique where we avoid the growth plates altogether. It's a little bit harder to do, but it certainly seems to work well. She's done growing, so I feel perfectly comfortable doing it this way.
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MARK ADAMCZYK, MD: And this is the standard way that most of the ACLs are reconstructed around the country, is that right?
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KERWYN JONES, MD: That's correct, yeah. Okay, I'll take the transfix guide.
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MARK ADAMCZYK, MD: So the technique that he's referring to with the younger children involves making these tunnels, or drill holes, in more of the end of the bone. I don't know if you can see my pointer on the Powerpoint slides here, but this is called the epiphysis of the bone or the very end of the bone. This is – this line here is called the growth plate, demonstrates that, and this is where we want to avoid drilling through. And this is where we want to avoid drilling through. So our tunnel would be made in this end of the bone and then same thing on the shinbone side in the end of the bone here rather than crossing the growth plate. And that's just simply another technique that's used, especially in kids that are younger and still have open growth plates. Now, sometimes we'll -- we'll go ahead and drill a tunnel across a growth plate if the child's getting very close to closing, say, you know, age 16, 17, we think they're just about done growing, and there are ways to tell that by obtaining x-rays to judge the bone age of the child, for example, something like that, so... you ready for us again?
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KERWYN JONES, MD: Yeah. I just want to show you something. There's various different ways of getting this graft up into the two tunnels that we drilled. This is just one particular device that's used. It's called a jig or a guide jig. Guide jigs basically

are something we put into a bone or into a joint that allows us to drill from the outside in and puts us right in a perfect place, so I don't know if you can see that on the camera or not, but this is the guide jig that's going to go up through the hole in the tibia, the lower bone, and we'll see it entering the knee there. We'll see it coming out through the knee here in a second. There it is. And these companies are smart; they label things so that you avoid a lot of potential areas. You can see that ANT. That just tells me that I have it facing the correct direction there. I have to manipulate this up into the -- the thigh bone, which we've done there, and then slide it all the way in, and you'll see, it'll bury to the number 30.
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MARK ADAMCZYK, MD: And the ANT doesn't refer to an ant or anything, does it?
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KERWYN JONES, MD: No. I hope not.
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MARK ADAMCZYK, MD: That's "anterior." That just means the front part of the knee, that's what the anterior means, so... and you can see how the -- the reamers drilled the absolute perfect size for this instrument, and again, that relates to the design of the -- of the implants and you can see how the tunnel is snug and this instrument will fit in there just right when the -- when the tunnel is fully prepared here.
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KERWYN JONES, MD: Yeah. Now, in this case, what happened is it doesn't want to go up there as smoothly as I would hope so what I have to do is figure there's something up in there, maybe a little soft tissue like some scar tissue or something that's just holding us back, so I'm going to get this shaver device up in there and just shave it out a little bit, make sure there's nothing left in there, that would stop us. There we go.
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MARK ADAMCZYK, MD: And those bubbles you sere on the screen there, when you have a tibial tunnel drilled or an area where the fluid can come out, sometimes air gets up into the knee joint, and it just – it shows up as air bubbles on the screen, so that's what you're looking at there at home. The will be removed from the knee at the end of the case, and it should not cause any problems.
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KERWYN JONES, MD: Hold this.
00:33:16
MARK ADAMCZYK, MD: And so you can see how the instrument fits in, again – nice – nice fit there with the instruments that the companies have designed for us.
00:33:40
KERWYN JONES, MD: There we go. That's right where we want it. Good. So now it goes good. Okay, now if you hold that, slide that in there, that looks pretty good. Now what 's going to happen now is – everything we're doing at this point is just to be able to get the vices in there that will allow us to pass the graft back into the knee. That looks pretty good to me. So, Mark, what weak team does Michigan get to beat up on this weekend?
00:34:36
MARK ADAMCZYK, MD: You know, I haven't even looked ahead. I don't think this number-two ranking is completely deserved, though. I'm in a room full of Ohio State fans, and so I'll keep quiet on that subject. So when you're drilling here, Dr. Kirwyn, you're going through that tunnel that you made in the femur there?
00:35:03
KERWYN JONES, MD: That's exactly right. This guide jig has allowed us to put it right through the tunnel right where we'd like it to be. So there's another guide pin going in through the thighbone or the femur. You can almost tap it in now if you want to.

And it's going right through the tunnel, just like you mentioned. I'll pull that silver bullet out after you get that across.
00:35:27
MARK ADAMCZYK, MD: And so that - -that pin you just drilled goes all the way through the leg. Aren't there nerves and blood vessels and things you're worried about there, or…?
00:35:35
KERWYN JONES, MD: Yeah, naturally, we know where the nerves where the nerves and blood vessels are. So this device has been designed so you can avoid those nerves and vessels.
00:35:43
MARK ADAMCZYK, MD: And all of them lay pretty much behind the bone, is that correct?
00:35:47
KERWYN JONES, MD: That's right.
00:35:48
MARK ADAMCZYK, MD:
So anything that we pass through the bone in this particular area should be safe as – as – as designed and according to the anatomy.
00:35:29
KERWYN JONES, MD: Right. That's exactly right. All right, now, he's got this device that's called a countersink. If any of you do woodworking, you know what a countersink is. It basically allows you top put something into a piece of wood, a nail or a screw, so that it would be sticking out very much, and that's exactly what this does. It countersinks the bone so that when we put this peg, this device to hold the ACL in, it won't be sticking out of the bone, and it'll be flush against the side of the bone, and it'll stop itself. And we're down to – give it just another turn. Yeah, that's looks good. Okay, back it up. She's a thin girl. So that's probably good, about 2, 2 1/2.
00:36:49
MARK ADAMCZYK, MD: You mentioned "thin girl." And one of the questions we have from home, too, is: "Do you know differences in male and female and anatomy, and do you differ your technique from females to males?" Is there anything you do differently, Kirwyn, when you're doing an ACL for a young man versus a young woman?
00:36:58
KERWYN JONES, MD: Yeah, you know, the difference is a couple things. One is that – you can see this wire being passed here, straight across. One is that the girls tend to have what's called a narrower notch. In other words, the area where the ACL comes from, right up here sometimes seems to be narrower. Some studies refute that, but so often times, we'll have to do a wider notchplasty on some of these girls.
00:37:20
MARK ADAMCZYK, MD: So what Dr. Benyon was doing before with the4 Burr tool to widen that out.
00:37:24
KERWYN JONES, MD: That's right. And then the other difference is that girls tend to be a little bit more knock-kneed. So I'm just a little bit more careful about making sure that I get the tunnel positioned just a little bit more – on the thighbone tunnel, a little bit more towards the side there rather than directly straight up. I think it gives them a slightly better degree of stability after the surgery is complete. So now you got this wire going through the knee, through the tunnel. We're going to, in fact, deliver it down. So you can see it's going through the knee - -through the tunnel, through the knee, down through the other tunnel, and coming out the leg here. So

all that we've done so far in these last several steps has allowed us to get this device down here so that we can deliver the new ACL right up into the knee.
00:38:21
MARK ADAMCZYK, MD: That wire looks like it's quite bent. Is it a special material? Will it stay bent like that? Will it give us problems?
00:38:27
KERWYN JONES, MD: Yeah, actually, this wire has a lot of what's called memory. SO you can bend it pretty far, and it'll just bounce right back to where it was before. Now, every device – plastic, metal, or whatnot – only has so much memory, and after you bend it too far, you could potentially snap it or it won't straighten out. But this one's a pretty good device for that in that it does have good memory. All right, let's see the graft. Now this is the important part. I'll give you the scope here, Phil. So here's the graft. Again, we have two tendons that have been put side to side. I've drawn some blue lines on them just so I know what's what, and we're going to fold them in half as they go into the knee. So the two tendons now make four strands. That'll make for a nice, thick graft that'll serve her well for a long, long time, hopefully. All right, I'll take a hemostat, Debbie. Gove you that back. And you can see the arthroscope is a great tool, allows you to do things through small holes, but it can also be somewhat of a nemesis because you do have all these tubes all over the place, and you sometimes have to work around them. But it certainly, I think, gives a much better result for the person you're operating on. So there we go. We have the two tendons, four strands, that are about to be delivered into the knee. So I'm going to hold the arthroscope, and Dr. Benyon's going to pull the two ends of that wire, and it's going to deliver right up into the knee. Go slowly there so they can see that. You're doing good. There, you can see the graft coming into the knee. You can see it going up into that tunnel. You can see our blue lines buried just where we want them. So there's the new ACL. Now, it'd be great if we could stop there, but as you can imagine, that wire's too flimsy to hold that graft in the knee. So this is what we have is this little devise that's shaped like a bullet. I don't know if that sows up well or not. And it's made of an absorbable material that'll absorb over two to three years inside the bone. So eventually, she'll have nothing left in the bone. He's threading that over top of that wire, that Nitinol wire. And I'm going to pull this out a little bit medially here after you get that one just so we don't have a kink. And he's going to pound that into the leg. In particular, he's going to pound it into the femur or the thighbone. And the two tendons will be draped over that device almost like you drape your pants – let's pull this medially a little bit just to get the kink out. Almost like you drape your pants over – yeah now you can put her all the way down on the purple there. Put this all the way down.
00:41:14
MARK ADAMCZYK, MD: What – what are you –
00:41:15
KERWYN JONES, MD: Over a hanger.
00:41:16
MARK ADAMCZYK, MD: What they're showing right there I just want to show you with my hand kind of briefly here. The tendons in the tunnel are in a position like this, and from the side, they're bringing this transfixion piece across. So it goes inside of the tendons just like that so the tendons are draped over, like you mentioned, just like a hanger so that they cannot be pulled downward, and they stay nice and tight within that – within the notch. So it works sort of just like that, the tendons draped over the top of it, just like that. And that's what the wire allows them to do is hit right in between those tendons and hold it in place. One of the questions we got from home is: "How do you secure the tendon to bone? And if the patient has metal allergies, what else can you use, and how strong is the

alternative?" Obviously, we're answering that question right now. This is how – this is one method, at least, of securing the tendon to the bone. There are many, many options available. The companies – medical companies devised different ways of doing this, and obviously, this is one particular way. There are also pins that go, actually, through the graft and hold it in place. There are screw that go next to the graft and squeeze it against the wall to hold it tightly within the tunnel. Some of those are made of metal, and these days, more and more, they're made of a bioabsorbable material. Often, that is polylactic acid. What is this particular one made of, Dr. Jones? Are you familiar with that?
00:42:48
KERWYN JONES, MD: Yeah, actually, we have the reps here, who might be able to just tell you, but this one, I believe, is P.L.L.A., correct?
00:42:55
MARK ADAMCZYK, MD: Yes, P.L.L.A. We have confirmation.
00:42:56
KERWYN JONES, MD: We don't have them on the mic, so. We're still a little bit short there.
00:43:00
MARK ADAMCZYK, MD: But that brings up a great point. You know, we rely on our reps a lot to bring us the implants that we need and have these delivered. The companies have been very instrumental in designing a lot of these products, and what you're seeing from us today is simply the final product of a lot of years of work and research and things developed by other orthopedic surgeons that we're able to use. So it's very good to have those available, especially for this young lady to have her ACL reconstructed.
00:43:36
KERWYN JONES, MD: So what we're doing is just doing the final seating of this implant. Seems like it's good. Oh, yeah, that's real good. Okay. Here's your mallet back. Now, before I pull the wire out, sometimes I'll just back this out. And feel with my hemostat, making sure that that implant's not too proud. We've got it countersunk good. But she's a thin girl. Again, we don't want that to be sticking out at all. That feels pretty good there. Now you can see, I can pull on my graft down here. It tightens up in the knee, but it, in fact, stays in the femur, the thighbone, real good. So we fixed it real well up there. So now all this can come out because I don't need this wire anymore. The one thing that stays in was that bioabsorbable implant, and we're almost home free because now you can see the two ligaments crossing over each other. The name "cruciate" actually means "crossing." And so the anterior cruciate crosses over the posterior cruciate there. So that's what we have. Now, the final part in fixing the ACL is to get it fixed down to the tibia bone. So we have it fixed to the femur up here. Now we have to get it fixed to the tibia bone. So I'm going to pull the scope out just for a minute.
00:44:54
MARK ADAMCZYK, MD: That's a good view of how they cross. The cruciate name right there – that's a very good example of that, and the Powerpoint slide demonstrates that as well. This is actually a normal one there, so…
00:45:10
KERWYN JONES, MD: All right, so now we're going to expose this wound down here so we can see the tendons coming out, and you'll see, perhaps – if they're long enough, you'll see the four strands. And I can, myself, just barely see the four strands coming out down here, which means they're certainly long enough. I've labeled them before. The one tendon, I put a blue stitch on the end, and I, in addition to that, marked it with some blue highlighter. Basically, it's a permanent sterile marker so that I know which two strands to tie together here. We'll put

several knots, and then Dr. Benyon will take that hemostat to make sure that the lengths of the two sutures are the same. So you can just pass that right up through here, Benyon, Dr. Benyon. There you go. Take that there. So here's the other strand with the two ends. I'm going tie them together in the same, exact length, like so .And that's important, because think about this: if we have four strands of graft in there, that's a great thing. We have a very nice, thick graft that will be stable for her, won't re-tear, but if one of the strands is put in looser than the others, then it's not doing anything and you have a three-stranded graft, and that's not good. So that's why we want these sutures exactly the same length, and then I can pour on all four of them with this device, which is a device used to separate the four strands.
00:46:45
MARK ADAMCZYK, MD: Looks like a Chinese star or something.
00:47:48
KERWYN JONES, MD: We do call it that. It's not sharp though, I assure you, or I wouldn't be handling it like this.
00:46:58
MARK ADAMCZYK, MD: So that puts equal tension on all strands of the graft as you pull on it, is that correct?
00:47:02
KERWYN JONES, MD: Yeah. It's a little tight up there. I don't like that. Sometimes you get a little bit of a suture macaroni here. So we're going to start back over.
00:47:15
MARK ADAMCZYK, MD: And this is where the marking of the sutures becomes very valuable. You can tell which is which, get them untangled pretty easily.
00:47:29
KERWYN JONES, MD: So there's two there. Maybe it wants to come underneath. It looks like it'll be a better way to go. Yeah, that'll be better. So that'll nice and – okay. Now, I don't know if you can see that on the camera, but basically, we have this device that pulls tension on all four strands equally so that all four strands will be nice and tight. And then I nearly straighten out her knee, and I take this – again, a guide pin. And I'm going to pass the guide pin between all four of those strands. Now, we're going to take – this is a nine graft, right? So we're going to take an 11 delta screw.
00:48:13
MARK ADAMCZYK, MD: Where does that screw go when you put it in there, Dr. Jones?
00:48:16
KERWYN JONES, MD: That's a good question. That screw actually goes in between all four of those strands. While we're waiting here, I'm going to cycle the knee a few times.
00:48:24
MARK ADAMCZYK, MD: So if I could use my hand again as a relatively crude model, the four strands of the graft are represented by these fingers here, and the screw is going to be inserted right in the middle and expand that out against the walls of the tunnel to hold it really nice and tight. So if the graft is like this, the screw will go in here like this, and you can see how that, just, expansion pressed the tendons against the wall of the tunnel and fixes it very tightly in place, not allowing it to slide up down so it can heal into the bony walls of the tunnel.
00:49:00
KERWYN JONES, MD: I don't know if you could see the screw there through the camera. Again, it's a P.L.L.A. screw, and – so it's absorbable. It will dissolve over time. The body absorbs it. Pulling tension on the graft while we're advancing the screw. What I'm feeling for is to see how tight this screw is, because if it's good and

tight, which it usually is, it will give us really good means of fixing the graft inside the tunnel and the tibia. And it's so tight that I'm starting to get tired out here. I need to get in the gym.
00:49:51
MARK ADAMCZYK, MD: You're like your – your Steelers there: getting a little weak, huh?
00:49:54
KERWYN JONES, MD: I don't know, they bounced back this weekend, Mark.
00:49:56
MARK ADAMCZYK, MD: Yeah, they did. They looked pretty good. We do have another question from our viewers in Kent Roosevelt High School: "How traumatic is this surgery to the patient?" Certainly, they will have some pain from the surgery, as you can imagine with drilling holes in the bone and passing screws and sutures and all these sorts of things. One of the things we do is usually give them a block. Our anesthesia team at the head of the table – you may see them up there. They do that before we even put the patient – or before we even start the surgery, after they're asleep, and that will numb up some of the nerves to the leg and decrease the pain that they have. They also develop swelling inside the knee. As you can imagine, from doing the work that we do inside, they do develop some bleeding, and that's absolutely normal. As far as the recovery, sometimes the surgery is done as an out-patient, and the patient is able to go home. So they're not – so it's not terribly traumatic to be – to the point of being unbearable. Often, we'll keep our patients overnight just to see, so…So you got it in?
00:51:14
KERWYN JONES, MD: Yeah, we got it in. So we got in, and we have it fixed, and it feels real good. Seems like after you do this surgery, getting towards the end, you get a little more bleeding. So it's sometimes harder to see, but this is the graft that I'm pointing at going up and down here. You can see some of the shiny fibers back here. This is probably another strand going up here, and I can hook the graft. If you give me a minute, I'm going to give a little suction here just to clear the picture. Hook the graft and pull on it, and it's stiff. I mean, I'm pulling pretty good there, and nothing's moving. I can hook it here behind this side and pull on it, and again, it's not moving anywhere. Can you hook the suction up there, Deb? Then I'm going to do another test. We're going to straighten the knee out and make sure that the graft has enough room to live inside the knee. In other words, we mentioned earlier about girls having a narrower area where the graft comes from, or the ACL comes from. So here we're straining and making sure that that doesn't pinch. And it'll get real close in this case but certainly not pinching. You would see it tenting those fibers of the graft if we're pinching. So as we go back down, you can see it looks real good all the way down. So that's the ACL in place now. Now, the final thing we can do is we can test her knee. This won't be so obvious in the camera, but I can feel it because before the surgery – you want to take the camera and just hold it there? – I did what's called a test to check the stability of her knee, and it was very loose. And now I can check it again if I use my hands, and you can see it doesn't move at all. I feel a big difference, and you can look at the graft, and you can see it tightens a little bit there, and it holds the knee together. So it won't be wobbly for her anymore. It'll be nice and stable. So I think she'll be real happy with this result her.
00:53:01
MARK ADAMCZYK, MD: That's looks great.
00:53:02
KERWYN JONES, MD: Yeah. Thanks.
00:53:04

MARK ADAMCZYK, MD: Nice and solid. Just using the model again to demonstrate what Dr. Jones was doing on the patient, by grasping the lower leg and holding the thigh bone -- a torn ACL will allow the shinbone to shift forward, and you can see how that could damage the menisci, something like that, as it shifts forward. And now, with an intact and reconstructed ACL, it doesn't allow that to happen. It's nice and tight, and it stays right in place where it should be. So that's using the model to help you see that there.
00:53:38
KERWYN JONES, MD: Now we're done with the ACL. I'm going to show you a few other things, Mark, if you don't mind, and if people have questions, feel free to go ahead and ask me. I'm going to just take the last few minutes and show you a few other common problems teenagers can have, and that is – particularly in girls but sometime sin boy – they can have problems related to the kneecap. And the kneecap, actually, when you bend and straighten the knee – you can see the kneecap above me here. And you can see the thighbone below me here. The kneecap, when you straighten and bend your knee, glides in that groove right there. And in some girls, occasionally some boys, that kneecap doesn't glide perfectly in that groove, it'll come out of place. That kneecap will slide out towards the outside, like that. I'm pushing on it now. It'll slide out, and that's a real difficult problem. Fortunately, that problem usually responds to exercise therapy and bracing, but it doesn't always. Sometimes the other problem kids can have in the knee is they can defects in the cartilage on the thighbone. So this is cartilage on the thighbone right here, this nice, white, shiny stuff. Can I have a probe, Debbie? And they can have a divot in the cartilage. Even without having had an injury, they can get a divot in the – she doesn't have one, fortunately, but it'll look like a little hole somewhere in this are or even further back in the knee, and we think it's because some kids have a tendency to have a weak spot in the bone that supports that cartilage and eventually crushes down the bone, crushes down the overlying cartilage. It's no longer smooth. And so it grinds inside the knee and causes symptoms or problems. That's another tough problem to fix, and fortunately, in most kids who are still growing, that oftentimes will heal in time, but unfortunately, in a small percentage of them, it won't heal. We'll have to go in and do surgery to fix that cartilage back down to the bone. There are also techniques if you lose the cartilage to replace it with cartilage from elsewhere in your knee that is perhaps not as important. So this is the normal – this is the perfect looking knee other than that ACL tear and the meniscus because her cartilage here is as smooth as we could possibly hope for. That's a good situation for her. She should have a good future.
00:55:58
MARK ADAMCZYK, MD: We've – we got a couple more questions here, Kirwyn. The first is: "Why isn't she bleeding with that giant hole in her knee?" And the reason for that is we use a tourniquet to stop any blood flow to the leg during the surgery. It helps us to see things better. As you can imagine, if it was bleeding like that, we wouldn't be able to see any of this, and the surgery would be nearly impossible. So that's why there's no bleeding right now. As soon as that tourniquet comes down, it's a whole different story, and that's when the fluid will build up. The effusion will develop, and the bleeding will be inside the knee. We have another question, too, and this, I think , leads into a good point at the end here: "How long before the athlete can return to full activity? Are there any movements of sports that would not be recommended?"
00:56:44
KERWYN JONES, MD: I'd like to hear what you say first, Mark, and then I'll tell you my two cents.
00:56:47

MARK ADAMCZYK, MD: Sure. Typically, you know, after surgery – now, you know, the initial part's done, and really, we're just beginning on the path to recovery. This is just simply the first step in the process. Typically, after surgery, like I mentioned, the patient will be either at home or in the hospital for one night to monitor and make sure things are okay. We place them into a brace, and we do use a brace that locks the knee in a straight position for the early part of recovery until the quadriceps or the extensor muscles of the knee start to function again. And then, as soon as the incisions are healed, we begin a very aggressive and early rehabilitation protocol to allow a return to sports. This goes on for about six months' time before we'll let an athlete go back to sports. There are various stages along the way. I think about three months' time, maybe four months, something like in that range is what we'll discontinue the use of the brace all the time. And then at six months, sports are able to be resumed again, and we do recommend the use of a – of a custom brace for that. Any other thoughts on that?
00:58:04
KERWYN JONES, MD: Yeah, I pretty much follow the same protocol you do. There are some doctors that will let their kids return a little bi earlier to sports, but the problem is that the ACL – the new ACL is basically, at this point, a dead piece of tendon inside of her knee. It's dead because there's no blood supply to it. So right now, it's pretty strong, and I couldn't, certainly, break it with my hands or even with a strong motor, but six weeks from now, that dead ACL will be even weaker, and it can rupture or break very, very easily, and it takes a while for that blood supply to return back to the ACL, and once it returns, it takes even a little bit longer for the ACL to develop back it normal strength. So if they return back too soon, they run the risk of reinjuring and being back in here again.
00:58:47
MARK ADAMCZYK, MD: Where does that blood supply come from, then?
00:58:51
KERWYN JONES, MD: Well, it comes from an artery which is a blood vessel in the back of the knee. So it's directly behind us. Got a pointer there, Debbie? You can't see it, but it comes from an artery that comes from the back of the knee back here, and it goes into the joint capsule, which is like a balloon that surrounds the joint, and that joint capsule wraps around the ACL here. And the blood supply comes out of the joint capsule and feeds the ACL. So primarily, it's from behind the knee, from back there. So…I don't think that that incision looked that big, Mark. Did you?
00:59:25
MARK ADAMCZYK, MD: No. No, it looks good. It looks like a very good reconstruction. Any thoughts as we wrap up here, Kirwyn?
00:59:34
KERWYN JONES, MD: No, I think the key point is what you said right there: this is only half the battle for this girl. I mean, she's waited over a month for this, and she's gone through a lot today with the nerves and whatnot, but the second half of the battle's going to be the next six months, and I know she's going to do fine, but it's important for the patients to know that the next six months, they have to work hard. That's 50% of them returning back to sports is working hard and complying with the program. It's real tempting to cheat or to go back sooner than you're supposed to, but that's usually not going to end up with a good result.
01:00:06
MARK ADAMCZYK, MD: I think those are – I think those are good thoughts from Dr. Jones to end on here. We'd – we really appreciate you tuning in and joining us for surgery today. I appreciate your questions from home, and thank you for joining us here at Akron Children's Hospital.
01:00:23

KERWYN JONES, MD: Thanks.
01:00:34
ANNOUNCER: This has been an anterior cruciate repair in a teenager performed at Akron Children's Hospital in Akron, Ohio. To obtain more information or to make an appointment or make a referral, please click the buttons on your screen.
01:00:53
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